तत् त्वं पूषन् अपावृणु
केन्द्रीय विद्यालय संगठन

KENDRIYA VIDYALAYA SANGATHAN

AHMEDABAD REGION

ACADEMIC YEAR 2022-23

SUBJECT: MATHEMATICS

COMPENDIUM

Of Diverse Questions For

CLASS - X

आज़ादी का अमृत महोत्सव

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TABLE OF CONTENT

CHAPTER: 01

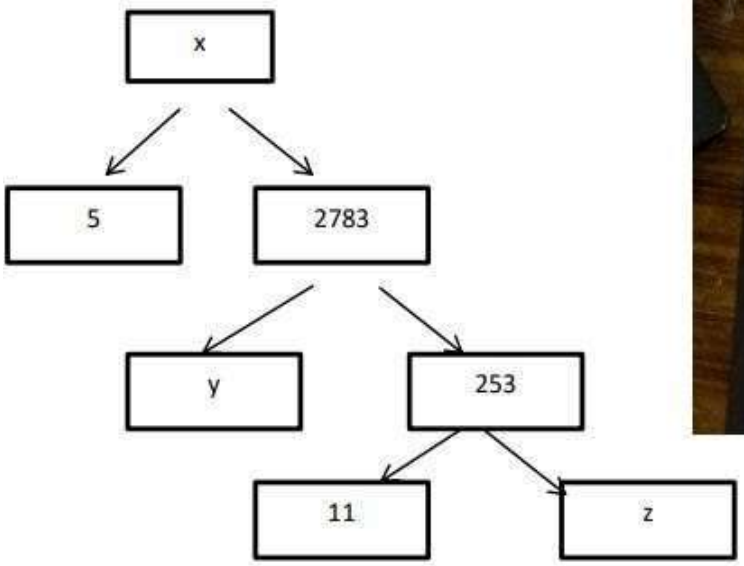
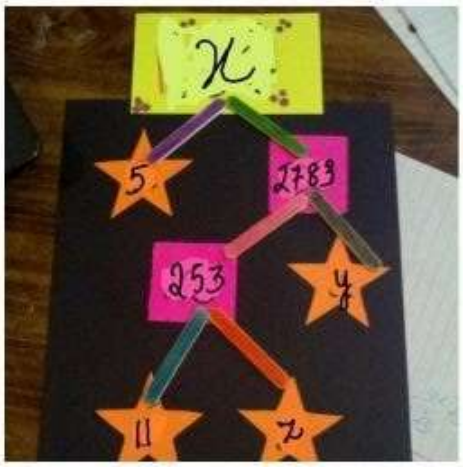
REAL NUMBERS

	COMPETENCY BASED QUESTIONS
Q1	HCF of the smallest composite number and smallest prime number is: A. 4 B. 2 C. 4 D. 0
Q2	If a is an odd number, b is not divisible by 3 and LCM of a and b is P then the LCM of 3a and 2b is: A. 5P B. 3P C. 6P D. 2P
Q3	What is the HCF of $3^3 \times 5$ and $3^2 \times 5^2$? A. 45 B. 225 C. 15 D. 60
Q4	If P is prime number then, what is the LCM of P, P^2, P^3? A. P B. P×P C. 0 D. P^3
Q 5	The product of three consecutive positive integers is divisible by A. 4 B. 6 C. 5 D. None of these
Q 6	The LCM of two numbers is 1200. Which of the following cannot be their HCF? A. 600 B. 500 C. 400 D. 200
Q 7	If the HCF(26,169) = 13 then, LCM(26,169)= A. 26 B. 52 C. 338 D. 13
Q 8	The largest number that divides 70 and 125, which leaves the remainders 5 and 8, is: A. 65 B. 15 C. 13 D. 25
Q 9	The least number that is divisible by all the from 1 to 5 is: A. 70 B. 60 C. 90 D. 80

Q 10	The Muscle Gym has bought 63 treadmills and 108 elliptical machines. The gym divides them into several identical sets of treadmills and elliptical machines for its branches located throughout the city, with no exercise equipment left over. What is the greatest number of branches the gym can have in the city? A. 7 B. 18 C. 108 D. 9
	CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
Q 1	Activity Incharge of your school this mansoon has asked students of your class to plant trees in 8 acre of school campus to promote tree planting practice and sensitize students about environment and oxygen producing trees. There are 28 girls and 32 boys in your class. For this purpose, school purchases sapling of trees from district forest department.
(i)	The minimum number of trees the school must acquire for distributing equally among all the students is (a) 396 (b) 371 (c) 224 (d) 415
(ii)	The exponent of 5 in prime factorisation of 32 is (a) 1 (b) 2 (c) 5 (d) 0
(iii)	Find product of HCF and LCM of (32,28) using relationship between HCF and LCM of two numbers (a) 256 (b) 840 (c) 832 (d) 896
(iv)	Which of the following is incorrect? (a) HCF ≤ LCM (b) HCF always divides LCM (c) HCF × LCM of 3 numbers = Product of 3 numbers (d) LCM of coprime numbers is the product of the same numbers
(v)	1×2×3×7×11 + 1 is a (a) Prime number (b) Composite number

	(c) Square number (d) Neither prime nor composite
Q 2	Shilpi, a newly appointed IAS officer wants to give thank giving party to all her mentors, teachers and guide who motivated and taught her to achieve this aim. She decided to give gifts to all of them. She has 36 diaries, 60 golden pens. She does not want to discriminate among her teachers, mentors and guide so she decided to distribute them equally among all of them.
(i)	How many maximum guests Shilpi can invite? (a) 6 (b) 180 (c) 120 (d) 12
(ii)	How many diaries and golden pens each guest get? (a) 5 diaries and 3 golden pens (b) 3 diaries and 5 golden pens (c) 2 diaries and 4 golden pens (d) 4 diaries and 2 golden pens
(iii)	Shilpi decided to add 42 watches also. In this case how many maximum guests Shilpi can invite? (a) 6 (b) 120 (c) 60 (d) 180
(iv)	How many items of each will category each guest gets? (a) 6 diaries, 5 golden pens and 6 watches (b) 6 diaries, 5 golden pens and 5 watches (c) 3 diaries, 5 golden pens and 7 watches (d) 6 diaries, 10 golden pens and 7 watches
(v)	If Shilpi decides to add 3 more watches, takes 6 diaries out then what is the maximum number of guests Shilpi can invite? (a) 12 (b) 30 (c) 15 (d) 24
Q 3	A seminar is being conducted by an educational organization, where the participants will be educators of different subjects the number of participants in Hindi, English and Mathematics are 60, 84 and 108 respectively.

(i)	In each room the same number of participants are to be seated and all of them being the same subject, hence maximum number of participants that can be accommodated in each room are (a) 14 (b) 12 (c) 16 (d) 18
(ii)	What is the minimum number of rooms required during the event? (a) 11 (b) 31 (c) 41 (d) 21
(iii)	The LCM of 60, 84 and 108 is (a) 3780 (b) 3680 (c) 4780 (d) 4680
(iv)	The product of HCF and LCM of 60, 84 and 108 is (a) 55360 (b) 35360 (c) 45500 (d) 45360
(v)	108 can be expressed as a product of its primes as (a) $2\times2\times2\times3\times3$ (b) $2\times2\times2\times3\times3\times3$ (c) $2\times2\times3\times3$ (d) $2\times2\times3\times3\times3$
Q 4	To enhance the reading skills of the grade X students, the school nominates you and rwo more of your friends to set up a class library. There are two sections – Section A and Section B of grade X. There are 32 students in Section A and 36 students in Section B.
(i)	What is the minimum number of books you aquire for the class library, so that they can be distributed equally among students of Section A and Section B? (a) 144 (b) 128 (c) 288 (d) 272
(ii)	If the product of two positive integers is equal to the product of their HCF and LCM is true then, the HCF of (32,36) is (a) 2 (b) 4 (c) 6 (d) 8
(iii)	36 can be expressed as a product of its primes as (a) $2\times2\times3\times3$

	(b) 2×3×3×3 (c) 2×2×2×3 (d) 2×0×3×0
(iv)	7×11×13×15 + 15 is a (a) Prime number (b) Composite number (c) Neither prime nor Composite (d) None of these
(v)	If p and q are positive integers such that p=a×b×b and q=a×a×b, where a,b are prime numbers, then LCM of (p,q) is (a) ab (b) a×a×b×b (c) a×a×a×b×b (d) a×a×a×b×b×b
Q 5	A Mathematics Exhibition is being conducted in your School and one of your friends is making a model of a factor tree. He has some difficulty and asks for your help in completing a quiz for the audience. Observe the following factor tree and answer the following questions:  
(i)	What will be the value of x? (a) 15005 (b) 13915 (c) 56920 (d) 17429
(ii)	What will be the value of y? (a) 23 (b) 22 (c) 11 (d) 19

(iii)	What will be the value of z? (a) 23 (b) 22 (c) 11 (d) 19
(iv)	According to Fundamental Theorem of Arithmetic 13915 is a (a) Composite number (b) Prime number (c) Neither Composite nor prime (d) Even number
(v)	The prime factorisation of 13915 is (a) 5×11×11×11×13×13 (b) 5×11×11×11×23×23 (c) 5×11×11×23 (d) 5×11×11×13×13
	OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
Q 1	LCM of smallest prime number and smallest composite number is _____.
Q 2	The least number that is divisible by all the numbers from 1 to 10 (both inclusive) is 2515. (True/False)
Q 3	The greatest possible speed at which a man can walk 135km and 225km in exact number of hours is 45km/hr. (Agree/Disagree)
Q 4	The LCM of two prime numbers is always 1.(True/False)
Q 5	The difference between any two consecutive natural numbers is _____.
Q 6	The number of the form 2m+5, where m is whole number is always odd number. (True/False)
Q 7	The largest number which divides 70 and 125, leaving remainders 5 and 8, respectively is 8. (True/False)
Q 8	The product of two consecutive natural numbers is always an even number. (Agree/Disagree)

Q 9	*π is _____ number. (a rational / an irrational)*
Q 10	Euler's number 'e' is an irrational number. (Agree/Disagree)
	SHORT ANSWER TYPE QUESTIONS
Q 1	If HCF of 65 and 117 is expressible in the form 65n – 117,then find the value of n.
Q 2	The LCM of two numbers is 14 times their HCF. The sum of LCM and HCF is 600. If one number is 280, then find the other number.
Q 3	If least prime factor of p is 3 and least prime factor of q is 5, then what is least prime factor of (p+q)?
Q 4	On a morning walk, three persons step out together and their steps measure 30cm,36cm and 40cm respectively. What is the minimum distance each should walk so that each can cover the same in complete steps?
Q 5	Determine the smallest 3-digit number which is exactly divisible by 6, 8 and 12.
Q 6	The traffic lights at at three different road crossings change after every 48 seconds, 72 seconds and 108 seconds respectively. If they change simultaneously at 7 am, at what time will they change simultaneously again?
Q 7	Determine the greatest 3-digit number which is exactly divisible by 8, 10 and 12.
Q 8	Find the least number which when divided by 6, 15 and 18 leave remainder 4 in each case.
Q 9	Three farmers have 490kg, 588kg and 882kg of wheat respectively. Find the maximum capacity of a bag so that the wheat can be packed in exact number of bags.
Q 10	Three tankers contain 403 litres, 434 litres and 465 litres of diesel respectively. Find the maximum capacity of a container that can measure the diesel of the three containers exact number of times.

	LONG ANSWER TYPE QUESTIONS
Q 1	During a sale, Colom pencils were being sold in pack of 24 each and crayons in pack of 32 each. If you want full packs of both the same number of pencils and crayons, how many of each would you need to buy?
Q 2	A street shopkeeper prepares 396 gulab jamuns and 342 ras-gullas he packs them, in combination. Each container consists of either gulabjamuns or ras-gullas but have equal number of pieces. Find the number of pieces he should put in each box so that number of boxes are least.
Q 3	State Fundamental Theorem of Arithmetic. Is it possible that HCF and LCM of two numbers be 24 and 540 respectively? Justify your answer.
Q 4	Explain why $(17\times5\times11\times3\times2 + 2\times11)$ is a composite number?
Q 5	Find HCF of 378, 180 and 420 by prime factorisation method. Is HCF × LCM of three numbers equal to the product of the three numbers?
Q 6	If n is an odd positive integer, show that $(n^2 - 1)$ is divisible by 8.
Q 7	Prove that $\sqrt{7}$ is an irrational number.
Q 8	Prove that $\sqrt{5}$ is irrational and hence show that $3 + \sqrt{5}$ is also irrational.
Q 9	Amita, Sneha, and Raghav start preparing cards for all persons of an old age home. In order to complete one card, they take 10, 16 and 20 minutes respectively. If all of them started together, after what time will they start preparing a new card together?
Q 10	Show that one and only one out of n, (n + 1) and (n + 2) is divisible by 3, where n is any positive integer.

CHAPTER -01

REAL NUMBER

SOLUTIONS OF THE PROBLEM

	SOLUTIONS TO COMPETENCY BASED QUESTIONS
Ans 1	B. 2
Ans 2	C. 6P
Ans 3	A. 45
Ans 4	D. P^3
Ans 5	B. 6
Ans 6	B.500
Ans 7	C.338
Ans 8	C.13
Ans 9	B. 60
Ans 10	D.9
	SOLUTIONS TO CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
Ans 1 (i)	(C) 224
(ii) (iii) (iv) (v)	(D) 0 (D) 896 (C) HCF × LCM of 3 numbers = Product of 3 numbers (A) Prime number

Ans 2	
(i)	(A)6
(ii)	(B)3 diaries and 5 golden pens
(iii)	(A) 6
(iv)	(D)6 diaries, 10 golden pens and 7 watches
(v)	(C)15
Ans 3	
(i)	(B)12
(ii)	(D) 21
(iii)	(A)3780
(iv)	(D)45360
(v)	(D)2×2×3×3×3
Ans 4	
(i)	(C)288
(ii)	(B)4
(iii)	(A)2×2×3×3
(iv)	(B)Composite number
(v)	(B)a×a×b×b
Ans 5	
(i)	(B)13915

(ii) (iii) (iv) (v)	(C)11 (B)23 (A)Composite number (C)5×11×11×23
	SOLUTIONS TO OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
Ans 1 Ans 2 Ans 3 Ans 4 Ans 5 Ans 6 Ans 7 Ans 8 Ans 9 Ans10	4 False Agree False 1 True False Agree An irrational Agree
	SOLUTIONS TO SHORT ANSWER TYPE QUESTIONS
Ans 1	Here, 117>65 117=65×1+52 65=52×1+13 52=13×4+0 Therefore HCF of 65 and 117 is 13. Now,65n – 117 = 13 This implies 65n=13+117=130 n = 130/65 = 2

Ans 2	According to the statement of the question, we have LCM of two numbers = 14×HCF of two numbers Also, LCM + HCF = 600 This implies 14×HCF + HCF =600 15 HCF = 600 HCF=40 Therefore LCM = 14×40=560 Now, one number is 280 So, 280× other number = 40×560 Thus,other number =(49×560)/280 = 80 Ans
Ans 3	Here, (p+q) must be an even number which is divisible by 2. Hence, the least prime factor of (p+q) is 2.
Ans 4	Here, find the LCM of 30cm, 36cm and 40cm 30= 2×3×5 36= 2×2×3×3 40= 2×2×2×5 LCM of 30,36 and 40 = 2×2×2×3×3×5 = 360 Hence, the required minimum distance is 360 cm.
Ans 5	LCM of 6, 8 and 12 = 2×2×2×3 = 24 Multiples of 24 are 24, 48, 72, 96, 120, 144,…..

	Hence, the smallest 3-digit number which is exactly divisible by 6, 8 and 12 is 120.
Ans 6	LCM of 48, 72 and 108 = 2×2×2×2×3×3×3×3 = 432 432 seconds = 7 min 12 seconds. Hence, they will change simultaneously again after 7 min 12 seconds from 7 am.
Ans 7	LCM of 8, 10 and 12 = 2×2×2×3×5 = 120 Multiples of 120 are 120, 240, 360, 480, 600, 720, 840, 960, 1080, … Hence, the greatest 3-digit number exactly divisible by 8, 10 and 12 is 960.
Ans 8	LCM of 6, 15 and 18 = 2×3×3×5 = 90 Hence, the required number is 90 + 4 ie, 94
Ans 9	HCF of 490, 588 and 882 = 2×7×7 = 98 Hence, the maximum capacity of a bag so that the wheat can be packed in exact number of bags is 98kg.
Ans10	403=13×31 434=2×7×31 465=3×5×31 So,HCF of 403, 434 and 465 = 31 Hence, the maximum capacity of the container that can measure the diesel of the three containers exact number of times is 31 litres.

	SOLUTIONS TO LONG ANSWER TYPE QUESTIONS
Ans 1	Number of pencils in a pack = 24 Number of crayons in a pack = 32 For buying full packs of each and same number of pencils and crayons we need to find LCM of 24 and 32. $24 = 2\times2\times2\times3$ $32 = 2\times2\times2\times2\times2$ LCM (24, 32) = $2\times2\times2\times2\times2\times3 = 96$ 96 crayon and 96 pencils or 96/24 = 4 packs of pencils and 96/32 = 3 packs of crayons.
Ans 2	Total number of gulab jamuns = 396 And total number of rasgullas = 342 So, the box in which the sweets are packed has equal number of either of the two. Therefore, the number of sweets per box = HCF (396,342) = 18 So, the shopkeeper must keep 18 pieces in each box so that number of boxes are least.
Ans 3	Every Composite number can be expressed as a product of primes, and this factorisation is unique, apart from the order in which the prime factors occur. As HCF = 24, LCM = 540 Now as we all know that LCM is always a multiple of HCF. Therefore LCM/HCF = 540/24 =22.5, Not an integer. Hence two numbers cannot have HCF and LCM as 24 and 540 respectively.

Ans 4	Given number = $17\times5\times11\times3\times2+2\times11$ $= 2\times11[17\times5\times3+1]$ $= 2\times11\times[255+1] = 2\times11\times256$ $= 2\times11\times2\times2\times2\times2\times2\times2\times2\times2 = 2\times2\times2\times2\times2\times2\times2\times2\times2\times11$ Since the given number can be expressed as the product of prime numbers, hence it is a composite number.
Ans 5	Prime factorisation of $378= 2\times3\times3\times3\times7$ $189= 2\times2\times3\times3\times5$ $420= 2\times2\times3\times5\times7$ $HCF= 2\times3 = 6$ For three positive numbers a, b and c HCF (a, b, c) × LCM (a, b, c) ≠ a × b × c
Ans 6	We know that an odd positive integer n is of the form (4q + 1) or (4 + 3) for some integer q. Case – I When n = (4q + 1) In this case $n^2 - 1 = (4q + 1)^2 1 = 16q^2 + 8q = 8q(2q + 1)$ which is clearly divisible by 8. Case – II When n = (4q + 3) In this case, we have $n^2 -1 = (4q + 3)^2 - 1 = 16q^2 + 24q + 8 = 8(2q^2+ 3q + 1)$ which is clearly divisible by 8. Hence $(n^2 - 1)$ is divisible by 8.
Ans 7	Let us assume, to the contrary, that $\sqrt{7}$ is a rational number. Then, there exist co-prime positive integers and such that

	$\sqrt{7} = a/b$, $b \neq 0$ So, $a = \sqrt{7}\, b$ Squaring both sides, we have $a^2 = 7b^2$ …… (i) $\Rightarrow$ 7 divides $a^2 \Rightarrow$ 7 divides a So, we can write a = 7c (where c is an integer) Putting the value of a = 7c in (i), we have $49c^2 = 7b^2$ $7^2 = b^2$ It means 7 divides b^2 and so 7 divides b. So, 7 is a common factor of both a and b which is a contradiction. So, our assumption that $\sqrt{7}$ is rational is wrong. Hence, we conclude that $\sqrt{7}$ is an irrational number.
Ans 8	Let us assume, to the contrary, that $\sqrt{5}$ is rational. So, we can find integers p and q ($q \neq 0$), such that $\sqrt{5} = p/q$, where p and q are coprime. Squaring both sides, we get 5 = p2/q2 $\Rightarrow 5q^2 = p^2$ …(i) $\Rightarrow$ 5 divides p^2 5 divides p So, let p = 5r Putting the value of p in (i), we get $5q^2 = (5r)^2$ $\Rightarrow 5q^2 = 25r^2$ $\Rightarrow q^2 = 5r^2$ $\Rightarrow$ 5 divides q^2 5 divides q So, p and q have atleast 5 as a common factor. But this contradicts the fact that p and q have no common factor. So, our assumption is wrong, is irrational.

	√5 is irrational, 3 is a rational number. So, we conclude that 3 + √5 is irrational.
Ans 9	To find the earliest (least) time, they will start preparing a new card together, we find the LCM of 10, 16 and 20. $10 = 2 \times 5$ $16 = 2^4$ $20 = 2^2 \times 5$ LCM = $2^4 \times 5 = 16 \times 5 = 80$ minutes They will start preparing a new card together after 80 minutes.
Ans10	Let n, n + 1, n + 2 be three consecutive positive integers. We know that n is of the form 3q, 3q + 1, or 3q + 2. Case I. When n = 3q, In this case, n is divisible by 3, but n + 1 and n + 2 are not divisible by 3. Case II. When n = 3q + 1, In this case n + 2 = (3q + 1) + 2 = 3q + 3 = 3(q + 1), (n + 2) is divisible by 3, but n and n + 1 are not divisible by 3. Case III. When n = 3q + 2, in this case, n + 1 = (3q + 2) + 1 = 3q + 3 = 3 (q + 1), (n + 1) is divisible by 3, but n and n + 2 are not divisible by 3. Hence, one and only one out of n, n + 1 and n + 2 is divisible by 3.

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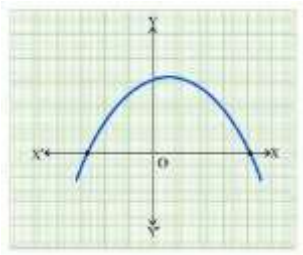
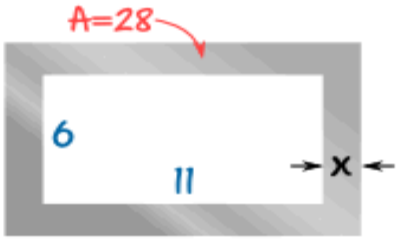
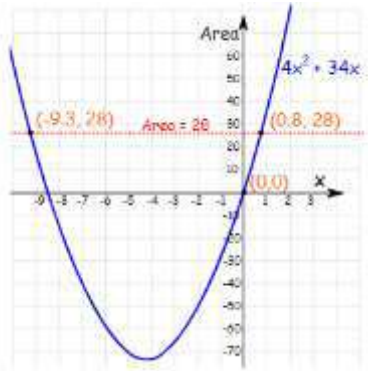
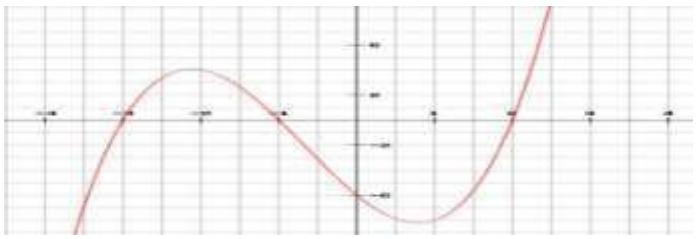
CHAPTER -02

POLYNOMIALS

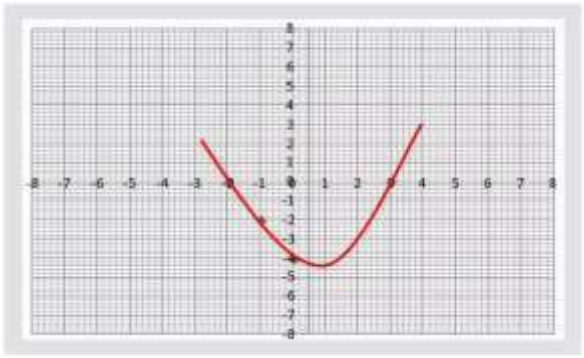
	COMPETENCY BASED QUESTIONS
Q1	If p(x) is a polynomial of at least degree one and p(k) = 0, then k is known as (a) value of p(x) (b) zero of p(x) (c) constant term of p(x) (c) none of these
Q2	If $p(x) = ax^2 + bx + c$, then c/a is equal to (a) 0 (b) 1 (c) sum of zeroes (d) product of zeroes
Q3	If $p(x) = ax^2 + bx + c$, then -b/a is equal to (a) 0 (b) 1 (c) sum of zeroes (d) product of zeroes
Q4	The quadratic polynomial whose sum of zeroes is 3 and product of zeroes is –2 is : (a) $x^2 + 3x - 2$ (b) $x^2 - 2x + 3$ (c) $x^2 - 3x + 2$ (d) $x^2 - 3x - 2$
Q 5	Which one of the following statements is correct (a) if $x^6 + 1$ is divided by x + 1, then the remainder is -2. (b) if $x^6 + 1$ is divided by x – 1, then the remainder is 2.

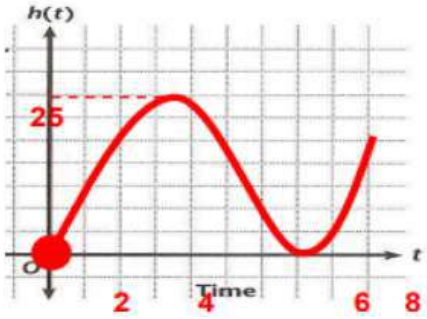
	(c) if $x^6 + 1$ is divided by $x + 1$, then the remainder is 1. (d) if $x^6 + 1$ is divided by $x - 1$, then the remainder is -1.
Q 6	The graph represnets a  a) Linear polynomial b) Cubic polynomial c) Quadratic polynomial d) Zero polynomial
Q 7	If $x^3 + 11$ is divided by $x^2 - 3$, then the possible degree of remainder is (a) 0 (b) 1 (c) 2 (d) less than 2
Q 8	If $x^5 + 2x^4 + x + 6$ is divided by g(x), and quotient is $x^2 + 5x + 7$, then the possible degree of g(x) is: (a) 4 (b) 3 (c) 2 (d) 5
Q 9	**Zeroes of a polynomial can be expressed graphically. Number of zeroes of polynomial is equal to number of points where the graph of polynomial is:** (a) Intersects x-axis (b) Intersects y-axis (c) Intersects y-axis or x-axis (d) None of the above

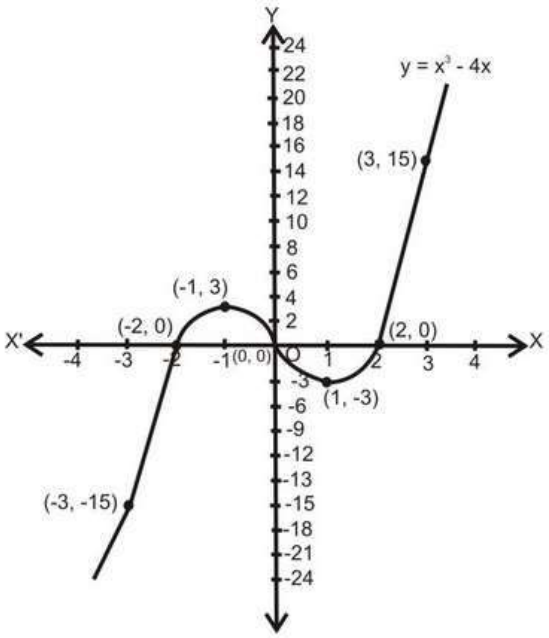
Q10	If one of the zeroes of a quadratic polynomial $ax^2 + bx + c$ is 0, then the other zero is (a) $-b/a$ (b) 0 (c) b/a (d) $-c/a$
	CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
Q I	**Steel Frame** Amit's company is going to make frames as part of a new product they are launching. The frame will be cut out of a piece of steel, and to keep the weight down, the final area should be **28 cm².** The inside of the frame has to be **11 cm by 6 cm.** 
(i)	What is the Polynomial of the area of steel before cutting and also write the degree of the polynomial obtained?
(ii)	Find the zeros of the polynomial for the area of steel after cutting out the 11 × 6 middle.
(iii)	From the graph find the value of x. 
(iv)	If x = 5 inches then the area of steel before cutting is _____ .
(v)	Find the perimeter of the steel frame in the given diagram.

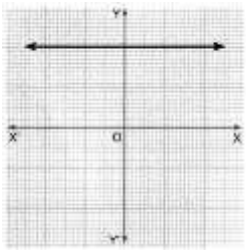
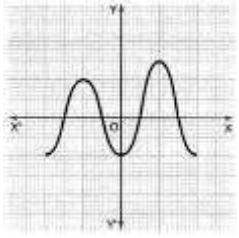
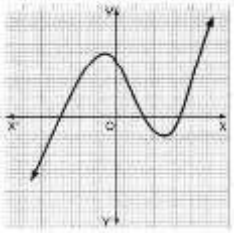
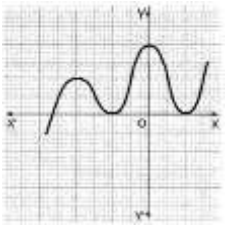
Q II	**Path of the Ball.** Football is played with a spherical ball. Usually, football is played outdoors on a large field. The projectile (path traced) of football in the form of parabola representing quadratic polynomial. 
(i)	The shape of the path traced shown is_____. a) Spiral b) Ellipse c) Linear d) Parabola
(ii)	**The graph of parabola opens upwards, if _____** a) $a = 0$ b) $a < 0$ c) $a > 0$ d) $a \geq 0$
(iii)	**Observe the following graph and answer**  In the above graph, how many zeroes are there for the polynomial? a) 0 b) 1 c) 2 d) 3

(iv)	**The three zeroes in the above shown graph are** a) 2, 3,-1 b) -2, 3, 1 c) -3, -1, 2 d) -2, -3, -1
(v)	**What will be the expression of the polynomial?** a) $x^3 + 2x^2 - 5x - 6$ b) $x^3 + 2x^2 - 5x + 6$ c) $x^3 + 2x^2 + 5x - 6$ d) $x^3 + 2x^2 + 5x + 6$
Q III	**Yoga Asanas** An asana is a body posture, originally and still a general term for a sitting meditation pose, and later extended in hatha yoga and modern yoga as exercise, to any type of pose or position, adding reclining, standing, inverted, twisting, and balancing poses. In the figure, one can observe that poses can be related to representation of quadratic polynomial. 
(i)	The shape of the poses shown is a) Spiral b) Ellipse c) Linear d) Parabola

(ii)	The graph of parabola opens downwards, if _____ a) $a \geq 0$ b) $a = 0$ c) $a < 0$ d) $a > 0$
(iii)	In the graph, how many zeroes are there for the polynomial?  a) 0 b) 1 c) 2 d) 3
(iv)	The two zeroes in the above shown graph are a) 2, 4 b) -2, 3 c) -8, 4 d) 2,-8
(v)	Find the zeroes of the quadratic polynomial $\sqrt{3}x^2 - 8x + 4\sqrt{3}$. a) $2/\sqrt{3}$, $4\sqrt{3}$ b) -2, 3 c) $2/\sqrt{3}$, $2\sqrt{3}$ d) 2,-8
Q IV	**Roller Coaster Ride**  Amit and Rahul decided to ride a new coaster. While waiting in line, Rahul notices that part of this coaster resembles the graph of a polynomial function that they have been studying in their maths class.
(i)	The brochure for the coaster says that, for the first 10 seconds of the ride, the height of the coaster can be determined by

	$h(t) = 0.3t^3 - 5t^2 + 21t$, where " t " is the time in seconds and "h" is the height in feet. Classify this polynomial by degree and by number of terms.
(ii)	Graph the polynomial function for the height of the roller coaster on the coordinate plane at the right. From the graph, find the maximum height of the roller coaster 
(iii)	Find the height of the coaster at t = 0 seconds. Explain why this answer makes sense
(iv)	Find the height of the coaster 9 seconds after the ride begins. Explain how you found the answer.
(v)	Evaluate h(2)
Q V	Water Tank A builder wants to build a sump to store water in an apartment. He planned in such a way that its base dimensions are (x + 1) and (x -2). 
(i)	Find how much he has to dig so that the volume of the rectangular prism will be $f(x) = x^4 + 2x^3 - 4x^2 - 7x - 2$.
(ii)	If x=10 units, what is the volume of the sump.

(iii)	If x = 10 and the builder wants to paint the outer portion on the sump, what is the cost of painting, if the cost of paint is Rs. 25/ per square unit.
(iv)	If the builder wants to close the sump, what is the cost of painting?
(v)	If the inner walls the tank needs to be coated at the rate of Rs.50 per sq m. What is the total cost of coating ? (Ignore the thickness of walls)
	OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
Q 1	Write the coefficient of $\mathbf{x^2}$ in each of the following? i)$2x^2+x+3$ ii) x^3-9x^2+7x+3
Q 2	The maximum number of zeroes that a polynomial of degree 4 can have is_____
Q 3	A quadratic polynomial whose sum of the zeroes is 2 and product is 1 is given by_____
Q 4	Number(s) of zeroes that a cubic polynomial has/have _____.
Q 5	If one zero of the quadratic polynomial $x^2 + 3x + b$ is 2, then the value of b is_____
Q 6	Zeroes of $p(z) = z^2 - 27$ are _____ and _____
Q 7	From the graph what are the zeroes of the polynomial: 
Q 8	The number of zeroes of a zero polynomial _____.

Q 9	Find the number of zeros in following case. a) b) c) d)    
Q 10	State whether the following statements are True or False i. A trinomial can have atmost three terms. ii. Every polynomial is a Binomial. iii. A binomial may have degree 5. iv. Zero of a polynomial is always 0. v. A polynomial cannot have more than one zero. vi. The degree of the sum of two polynomials each of degree 5 is always 5.
	SHORT ANSWER TYPE QUESTIONS
Q 1	If α and β are the zeroes of the polynomial $ax^2 + bx + c$, find the value of $\alpha^2 + \beta^2$
Q 2	If the sum of the zeroes of the polynomial $p(x) = (k^2 - 14)\, x^2 - 2x - 12$ is 1, then find the value of k.
Q 3	If α and β are the zeroes of a polynomial such that $\alpha + \beta = -6$ and $\alpha\beta = 5$, then find the polynomial.
Q 4	Find a quadratic polynomial, the sum and product of whose zeroes are 0 and $-\sqrt{2}$ respectively
Q 5	Find the zeroes of the quadratic polynomial $3x^2 - 75$ and verify the relationship between the zeroes and the coefficients
Q 6	If the square of the difference of the zeros of the quadratic polynomial $f(x)=x^2+px+45$ is equal to 144 , find the value of p.
Q 7	Find the value of 'k ' such that the quadratic polynomial $x^2-(k+6)x+2(2k+1)$ has sum of the zeros is half of their product.
Q 8	If α and β are the zeros of the quadratic polynomial $f(x)=x^2-p(x+1)-c$, show that $(\alpha+1)(\beta+1)=1-c$.

Q 9	If one zero of the quadratic polynomial $f(x)=4x^2-8kx-9$ is negative of the other, find the value of 'k'.
Q 10	Determine whether the given values of x are zeroes of the given polynomials or not x^2+6x+5 , x=-1 and x=-5.
	LONG ANSWER TYPE QUESTIONS
Q 1	Find the values of a and b so that $x^4 + x^3 + 8x^2 + ax - b$ is divisible by $x^2 + 1$.
Q 2	If a polynomial $3x^4 - 4x^3 - 16x^2 + 15x + 14$ is divided by another polynomial $x^2 - 4$, the remainder comes out to be px + q. Find the value of p and q.
Q 3	**Obtain all other zeroes of $3x^4 + 6x^3 - 2x^2 - 10x - 5$, if two of its zeroes are √(5/3) and-√(5/3).**
Q 4	If 4 is a zero of the cubic polynomial $x^3 - 3x^2 - 10x + 24$, find its other two zeroes.
Q 5	If $p(x) = x^3 - 2x^2 + kx + 5$ is divided by (x – 2), the remainder is 11. Find k. Hence find all the zeroes of $x^3 + kx^2 + 3x + 1$. (2012)
Q 6	Obtain all other zeros of $(x^4 + 4x^3 - 2x^2 - 20x - 15)$ if two of its zeros are √5 and – √5.
Q 7	If (x + 1) and (x – 2) are the factors of the polynomial $x^3 + kx^2 + hx + 6$ then find the value of h and k
Q 8	If α and β are the zeros of the polynomial $f(x)=x^2+px+q$, find polynomial whose zeros are $(\alpha+\beta)^2$ and $(\alpha-\beta)^2$.
Q 9	What must be subtracted from the polynomial $f(x)=x^4+2x^3-13x^2-12x+21$ so that the resulting polynomial is exactly divisible by $g(x)=x^2-4x+3$.
Q 10	One factor of the polynomial $f(x) = 3x^3 + ax^2 + 4x + b$ is (x + 2). If it is divided by (x – 3) then a remainder of – 5 is left. Find the values of a and b.

CHAPTER-02

POLYNOMIALS

SOLUTIONS OF THE PROBLEMS

	SOLUTIONS TO COMPETENCY BASED QUESTIONS
Ans 1	(b) zero of p(x)
Ans 2	(d) product of zeroes
Ans 3	(c) sum of zeroes
Ans 4	(d) $x^2 - 3x - 2$
Ans 5	b) 2 $p(x) = x^6 + 1$ when divided by $x - 1$, then remainder = $p(1)$ $\therefore p(1) = 1^6 + 1 = 2$
Ans 6	C) Quadratic polynomial
Ans 7	d) less than 2
Ans 8	3
Ans 9	(a) Intersects x-axis
Ans 10	a) $-b/a$
	SOLUTIONS TO CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
I	**Steel Frame**
i)	$(2x+11)(2x+6)=4x^2 +34x+66$ Degree 2
ii)	$P(x)=(11+2x)(6+2x)-(66)= 66+22x+12x+4x^2 -66= 4x^2+ 34x =x(4x-34)$ $0= x(4x-34)$ Thus , $x=0$ and $x = 17/2$
iii)	$x=0$ and $x=-8.5$

iv)	Area= p(x)=(11+2x) (6+2x) = $4x^2+34x+66$ P(5)= 4(25) +34 (5) +66 = 100 + 170 + 66 = 336 sq m
v)	P outer= 2 (l+b) = 2 (11+2x +6+2x) =2 (17+4x) = 8x+34 P inner = 2(6+11) = 34 P inner + outer = 8x+68
II	**Path of the Ball.**
i)	d) Parabola
ii)	c) a > 0
iii)	d) 3
iv)	c) -3, -1, 2
v)	a) $x^3 + 2x^2 – 5x – 6$
III	**Yoga Asanas**
i)	d) Parabola
ii)	c) a < 0
iii)	c) 2
iv)	b) -2, 3

v)	$\sqrt{3}x^2 - 6x - 2x + 4\sqrt{3} = \sqrt{3}x(x - 2\sqrt{3}) - 2(x - 2\sqrt{3}) = (x - 2\sqrt{3})(\sqrt{3}x - 2)$ c) $2/\sqrt{3}$, $2\sqrt{3}$
IV	**Roller Coaster Ride**
i)	Cubic & Trinomial
ii)	25 feet
iii)	h(0)= 0 This means that the ride starts on the ground
iv)	The answer is 2.7 feet found by substituting x = 9 in the equation
v)	$h(t) = 0.3t^3 - 5t^2 + 21t$ $=0.3(8) - 5(4) + 21(2) = 2.4 - 20 + 42 = 24.2$
V	Water Tank
i)	$x^4 + 2x^3 - 4x^2 - 7x - 2 \div (x+1)(x-2) = x^4 + 2x^3 - 4x^2 - 7x - 2 \div [x^2 - x - 2]$ $= x^2 + 3x + 1$
ii)	volume = f(10) = 11,528
iii)	Area = $2[(x + 1) \times (x^2 + 3x + 1) + (x - 2)(x^2 + 3x + 1)]$ $= 2[11 \times 131 + 8 \times 131]$ $= 2 \times 131 \times 19$ $= 4978$ Total Cost = Area x cost per sq m = 4978 x25 = Rs. 1,24,450
iv)	Area added to be painted =base area $=(x + 1)(x - 2) = 11 \times 8 = 88$ sq m Cost added for painting = 88 x 25 =2200 Rs Final cosy = 124450+ 2200 = 1,26,650 Rs.
v)	Area to be coated = 4 wall + base area = 4978 +88 sq m =5066 sq. m

	Total cost of coating = 5066 x50 = Rs. 2,53,300
	Solution of Objective Questions Other than MCQ
1	(i) 2 ii) -9
2	4
3	$x^2 - 2x + 1$
4	3
5	$b = -10$
6	$+3\sqrt{3}$, $-3\sqrt{3}$
7	(-2,0) , (0,0) & (2,0)
8	Infinite
9	a) There is no zero as the graph does not intersect the X-axis. b) 4 c) 3 d) 3
10	i. False. A trinomial has exactly three terms. ii. False. Every polynomial is not a binomial. iii. True. Binomial is a polynomial whose degree is a whole number greater than equal to one. So, it may have degree 5. iv. False. Zero of a polynomial can be any real number. v. False, A polynomial can have any number of zeroes. It depends upon the degree of the polynomial. vi. False. The degree of the sum of any two polynomials of same degree is not always the same. For example; Let $f(x)=x^4+2$ Degree 4 $g(x)=-x^4+4x^3$ Degree 4 $Sum=f(x)+g(x) = x^4+2 -x^4+4x^3 = 4x^3+2$ Degree 3

	SOLUTIONS TO SHORT ANSWER TYPE QUESTIONS
1	$\alpha + \beta = -b/a$, $\alpha\beta = c/a$ $\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$ $= (-b/a)^2 - 2(c/a)$ $= b^2/a^2 - 2c/a$ $= b^2-2ca / a^2$
2	$p(x) = (k^2 - 14)x^2 - 2x - 12$ Here $a = k^2 - 14$, $b = -2$, $c = -12$ Sum of the zeroes, $(\alpha + \beta) = 1$ …[Given] $\Rightarrow -b/a = 1$ $\Rightarrow -(-2)k^2-14 = 1$ $\Rightarrow k^2 - 14 = 2$ $\Rightarrow k^2 = 16$ $\Rightarrow k = \pm 4$
3	Quadratic polynomial is $x^2 - Sx + P$ $\Rightarrow x^2 - (-6)x + 5$ $\Rightarrow x^2 + 6x + 5$
4.	The sum of roots is $a-b=0 \Longrightarrow b=0$ The product of roots is $a/c=-1 \Longrightarrow c=-a$ So the Quadratic polynomial is ax^2-a
5	Let, $f(x)=3x^2-75=0$ $\Rightarrow 3x^2-75=0$ $\Rightarrow x^2-25=0$ $\Rightarrow (x-5)(x+5)=0$ $\Rightarrow x=-5,5$ So, zeros of quadratic equation are 5 and −5

	Verification: Sum of zeros = −coefficient of x / coefficient of x^2 $=-0/3$ $=0$ Also sum of zeroes = -5+5=0 And, Product of zero =constant term/ coefficient of x^2 $=-753$ $=-25$ Product of zeroes =-5x5=−25 Hence verified.
6	It is given that $(\alpha - \beta)^2=144$ From the given quadratic polynomial, $f(x)=x^2+px+45$ The sum of the roots, $\alpha + \beta =-p$ and the product of the roots, $\alpha\beta =45$. Since, $(\alpha - \beta)^2=144$ $\Rightarrow \alpha^2+ \beta^2-2 \alpha\beta =144$ $\Rightarrow (\alpha + \beta)^2- 4 \alpha\beta =144$ Substituting, $\alpha + \beta =-p$ and $\alpha\beta =45$ we get: $\Rightarrow(-p)^2-4\times45=144$ $\Rightarrow p^2=144+180$ $\Rightarrow p^2=324$ Therefore, $p=\pm18$

7	It is given that, Sum of the zeros =1/2 × Product of the zeros. From the given quadratic polynomial, $x^2-(k+6)x+2(2k+1)$ the sum of the zeros =(k+6) and product of the zeros =2(2k+1). Hence, $\Rightarrow(k+6) =12[2(2k+1)]$ $\Rightarrow k+6=2k+1$ $\Rightarrow k=5.$
8	It is given that α and β are the roots of the quadratic polynomial $f(x)=x^2-p(x+1)-c.$ $f(x)=x^2-px-(p+c)$ $\therefore \alpha + \beta = p$ And $\alpha\beta =-(p+c)$ Thus, $\Rightarrow(\alpha +1)(\beta +1) = \alpha\beta +(\alpha + \beta)+1$ $\Rightarrow(\alpha +1)(\beta +1) =-p-c+p+1$ $\Rightarrow(\alpha +1)(\beta +1) =1-c.$
9	It is given that one zero of the quadratic polynomial $f(x)=4x^2-8kx-9$ is the negative of the other, Let us take one zero to be α, then the other is $-\alpha$ Hence, the sum of the zeros = 0 $\Rightarrow$-b/a = 0 $\Rightarrow 8k/4=0$ $\Rightarrow k=0$
10.	P(x)= x2+6x+5 P(-1) = $(-1)^2$+6(-1)+5 =1-6+5=0 therefore x=-1 is a zero P(-5) = $(-5)^2$+6(-5)+5 =25-30+5 =0 therefore x=-5 is a zero

	SOLUTIONS TO LONG ANSWER TYPE QUESTIONS
1.	$x^2+1 \overline{)} x^4 + x^3 + 8x^2 + ax - b \ (x^2+ x+ 7$ $(-) \quad x^4 \quad +x^2$ $X^3 -7x^2+ax-b$ $(-) \quad X^3 \quad +x$ $-7x^2+ (a-1) x -b$ $-7x^2 \quad +7$ $(a-1) x- b-7$ If $x^4 + x^3 + 8x^2 + ax - b$ is divisible by $x^2 + 1$ Remainder = 0 $(a - 1) x - b - 7 = 0$ $(a - 1) x + (-b - 7) = 0 . x + 0$ $a - 1 = 0, -b - 7 = 0$ $a = 1, b = -7$ $a = 1, b = -7$
2	$x^2-4 \overline{)} 3x^4 - 4x^3 -16x^2 + 15x +14 \ (3x^2-4x-4$ $(-) \quad 3x^4 \quad -12x^2$ $-4x^3 -4x^2+15x+14$ $(-) \quad -4x^3 \quad +16x$ $-4x^2 - x \quad +14$ $(-) \quad -4x^2 \quad +16$ $-x \quad -2$ Remainder =-x-2 px+q =-x-2 p=-1, q=-2
3	Since this is a polynomial of degree 4, hence there will be a total of 4 roots. $\sqrt{}$ (5/3) and -$\sqrt{}$ (5/3) are zeroes of polynomial f(x). $\therefore [x-\sqrt{}(5/3)] [x+\sqrt{}(5/3)] = x^2-(5/3)$ $x^2-4 \overline{)} 3x^4 + 6x^3 -2x^2 - 10x -5 \ (3x^2 + 6x + 3$

	(-) $3x^4$ $-5x^2$ $-6x^3 + 3x^2 - 10x - 5$ (-) $-6x^3$ $-10x$ $3x^2$ -5 (-) $3x^2$ -5 0 Therefore, $3x^2 + 6x + 3 = 3x(x + 1) + 3(x + 1)$ $= (3x + 3)(x + 1)$ $= 3(x + 1)(x + 1)$ $= 3(x + 1)(x + 1)$ Hence, $x + 1 = 0$ i.e. $x = -1, -1$ is a zero of p(x). So, its zeroes are given by: $x = -1$ and $x = -1$. Therefore, all four zeroes of the given polynomial are: $\sqrt{(5/3)}$ and $-\sqrt{(5/3)}$, -1 and -1.
4	Given cubic polynomial is $p(x) = x^3 - 3x^2 - 10x + 24$ 4 is a zero of p(x). So, $(x - 4)$ is the factor of p(x). Let us divide the given polynomial by $(x - 4)$. $x - 4 \overline{)} \; x^3 - 3x^2 - 10x + 24 \; (\; x^2 + x - 6$ (-) x^3 $- 4x^2$ $x^2 - 10x + 24$ (-) $-x^2$ $- 4x$ $-6x + 24$ (-) $-6x + 24$ 0 Here, the quotient $= x^2 + x - 6$ $= x^2 + 3x - 2x - 6$ $= x(x + 3) - 2(x + 3)$ $= (x - 2)(x + 3)$ Therefore, the other two zeroes of the given cubic polynomial are 2 and -3.

5	$p(x) = x^3 - 2x^2 + kx + 5$, When x – 2, $p(2) = (2)^3 - 2(2)^2 + k(2) + 5$ $\Rightarrow 11 = 8 - 8 + 2k + 5$ $\Rightarrow 11 - 5 = 2k$ $\Rightarrow 6 = 2k$ $\Rightarrow k = 3$ Let $q(x) = x^3 + kx^2 + 3x + 1$ $= x^3 + 3x^2 + 3x + 1$ $= x^3 + 1 + 3x^2 + 3x$ $= (x)^3 + (1)^3 + 3x(x + 1)$ $= (x + 1)^3$ $= (x + 1)(x + 1)(x + 1)$ …[$\because a^3 + b^3 + 3ab(a + b) = (a + b)^3$] All zeroes are: $x + 1 = 0 \Rightarrow x = -1$ $x + 1 = 0 \Rightarrow x = -1$ $x + 1 = 0 \Rightarrow x = -1$ Hence zeroes are -1, -1 and -1.
6	The given polynomial is $f(x) = x^4 - 4x^3 - 2x^2 - 20x - 15$ Since $(x - \sqrt{5})$ and $(x + \sqrt{5})$ are the zeroes of f(x) it follows that each one of $(x - \sqrt{5})$ and $(x + \sqrt{5})$ is a factor of f(x). Consequently, $(x - \sqrt{5})(x + \sqrt{5}) = (x^2 - 5)$ is a factor of f(x). On dividing f(x) by (x2 – 5), we get $x^2 - 5 \overline{)}\ x^4 - 4x^3 - 2x^2 - 20x - 15\ (x^2 + 4x + 3$ (-) $x^4 - 5x^2$ $4x^3 - 3x^2 - 20x - 15$ (-) $4x^3 - 20x$ $-3x^2 - 15$ (-) $-3x^2 - 15$ 0 $f(x) = 0$ $x^4 - 4x^3 - 2x^2 - 20x - 15 = 0$

	$(x^2- 5)\ (x^2+ 4x +3) \quad = 0$ $(x - \sqrt{5})\ (x + \sqrt{5})\ (x+1)\ (x+3) =0$ $X= \sqrt{5}\ , -\sqrt{5}, -1,-3$ are the zeroes
7	Let $f(x) = x^3 + kx^2 + hx + 6$ If $(x + 1)$ and $(x - 2)$ are the factors of $f(x)$, then $f(-1) = 0$ and $f(2) = 0$ $\therefore f(-1) = (- 1)^3 + k(-1)^2 + h(- 1) + 6 = 0$ $\Rightarrow -1 + k - h + 6 = 0$ $\Rightarrow k - h + 5=0$ ….(1) and $f(2) = (2)^3 + k(2)^2 + h(2) + 6 = 0$ $= 8 + 4k + 2h + 6 = 0$ $\Rightarrow 4k + 2h + 14 = 0$ …….(2) Solving equation (1) and (2) Multiplying equation (1) by 2 and adding to equation (2) $2k -2h = -10$ $\underline{4k + 2h = -14}$ $6k \quad =-24$ $K= -4$ Putting the value of ft in equation (1) $k - h = - 5$ $\Rightarrow - 4 - h = - 5$ $\Rightarrow -h = -5 + 4 = -1$ $\Rightarrow h = 1$ Hence we get $h = 1$ and $k = - 4$.
8	If the zeros of the polynomial $f(x)=x^2+px+q$ are taken as α and β. $\alpha+\beta=-p$ $\alpha\beta=q$ $(\alpha+\beta)^2=p^2$ $(\alpha-\beta)^2=(\alpha+\beta)^2-4\alpha\beta$ $=p^2-4q$

	New Roots are $(\alpha+\beta)^2$ and $(\alpha-\beta)^2$ Sum$=(\alpha+\beta)^2+(\alpha-\beta)^2$ $=p^2+p^2-4q$ $=2(p^2-2q)$ Product$=(\alpha+\beta)^2(\alpha-\beta)^2$ $=p^2(p^2-4q)$ Therefore $f(x)=K\ [\ x^2-2(p^2-2q)\,x+p^2(p^2-4q)\ ]$
9	$P(x) = x^4 + 2x^3 - 13x^2 - 12x + 21$ $g(x) = x^2 - 4x + 3$ $P(x) = q(x)\,g(x) + r$ Dividend = Quotient× Divisor + Remainder $P(x) = q(x)\,g(x) + r(x)$ $P(x) - r(x) = q(x)\,g(x)$ $x^2 - 4x + 3 \overline{)}\ x^4 + 2x^3 - 13x^2 - 12x + 21$ (x^2+6x+8 (-) $x^4 - 4x^3 + 3x^2$ $6x^3 - 16x^2 - 12x + 21$ (-) $6x^3 - 24x^2 + 18x$ $8x^2 - 30x + 21$ (-) $8x^2 - 32x + 24$ $2x - 3$ $r(x) = 2x - 3$ Therefore, $r(x) = 2x - 3$ has to be subtracted so that resulting polynomial is divisible by $g(x)$
10.	$f(x) = 3x^3 + ax^2 + 4x + b$ Its factor is $(x + 2)$. Therefore, $f(-2) = 3(-2)^3 + a(-2)^2 + 4(-2) + b = 0$

	$\Rightarrow -24 + 4a - 8 + b = 0$ $\Rightarrow 4a + b - 32 = 0$ …..(1) and adding + 5 the factor is (x – 3). Hence $f(x) = 3x^3 + ax^2 + 4x + b$ $f(3) + 5 = 3(3)^3 + a(3)^2 + 4 \times 3 + b + 5 = 0$ $\Rightarrow 81 + 9a + 12 + b + 5 = 0$ $\Rightarrow 9a + b + 98 = 0$ ……(2) Solving equations (1) and (2) $9a + b = -98$ $4a + b = 32$ - - - $5a = -130$ $a = -26$ Putting the value of a in equation (1) $4a + b = 32$ $4(-26) + b = 32$ $-104 + b = 32$ $b = 104 + 32 = 136$ Therefore a = – 26, b = 136

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CHAPTER : 03

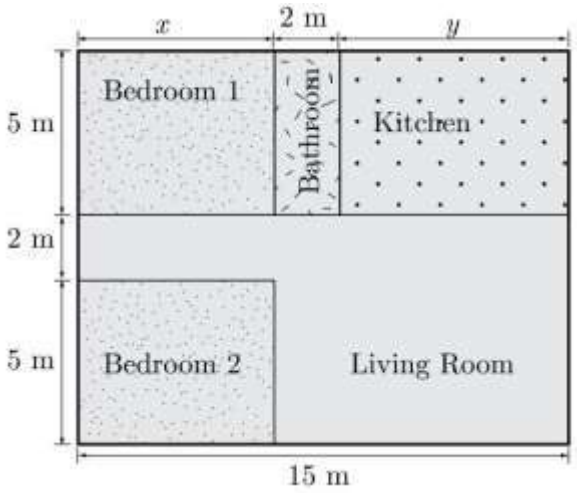
PAIR OF LINEAR EQUATIONS IN TWO VARIABLES

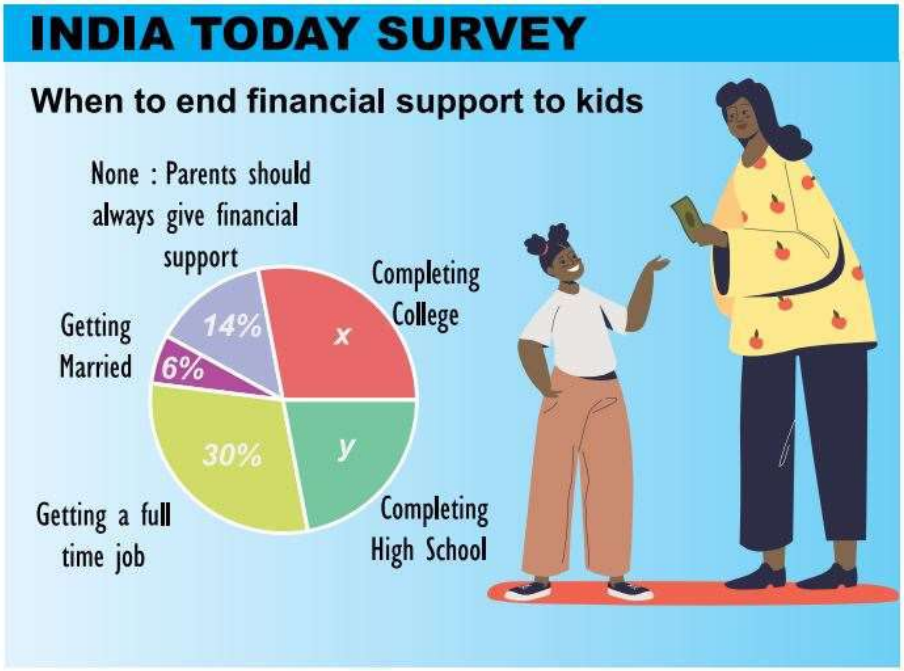
	COMPETENCY BASED QUESTIONS
Q1	The value of k for which the system of equations x + y – 4 = 0 and 2X + ky - 3 = 0, has no solution, is (a) -2 (b) ≠2 (c) 3 (d) 2
Q2	If a pair of linear equations is consistent, then the lines will be (a) parallel (b) always coincident (c) intersecting or coincident (d) always intersecting
Q3	The pair of equations y = 0 and y = – 7 has (a) one solution (b) two solutions (c) infinitely many solutions (d) no solutions
Q4	x and y are two different digits. If the sum of the two digit numbers formed by using both the digits is a perfect square, then value of x + y is (a) 10 (b) 11 (c) 12 (d) 13
Q 5	The pair of linear equations 2kx + 5y = 7, 6x - 5y= 11 has a unique solution, if (a) k ≠-3 (b) k ≠ $\frac{2}{3}$ (c) k ≠5 (d) k ≠ $\frac{2}{9}$
Q 6	One equation of a pair of dependent linear equations −5x + 7y = 2. The second equation can be (a) 10x + 14y + 4 = 0 (b) -10x -14y - 4 = 0 (c) -10x + 14y + 4 = 0 (d) 10x – 14y = - 4

Q 7	If x = a and y = b is the solution of the equations x – y = 2 and x + y = 4, then the values of a and b are, respectively (a) 3 and 5 (b) 5 and 3 (c) 3 and 1 (d) -1 and -3
Q 8	The pair of equations x = a and y = b graphically represents lines which are (a) parallel (b) intersecting at (b, a) (c) coincident (d) intersecting at (a, b)
Q 9	For what value of k, do the equations 3x – y + 8 = 0 and 6x − ky = −16 represent coincident lines? (a) $\frac{1}{2}$ (b) $\frac{-1}{2}$ (c) 2 (d) - 2
Q10	The pair of equations x + 2y + 5 = 0 and −3x - 6y + 1 = 0 represents (a) Parallel lines (b) Intersecting lines (c) Coincident lines (d) None of these
	CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
Q 1	MASK: Masks are an additional step to help prevent people from getting and spreading COVID-19. They provide a barrier that keeps respiratory droplets from spreading. Wear a mask and take every day preventive actions in public settings. Due to ongoing Corona virus outbreak, Wellness Medical store has started selling masks of decent quality. The store is selling two types of masks currently type A and type B. 

	The cost of type A mask is Rs. 15 and of type B mask is Rs. 20. In the month of April, 2020, the store sold 100 masks for total sales of Rs. 1650.
(i)	How many masks of type A were sold in the month of April? (a) 70 (b) 30 (c) 50 (d) 60
(ii)	How many masks of type B were sold in the month of April? (a) 40 (b) 50 (c) 30 (d) 70
(iii)	If the store had sold 50 masks of each type, what would be its sales in the month of April? (a) 2000 (b) 1750 (c) 2150 (d) 1800
(iv)	If the cost of type A mask would have been Rs.20 and of type B mask be Rs.25, then total sale for the month of April would be (a) 2050 (b) 1650 (c) 1750 (d) 2150
(v)	The pair of linear equations formed here represents (a) Parallel lines (b) Intersecting lines (c) Coincident lines (d) None of these
Q 2	Mr. RK Agrawal is owner of a famous amusement park in Delhi. The ticket charge for the park is Rs 150 for children and Rs 400 for adult. 

	Generally he does not go to park and it is managed by team of staff. One day Mr. Agrawal decided to random check the park and went there. When he checked the cash counter, he found that 480 tickets were sold and Rs 134500 was collected.
(i)	Let the number of children visited be x and the number of adults visited be y. Which of the following is the correct system of equations that model the problem? (a) $x + y = 480, 3x + 8y = 2690$ (b) $x + y = 240, 30x + 40y = 134500$ (c) $5x + 3y = 2690, 150x + 400y = 134500$ (d) $x + 3y = 140, x + y = 4500$
(ii)	How many children visited the park? (a) 340 (b) 140 (c) 230 (d) 190
(iii)	How many adults visited the park? (a) 270 (b) 250 (c) 180 (d) 220
(iv)	How much amount collected if 300 children and 350 adults visited the park? (a) 150000 (b) 160000 (c) 185000 (d) 225000
(v)	The pair of linear equations in the problem here represent the lines which are (a) consistent (b) inconsistent (c) coincident (d) none of these
Q 3	Architect: An architect is a skilled professional who plans and designs buildings and generally plays a key role in their construction. Architects are highly trained in the art and science of building design. Since they bear responsibility for the safety of their buildings' occupants, architects must be professionally licensed. Varsha is a licensed architect and design very innovative house. She has made a house layout for her client which is given below. In the

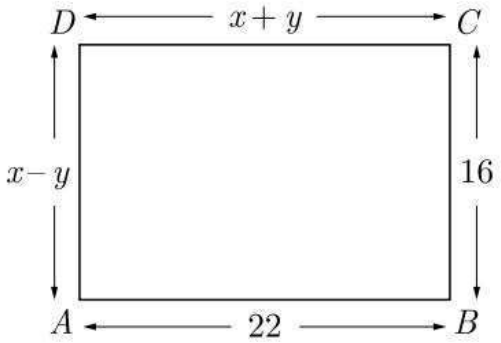
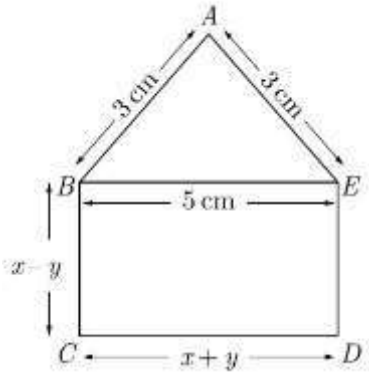
	layout, the design and measurements has been made such that area of two bedrooms and kitchen together is 95 m^2. 
(i)	Which pair of linear equations does describe this situation? (a) x + y = 17, 3x + y = 15 (b) x + y = 27, 3x + 4y = 95 (c) 5x + 2y = 15, x + 4y = 12 (d) 2x + y = 19, x + y = 13
(ii)	What is the length of the outer boundary of the layout? (a) 40 m (b) 54 m (c) 27 m (d) 48 m
(iii)	What is the area of bedroom 1? (a) 30 m^2 (b) 40 m^2 (c) 55 m^2 (d) 25 m^2
(iv)	What is the area of kitchen in the layout? (a) 60 m^2 (b) 50 m^2 (c) 35 m^2 (d) 40 m^2
(v)	What is the cost of laying tiles in Kitchen at the rate of ₹ 50 per m^2? (a) ₹3000 (b) ₹2500 (c) ₹1750 (d) ₹2000
Q 4	At some point, it's time to gently ease, kids off the parental gravy train. The circle graph shows the percentage of parents who think significant financial support should end at various milestones.

	 The difference in the percentage who would end this support after completing college and after completing high school is 6%.
(i)	What is the percentage of parents who would end financial support after a child completes college. (a) 26% (b) 34% (c) 28% (d) 22%
(ii)	What is the percentage of parents who would end financial support after a child completes high school. (a) 22% (b) 24% (c) 18% (d) 14%
(iii)	What is the total combined percentage of parents who would end financial support after a child completes high school and after getting a full time job? (a) 42% (b) 56% (c) 52% (d) 48%
(iv)	What is the total combined percentage of parents who would end financial support after a child completes college and after getting married? (a) 28% (b) 36% (c) 42% (d) 34%

(v)	The pair of linear equations in the problem here represent the lines which have (a) one solution (b) two solutions (c) infinitely many solutions (d) no solutions
Q 5	Architectural Wonders: When it was first constructed in 1889, the Eiffel Tower in Paris, France, was the tallest structure in the world. In 1975, the CN Tower in Toronto, Canada, became the world's tallest structure.   The CN Tower is 153 ft less than twice the height of the Eiffel Tower, and the sum of their heights is 2799 ft.
(i)	Let the height of Eiffel tower be x and the height of CN tower be y. Which of the following is the correct system of equations that model the problem? (a) $x - y = 153, x + 2y = 2799$ (b) $2x - y = 153, x + y = 2799$ (c) $x - 2y = 2690, 2x + y = 153$ (d) $x + 3y = 153, x - y = 2690$
(ii)	How tall is CN tower? (a) 2050 ft (b) 1725 ft (c) 1815 ft (d) 1125ft
(iii)	How tall is Eiffel tower? (a) 1125 ft (b) 984 ft (c) 1215 ft (d) 824ft
(iv)	What is the difference of the heights of CN Tower and Eiffel Tower?

	(a) 972 ft (b) 783 ft (c) 831 ft (d) 585ft
(v)	The pair of linear equations in the problem here represent the lines which are (a) Parallel lines (b) Intersecting lines (c) Coincident lines (d) None of these
	OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
	State True and False in Q No. 1 to 10.
Q 1	$ax^2 + by + c = 0$ is a linear equation in two variable.
Q 2	(4, 2) is the solution of the equations $x - 2y = 0$ and $3x + 4y = 20$.
Q 3	A pair of linear equations which has no solution, is called an inconsistent pair of linear equations.
Q 4	If two lines $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ are parallel then, $\frac{a1}{a2} = \frac{b1}{b2} = \frac{c1}{c2}$
Q 5	If a pair of linear equations is consistent, then the lines will be intersecting or coincident.
Q 6	(3, -1) is not the solution of the equations $2x - 5y = 0$ and $3x + 2y = 20$.
Q 7	$x + 2y - 4 = 0$ and $2x + 4y - 12 = 0$ are intersecting lines.
Q 8	$2x + 3y - 9 = 0$ and $4x + 6y - 18 = 0$ are coincident lines.
Q 9	The pair of equations $x = a$ and $y = b$ graphically represents lines which are intersecting at (a, b).
Q 10	Pair of linear equations: $9x + 3y + 12 = 0$, $8x + 6y + 24 = 0$ have infinitely many solutions.
	SHORT ANSWER TYPE QUESTIONS
Q 1	For what value of k, the system of equations $kx + 3y = 1$, $12x + ky = 2$ has no solution.
Q 2	Two lines are given to be parallel. The equation of one of the lines is $4x + 3y = 14$, then find the equation of the second line.
Q 3	In a number of two digits, unit's digit is twice the tens digit. If 36 be added to the number, the digits are reversed. The number is?

Q 4	Aruna has only ₹1 and ₹2 coins with her. If the total number of coins that she has is 50 and the amount of money with her is ₹75, then the number of ₹1 and ₹2 coins are?
Q 5	For what value of k, do the equations $3x - y + 8 = 0$ and $6x - ky = -16$ represent coincident lines?
Q 6	Find the value of k for which the system of linear equations $x + 2y = 3$, $5x + ky + 7 = 0$ is inconsistent.
Q 7	Solve $x + y = 5$ and $2x - 3y = 4$ by elimination method to find the value of x and y.
Q 8	Solve $3x - 5y - 4 = 0$ and $9x = 2y + 7$ by substitution method to find the value of x and y.
Q 9	Solve for x and y : $3x + 4y = 10$ $2x - 2y = 2$
Q 10	For what value of k , will the following pair of equations have infinitely many solutions: $2x + 3y = 7$ and $(k + 1)x + (2k - 1)y = 4k + 1$.
	LONG ANSWER TYPE QUESTIONS
Q 1	A part of monthly hostel charge is fixed and the remaining depends on the number of days one has taken food in the mess. When Swati takes food for 20 days, she has to pay ₹3,000 as hostel charges whereas Mansi who takes food for 25 days ₹3,500 as hostel charges. Find the fixed charges and the cost of food per day.
Q 2	For flood victim's two sections A and B of class X contributed Rs. 1,500. If the contribution of X-A was Rs. 100 less than that of X-B, find graphically the amounts contributed by both the sections.
Q 3	Seven times a two digit number is equal to four times the number obtained by reversing the order of its digits. If the difference of the digits is 3, determine the number.
Q 4	4 chairs and 3 tables cost Rs 2100 and 5 chairs and 2 tables cost Rs 1750. Find the cost of one chair and one table separately.
Q 5	If a bag containing red and white balls, half the number of white balls is equal to one-third the number of red balls. Thrice the total number of balls exceeds seven times the number of white balls by 6. How many balls of each color does the bag contain?
Q 6	A father's age is three times the sum of the ages of his two children. After 5 years his age will be two times the sum of their ages. Find the present age of the father.

Q 7	A and B are two points 150 km apart on a highway. Two cars start A and B at the same time. If they move in the same direction they meet in 15 hours. But if they move in the opposite direction, they meet in 1 hours. Find their speeds
Q 8	The cost of 2 kg of apples and 1kg of grapes on a day was found to be Rs. 160. After a month, the cost of 4kg of apples and 2kg of grapes is Rs. 300. Represent the situations algebraically and geometrically.
Q 9	In the figure given below, ABCD is a rectangle. Find the values of x and y. 
Q 10	In the figure below ABCDE is a pentagon with BE || CD and BC || DE. BC is perpendicular to DC. If the perimeter of ABCDE is 21 cm, find the values of x and y. 

CHAPTER : 03

PAIR OF LINEAR EQUATIONS IN TWO VARIABLES

SOLUTION OF THE PROBLEMS

	SOLUTIONS TO COMPETENCY BASED QUESTIONS
Ans 1	(d) 2 , Here $\frac{a1}{a2} = \frac{1}{2}$, $\frac{b1}{b2} = \frac{1}{k}$ and $\frac{c1}{c2} = \frac{-4}{-3} = \frac{4}{3}$, Since system has no solution, we have $\frac{a1}{a2} = \frac{b1}{b2} \neq \frac{c1}{c2}$ $\frac{1}{2} = \frac{1}{k} \neq \frac{4}{3}$ k = 2
Ans 2	(c) intersecting or coincident
Ans 3	(d) no solutions, The pair of both equations are parallel to x-axis and we know that parallel lines never intersects. So, there is no solution of these lines.
Ans 4	(b) 11, The numbers that can be formed are (10x + y) and (10y + x). Hence, (10x + y) + (10y + x) = 11(x + y). If this is a perfect square than x + y = 11.
Ans 5	(a) k ≠-3, Here $\frac{a1}{a2} = \frac{2k}{6}$, $\frac{b1}{b2} = \frac{5}{-5}$ Since system has unique solution, we have $\frac{a1}{a2} \neq \frac{b1}{b2}$ $\frac{2k}{6} \neq \frac{5}{-5}$ $\frac{k}{3} \neq -1$ k ≠ - 3
Ans 6	(d) 10x – 14y = - 4
Ans 7	(c) 3 and 1
Ans 8	(d) intersecting at (a, b)

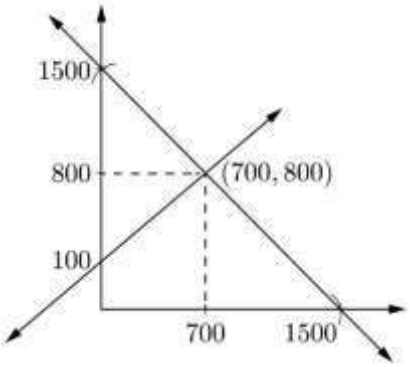
Ans 9	(c) 2, Here $\frac{a1}{a2} = \frac{3}{6} = \frac{1}{2}$, $\frac{b1}{b2} = \frac{-1}{-k} = \frac{1}{k}$ and $\frac{c1}{c2} = \frac{8}{16} = \frac{1}{2}$, Since system has no solution, we have $\frac{a1}{a2} = \frac{b1}{b2} = \frac{c1}{c2}$ $\frac{1}{2} = \frac{1}{k} = \frac{1}{2}$ k = 2
Ans10	(a) Parallel lines
	SOLUTIONS TO CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
Ans 1	(i) (a) 70, Let x be the mask of type A sold and y be the type of mask B sold in april. Now, x + y = 100 ……(1) And 15x + 20y =1650 ……..…(2) Multiplying equation (1) by 15 and subtracting from (2) we obtain, 5y = 150 y = 30 x = 100 – 30 = 70 Hence 70 masks of type A were sold.
	(ii) (c) 30 As, y = 30
	(iii) (b) 1750, Total Sales = 50 x 15 + 50 x 20 = 1750
	(iv) (d) 2150, Total Sales = 70 x 20 + 30 x 25 = 2150
	(v) (b) Intersecting lines, Because they have exactly one solution.
Ans 2	(i) (a) x + y = 480, 3x + 8y = 2690 Since 480 people visited, we obtain x + y = 480 ……..(1) Collected amount is Rs 134500 thus 150x + 400y = 134500 3x + 8y = 2690……..(2)
	(ii) (c) 230

	Solving the equations (1) and (2) we get x = 230 and y = 250 So, number of children attended = 230
	(iii) (b) 250 Number of adults attended = 250
	(iv) (c) 185000 Amount = 150 x 300 + 400 x 350 = 185000
	(v) (a) consistent Because they have one solution.
Ans 3	(i) (d) $2x + y = 19$, $x + y = 13$ Area of two bedrooms = $5x + 5x = 10x$ m^2 Area of kitchen = $5y$ m^2 Thus $10x + 5y = 95$ $2x + y = 19$……(1) Also from the figure, we have, $x + 2 + y = 15$ $x + y = 13$…….(2)
	(ii) (b) 54 m, Length of outer boundary = 2(5 + 2 + 5 + 15) = 54 m
	(iii) (a) 30 m^2 Solving $2x + y = 19$ and $x + y = 13$ we get $x = 6$ m and $y = 7$ m Area of bedroom = 5 x 6 = 30 m^2
	(iv) (c) 35 m^2 Area of Kitchen = 5 x 7 = 35 m^2
	(v) (c) ₹1750 Total cost of laying tiles in Kitchen = 50 x 35 = 1750 m^2
Ans 4	(i) (c) 28% According to the question, we have

	$x + y + 30 + 6 + 14 = 100$ $x + y = 50$……..(1) The difference in the percentage who would end this support after completing college and after completing high school is 6%. Thus $x - y = 6$ ……(2) Solving equation (1) and (2) we get $x = 28$ and $y = 22$ So, the percentage of parents who would end financial support after a child completes college is 28.
	(ii) (a) 22% The percentage of parents who would end financial support after a child completes high school is 22%.
	(iii) (c) 52% The total combined percentage of parents who would end financial support after a child completes high school and after getting a full time job is 30% + 22% = 52%.
	(iv) (d) 34% The total combined percentage of parents who would end financial support after a child completes college and after getting married is 28% + 6% = 34 %
	(v) (a) one solution
Ans 5	(i) (a) $2x - y = 153$, $x + y = 2799$ Height of Eiffel tower be x and CN tower be y. The CN tower is 153 ft less than twice the height of the Eiffel Tower, thus $2x - y = 153$ ……(1) The sum of their heights is 2799 ft, thus $x + y = 2799$ ……..(2)
	(ii) (c) 1815 ft

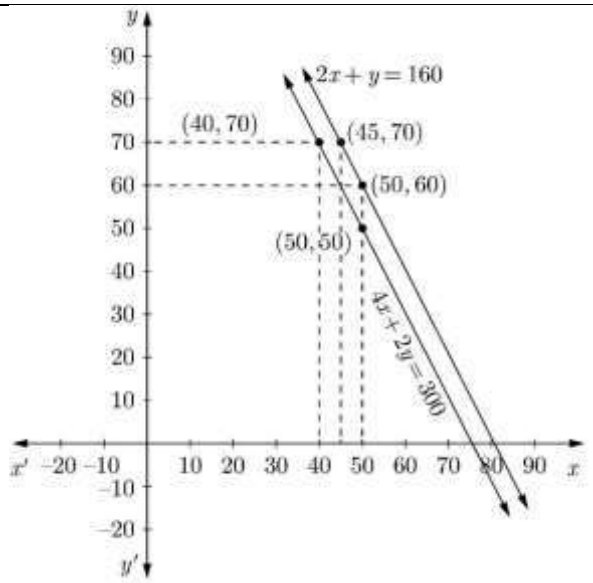
	Solving equation (1) and (2), we get x = 984 and y = 1815 So, the height of CN Tower is 1815 ft.
	(iii) (b) 984 ft The height of Eiffel Tower is 984 ft.
	(iv) (c) 831 ft Difference = 1815 – 984 = 831 ft
	(v) (b) Intersecting lines
	SOLUTIONS TO OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
Ans 1	False
Ans 2	True
Ans 3	True
Ans 4	False
Ans 5	True
Ans 6	True
Ans 7	False
Ans 8	True
Ans 9	True
Ans10	False
	SOLUTIONS TO SHORT ANSWER TYPE QUESTIONS
Ans 1	Here $\frac{a1}{a2} = \frac{k}{12}$, $\frac{b1}{b2} = \frac{3}{k}$ and $\frac{c1}{c2} = \frac{-1}{-2} = \frac{1}{2}$, Since system has no solution, we have $\frac{a1}{a2} = \frac{b1}{b2} \neq \frac{c1}{c2}$ $\frac{k}{12} = \frac{3}{k} \neq \frac{1}{2}$ From $\frac{k}{12} = \frac{3}{k}$ we have $k^2 = 36$

	$k = \pm 6$ From $\frac{3}{k} \neq \frac{1}{2}$ we have $k \neq 6$ Thus $k = -6$
Ans 2	The equation of one line is $4x + 3y = 14$. We know that if two lines $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ are parallel then, $\frac{a1}{a2} = \frac{b1}{b2} \neq \frac{c1}{c2}$ $\frac{4}{a2} = \frac{3}{b2} \neq \frac{c1}{c2}$ $\frac{a2}{b2} = \frac{4}{3} = \frac{12}{9}$ Hence, one of the possible, second parallel line is $12x + 9y = 5$.
Ans 3	48
Ans 4	25 and 25
Ans 5	$k = 2$
Ans 6	$k = 10$
Ans 7	$x = \frac{19}{5}$, $y = \frac{6}{5}$
Ans 8	$x = \frac{9}{13}$, $y = \frac{-5}{13}$
Ans 9	$x = 2$ and $y = 1$
Ans10	$k = 5$
	SOLUTIONS TO LONG ANSWER TYPE QUESTIONS
Ans 1	Let fixed charge be ₹x and per day food cost be ₹y $x + 20y = 3000$ ……..(1) $x + 25y = 3500$ ……(2) Subtracting (1) from (2) we have $5y = 500$ $y = 100$ Substituting this value of y in (1), we have $x + 20(100) = 3000$

	$x = 1000$ Fixed charge and cost of food per day are ₹1000 and ₹100.
Ans 2	Let amount contributed by two sections X-A and X-B be ₹x and ₹y. $x + y = 1500$ ……..(1) $y - x = 100$ ……..(2) From (1), $y = 1500 - x$ x 0 700 y 1500 800 From (2), $y = 100 + x$ x 0 700 y 100 800 Plotting the above points and drawing lines joining them, we get the following graph.  Clearly, the two lines intersect at point (700, 800). Hence X-A contributes ₹700 and X-B contributes ₹800.
Ans 3	Let the tan's and unit digit be y and x respectively, so the number is $10y + x$ The number when digits are reversed $10x + y$. Thus $7(10y + x) = 4(10x + y)$ $70y + 7x = 40x + 4y$ $70y - 4y = 40x - 7x$ $2y = x$ ……(1) Also, $x - y = 3$ ……(2) From (1) and (2) we get $y = 3$ and $x = 6$

	Hence the number is 36.
Ans 4	Let cost of 1 chair be ₹x and cost of 1 table be ₹y According to the question, $4x + 3y = 2100$ ……..(1) $5x + 2y = 1750$ ……(2) Solving (1) from (2) we have $x = 150$ and $y = 500$ The cost of chair and table is ₹150 and ₹500 respectively.
Ans 5	Let the number of red balls be x and white balls be y According to the question, $\frac{y}{2} = \frac{1}{3}x$ $2x - 3y = 0$ ……..(1) And $3(x + y) - 7y = 6$ $3x - 4y = 6$ ……(2) Solving (1) from (2) we have $y = 12$ and $x = 18$ Hence, number of red balls = 18 and number of white balls = 12.
Ans 6	Let x be the age of father and y be the sum of the ages of his children. After 5 years, Father's age = (x + 5) years Sum of the ages of his children = (y + 10) years According to the question, $x = 3y =$ ……..(1) and $x + 5 = 2(y + 10)$ $x - 2y = 15$ ……(2) Solving (1) from (2) we have $y = 15$

<table>
<tr><td></td><td>and $x = 45$
Hence, father's present age is 45.</td></tr>
<tr><td>Ans 7</td><td>Let the speed of car I from A be x and speed of car II from B be y.
Same Direction:
Distance covered by car I = 150 + Distance covered by car II
$15x = 150 + 15y$
$x - y = 10$ ……..(1)
Opposite Direction:
Distance covered by car I + Distance covered by car II =150
$x + y = 150$ ……(2)
Solving (1) from (2) we have
$x = 80$
and $y = 70$
Speed of car I from A = 80 km/h and speed of car II from B = 70km/h.</td></tr>
<tr><td>Ans 8</td><td>Let cost of 1 kg apple be ₹x and cost of 1 kg of grapes be ₹y
$2x + y = 160$ ……..(1)
$4x + 2y = 300$ ……..(2)
From (1), $y = 160 - 2x$<table><tr><td>x</td><td>50</td><td>45</td></tr><tr><td>y</td><td>60</td><td>70</td></tr></table>From (2), $y = 150 - 2x$<table><tr><td>x</td><td>50</td><td>40</td></tr><tr><td>y</td><td>50</td><td>70</td></tr></table>Plotting the above points and drawing lines joining them, we get two parallel lines as following graph shows.</td></tr>
</table>

	
Ans 9	From the given figure we have x + y = 22 ……..(1) and x - y = 16 ……..(2) Solving (1) from (2) we have x = 19 and y = 3
Ans10	Since BE || CD and BC || DE with BC is perpendicular to DC, bcde is a rectangle. BE = CD, x + y = 5 ……..(1) and DE = BE = x – y Since perimeter of ABCDE is 21, AB + BC + CD + DE + EA = 21 3 + x – y + x + y + x – y + 3 = 21 6 + 3x – y = 21 3x – y = 15 ……..(2) Solving (1) from (2) we have x = 5 and y = 0

----------X----------X----------X ----------

CHAPTER : 04

QUADRATIC EQUATIONS

	COMPETENCY BASED QUESTIONS
Q1	Which one of the following is not a quadratic equation? (a) $(x+2)^2 = 2(x+3)$ (b) $x^2 + 3x = (-1)(1-3x)^2$ (c) $(x+2)(x-1) = x^2 - 2x - 3$ (d) $x^3 - x^2 + 2x + 1 = (x+1)^3$
Q2	Which of the following equations has – 1 as a root? (a) $x^2 + 3x - 10 = 0$ (b) $x^2 - x - 12 = 0$ (c) $3x^2 - 2x - 5 = 0$ (d) $9x^2 + 24x + 16 = 0$
Q3	If the difference of roots of the quadratic equation $x^2+kx+12=0$ is 1, the positive value of k is (a) – 7 (b) 7 (c) 4 (d) 8
Q4	Which of the following are the roots of $3x^2 +2x-1=0$ (a) $x=-1$ (b) $x=1/3$ (c) $x=-1/2$ (d) $x=2$
Q 5	If one root of quadratic equation $4x^2 - 2x + k - 4 = 0$ is reciprocal of the other, then the value of k is (a) -4 (b) 2 (c) 4 (d) 8
Q 6	The two consecutive odd positive integers, sum of whose squares is 290 are (a) 13, 15 (b) 11, 13 (c) 7, 9 (d) 5, 7
Q 7	Find the value of k for which $m=1/\sqrt{3}$ is a root of the equation $km^2+(\sqrt{3}-\sqrt{2})m-1=0$. (a) $\sqrt{2}$ (b) 2 (c) $\sqrt{6}$ (d) 5
Q 8	If the equation $x^2-kx+9=0$ does not possess real roots, then

	(a) – 6< k <6 (b) k>6 (c) k<–6 (d) k=±6
Q 9	If $p^2x^2 - q^2 = 0$, then x= _____. (a) ±q/p (b) ±p/q (c) p (d) q
Q10	The quadratic equation whose one rational root is $3+\sqrt{2}$ is (a) $x^2 - 7x + 5$ (b) $x^2 + 7x + 6 = 0$ (c) $x^2 - 7x + 6$ (d) $x^2 - 6x + 7 = 0$
	CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
Q 1	Kartik went to his hometown to visit his grandmother by covering a distance of 150 km via his car. The time taken by him to cover this distance while visiting his grandmother was 2.5 hours more than the time taken in return journey. He realised that he returned at a speed of 10 km/hr more than the speed of going.  Now answer the following question, based on this information:
(i)	Express the above condition in form of a quadratic equation, given that Kartik's speed while going was x km/hr. (a) $\frac{150}{x} - \frac{150}{x+10} = \frac{5}{2}$ (b) $\frac{150}{x} + \frac{150}{x-10} = \frac{5}{2}$ (c) $\frac{150}{x} + \frac{150}{x+10} = \frac{5}{2}$ (d) $\frac{150}{x} - \frac{150}{x-10} = \frac{5}{2}$
(ii)	What was his speed while going? (a) 10 km/hr (b) 20 km/hr (c) 30 km/hr (d) 40 km/hr
(iii)	What was his speed while returning?

	(a) 30 km/hr (b) 40 km/hr (c) 50 km/hr (d) 20 km/hr
(iv)	What was the time taken by him to reach the destination (to visit his grandmother)? (a) 6 hours (b) 6.5 hours (c) 7 hours (d) 7.5 hours
(v)	What was the time taken by him to return to his original position? (a) 5 hours (b) 5.5 hours (c) 6 hours (d) 7 hours
Q 2	A teacher organized a picnic for his students. Many students enrolled for the picnic. It was known that the budget for food was Rs 480 for all the students. On the day of the picnic, out of the total enrolled, 8 failed to go for the picnic and thus the cost of food for each student who went increased by Rs 10.  Now answer the following question, based on this information:
(i)	Form a quadratic equation for the above case, given that the total number of students who enrolled for the picnic be x. (a) $(x+8)\left(\frac{480}{x}+10\right) = 480$ (b) $(x-8)\left(\frac{480}{x}\right) = 480$ (c) $(x+10)\left(\frac{480}{x}-8\right) = 480$ (d) $\frac{480}{x-8} - \frac{480}{x} = 10$
(ii)	What was the total number of students who enrolled for the picnic?

	(a) 26 (b) 24 (c) 28 (d) 22
(iii)	What was the total number of students who actually went for the picnic? (a) 16 (b) 18 (c) 20 (d) 14
(iv)	What was the old cost of food per student had there been no increase in per head cost and everyone would have attended the picnic? (a) Rs 32 (b) Rs 28 (c) Rs 20 (d) Rs 22
(v)	What was the new cost of food per student? (a) Rs 30 (b) Rs 28 (c) Rs 26 (d) Rs 28
Q 3	Water Distribution System: Delhi Jal Board (DJB) is the main body of the Delhi Government which supplies drinking water in the National Capital Territory of Delhi. Distribution system is well knit and properly planned. Maintenance of underground pipe and hose system is also performed at regular interval of time. Many rivers and canals are inter-connected in order to ensure un-interrupted water supply. It has been meeting the needs of potable water for more than 16 million people. It ensures availability of 50 gallons per capita per day of pure and filtered water with the help of efficient network of water treatment plants and pumping stations. In a particular locality, DJB constructed two big reservoir labelled as Reservoir–A and Reservoir–B. Reservoir–A: In order to fill it, department uses two pipes of different diameter. Reservoir–B: Department uses two taps to store water in this reservoir.

	Refer to Reservoir-A
(i)	Two pipes running together can fill the reservoir in $11\frac{1}{9}$ minutes. If one pipe takes 5 minutes more than the other to fill the reservoir, the time in which each pipe alone would fill the reservoir is (a) 10 min, 12 min (b) 25 min, 20 min (c) 15 min, 18 min (d) 22 min, 28 min
(ii)	In case two pipes running together can fill a reservoir in 6 minutes. If one pipe takes 5 minutes more than the other to fill the reservoir, the time in which each pipe would fill the reservoir separately is (a) 8 min, 6 min (b) 10 min, 15 min (c) 12 min, 16 min (d) 16 min, 18 min
	Refer to Reservoir-B
(iii)	Two water taps together can fill a reservoir in $9\frac{3}{8}$ hours. The tap of larger diameter takes 10 hours less than the smaller one to fill the reservoir separately. The time in which each tap can separately fill the reservoir will be (a) 15 hrs, 25 hrs (b) 20 hrs, 22 hrs (c) 14 hrs, 18 hrs (d) 18 hrs, 16 hrs
(iv)	Two taps running together can fill the reservoir in $3\frac{1}{13}$ minutes. If one tap takes 3 minutes more than the other to fill it, how many minutes each tap would take to fill the reservoir? (a) 12 min, 15 min (b) 6 min, 9 min (c) 18 min, 14 min (d) 5 min, 8 min

(v)	If two tapes function simultaneously, reservoir will be filled in 12 hours. One tap fills the reservoir 10 hours faster than the other. The time that the second tap takes to fill the reservoir is given by (a) 25 hrs (b) 28 hrs (c) 30 hrs (d) 32 hrs
Q 4	A Hill Station: In the last summer, I enjoyed a tour to a hill station at Shimla. I was accompanied by my five friends and enjoyed the natural beauties of mountains, rivers, streams, forests etc. The beginning of the tour was the most adventurous itself! How amazingly my group win the bet! Actually, the story is that my two friends along with me preferred train to go to Shimla, but other three were forcing for a car or a bus. At last the consensus was reached and we were divided ourselves in two groups of 3 each and started for Shimla at the same time. It was decided that the group who reach the destination first, would be declared as the winner, and runner up the group have to bear the expanses of the tour. I named my group, 'Group A' while the second group was named as 'Group B'. Luckily we reached Shimla 1 hour before the Group-B and enjoyed the trip for absolutely FREE!! How thrilling it was the tour!  
	Refer to Group-A

(i)	An express train takes 1 hour less than a passenger train to travel 132 km between Delhi and Shimla (without taking into consideration the time they stop at intermediate stations). If the average speed of the express train is 11 km/hr more than that of the passenger train, the average speeds of the two trains will be (a) 33 km/h, 44 km/hr (b) 40 km/h, 45 km/h (c) 30 km/h, 38 km/h (d) 42 km/h, 62 km/h
(ii)	An express train makes a run of 240 km at a certain speed. Another train whose speed is 12 km/hr less takes an hour longer to make the same trip. The speed of the express train will be (a) 60 km/h (b) 50 km/h (c) 65 km/h (d) 48 km/h
(iii)	A journey of 192 km from Delhi to Shimla takes 2 hours less by a super fast train than that by an ordinary passenger train. If the average speed of the slower train is 16 km/hr less than that of the faster train, average speed of super fast train is (a) 50 km/h (b) 48 km/h (c) 55 km/h (d) 60 km/h
	Refer to Group-B
(iv)	A deluxe bus takes 3 hours less than a ordinary bus for a journey of 600 km. If the speed of the ordinary bus is 10 km/hr less than that of the deluxe bus, the speeds of the two buses will be (a) 35 km/h, 42 km/h (b) 42 km/h, 52 km/h (c) 40 km/h, 50 km/h (d) 30 km/h, 58 km/h
(v)	A bus travels a distance of 300 km at a uniform speed. If the speed of the bus is increased by 5 km an hour, the journey would have taken two hours less. The original speed of the bus will be (a) 20 km/h (b) 15 km/h (c) 22 km/h (d) 25 km/h

Q 5	Seven years ago, Surya's age was five times the square of Tara's age. Three years hence, Tara's age will be two-fifth of Surya's age. 
(i)	If seven years ago, Tara's age be x years, then Surya's age is (a) $(5x-7)^2$ years (b) $5x^2$ years (c) $5x^2+7$ years (d) $5x^2-7$ years
(ii)	After three years, Tara's age will be (a) x+3 years (b) x−3 years (c) x+7 years (d) x+10 years
(iii)	The quadratic equation related to the given problem is (a) $2x^2-x-6=0$ (b) $5x^2-x+6=0$ (c) $3x^2-2x+5=0$ (d) $7x^2-3x+1=0$
(iv)	(iv) Present age of Surya is (a) 27 years (b) 20 years (c) 30 years (d) 37 years
(v)	(v) When Tara's will be 10 years old, at that time Surya's age will be (a) 40 years (b) 47 years (c) 45 years (d) 52 years
	OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
Q 1	True or False: The quadratic equation $(x - 1)^2 + 2(x + 1) = 0$ has no real roots.
Q 2	True or False: 0.3 is a root of $x^2 - 0.9 = 0$.
Q 3	Every quadratic equation has atleast one real root. (True/False)
Q 4	The graph of a quadratic polynomial is a straight line. (True/False)
Q 5	_____ is a root of quadratic equation $x^2 - 0.04 = 0$.

Q 6	The equation of the form $ax^2 + bx = 0$ will always have _____ roots.
Q 7	If one root of quadratic equation $6x^2 - x - k = 0$ is 2/3, value of k is _____.
Q 8	Roots of Quadratic equation $x^2 - 7x = 0$ are _____ and _____ .
Q 9	If the coefficient of x^2 and constant term of a quadratic equation have _____ signs then the quadratic equation has real roots.
Q 10	If the equation $x^2 + x - 5 = 0$ then product of its two roots is _____ .
	SHORT ANSWER TYPE QUESTIONS
Q 1	If $ax^2 + bx + c = 0$ has equal roots, find the value of c.
Q 2	If *a* and *b* are the roots of the equation $x^2 + ax - b = 0$, then find *a* and *b.*
Q 3	Write the set of values of k for which the quadratic equation $2x^2 + kx + 8 = 0$ has real roots.
Q 4	If one of the roots of $x^2 + px - 4 = 0$ is – 4, then find the product of its roots and the value of *p*.
Q 5	In each of the following equations, find the value of unknown constant for which the given value is a solution of the equation: (i) $x^2-k^2=0$; x = 0.3 (ii) $3x^2+2ax-3=0$; x = −1/2
Q 6	Find discriminant of the quadratic equation $3x^2 + 4x - 5 = 0$. What type of roots does the given quadratic equation have?

Q 7	The area of a rectangular plot is 428 sq m. The length of the plot (in metres) is two more than twice its breadth. Find the length and breadth of the plot.
Q 8	Does there exist a quadratic equation whose coefficients are rational but both of its roots are irrational? Justify your answer.
Q 9	The sides of two square plots are (2x −1)m and (5x+4)m. The area of the second square plot is 9 times the area of the first square plot. Find the side of the larger plot.
Q 10	If ad≠bc, then prove that the equation $(a^2+b^2)x^2 + 2(ac+bd)x + (c^2+d^2) = 0$ has no real roots.
	LONG ANSWER TYPE QUESTIONS
Q 1	If -5 is a root of the quadratic equation $2x^2 + px - 15 = 0$ and the quadratic equation $p(x^2 + x) + k = 0$ has equal roots, then find the value of k.
Q 2	Solve the following quadratic equation: $2x^2 + 4x - 8 = 0$
Q 3	Find the roots of the quadratic equation $2x^2 + \frac{5}{3}x - 2 = 0$ by factorisation method.
Q 4	In a class test, the sum of Manya's marks in English and Science is 30. Had she got 2 marks more in English and 3 marks less in Science, the product of her marks would have been 210. Find her marks in the two subjects.
Q 5	If the roots of the quadratic equation (x – a) (x – b) + (x – b) (x – c) + (x – c) (x – a) = 0 are equal, then show that a = b = c.
Q 6	The sum of the reciprocals of Rehman's age (in years) 3 years ago and 5 years from now is Find his present age.

Q 7	In a rectangular park of dimensions 50 m × 40 m, a rectangular pond is constructed so that the area of grass strip of uniform width surrounding the pond would be 1184 m^2. Find the length and breadth of the pond.
Q 8	Zahlen and Zeba together have 25 balloons to blow air in. Both of them lost 5 balloons each due to bursting and the product of the number of balloons they now have, is 54. Find out how many balloons they had to start with?
Q 9	In a class test, the sum of Gagan's marks in Mathematics and English is 45. If he had 1 more mark in Mathematics and 1 less in English, the product of marks would have been 500. Find the original marks obtained by Gagan in Mathematics and English separately.
Q 10	A motor boat whose speed in still water is 16 km/h, takes 2 hours more to go 60 km upstream than to return to the same spot. Find the speed of the stream.

CHAPTER-04

QUADRATIC EQUATIONS

SOLUTION OF THE PROBLEMS

	SOLUTIONS TO COMPETENCY BASED QUESTIONS
Ans 1	(c)
Ans 2	(c)
Ans 3	(b)
Ans 4	(b)
Ans 5	(d)
Ans 6	(b)
Ans 7	(c)
Ans 8	(a)
Ans 9	(a)
Ans 10	(d)
	SOLUTIONS TO CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
Ans 1	
(i)	(a) $\frac{150}{x} - \frac{150}{x+10} = \frac{5}{2}$
(ii)	(b) 20 km/hr
(iii)	(a) 30 km/hr
(iv)	(d) 7.5 hours
(v)	(a) 5 hours

Ans 2	
(i)	(d) $\frac{480}{x-8} - \frac{480}{x} = 10$
(ii)	(b) 24
(iii)	(a) 16
(iv)	(c) Rs.20
(v)	(a) Rs 30
Ans 3	
(i)	(b) 25 min, 20 min
(ii)	(b) 10 min, 15 min
(iii)	(a) 15 hours, 25 hours
(iv)	(d) 5 min, 8 min
(v)	(c) 30 hours
Ans 4	
(i)	(a) 33 km/h, 44 km/hr
(ii)	(a) 60 km/h
(iii)	(b) 48 km/h
(iv)	(c) 40 km/h, 50 km/h
(v)	(d) 25 km/h
Ans 5	
(i)	(b) $5x^2$ years
(ii)	(d) x+10 years
(iii)	(a) $2x^2-x-6=0$

(iv)	(a) 27 years
(v)	(d) 52 years
	SOLUTIONS TO OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
Ans 1	True. Reason: $(x-1)^2 + 2(x+1) = 0$ $\Rightarrow \quad x^2 + 3 = 0$ $\Rightarrow \quad x^2 + 0.x + 3 = 0$ So, D$= -12 < 0$ Therefore, the roots are not real.
Ans 2	False
Ans 3	False
Ans 4	False
Ans 5	± 0.2
Ans 6	Real
Ans 7	2
Ans 8	0 , 7
Ans 9	Opposite
Ans 10	-5
	SOLUTIONS TO SHORT ANSWER TYPE QUESTIONS
Ans 1	Given : quadratic equation $ax^2 + bx + c = 0$ has equal roots. For equal roots, D = 0 i.e., $b^2 - 4ac = 0$

	⇒ $b^2 = 4ac$ ⇒ $c = b^2/4a$
Ans 2	Sum of the root, $a+b=-a$ Product of the roots, $ab=-b$ $ab=-b$ ⇒ $a=-1$ & $a+b=-a$ $b=-2a$ ⇒ $b=-2(-1)=2$
Ans 3	For quadratic equation $2x^2 + kx + 8 = 0$ to have real roots $D \geq 0$ ⇒ $b^2 - 4ac \geq 0$ ⇒ $k^2 - 4(2)(8) \geq 0$ ⇒ $k^2 - 64 \geq 0$ ⇒ $k^2 \geq 64$ ⇒ $k \leq 8 \; and \; k \geq 8$
Ans 4	If -4 is a root of the quadratic equation $x^2 + px - 4 = 0$ $\therefore (-4)^2 + p(-4) - 4 = 0$ ⇒ 16 − 4p − 4=0 ⇒ 12 − 4p = 0

	⇒ p = 3 Now, Product of the roots = c/a ∴ Product of the roots in $x^2 + px - 4 = 0$ is −4/1 = −4
Ans 5	(i) $x^2-k^2=0$; x=0.3 Since, x=0.3 is a solution of given equation, so it will satisfy the given equation. On putting x=0.3 in the given equation, we get $(0.3)^2 - k^2 = 0$ ⇒ $k^2 = (0.3)^2$ ⇒ k = ± 0.3 (ii) $3x^2+2ax-3=0$; x = −1/2 Since, x=−1/2 is a solution of given equation, so it will satisfy the given equation. On putting x=−1/2 in the given equation, we get $3(-1/2)^2 + 2a(-1/2) - 3= 0$ ⇒ 3/4 − a = 3 ⇒ a = 3/4 − 3 ⇒ a = − 9/4
Ans 6	Comparing the given quadratic equation $3x^2 + 4x - 5 = 0$ with standard quadratic equation $ax^2+bx+c=0$, we get a = 3, b = 4 and c = −5

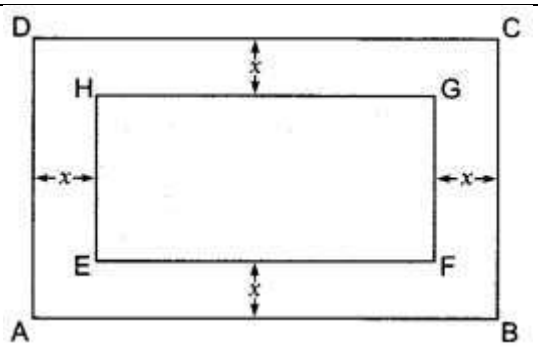
	∴ Discriminant, $D = b^2 - 4ac$ $= 4^2 - 4(3)(-5)$ $= 16 + 60$ $= 76$ Since D>0, the roots are real and distinct.
Ans 7	Let the breadth of the plot be x metres. Then the length of the plot = 2x + 2 metres Since, area of the plot = 428 m^2 (Given) ∴ $x(2x + 2) = 428$ ⇒ $2x^2 + 2x - 428 = 0$ ⇒ $x^2 + x - 214 = 0$
Ans 8	Yes. e.g. $x^2 - 4x + 1 = 0$ is a quadratic equation with rational coefficients. Its roots are $\frac{-(-4)\pm\sqrt{(-4)^2-4(1)(1)}}{2} = \frac{4\pm\sqrt{(-4)^2-4(1)(1)}}{2} = \frac{4\pm\sqrt{12}}{2} = 2 \pm \sqrt{3}$, which are irrational.
Ans 9	$(5x+4)^2 = 9(2x-1)^2$ ⇒ $5x+4 = \pm 3(2x-1)$ ⇒ $5x+4+6x-3=0$ Or $5x+4+6x+3=0$ ⇒ $11x=-1$ Or $5x+4-6x+3=0$

	⇒ x=−1/11 Or −x+7=0 ⇒ x=7 Discard x=−1/11. So, Side of larger plot is (5x+4)m= 5(7)+4=39m.
Ans 10	Given: quadratic equation $(a^2+b^2)x^2 + 2(ac+bd)x + (c^2+d^2) = 0$ $D = b^2 - 4ac$ $= 4 (ac+bd)^2 - 4 (a^2+b^2)(c^2+d^2)$ $= -4 (a^2d^2 + b^2c^2 - 2abcd)$ $= -4 (ad - bc)^2$ Since $ad \neq bc$ Therefore $D < 0$ Hence, the equation has no real roots.
	SOLUTIONS TO LONG ANSWER TYPE QUESTIONS
Ans 1	-5 is a root of the quadratic eq. $2x^2 + px - 15 = 0$ $\Rightarrow 2(-5)^2 + p(-5) - 15 = 0$ $\Rightarrow 2(25) - 5p - 15 = 0$ $\Rightarrow 50 - 5p - 15 = 0$ $\Rightarrow 35 - 5p = 0$ $\Rightarrow 5p = 35$ $\Rightarrow p = 7$ The quadratic equation $px^2 + px + k = 0$ has equal roots. $\Rightarrow$ D=0 $\Rightarrow p^2 - 4(p)(k) = 0$ $\Rightarrow 7^2 - 4(7)(k) = 0$

	$\Rightarrow \ 49 - 28k = 0$ $\Rightarrow \ 28k = 49$ $\Rightarrow \ k = 49/28 = 7/4$
Ans 2	We have: $2x^2 + 4x - 8 = 0$ Dividing by 2, we get $x^2 + 2x - 4 = 0$ .....(i) Comparing (i) with $ax^2 + bx + c = 0$, a = 1, b = 2, c = − 4 $\therefore$ b2 − 4ac = $(2)^2 - 4\ (1)\ (-4)$ = 4 + 16 = 20 Since, x = $\frac{-b \pm \sqrt{b^2-4ac}}{2a}$ $\therefore$ x = $\frac{-2 \pm \sqrt{20}}{2}$ $\Rightarrow$ x = $\frac{-2 \pm 2\sqrt{5}}{2}$ $\Rightarrow$ x = $-1 \pm \sqrt{5}$ Taking +ve sign, we get x = $-1 + \sqrt{5}$ Taking −ve sign, we get x = $-1 - \sqrt{5}$ Thus, the required roots x = $-1 + \sqrt{5}$ and x = $-1 - \sqrt{5}$.
Ans 3	Given equation is $2x^2 + \frac{5}{3}x - 2 = 0$ On multiplying by 3 both sides, we get $6x^2 + 5x - 6 = 0$

	$\Rightarrow \quad 6x^2 + (9x - 4x) - 6 = 0$ [by splitting the middle term] $\Rightarrow \quad 6x^2 + 9x - 4x - 6 = 0$ $\Rightarrow \quad 3x(2x + 3) - 2(2x + 3) = 0$ $\Rightarrow \quad (2x + 3)(3x - 2) = 0$ Now, $(2x + 3) = 0$ $\Rightarrow \quad x = -3/2$ and $(3x - 2) = 0$ $\Rightarrow \quad x = 2/3$ Hence, the roots of the equation $2x^2 + \frac{5}{3}x - 2 = 0$ are -3/2 and 2/3.
Ans 4	Let Manya's marks in English be x. Therefore, Manya's marks in Science is (30 – x). Now, according to question, $\Rightarrow (x + 2)(30 - x - 3) = 210$ $\Rightarrow (x + 2)(27 - x) = 210$ $\Rightarrow 27x - x^2 + 54 - 2x = 210$ $\Rightarrow 25x - x^2 + 54 - 210 = 0$ $\Rightarrow 25x - x^2 - 156 = 0$ $\Rightarrow -(x^2 - 25x + 156) = 0$ $\Rightarrow x^2 - 25x + 156 = 0$ $= x^2 - 13x - 12x + 156 = 0$ $\Rightarrow x(x - 13) - 12(x - 13) = 0$ $\Rightarrow (x - 13)(x - 12) = 0$ Either x – 13 or x – 12 = 0 $\therefore$ x = 13 or x = 12 Therefore, Manya's marks in English = 13 and marks in Science = 30 – 13 = 17.

	or Manya's marks in English = 12 and marks in Science = 30 – 12 = 18.
Ans 5	Given $(x – a)(x – b) + (x – b)(x – c) + (x – 6)(x – a) = 0$ $\Rightarrow x^2 – ax – bx + ab + x^2 – bx – cx + bc + x^2 – cx – ax + ac = 0$ $\Rightarrow 3x^2 – 2(a + b + c)x + ab + bc + ca = 0$ Now, for equal roots, D = 0 $\Rightarrow B^2 – 4AC = 0$ $\Rightarrow 4(a + b + c)^2 – 12(ab + bc + ca) = 0$ $4a^2 + 4b^2 + 4c^2 + 8ab + 8bc + 8ca – 12ab – 12bc – 12ca = 0$ $\Rightarrow 2[2a^2 + 2b^2 + 2c^2 – 2ab – 2bc – 2ca] = 0$ $\Rightarrow 2[(a^2 + b^2 – 2ab) + (b^2 + c^2 – 2bc) + (c^2 + a^2 – 2ca)] = 0$ $\Rightarrow [(a – b)^2 + (b – c)^2 + (c – a)^2] = 0$ $\Rightarrow a – b = 0, b – c = 0, c – a = 0$ $\Rightarrow a = b, b = c, c = a$ $\Rightarrow a = b = c$ (Hence Proved)
Ans 6	Let the present age of Rehman be x years. Three years ago, Rehman's age = (x – 3) years Five years from now, Rehman's age = (x + 5) years Now, according to question, we have $\frac{1}{x-3} + \frac{1}{x+5} = \frac{1}{3}$ $\Rightarrow \frac{x+5+x-3}{(x-3)(x+5)} = \frac{1}{3}$ $\Rightarrow \frac{2x+2}{(x-3)(x+5)} = \frac{1}{3}$ $\Rightarrow 6x + 6 = (x - 3)(x + 5)$ $\Rightarrow 6x + 6 = x^2 + 5x - 3x - 15$ $\Rightarrow x^2 + 2x - 15 - 6x - 6 = 0$ $\Rightarrow x^2 + 2x - 15 - 6x - 6 = 0$

	$\Rightarrow \quad x^2 - 4x - 21 = 0$ $\Rightarrow \quad x^2 - 7x + 3x - 21 = 0$ $\Rightarrow \quad x(x-7) + 3(x-7) = 0$ $\Rightarrow \quad (x-7)(x+3) = 0$ $\Rightarrow \quad x = 7$ or $x = -3$ But $x \neq -3$ (age cannot be negative) Therefore, present age of Rehman = 7 years.
Ans 7	 Let ABCD be rectangular lawn and EFGH be rectangular pond. Let x m be the width of grass area, which is same around the pond. Given, Length of lawn = 50 m Width of lawn = 40 m Length of pond = (50 – 2x)m Breadth of pond = (40 – 2x)m Also given, Area of grass surrounding the pond = 1184 m^2 ⇒ Area of rectangular lawn – Area of pond = 1184 m^2 ⇒ 50 × 40 – {(50 – 2x) × (40 – 2x)} = 1184 ⇒ 2000 – (2000 – 80x – 100x + $4x^2$) = 1184 ⇒ 2000 – 2000 + 180x – $4x^2$ = 1184 ⇒ $4x^2$ – 180x + 1184 = 0 ⇒ x^2 – 45x + 296 = 0 ⇒ x^2 – 37x – 8x + 296 = 0 ⇒ x(x – 37) – 8(x – 37) = 0 ⇒ (x – 37) (x – 8) = 0

	⇒ x- 37 = 0 or x – 8 = 0) ⇒ x = 37 or x = 8 x = 37 is not possible (as length of pond will becomes 50–2×37=–24 which is not possible) Hence, x = 8 is acceptable. ∴ Length of pond = 50 – 2 × 8 = 34 m Breadth of pond= 40 – 2 × 8 = 24 m
Ans 8	Given, Zahlen and Zeba together have 25 balloons to blow air in. Let Zahlen plumped x balloons. Then, number of balloons Zeba plumped = 25−x Both of them lost 5 balloons each due to bursting. ∴ The number of plumped balloons Zahlen has = x−5 and the number of plumped balloons Zeba has = 25−x−5 = 20−x Now, product of the number of balloons = 54 ∴ (x – 5) (20−x) = 54 ⇒ $20x - x^2 - 100 + 5x = 54$ ⇒ $-x^2 + 25x - 100 - 54 = 0$ ⇒ $-x^2 + 25x - 154 = 0$ ⇒ $x^2 - 25x + 154 = 0$ [multiplying by (−1)] Now, by factorisation method, we get $x^2 - 11x - 14x + 154 = 0$ ⇒ x(x – 11) – 14(x – 11) = 0 ⇒ (x – 11)(x – 14) = 0

	$\Rightarrow \quad x-11=0 \quad$ or $\quad x-14=0$ $\Rightarrow \quad x = 11 \quad$ or $\quad x = 14$ When Zahlen has 11 balloons, then Zeba has = 25 − 11 = 14 balloons. When Zahlen has 14 balloons, then Zeba has = 25 − 14 = 11 balloons.
Ans 9	Let Gagan's marks in Maths be x, Then Marks in English = (45 − x) ∴ According to the question, $(x + 1) \times (45 - x + 1) = 500$ $\Rightarrow (x + 1) \times (44 - x) = 500$ $\Rightarrow 44x - x^2 + 44 - x = 500$ $\Rightarrow - x^2 + 44x - 456 - x = 0$ $\Rightarrow x^2 - 43x + 456 = 0$ $\Rightarrow x^2 - 19x - 24x + 456 = 0$ $\Rightarrow x (x - 19) - 24 (x - 19) = 0$ $\Rightarrow (x - 19) (x - 24) = 0$ Either $x - 19 = 0 \quad \Rightarrow x = 19$ or $\quad x - 24 = 0 \Rightarrow x = 24$ When x = 19, then 45 − 19 = 26 When x = 24, then 45 − 24 = 21 ∴ Gagan's marks in Maths = 19 and in English = 26 Or Gagan's marks in Maths = 24 and in English = 21

Ans 10	Let the speed of the stream = x km/hr For the motor boat, we have: Downstream speed = (16 + x) km/hr Upstream speed = (16 − x) km/hr For going 60 km: Downstream = $\frac{60}{16+x}$ hours Upstream = $\frac{60}{16-x}$ hours According to the question, $\frac{60}{16-x} - \frac{60}{16+x} = 2$ ⇒ 60 (16 + x) − 60 (16 − x) = 2 (16 − x) (16 + x) ⇒ 960 + 60x − 960 + 60x = 2 (256 − x^2) ⇒ 120x = 2 × 256 − 2x^2 ⇒ x^2 + 60x = 256 ⇒ x^2 + 60x − 250 = 0 ...(1) Comparing (1) with $ax^2 + bx + c = 0$, we get a = 1, b = 60, c = − 256 ∴ $b^2 - 4ac = (60)^2 - 4(1)(-256)$ = 3600 + 1024 = 4624 ∴ $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$

$= \frac{-60 \pm \sqrt{4624}}{2(1)}$

$\Rightarrow x = \frac{-60 \pm 68}{2}$

Taking +ve sign, we get $x = \frac{-60+68}{2} = \frac{8}{2} = 4$

Taking −ve sign, we get $x = \frac{-60-68}{2} = \frac{-128}{2} = -64$

Since, the speed of a stream cannot be negative,

$\therefore x = -64$ is not admissible.

$\therefore x = 4$

$\Rightarrow$ speed of the stream = 4 km/hr.

----------X----------X----------X----------

CHAPTER : 05

ARITHMETIC PROGRESSIONS

	COMPETENCY BASED QUESTIONS
Q1	The number of multiples of 4 between 10 and 250 is: (a)50 (b)40 (c)60 (d)30
Q2	If the sum of three consecutive terms of an increasing A.P. is 51 and the product of the first and third of these terms is 273, then the third term is (a) 13 (b) 9 (c) 21 (d) 17
Q3	If the sum of n terms of an A.P. is 2 n 2 + 5 n 2n2+5n, then its nth term is (a) 4n – 3 (b) 3n – 4 (c) 4n + 3 (d) 3n + 4
Q4	If the sum of n terms of an A.P. be 3 n 2 + n 3n2+n and its common difference is 6, then its first term is (a) 2 (b) 3 (c) 1 (d) 4
Q 5	If 17th term of an A.P. exceeds its 10th term by 7. The common difference is: (a)1

	(b)2 (c)3 (d)4
Q 6	The first term and common difference for the A.P. 3,1,-1,-3 is: (a)1 and 3 (b)-1 and 3 (c)3 and -2 (d)2 and 3
Q 7	If a=10 and d=10, then first four terms will be: (a)10,30,50,60 (b)10,20,30,40 (c)10,15,20,25 (d)10,18,20,30
Q 8	In an Arithmetic Progression, if a=28, d=-4, n=7, then an is: (a)4 (b)5 (c)3 (d)7
Q 9	The middle most term (s) of the AP:−11, −7, −3, ..., 49 is: (a) 18, 20 (b) 19, 23 (c) 17, 21 (d) 23, 25
Q10	If the common difference of an AP is 5, then what is a 18 − a 13 a18−a13? (a) 5 (b) 20

	(c) 25 (d) 30
	CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
Q	In a class the teacher asks every student to write an example of A.P. Two friends Geeta and Madhuri writes their progressions as -5, -2, 1,4, ... and 187, 184, 181, ... respectively. Now, the teacher asks various students of the class the following questions on these two progressions. Help students to find the answers of the questions.
(i)	Find the 34^{th} term of the progression written by Madhuri. (a) 286 (b) 88 (c) -99 (d) 190
(ii)	Find the sum of common difference of the two progressions. (a) 6 (b) -6 (c) 1 (d) 0
(iii)	Find the 19^{th} term of the progression written by Geeta. (a) 49 (b) 59 (c) 52 (d) 62
(iv)	Find the sum of first 10 terms of the progression written by Geeta. (a) 85 (b) 95 (c) 110 (d) 200
(v)	Which term of the two progressions will have the same value? (a) 31 (b) 33 (c) 32 (d) 30
Q 2	Amit was playing a number card game. In the game, some number cards (having both +ve or -ve numbers) are arranged in a row such that they are following an arithmetic progression. On his first turn, Amit picks up 6^{th} and 14^{th}card and finds their sum to be -76. On the second turn he picks up 8^{th} and 16^{th}card and finds their sum to be -96. Based on the above information, answer the following questions.
(i)	What is the difference between the numbers on any two consecutive cards? (a) 7 (b) -5 (c) 11 (d) -3
(ii)	The number on first card is (a) 12 (b) 3 (c) 5 (d) 7
(iii)	What is the number on the 19^{th} card? (a) -88 (b) -83 (c) -92 (d) -102
(iv)	What is the number on the 23^{rd} card? (a) -103 (b) -122 (c) -108 (d) -117

(v)	The sum of numbers on the first 15 cards is (a) -840 (b) -945 (c) -427 (d) -420
Q 3	India is competitive manufacturing location due to the low cost of manpower and strong technical and engineering capabilities contributing to higher quality production runs. The production of TV sets in a factory increases uniformly by a fixed number every year. It produced 16000 sets in 6th year and 22600 in 9th year.
(i)	In which year, the production is Rs 29,200. a) 12 (b) 13. (C) 15. (d) 20
(ii)	Find the production during first year. a) 5000 (b) 4000 (c) 3000 (d) 2000
(iii)	Find the difference of the production during 7th year and 4th year. **(a)** 6600 (b) 6000 (c) 1600 (d) 1100
(iv)	Find the production during first 3 years (a)21600 (b) 31299 (c) 10000 (d) 12345
(v)	Find the production during first 8 years (a)21600 (b) 31299 (c) 20400 (d) 12345
Q 4	Your elder brother wants to buy a car and plans to take loan from a bank for his car. He repays his total loan of Rs 1,18,000 by paying every month starting with the first instalment of Rs 1000. If he increases the instalment by Rs 100 every month , answer the following
(i)	The amount paid by him in 30th installment is a) 3900 b) 3500 c) 3700 d) 3600
(ii)	The amount paid by him in the 30 installments is a) 37000 b) 73500 c) 75300 d) 75000
(iii)	What amount does he still have to pay offer 30th installment? a) 45500 b) 49000 c) 44500 d) 54000
(iv)	If total installments are 40 then amount paid in the last installment? a) 4900

	b) 3900 c) 5900 d) 9400
(v)	The ratio of the 1st installment to the last installment is a) 1:49 b) 10:49 c) 10:39 d) 39:10
Q 5	Your friend Veer wants to participate in a 200m race. He can currently run that distance in 51 seconds and with each day of practice it takes him 2 seconds less. He wants to do in 31 seconds.
(i)	Which of the following terms are in AP for the given situation? a) 51,53,55…. b) 51, 49, 47…. c) -51, -53, -55…. d) 51, 55, 59…
(ii)	What is the minimum number of days he needs to practice till his goal is achieved? a) 10 b) 12 c) 11 d) 9
(iii)	Which of the following term is not in the AP of the above given situation? a) 41 b) 30 c) 37 d) 39
(iv)	If nth term of an AP is given by an = 2n + 3 then common difference of an AP is a) 2 b) 3 c) 5 d) 1
(V)	The value of x, for which 2x, x+ 10, 3x + 2 are three consecutive terms of an AP a) 6 b) -6 c) 18 d) -18
	OBJECTIVE TYPE QUESTIONS (OTHER MCQs)
Q 1	If 7th and 13th terms of an A.P. be 34 and 64 respectively, then its 18th term is a) 87 (b) 88

	(c) 89 (d) 90
Q 2	In an AP, if d = –4, n = 7, a n an = 4, then a is (a) 6 (b) 7 (c) 20 (d) 28
Q 3	In an AP, if a = 3.5, d = 0, n = 101, then a n an will be (a) 0 (b) 3.5 (c) 103.5 (d) 104.5
Q 4	The first four terms of an AP, whose first term is –2 and the common difference is –2, are (a) – 2, 0, 2, 4 (b) – 2, 4, – 8, 16 (c) – 2, – 4, – 6, – 8 (d) – 2, – 4, – 8, –16
Q 5	The number of multiples lie between n and x 2 x2 which are divisible by n is (a) n + 1 (b) n (c) n – 1 (d) n – 2
Q 6	If p, q, r and s are in A.P. then r – q is (a) s – p (b) s – q (c) s – r (d) none of these
Q 7	The famous mathematician associated with finding the sum of the first 100 natural numbers is (a) Pythagoras

	(b) Newton (c) Gauss (d) Euclid
Q 8	The 21st term of the AP whose first two terms are –3 and 4 is (a) 17 (b) 137 (c) 143 (d) –143
Q 9	If p, q, r, s, t are the terms of an A.P. with common difference -1 the relation between p and t is: (a) t = p – 5 (b) t = p – 4 (c) t = p – 6 (d) t = p + 4
Q 10	If the 2nd term of an AP is 13 and the 5th term is 25, what is its 7th term? (a) 30 (b) 33 (c) 37 (d) 38
	SHORT ANSWER TYPE QUESTIONS
Q 1	find the common difference of an AP 6, 12, 18, 24, 30…
Q 2	Write first four term of AP where a is 5 and d is 5
Q 3	Write the first term and the common difference of arithmetic progression 3,7,11, 15, 19,…
Q 4	Which term of an AP 21,18,15 is 0?
Q 5	Find the 12^{th} term and 24^{th} term of an AP 9,13,17,….?
Q 6	If the first term is 2 and the common difference is 5 and there are 15 terms. Then find the sum of AP .

Q 7	If the first term of an AP is 4,and the common difference is -3.Find the first four terms.
Q 8	1,70,139….. Find common difference and sum of first 6 Term.
Q 9	Check whether -120 is a term of the AP :- 12,8,4…..
Q 10	In an AP : Given a=8 , d=2 , an=46 . Find n
	LONG ANSWER TYPE QUESTIONS
Q 1	How many three digit number is divisible by 6.
Q 2	The sum of how many terms of the AP 8,15,22,.. is 395?
Q 3	If the AP is 16,32,48,64,…. . Find the 19^{th} and 99^{th} term.
Q 4	Find the 21^{st} term if the AP:5,10,15,20,25,…545.
Q 5	How many two digit positive integer are divisible by 8?
Q 6	The sum of the third and seventh terms of an AP is 10 and their sum of fourth and ninth terms is 13 find the sum of first fourteen terms of an AP.
Q 7	find the sum of last five terms of arithmetic progression5, 15, 25…, 215, 225
Q 8	find the value of n where a is 6 and d is 2 last term is 26
Q 9	Find the number of multiples of 6 between 100 and 200.
Q 10	check whether - 200 is a term of an AP 11 comment 8, 5, 2,…

CHAPTER-05

ARITHMETIC PROGRESSION

SOLUTION OF THE PROBLEM

	SOLUTIONS TO COMPETENCY BASED QUESTIONS
Ans 1	Answer: (c) 60 Explanation: The multiples of 4 after 10 are: 12, 16, 20, 24, … So here, a = 12 and d = 4 Now, 250/4 gives remainder 2. Hence, 250 – 2 = 248 is divisible by 2. 12, 16, 20, 24, …, 248 So, nth term, an = 248 As we know, an = a+(n−1)d 248 = 12+(n-1)×4 236/4 = n-1 59 = n-1 n = 60
Ans2	Answer: (c) 21 Explanation: Let 3 consecutive terms A.P is a –d, a, a + d. and the sum is 51 So, (a –d) + a + (a + d) = 51 3a –d + d = 51 3a = 51 a = 17 The product of first and third terms = 273 So, (a –d) (a + d) = 273 a2 –d2 = 273 172 –d2 = 273 289 –d2 = 273 d2 = 289 –273 d2 = 16 d = 4 Third term = a + d = 17 + 4 = 21
Ans3	(c) 4n + 3 Explanation: Here Sn = 2n2 + 5n Sum of the A.P with 1 term = S1 = 2 + 5 = 7 = first term Sum of the A.P with 2 terms = 8 + 10 = 18 Sum of the A.P with 3 terms = 18 + 15 = 33 a2 = S2 – S1 = 18 – 7 = 11 d = a2 –a1 = 11 – 7 = 4 nth term = a + (n–1) d = 7 + (n–1) 4 nth term = 4n + 3
Ans4	Answer: (d) 4 Explanation: Here, S n = 3 n 2 + n Sn=3n2+n d = 6 Putting n= 1 S 1 S1 = 3 + 1 = 4 Sum of first 1 term = first term = 4
Ans5	Answer: (a) 1 Explanation: N t h Nth term in AP is: a n an = a+(n-1)d a 17 a17 = a+(17−1)d a 17 a17 = a +16d In the same way, a 10 a10 = a+9d Given, a 17 − a 10 = 7 a17−a10=7 Therefore, (a +16d)−(a+9d) = 7 7d = 7 d = 1 Therefore, the common difference is 1.
ANS6	Answer: (c) 3 and -2 Explanation: First term, a = 3 Common difference, d = Second term – First term ⇒ 1 – 3 = -2 ⇒ d = -2
ANS7	Answer: (b)10,20,30,40 Explanation: a = 10, d = 10 a 1 a1 = a = 10 a 2 = a 1 + d a2=a1+d = 10+10 = 20 a 3 = a 2 + d a3=a2+d = 20+10 = 30 a 4 = a 3 + d a4=a3+d = 30+10 = 40
ANS8	Answer: (a) 4 Explanation: For an AP, a n an = a+(n-1)d = 28+(7-1)(-4) = 28+6(-4) = 28-24 a n = 4
ANS9	Answer: (c) 17, 21 Explanation: Here, a = −11 d = − 7 − (−11) = 4 And a n an = 49 We have, a n an = a + (n − 1)d ⇒ 49 = −11 + (n − 1)4 ⇒ 60 = (n − 1)4 ⇒ n = 16 As n is an even number, there will be two middle terms which are 16/2th and [(16/2)+1]th, i.e. the 8th term and the 9th term. a 8 a8 = a + 7d = − 11 + 7 × 4 = 17 a 9 a9 = a + 8d = − 11 + 8 × 4 = 21

ANS10	Answer: (c) 25 Explanation: Since, d = 5 a 18 – a 13 a18–a13 = a + 17d – a – 12d = 5d = 5 × 5 = 25
	SOLUTIONS TO CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
1	☐ Geeta's A.P. is -5, -2, 1,4, ... Here, first term (a_1) = -5 and common difference (d_1) = -2 + 5 = 3 Similarly, Madhuri's A.P. is 187, 184, 181, ... Here first term (a_2) = 187 and common difference (d_2) = 184 - 187 = -3 **(i) (b):** $t_{34} = a_2 + 33d_2 = 187 + 33(-3) = 88$ **(ii) (d):** Required sum = 3 + (-3) = 0 **(iii) (a):** $t_{19} = a_1 + 18d_1 = (-5) + 18(3) = 49$ **(iv) (a)** **:** S10=n2[2a1+(n−1)d1]=102[2(−5)+9(3)]=85S10=n2[2a1+(n−1)d1]=102[2(−5)+9(3)]=85 **(v) (b):** Let n^{th} terms of the two A.P:s be equal. ∴∴ -5 + (n - 1)3 = 187 + (n - 1)(-3) ⇒⇒ 6(n - 1) = 192 ⇒⇒ n = 33 ☐ Here the savings form an A.P. i.e., Rs 2.75, Rs 3, Rs 3.25, ... So, a = 2.75, d = 3 - 2.75 = 0.25
2	(i) (b.) -5, a6 + a14 = -76 and a8 + a16 = -96 solve for a an d. (ii) (d.) 7 (iii) (b.) -83 (iv) (a) – 103. a23 = a + 22d = 7 + 22(-5) = 7-110 = -103 (v) (d) -420 solve Sn for n =15, a=7, d=-5
3	(i) (a) N = 12 (ii) (a) Rs 5000 (ii) (a) Difference = 18200 - 11600 = 6600 (iv) (a) Production during first 3 year = 5000 + 7200 + 9400 = 21600 (v) (c) Production during 8th year is (a+7d) = 5000 + 2(2200) = 20400
4	(i) a) 3900

	(ii) b) 73500
	(iii) (c) 44500 (iv) (a) 4900 (v) (b) 10:49
5	(i). b (ii) c (iii). b (iv) a (v) a
	SOLUTIONS TO OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
1	(c) 89 Explanation: Here, a7 = 34 a13 = 64 a7 = a + 6d = 34…….(1) a13 = a + 12d = 64……(2) Subtracting (1) from (2) 6d = 30 d = 5 Multiplying (1) by 2 2a + 12d = 68…….(3) Subtracting (2) from (3) a = 4 a18 = a + (n–1) d a18 = 4 + (17) 5 a18 = 89
2	Answer: (d) 28 Explanation: For an A.P a n an = a + (n – 1)d 4 = a + (7 – 1)(–4) 4 = a + 6(–4) 4 + 24 = a a = 28
3	3. Answer: (b) 3.5 Explanation: For an A.P a n an = a + (n – 1)d = 3.5 + (101 – 1) × 0 = 3.5
4	(c) – 2, – 4, – 6, – 8 Explanation: Let the first four terms of an A.P are a, a+d, a+2d and a+3d Given that the first termis –2 and difference is also –2, then the A.P would be: – 2, (–2–2), [–2 + 2 (–2)], [–2 + 3(–2)] = –2, –4, –6, –8
5	(d) n – 2
6	(c) s – r
7	(c) Gauss Explanation: Gauss is the famous mathematician associated with finding the sum of the first 100 natural Numbers
8	(b) 137
9	(b) t = p – 4
10	(b) 33
	SOLUTIONS TO SHORT ANSWER TYPE QUESTIONS
1	6
2	,10,15,20

3	A=3 d=4
4	0=21+(n-1)-3 , n=8
5	A12= 9+(12-1)4=53 and a24=9+(24-1)4=101
6	S15=15/2(2x2+14x5)
7	4,1,-2,-5,-8
8	S6=6/2(2x1+(6-1)69)
9	Yes as n=34
10	46=8+(n-1)2 N=20
	SOLUTIONS TO LONG ANSWER TYPE QUESTIONS
1	A= 102 d= 6 An = 996 996=102+ (n-1)6
2	395=n/2(8x2+(n-1)7)
3	A19=16+(19-1)16 and A99=16+(99-1)16
4	A21= 5+(21-1)5
5	A=16 d=8 An=96 96=16+(n-1)8 n=11
6	A+4d=5 and 2a+11d=13 D=1 a=1 s14= 14/2(1+14)
7	S5 = 5/2 (200+225)
8	26=6+(n-1)2 N=11

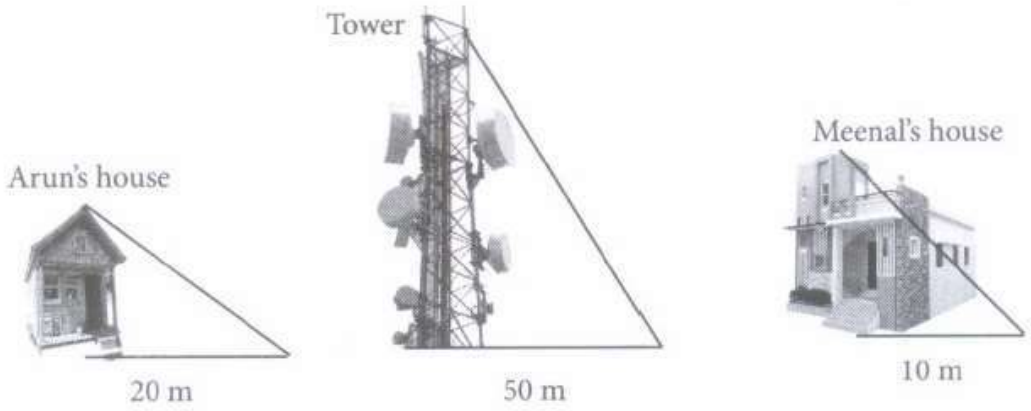
CHAPTER: 06

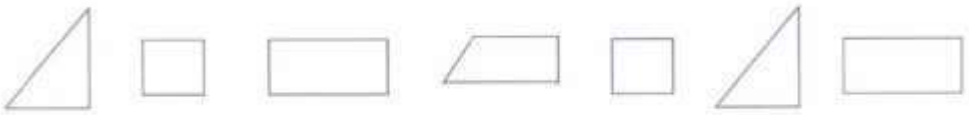
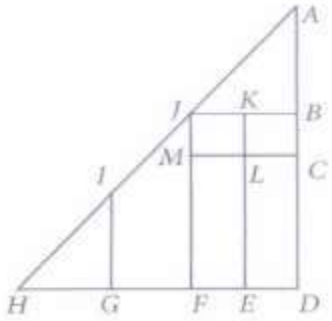
TRIANGLES

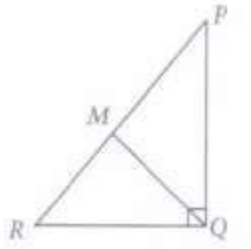
	COMPETENCY BASED QUESTIONS
Q1	Hypotenuse of a right triangle is 25 cm and out of the remaining two sides, one is longer than the other by 5 cm. The lengths of the other two sides are- (a) 15 cm and 10 cm (b) 15 cm and 20 cm (c) 12 cm and 23 cm (d) 10 cm and 15 cm
Q2	In ΔABC, AB = 24 cm, BC = 10 cm and AC = 26 cm, such that the ΔABC is- (a) a right triangle (b) an acute angled triangle (c) obtuse angled triangle (d) a right isosceles triangle
Q3	ABC and BDE are two equilateral triangles such that D is the mid-point of BC. Ratio of the areas of triangles ABC and BDE is- (a) 2 : 1 (b) 4 : 1 (c) 1 : 2 (d) 1 : 4
Q4	If S is a point on side PQ of a ΔPQR such that PS = QS = RS, then-

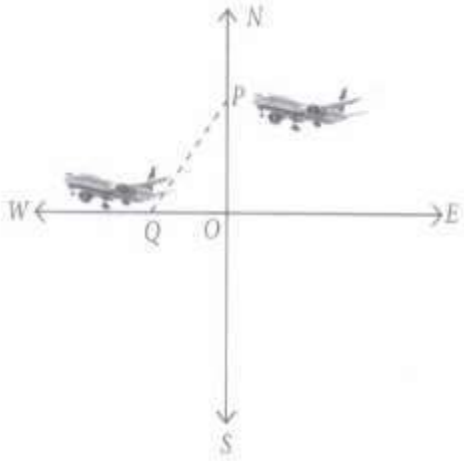
	(a) PR . QR = RS2 (b) QS2 + RS2 = QR2 (c) PR2 + QR2 = PQ2 (d) PS2 + RS2 = PR2
Q 5	If in a triangle, square of one side is equal to the sum of the squares of the other two sides, then the angle opposite the first side is- (a) an acute angle (b) obtuse angle (c) a right angle (d) a reflex angle
Q 6	Identify the one which is not the congruence criteria of two triangles. (a) RHS (b) SAS (c) ASA (d) AAS
Q 7	If ΔABC ~ ΔQRP, ar(ABC)/ar(PQR) = 9/4, AB = 18 cm and BC = 15 cm, then PR is equal to- (a) 10 cm (b) 12 cm (c) 20/3 cm (d) 8 cm

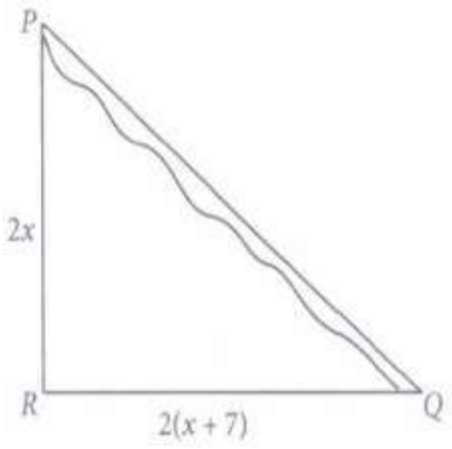
Q 8	If in two triangles DEF and PQR, ∠D = ∠Q and ∠R = ∠E, then which of the following is not true? (a) EF/PR = DF/PQ (b) DE/PQ = EF/RP (c) DE/QR = DF/PQ (d) EF/RP = DE/QR
Q 9	If ΔABC ~ ΔEDF and ΔABC is not similar to ΔDEF, then which of the following is not true? (a) BC . EF = AC. FD (b) AB . EF = AC. DE (c) BC . DE = AB. EF (d) BC . DE = AB. FD
Q10	D and E are respectively the points on the sides AB and AC of a triangle ABC such that AD = 2 cm, BD = 3 cm, BC = 7.5 cm and DE || BC. Then, length of DE (in cm) is- (a) 2.5 (b) 3 (c) 5 (d) 6
	CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
Q 1	Meenal was trying to find the height of the tower near his house. She is using the properties of similar triangles. The height of Meenal's house is 20 m. When Meenal's house casts a shadow of 10m long on the ground, at the same time, the tower casts a shadow of 50 m long and

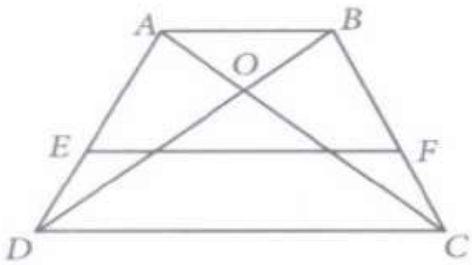
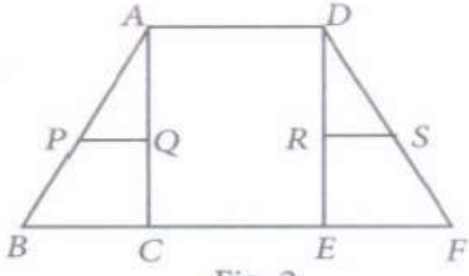
	Arun's house casts a shadow of 20 m long on the ground as shown below.  Based on the above information, answer the following questions.
(i)	What is the height of the tower? (a) 100 m (b) 50 m (c) 15 m (d) 45 m
(ii)	What will be the length of the shadow of the tower when Meenal's house casts a shadow of 15 m? (a) 45 m (b) 70 m (c) 75 m (d) 72 m
(iii)	Height of Aruns house is (a) 80 m (b) 75 m (c) 60 m (d) 40 m
(iv)	If the tower casts a shadow of 40 rn, then find the length of the shadow of Arun's house (a) 18 m (b) 17 m (c) 16 m (d) 14 m
(v)	If the tower casts a shadow of 40 m, then what will be the length of the shadow of Meenal's house? (a) 7 m (b) 9 m (c) 4 m (d) 8 m
Q 2	In a classroom, students were playing with some pieces of cardboard as shown below.

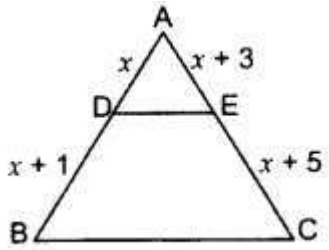
	 All of a sudden, teacher entered into classroom. She told students to arrange all pieces. On seeing this beautiful image, she observed that Δ ADH is right angled triangle, which contains.  (i) right triangles ABJ and IGH. (ii) quadrilateral GFJI (iii) squares JKLM and LCBK (iv) rectangles MLEF and LCDE. After observation, she ask certain questions to students. Help them to answer these questions.
(i)	If an insect (small ant) walks 24 m from H to F, then walks 6 m to reach at M, then walks 4 m to reach at L and finally crossing K, reached at J. Find the distance between initial and final position of insect. (a) 25m (b) 26m (c) 27m (d) 28m
(ii)	If m, n and r are the sides of right triangle ABJ, then which of the following can be correct?

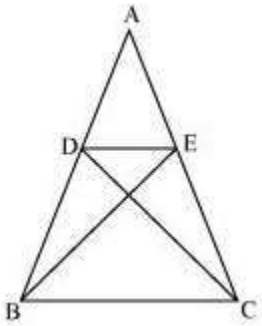
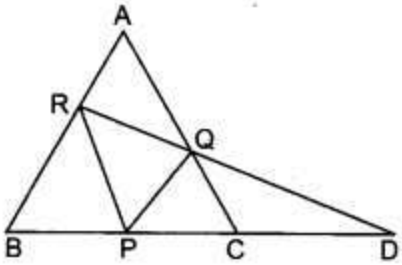
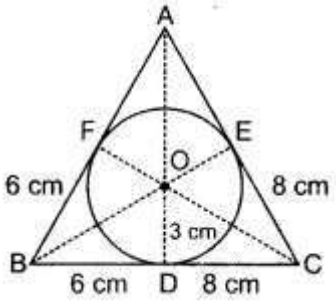
	(a) $m^2+n^2= r^2$ (b) $m^2+n^2+r^2-=0$ (c) m2 + n2 = 2r2 (d) none of these
(iii)	If ΔABJ ~ ΔADH, then which similarity criterion is used here? (a) AA (b) SAS (c) AAS (d) SSS
(iv)	If ∠ABJ = 90° and B, J are mid points of sides AD and AH respectively and BJ || DH, then which of the following option is false? (a)△ABJ~△ADH (b)2BJ=DH (c)$AJ^2=JB^2+AB^2$ (d)AB/BD=AJ/AH
(v)	If ΔPQR is right triangle with QM ⊥ PR, then which of the following is not correct?  (a)ΔPMQ~ΔPQR (b)$QR^2=PR^2-PQ^2$ (c)$PR^2=PQ+QR$ (d)ΔPMQ~ΔQMR
Q 3	An aeroplane leaves an airport and flies due north at a speed of 1200km /hr. At the same time, another aeroplane leaves the same station and flies due west at the speed of 1500 km/hr as shown below. After 1 1/2 hr both the aeroplanes reaches at point P and Q respectively.

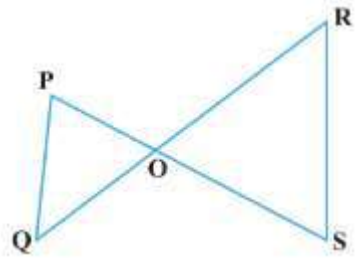
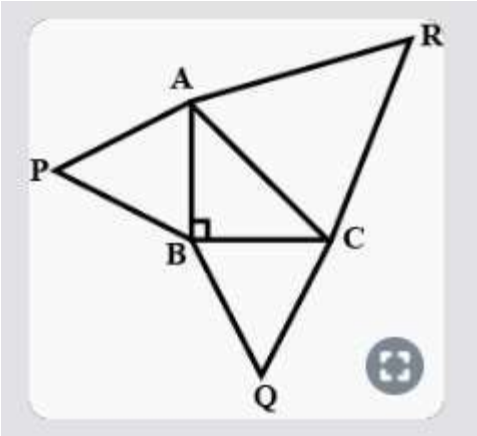
	
(i)	Distance travelled by aeroplane towards north after 1 1/2 hr is (a) 1800 km (b) 1500 km (c) 1400km (d) 1350 km
(ii)	Distance travelled by aeroplane towards west after 1 1/2 hr is (a) 1600 km (b) 1800 km (c) 2250km (d) 2400 km
(iii)	In the given figure, ∠POQ is (a) 70° (b) 90° (c) 80° (d) 100°
(iv)	Distance between aeroplanes after 1 1/2 hr is (a)450√41 km (b)350√31 km (c)125√12 km (d)472√41 km
(v)	Area of ΔΔPOQ is (a) 185000km^2 (b) 179000km^2 (c) 186000km^2 (d) 2025000 km^2
Q 4	Minister of a state went to city Q from city P. There is a route via city R such that PR ⊥RQ. PR = 2x km and RQ = 2(x + 7) km. He noticed that there is a proposal to construct a 26 km highway which directly connects the two cities P and Q.

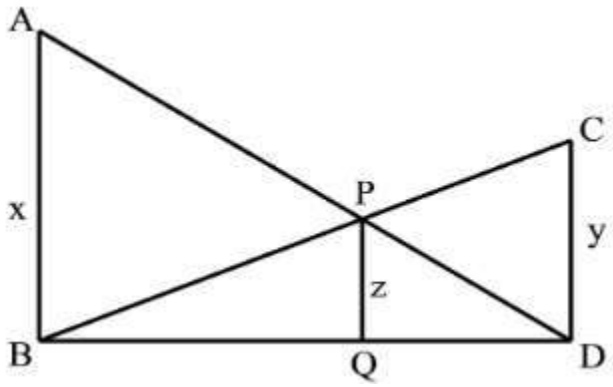
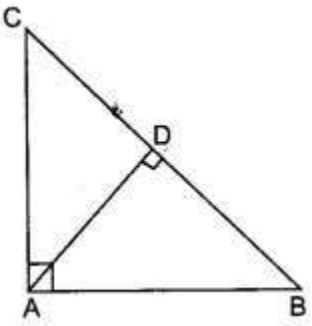
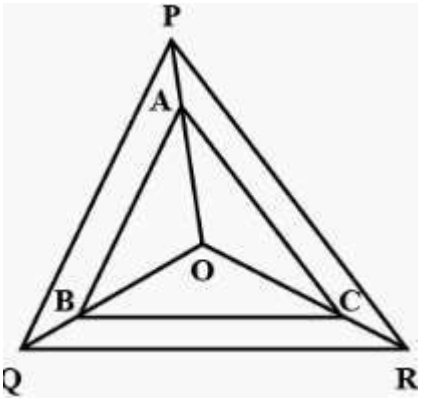
	 Based on the above information, answer the following questions.
(i)	Which concept can be used to get the value of x? (a) Thales theorem (b) Pythagoras theorem (c) Converse of thales theorem (d) Converse of Pythagoras theorem
(ii)	The value of x is (a) 4 (b) 6 (c) 5 (d) 8
(iii)	The value of PR is (a) 10 km (b) 20 km (c) 15 km (d) 25 km
(iv)	The value of RQ is (a) 12 km (b) 24 km (c) 16 km (d) 20 km
(v)	How much distance will be saved in reaching city Q after the construction of highway? (a) 10 km (b) 9 km (c) 4 km (d) 8 km
Q 5	Class teacher draw the shape of quadrilateral on board. Ankit observed the shape and explored on his notebook in different ways as shown below.

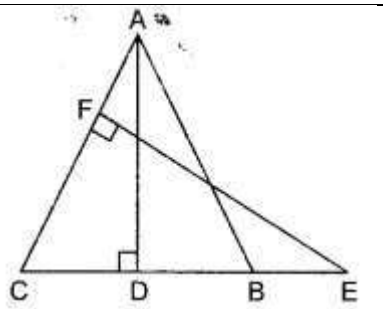
	 Fig. 1  Fig. 2 Based on the above information, answer the following questions.
(i)	i) In if ABCD is a trapezium with AB || CD, E and F are points on non-parallel sides AD and BC respectively such that EF || AB, then AE/ED= (a) BE/CD (b) AB/CD (c) BF/FC (d) None of these
(ii)	(ii) In if AB || CD, and DO = 3x - 19, OB = x - 5, OC = x - 3 and AO = 3, then the value of x can be (a) 5 or 8 (b) 8 or 9 (c) 10 or 12 (d) 13 or 14
(iii)	(iii) In if OD = 3x - 1, OB = 5x - 3, OC = 2x + 1 and AO = 6x - 5, then the value of x is (a) 0 (b) 1 (c) 2 (d) 3
(iv)	In Δ ABC, if PQ || BC and AP = 2.4 cm, AQ = 2 cm, QC = 3 cm and BC = 6 cm, then AB + PQ is equal to (a) 7.2 cm (b) 5.9 cm (c) 2.6 cm (d) 8.4 cm
(v)	In ΔDEF, if RS || EF, DR = 4x - 3, DS = 8x - 7, ER = 3x - 1 and FS = 5x - 3, then the value of x is (a) 1 (b) 5.9 cm (c) 2.6 cm (d) 8.4 cm
	OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
Q 1	An acute triangle has only one acute angle. (True/ False)
Q 2	The sum of two interior opposite angles is equal to _____.
Q 3	A triangle can be both isosceles and obtuse. (True/ False)

Q 4	If the length of sides of triangle is a, b and c. Semi-perimeter of triangle is s. Then the area of triangle is equal to _____.
Q 5	An isosceles triangle is a triangle which has exactly two sides with equal length. (True/ False)
Q 6	There are _____ ways available for finding two triangles congruent.
Q 7	A triangle may contain two obtuse angles. (True/ False)
Q 8	All isosceles triangles are similar. (True/ False)
Q 9	A right angled triangle can also be isosceles triangle. (True/ False)
Q 10	The largest side of a right angles triangle is known as _____.
	SHORT ANSWER TYPE QUESTIONS
Q 1	If ΔABC ~ ΔPQR, perimeter of ΔABC = 32 cm, perimeter of ΔPQR = 48 cm and PR = 6 cm, then find the length of AC.
Q 2	In ΔABC, DE || BC, find the value of x. 
Q 3	The sides AB and AC and the perimeter P, of ΔABC are respectively three times the corresponding sides DE and DF and the perimeter P, of ΔDEF. Are the two triangles similar? If yes, find ar(△ABC)/ar(△DEF).
Q 4	In the following figure, if ΔABE ≅ ΔACD, show that ΔADE ~ ΔABC.

	
Q 5	In an equilateral triangle of side $3\sqrt{3}$ cm, find the length of the altitude.
Q 6	In the given figure PQ || BA; PR || CA. If PD = 12 cm. Find BD X CD. 
Q 7	In figure, a triangle ABC is drawn to circumscribe a circle of radius 3 cm, such that the segments BD and DC into which BC is divided by the point of contact D are of lengths 6 cm and 8 cm respectively. Find the side AB if the area of $\Delta ABC = 63\ cm^2$. 
Q 8	ΔABC is an isosceles triangle in which AC = BC. If $AB^2 = 2AC^2$ then, prove that ΔABC is right triangle.
Q 9	In the figure, if PQ || RS, prove that Δ POQ ~ Δ SOR.

	
Q 10	A vertical pole of length 6 m casts a shadow 4 m long on the ground and at the same time a tower casts a shadow 28 m long. Find the height of the tower.
	LONG ANSWER TYPE QUESTIONS
Q 1	State and prove Converse of Pythagoras' Theorem.
Q 2	Show that the area of the triangle on the hypotenuse is equal to the sum of the areas of triangles on the other two sides. 
Q 3	In $\triangle ABC, AX \perp BC$ and Y is middle point of BC. Then prove that (i) $AB^2=AY^2+4BC^2-BC.XY$ (ii) $AC^2=AY^2+4BC^2+BC.XY$
Q 4	In figure, AB || PQ || CD, AB = x units, CD =y units and PQ = z units, prove that $1/x + 1/y = 1/z$.

	
Q 5	If in a right angle AABC, right angled at A, AD ⊥ BC, then prove that $AB^2 + CD^2 = BD^2 + AC^2$. 
Q 6	If D,E and F are respectively the midpoints of sides AB,BC and CA of ΔABC then what is the ratio of the areas of ΔDEF and ΔABC?
Q 7	In **ΔABC**,**PQ∥AB**, P,Q are on BC and CA respectively if CQ: QA=1:3 are CP=4 then BC=?
Q 8	A, B and C are points on OP, OQ and OR respectively such that AB||PQ. Show that BC||QR. 
Q 9	In figure, ABC is an isosceles triangle in which AB = AC. E is a point on the side CB produced, such that FE ⊥ AC. If AD ⊥ CB, prove that AB X EF = AD X EC.

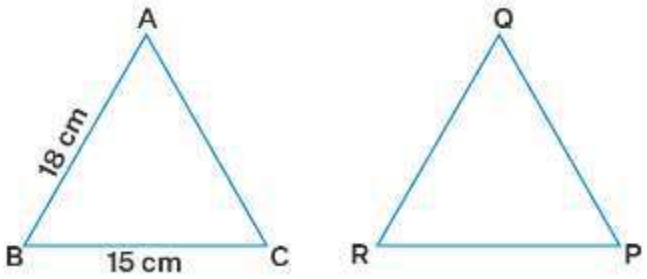
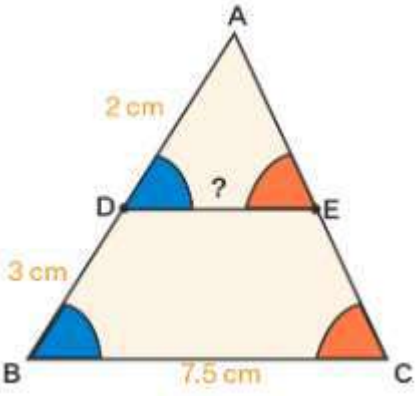
	
Q 10	Two triangles ABC and DBC lie on the same side of the base BC. From a point P on BC, PQ||AB and PR||BD are drawn. They meet AC in Q and DC in R respectively. Prove that QR||AD.

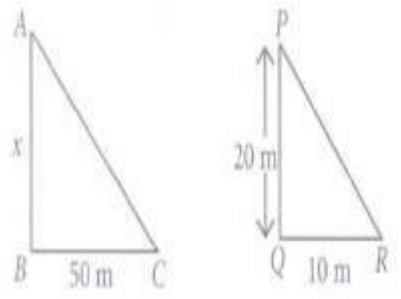
CHAPTER-06

TRIANGLE

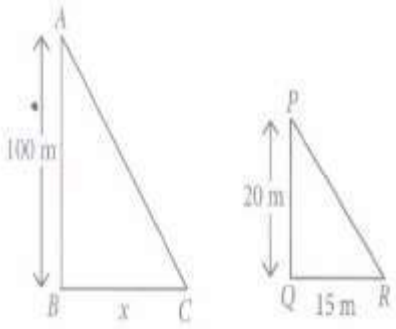
SOLUTIONS OF THE PROBLEM

	SOLUTIONS TO COMPETENCY BASED QUESTIONS
Ans 1	(b) By applying Pythagoras Theorem $AB^2 + BC^2 = AC^2$ $x^2 + (x+5)^2 = 625$ $2x^2 + 25 + 10x = 625$ $2x^2 + 10x - 600 = 0$ $x = 15, -20$ $x = 15$ Length of side of triangle are 15, 20
Ans 2	(a)
Ans 3	(b) ABC and BDE are two equilateral triangles. All angles are 60°, then they are all similar triangles Ratio of area of similar triangles is equal to ratio of square of their sides. Area of triangle BDE/Area of triangle ABC = $BC2/BD^2$ BC = 2 × BD (due to the mid point theorem) Area of triangle BDE/Area of triangle ABC = $(2BD)2/BD^2$ $4BD^2/BD^2$ 4 : 1
Ans 4	(c)
Ans 5	(c)
Ans 6	(d)
Ans 7	(a) Given, the triangles ABC and PQR are similar. Area of ABC/Area of PQR = 9/4 The length of the sides AB = 18 cm

	BC = 15 cm We have to find the length of PR.  We know that the ratio of the areas of two similar triangles is equal to the ratio of the squares of their corresponding sides. So, area of ABC/area of PQR = BC^2/PR^2 $9/4 = (15)^2/PR^2$ $3/2 = 15/PR$ $3(PR) = 15(2)$ $PR = 30/3$ $PR = 10$ cm Therefore, the length of PR is 10 cm.
Ans 8	(b)
Ans 9	(c)
Ans 10	(b)  Consider the triangles △ADE and △ABC.

	Since DE || BC, the corresponding angles are equal. ∠ADE = ∠ABC ∠AED= ∠ACB Thus by AA similarity we find △ADE and △ABC are similar. △ADE ~ △ABC If two triangles are similar, then their sides are proportional. AE/AC = DE/BC = AD/AB So, AD/AB = DE/BC AB = AD + BD = 2 + 3 = 5 cm 2/5 = DE/7.5 2(7.5) = (5)DE DE = 15/5 DE = 3 cm Therefore, the length of DE is 3cm.
	SOLUTIONS TO CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
Ans 1	(i) (a): Since ΔABC - ΔPQR  ∴AB/PQ=BC/QR x/20=50/10 x=100 Thus, height of tower is 100 m.

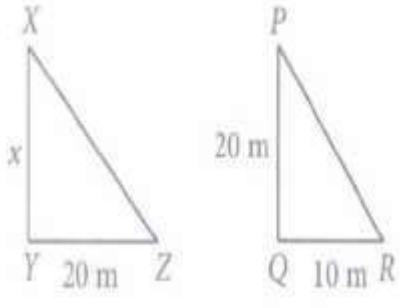
(ii) (c): Since ΔABC - ΔPQR



∴100/20=x/15

x=1500/20=75 m

(iii) (d): Since, the shapes are similar

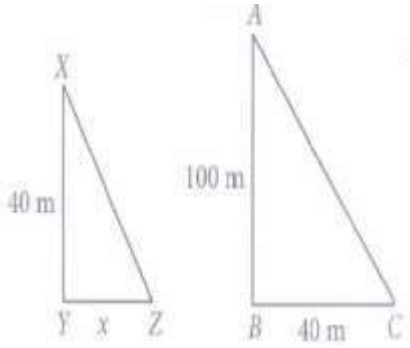


∴x/20=20/10

x=20×20/10=40 m

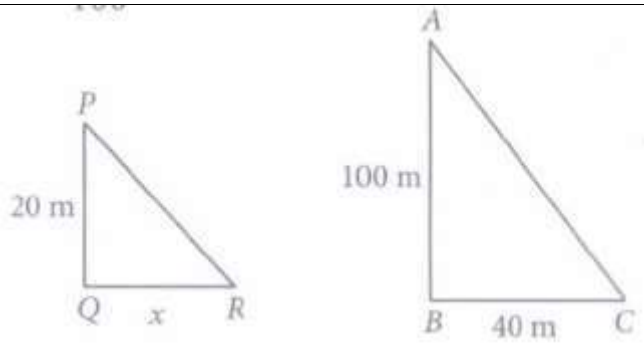
(iv) (b): Since, the shapes are similar, so, 40/100=x/40

x = 16m



(v) (d): Since, the shapes are similar, so 20/100=x/40

x=20×40/100=8 m



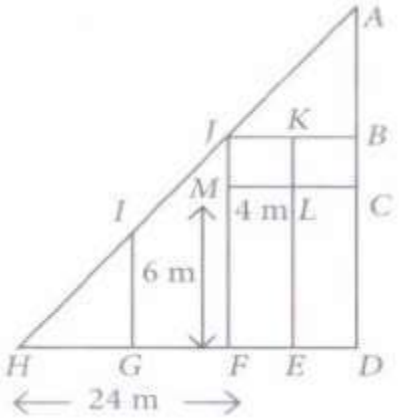
Ans 2

(b): As JKLM is a square.

∴ ML=JM=4m

So, JF = 6 + 4 = 10m

Required distance between initial and final position of insect = HJ



$=\sqrt{(HF)^2+(JF)^2}$

$=\sqrt{(24)^2+(10)^2}$

$=\sqrt{676}=26$ m

(ii) (a): By Pythagoras, $n^2 + m^2 = r^2$

(iii) (a) : In ΔΔABJ and ΔΔADH

<B = <D= 90°

<A = <A (common)

∴∴ By AA similarity criterion, ΔΔABJ ~~ ΔΔADH.

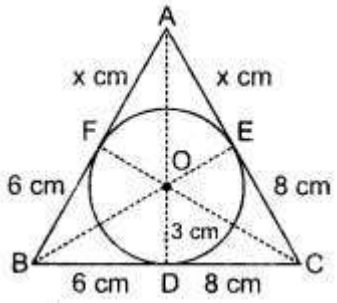
	(iv) (d): Since,ΔABJ~ΔADHΔABJ~ΔADH [By AA similarity criterion] ∴ AB/AD=AJ/AH. (v) (c): Since, $PR^2 = PQ^2 + QR^2$ [By Pythagoras theorem]
Ans 3	(i) (a): Speed = 1200 km/hr Time =1 1/2hr=32hr ∴ Required distance = Speed x Time =1200×3/2=1800 km (ii) (c): Speed = 1500 km/hr Time = 32 hr. ∴ Required distance = Speed x Time =1500×3/2=2250 km (iii) (b): Clearly, directions are always perpendicular to each other. ∴∠POQ=90∘ (iv) (a): Distance between aeroplanes after 1 1/2 hour $=\sqrt{}[(1800)^2+(2250)^2]=\sqrt{}(3240000+5062500)=\sqrt{}8302500=450\sqrt{}41$km (v) (d): Area of ΔPOQ= 1/2x base x height $=12\times2250\times1800=2250\times900=2025000$ km^2
Ans 4	(i) (b) (ii) (c): Using Pythagoras theorem, we have $PQ^2 = PR^2 + RQ^2$ $(26)^2=(2x)^2+(2(x+7))^2\Rightarrow676=4x^2+4(x+7)^2$ $169=2x^2+49+14x$ $x^2+7x-60=0$ $x^2+12x-5x-60=0$ $x(x+12)-5(x+12)=0\Rightarrow(x-5)(x+12)=0$

	$x=5, x=-12$ $\therefore x=5$ [Since length can't be negative] (iii) (a) : PR = 2x = 2 x 5 = 10 km (iv) (b): RQ= 2(x + 7) = 2(5 + 7) = 24 km (v) (d): Since, PR + RQ = 10 + 24 = 34 km Saved distance = 34-26= 8 cm
Ans 5	(i) (c) (ii) (b): Since $\Delta AOB \sim \Delta COD$ [ByAA similarity criterion] $\therefore AO/OC=BO/OD \Rightarrow 3x-3=x-53x-19$ $3(3x-19)=(x-5)(x-3)$ $9x-57=x^2-3x-5x+15 \Rightarrow x^2-17x+72=0$ $(x-8)(x-9)=0 \Rightarrow x=8$ or 9 (iii) (c) : Since, $\Delta AOB \sim \Delta COD$ [ByAA similarity criterion] $\therefore AO/OC=BO/OD \Rightarrow 6x-52x+1=5x-33x-1$ $\Rightarrow (6x-5)(3x=1)=(5x-3)(2x+1)$ $\Rightarrow 18x^2-6x-15x+5=10x^2+5x-6x-3$ $\Rightarrow 8x^2-20x+8=0 \Rightarrow 2x^2-5x+2=0$ From options, x = 2 is the only value that satisfies this equation. (iv) (d): Since, $\Delta APQ \sim \Delta ABC$ [ByAA similarity criterion] $\therefore AP/AB=AQ/AC=PQ/BC \Rightarrow 2.4/AB=2/5=PQ/6$ $\therefore AB=2.4\times 5/2=6$ cm and $PQ=2\times 6/5=2.4$ cm $\therefore AB+PQ=6+2.4=8.4$ cm (v) (a): Since, $\Delta DRS \sim \Delta DEF$ [ByAA similarity criterion] $\therefore DE/DR=DF/DS \Rightarrow (DE/DR)-1=(DF/DS)-1$ $(DE-DR)/DR=(DF-DS)/DS$

	ER/DR=FS/DS DR/ER=DS/FS $(4x-3)/(3x-1)=(8x-7)/(5x-3)$ $20x^2-12x-15x+9=24x^2-8x-21x+7$ $\Rightarrow 4x^2-2x-2=0\Rightarrow 2x^2-x-1=0$ Only option (a) i.e., x = 1 satisfies this equation.
	SOLUTIONS TO OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
1	False
2	Exterior Angle
3	True
4	√s(s-a)(s-b)(s-c)
5	False
6	Five
7	False
8	False
9	True
10	Hypotenuse
	SOLUTIONS TO SHORT ANSWER TYPE QUESTIONS
1	Given- ΔABC ~ ΔPQR. Therefore, Perimeter of ΔABC =AC Perimeter of ΔABC PR

	$\frac{32}{48} = \frac{AC}{6}$ AC=4 cm
2	Given- In ΔABC DE || BC. $\frac{AD}{BD} = \frac{AE}{EC}$ Thales Theorem $x(x + 5) = (x + 3)(x + 1)$ $x2 + 5x = x2 + 3x + x + 3$ $x2 + 5x – x2 – 3x – x = 3$ ∴ x = 3 cm
3	Given: AB = 3DE and AC = 3DF $\frac{\text{Perimeter of } \Delta ABC}{} = \frac{AB}{} = \frac{AC}{} = 3$ –(Given) Perimeter of ΔABC DE DF ΔABC ~ ΔDEF (SSS similarity) $\frac{ar(\Delta ABC)}{} = \left(\frac{AB}{}\right)^2 = \left(\frac{3}{}\right)^2 = 9$ $\frac{ar(\Delta DEF)}{}$ DE 1 Because The ratio of the areas of two similar Δs is equal to the ratio of the squares of their corresponding sides
4	It is given that ΔABE ≅ ΔACD. ∴ AB = AC [By CPCT] (1) And, AD = AE [By CPCT] (2) In ΔADE and ΔABC,

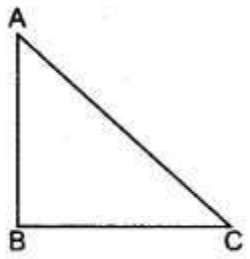
	[Dividing equation (2) by (1) ∠A = ∠A [Common angle] ∴ ΔADE ~ ΔABC [By SAS similarity criterion]
5	Given side of an equilateral triangle **ABC=33cm** Let AD=h (altitude) **BD=1/2BC** (Altitude bisect the base) **BD=1/2.3√ 3=3√3/2** cm $\mathbf{AB^2=AD^2+BD^2}$ $\mathbf{(3\sqrt{3})^2=(h)^2+(3\sqrt{3}/2)^2}$ $\mathbf{27=h^2+27/4}$ $\mathbf{h^2=108-27/4}$ $\mathbf{h^2=81/7}$ **h=81/4** **h=9/2** **=4.5cm** Hence, the length of the altitude h is 4.5 cm
6	In Δ BRD, PQ || BR as PQ || BA So by basic Proportionality Theorem, PD/BR=DQ/DR…(i) In Δ PRD, CQ || PR as PR || CA So By basic proportionality theorem. CD/PD=DQ/DR….(ii) From eq (i) and eq (ii) PD/BD=CD/PD Cross multiplying we get, PD × PD = BD × CD ⇒ BD × CD = PD2 = 122

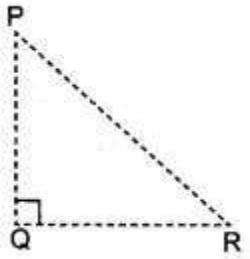
	⇒ BD × CD = 144 ∴ the product of BD and CD is 144.
7	 Let AF=AE=x. Length of Tangent from an external point is equal. Area of ΔABC=Area of ΔOBC+ Area of ΔOAB + Area of ΔOAC 63=1/2x14x3+1/2x(6+x)x3+1/2x(8+x)x3 63=3/2(14+6+x+8+x) 42=28+2x 2x=14 x=7 AB=(6+7)cm=13cm
8	$AB^2 = 2AC^2$ $AB^2 = AC^2+AC^2$ Also AC=BC $AB^2 = AC^2+BC^2$ By converse of Pythagoras theorem, ΔABC is right triangle where ∠C=90°.
9	Given, PQ || RS ∠P = ∠S (Alternate angles) and ∠Q = ∠R

	Also, ∠POQ = ∠SOR (Vertically opposite angles) Therefore, Δ POQ ~ Δ SOR (by AAA similarity criterion) Hence proved.
10	Given, Length of the vertical pole = 6 m Shadow of the pole = 4 m Let the height of the tower be h m. Length of the shadow of the tower = 28 m In ΔABC and ΔDFE, ∠C = ∠E (angle of elevation) ∠B = ∠F = 90° By AA similarity criterion, ΔABC ~ ΔDFE We know that the corresponding sides of two similar triangles are proportional. AB/DF = BC/EF 6/h = 4/28 h = (6 ×28)/4 h = 6 × 7 h = 42 Hence, the height of the tower = 42 m.
	SOLUTIONS TO LONG ANSWER TYPE QUESTIONS
1	The converse of Pythagoras theorem is states that:

In a triangle, if the square of one longest side is equal to the sum of squares of the other two sides then the angle opposite the first side is a right angle.

Now, to prove this statement let us consider two triangles ΔABC&ΔPQR from which ΔPQR is right-angled at Q .





In ΔABC we have AC as the longest side and by Pythagoras theorem we get

$\Rightarrow AC^2=AB^2+BC^2$.....(i)

We have to prove that ΔABC is right triangle.

Now, we construct another triangle ΔPQR which is a right triangle $\angle Q=90^\circ$ and AB=PQ and BC=QR.

So, by Pythagoras theorem we have $PR^2=QR^2+PQ^2$

Now, by construction we have AB=PQ&BC=QR

So, substituting the values we get

$\Rightarrow PR^2=AB^2+BC^2$.....(ii)

Now, from equation (i) and (ii) we get

$\Rightarrow AC^2=PR^2\Rightarrow AC=PR$

Now, in ΔABC&ΔPQR we have

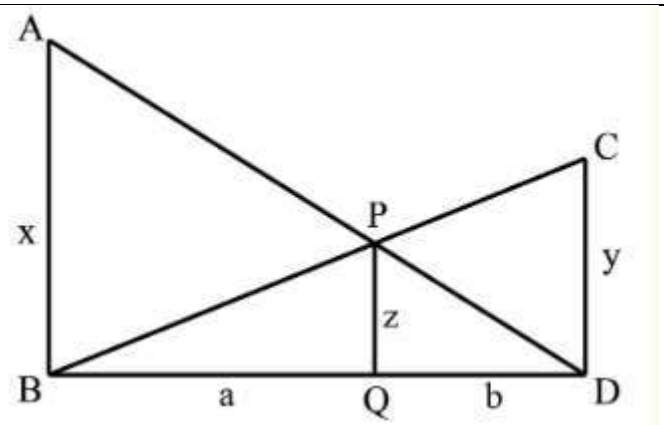
$\Rightarrow AB=PQ\Rightarrow BC=QR$ (by construction)

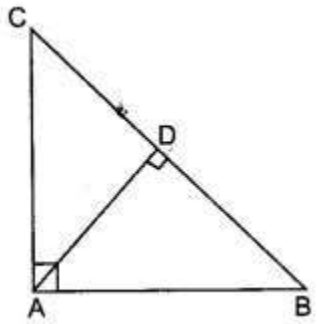
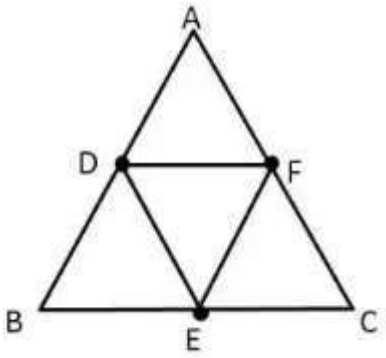
$\Rightarrow AC=PR$ (Proved above)

So we get $\Delta ABC\cong\Delta PQR$ (SSS congruency)

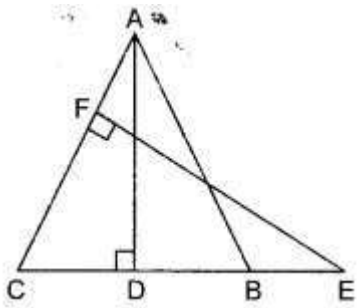
So we get

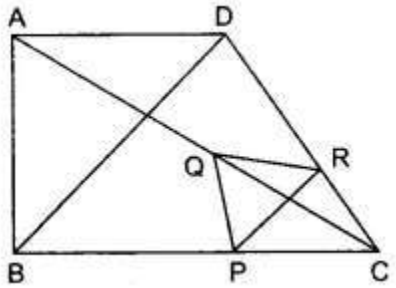
	∠Q=∠B (corresponding angles of congruent triangles) And we have ∠Q=90∘ So, ∠B=90∘ Hence proved that ΔABC is right triangle.
2	Given A right angled triangle ABC with right angle at B. Equilateral triangles PAB, QBC and RAC are described on sides AB, BC and CA respectively. To prove Area(△PAB)+Area(△QBC)=Area(△RAC). Proof Since triangles PAB, QBC and RAC are equilateral. Therefore, they are equiangular and hence similar. ∴ $\frac{\text{Area}(\triangle RAC)}{\text{Area}(\triangle PAB)} + \frac{\text{Area}(\triangle RAC)}{\text{Area}(\triangle QBC)} = \frac{AB^2}{AC^2} + \frac{BC^2}{AC^2}$ $\frac{\text{Area}(\triangle RAC)}{\text{Area}(\triangle PAB)} + \frac{\text{Area}(\triangle RAC)}{\text{Area}(\triangle QBC)} = \frac{AB^2+BC^2}{AC^2}$ $\frac{\text{Area}(\triangle RAC)}{\text{Area}(\triangle PAB)} + \frac{\text{Area}(\triangle RAC)}{\text{Area}(\triangle QBC)} = \frac{AC^2}{AC^2}$ [Because △ is a right angled triangle with ∠B=90 °, $AC^2 = AB^2+BC^2$] $\frac{\text{Area}(\triangle PAB)+\text{Area}(\triangle QBC)}{\text{Area}(\triangle RAC)} = 1$ Area(△PAB)+Area(△QBC)=Area(△RAC) [Hence proved]

3	(1) In $\triangle$**ABC** $(\mathbf{AB})^2=(\mathbf{AX})^2+(\mathbf{BX})^2$ $=(\mathbf{AX})^2+(\mathbf{BX}-\mathbf{XY})^2$ $=(\mathbf{AX})^2+(\mathbf{BX})^2+(\mathbf{XY})^2-\mathbf{2BY.XY}$ $=(\mathbf{AX})^2+[\mathbf{2BC}]^2+(\mathbf{XY})^2-\mathbf{2BC/2.XY}$ $=(\mathbf{AX})^2+(\mathbf{XY})^2+\mathbf{4}(\mathbf{BC})^2-\mathbf{BC.XY}$ $=(\mathbf{AY})^2+\mathbf{4}(\mathbf{BC})^2-\mathbf{BC.XY}$ [**In** $\triangle$**AXY**$(\mathbf{AY})^2=(\mathbf{AX})^2+(\mathbf{XY})^2$] (2) In $\triangle$**AXC** $(\mathbf{AC})^2=(\mathbf{AX})^2+(\mathbf{XC})^2$ $=(\mathbf{AX})^2+(\mathbf{XY}+\mathbf{YC})^2$ $=(\mathbf{AX})^2+(\mathbf{XY})^2+(\mathbf{YC})^2+\mathbf{2XY}.\mathbf{YC}$ $=(\mathbf{AX})^2+(\mathbf{XY})^2+[\mathbf{2BC}]^2+\mathbf{2BC/2.XY}$ $=(\mathbf{AY})^2+\mathbf{4}(\mathbf{BC})^2+\mathbf{BC.XY}$ [**In** $\triangle$**AXY**$(\mathbf{AY})^2=(\mathbf{AX})^2+(\mathbf{XY})^2$]
4	 Since AB||PQ||CD, using A-A similarity ΔBQP~ΔBDC and ΔDQP~ΔDBA. In ΔDQP and ΔDBA,QD/BD=b/(a+b)=z/x−−−−(1) In ΔBQP and ΔBDC,BQ/BD=a/(a+b)=z/y−−−−(2) Adding 1 and 2, we get, (a+b)/(a+b)=z/x+z/y 1=z(1/x+1/y) 1/x+1/y=1/z

5	 In $\triangle ADC$, $\angle ADC = 90°$ $\therefore AC^2 = AD^2 + CD^2$ (By Pythagoras theorem) ..... (**1**) In $\triangle DBA$, $\angle ADB = 90°$ $\therefore AB^2 = AD^2 + BD^2$ (By Pythagoras theorem) ..... (**2**) Subtracting (**1**) from (**2**), we get $AB^2 - AC^2 = AD^2 + BD^2 - AD^2 - CD^2$ $\therefore AB^2 - AC^2 = BD^2 - CD^2$ $\therefore AB^2 + CD^2 = BD^2 + AC^2$
6	 Given **D**,**E** and **F** are respectively the midpoints of sides **AB**,**BC** and **CA** of **ΔABC** To find :**ar**($\triangle$**ABC**)/**ar**($\triangle$**DEF**) We know that The line segment joining the midpoints of any two sides of a triangle is half the third side and parallel to it. $\therefore FD = \frac{1}{2}BC, ED = \frac{1}{2}AC$ and $EF = \frac{1}{2}AB$ In $\triangle ABC$ and $\triangle EFD$, we have $AB/EF = BC/FD = AC/ED = 2$ ...(**i**) $\Rightarrow \triangle ABC \sim \triangle EFD$ [by SSS similarity criterion]

	Also, We know that If two triangles are similar, then the ratio of the area of both triangles is equal to the square of the ratio of their corresponding sides $\therefore$**ar**($\triangle$**EFD**)/**ar**($\triangle$**ABC**)=(**AB/EF**)$^{\mathbf{2}}$=**4** [from (**i**)] $\Rightarrow$**ar**($\triangle$**ABC**)/**ar**($\triangle$**EFD**)=**1/4** Hence, the ratio of the areas of $\triangle$**DEF** and $\triangle$**ABC** is **1**:**4** .
7	We have, InΔABC P and Q are mid-point of side BC and CA respectively. Given that, CQ:QA=1:3 and CP=4 Then, BC=? So, We know that, Similar triangle theorem, In ΔABC QACQ=PBCP 31=PB4 PB=12 Now, BC=BP+PB BC=12+4 BC=16 Hence, this is the answer.

8	In △OPQ, we have AB∥PQ Therefore, by using basic proportionality theorem , we have OA/AP=OB/BQ.....(i) IN △OPR, we have AC∥PR Therefore, by using basic proportionality theorem , we have OC/CR=OA/AP.....(ii) Comparing (i)&(ii), we get OB/BQ=OC/CR Therefore, by using converse of basic proportionality theorem, we get BC∥QR.
9	To prove: **AB**×**EF**=**AD**×**EC**  Proof: AB=AC (∵ ABC is isosceles) ∴∠**B**=∠**C** (angles opposite to equal sides are equal) - (1) In **ΔABD** and **ΔECF** ∠**ABD**=∠**ECF** (from (1)) ∠**ADB**=∠**EFC** (Both are **90°**) Using AA similarity **ΔADB**~**ΔECF**

	⇒**AB/EC**=**AD/EF** ⇒**AB**×**EF**=**AD**×**EC** ∴ Hence proved.
10	 Given Two triangles ABC and DBC lie on the same side of the base BC. Points P,Q and R are points on BC,AC and CD respectively such that PR||BD and PQ||AB. To prove QR||AD Proof In △**ABC**, we have **PQ||AB** ∴ **CP/PB**=**CQ/QA**.....(i) [By Basic proportionality Theorem] In △**BCD**, we have **PR||BD** ∴ **CP/PB**=**CR/RD**.....(ii) [By Thale's Theorem] From (i) and (ii), we have **CQ/QA**=**CR/RD** Thus, in △**ACD**, Q and R are points on AC and CD respectively such that **CQ/QA**=**CR/RD** ∴ **QR||AD** [By the converse of Basic Proportionality Theorem]

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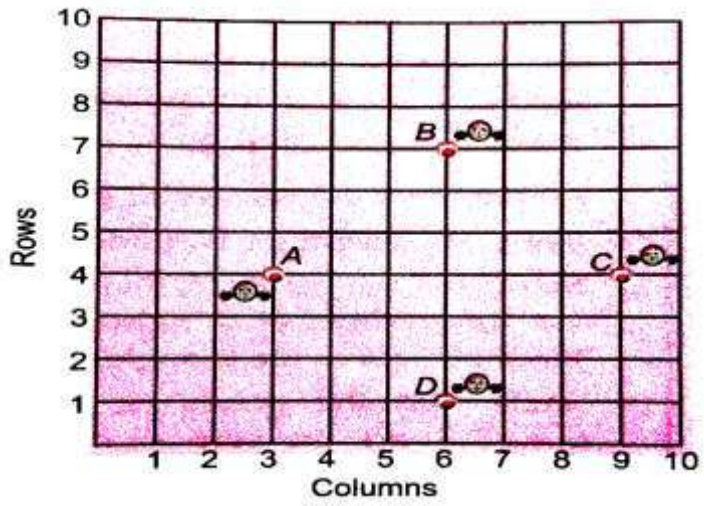
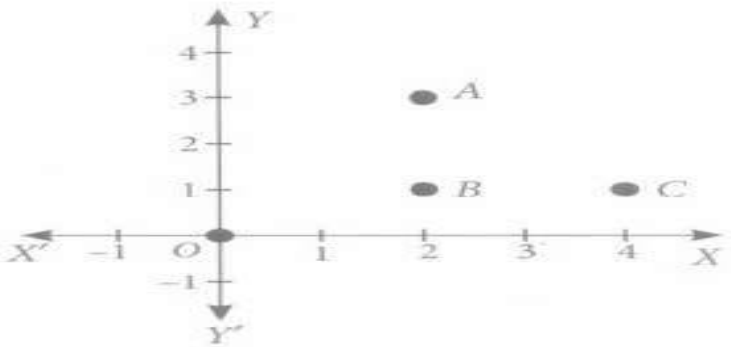
CHAPTER: 07

COORDINATE GEOMETRY

	COMPETENCY BASED QUESTIONS
Q-1	The distance of the point (2,3) from the x-axis is (a) 2 (b) 3 (c) 1 (d) 5
Q-2	The distance of the point P(-6,8) from the origin is (a) 8 (b) $2\sqrt{7}$ (c) 10 (d) 6
Q-3	The distance between the points A(0,6) and B(0,-2) is (a) 6 (b) 8 (c) 4 (d) 2
Q-4	The distance between the points (0,5) and (-5,0) is (a) 5 (b) $5\sqrt{2}$ (c) $2\sqrt{5}$ (d) 10
Q-5	If the distance between the points (2,-2) and (-1,y) is 5, then the value of y is (a) -2 (b) 2 (c) -1 (d) 1
Q-6	If the distance between the points (4,p) and (1,0) is 5, then value of p is (a) 4 only (b) ± 4 (c) -4 only (d) 0
Q-7	The mid-point of the line segment joining the points A(-2,8) and B(-6,-4) is (a) (-4,-6) (b) (2,6) (c)(-4,2) (d) (4,2)
Q-8	If P($\frac{a}{3}$,4) is the mid-point of the line segment joining the points Q(-6,5) and R(-2,3), then the value of a is (a) -4 (b) -12 (c) 12 (d) -6

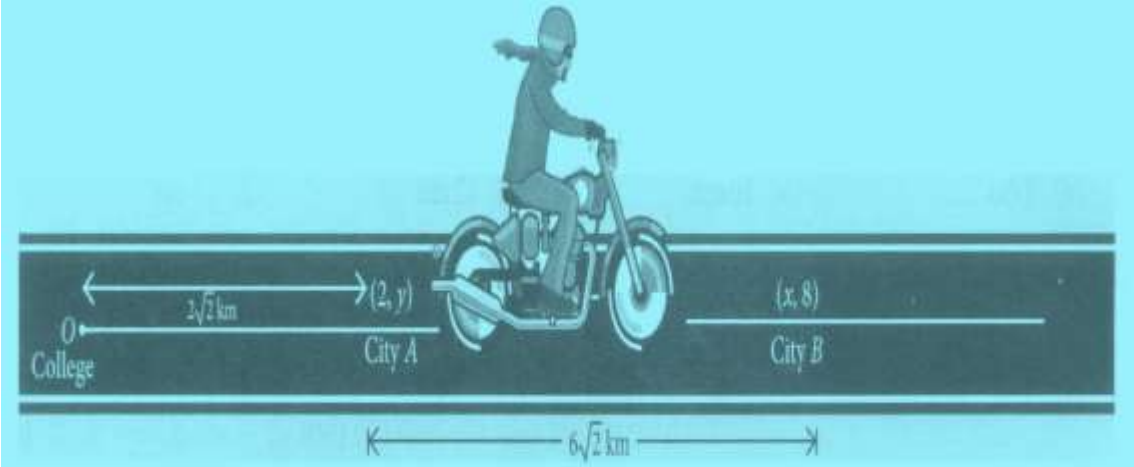
Q-9	The values of y, for which the distance between the points P(2,-3) and Q(10,y) is 10 units, are (a) 9,6 (b) 3,-9 (c) -3,9 (d) 9,-6
Q-10	ABCD is a rectangle whose three vertices are A(0,3), B(0,0) and C(5,0). Then the length of its diagonal is (a) 5 (b) 3 (c) $\sqrt{34}$ (d) 4
	CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
Q-1	**SEATING ARRANGEMENT** In a classroom, four friends are seated at the points A, B, C and D as shown below. All the friends are observing this seating arrangement and ask different questions to each other. Observe the seating arrangement and help them to answer the following questions: 
(i)	The co-ordinates of point A and point B respectively are (a) (4,3) and (7,6) (b) (4,3) and (6,7) (c) (3,4) and (7,6) (d) (3,4) and (6,7)
(ii)	What are the coordinates of point C and D respectively? (a) (6,1) and (9,4) (b) (1,6) and (4,9)

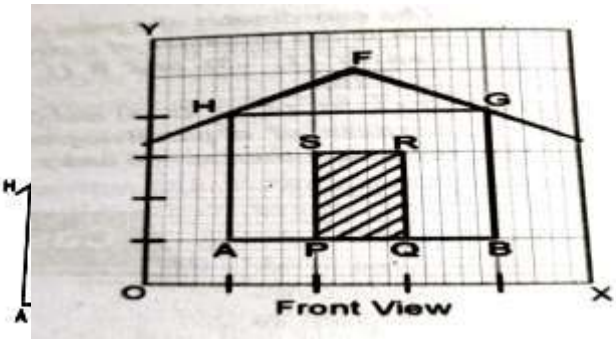
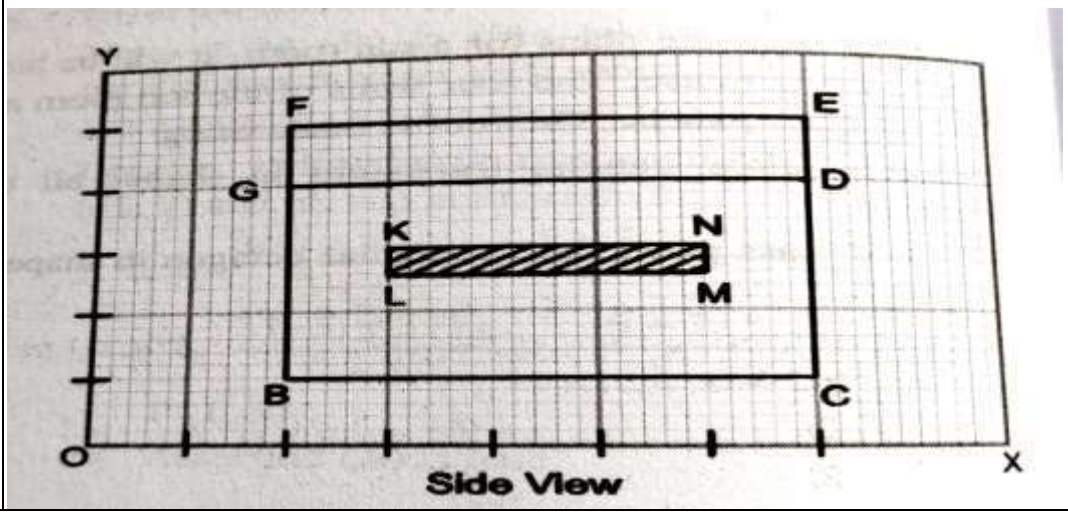
	(c) (9,4) and (6,1) (d) (9,4) and (1,6)
(iii)	What is the distance between two friends seating at point A and B? (a) 2√5 units (b) 3√2 units (c) 2√3 units (d) None of these
(iv)	What is the distance between two friends seating at point A and C? (a) √26 units (b) 6 units (c) 4 units (d) None of these
(v)	Given seating arrangement is in the form of a (a) rhombus (b) kite (c) square (d) None of these
Q-2	**LOCALITY** Alia and Shagun are friends living on the same street in Patel Nagar. Shagun's house is at the intersection of one street with another street on which there is a library.  They both study in the same school and that is not far from Shagun's house.

	Suppose the school is situated at the point O, i.e., the origin, Alia's house is at A. Shagun’s house is at B and library is at C. Based on the above information, answer the following questions.
(i)	How far is Alia's house from Shagun’s house? (a) 3 units (b) 4 units (c) 5 units (d) 2 units
(ii)	How far is the library from Shagun’s house? (a) 3 units (b) 2 units (c) 5 units (d) 4 units
(iii)	How far is the library from Alia's house? (a) 2 units (b) 3 units (c) 4 units (d) None of these
(iv)	Which of the following is true? (a) ABC forms a scalene triangle (b) ABC forms an isosceles triangle (c) ABC forms an equilateral triangle (d) None of these
(v)	How far is the school from Alia's house than Shagun’s house? (a) $\sqrt{13}$ units (b) $\sqrt{5}$ units (c) $(\sqrt{13} + \sqrt{5})$ units (d) $(\sqrt{13} - \sqrt{5})$ units

Q-3	**"NO SMOKING CAMPAIGN"** To raise social awareness about hazards of smoking, a school decided to start 'No smoking' campaign. 10 students are asked to prepare campaign banners in the shape of a triangle. The vertices of one of the triangle are P(-3,4), Q(3, 4) and R(-2, -1).   Based on the above information, answer the following questions.
(i)	The coordinates of centroid of ΔPQR are (a) $\left(\frac{2}{3},\frac{7}{3}\right)$ (b) $\left(\frac{1}{3},\frac{1}{3}\right)$ (c) $\left(\frac{-2}{3},\frac{7}{3}\right)$ (d) $\left(\frac{7}{3},\frac{2}{3}\right)$
(ii)	If S be the mid-point of line joining P and Q, then coordinates of S are (a) (4,0) (b) (2,0) (c) (0,4) (d) (0,2)
(iii)	If T be the mid-point of line joining R and Q, then coordinates of T are (a) $(\frac{1}{2},\frac{1}{2})$

	(b) $(\frac{3}{2},\frac{1}{2})$ (c) $(\frac{1}{2},\frac{3}{2})$ (d) None of these
(iv)	If U be the mid-point of line joining R and P, then coordinates of U are (a) $(\frac{-5}{2},\frac{3}{2})$ (b) $(\frac{3}{2},\frac{-5}{2})$ (c) $(\frac{3}{2},\frac{5}{2})$ (d) $(\frac{5}{2},\frac{3}{2})$
(v)	The coordinates of centroid of ΔSTU are (a) $(\frac{2}{3},\frac{7}{3})$ (b) $(\frac{1}{3},\frac{1}{3})$ (c) $(\frac{-2}{3},\frac{7}{3})$ (d) $(\frac{7}{3},\frac{2}{3})$
Q-4	**RIDE** A person is riding his bike on a straight road towards East from his college to city A and then to city B. At some point in between city A and city B, he suddenly realises that there is not enough petrol for the journey. Also, there is no petrol pump on the road between these two cities.

	 Based on the above information, answer the following questions.
(i)	The value of y is equal to (a) 2 (b) 3 (c) 4 (d) 5
(ii)	The value of x is equal to (a) 4 (b) 5 (c) 8 (d) 7
(iii)	If M is any point exactly in between city A and city B, then coordinates of M are (a) (3,3) (b) (4,4) (c) (5,5) (d) (6,6)
(iv)	The ratio in which A divides the line segment joining the points O and M is (a) 1:2 (b) 2:1

	(c) 2:3 (d) 3:2
(v)	If the person analyses the petrol at the point M(the mid-point of AB), then what should be his decision? (a) travel back to college (b) try his luck to move towards city B (c) travel back to city A (d) None of these
Q-5	**PLANNING OF A HUT** Ravi decided to construct a three dimensional model. The model of the hut has been shown below along with its front and side views. So that the construction can be understood clearly.  Observe the above situation and answer the questions. 

(i)	Find the mid-point of the segment joining H(1,4) and G(4,4).[**Refer to front view**] (a) $(\frac{5}{2}, 4)$ (b) (2,4) (c) $(\frac{1}{2}, \frac{5}{2})$ (d) (4,8)
(ii)	What is the distance of point F from x-axis? [**Refer to front view**] (a) 4 (b) 5 (c) 6 (d) 25
(iii)	What is the distance between B and E? [**Refer to side view**] (a) √5 (b) 4 (c) √41 (d) 9
(iv)	If a point V(x, y) is equidistant from F(2,5) and E(7,5), then: (a) x + y=9 (b) x – y= 0 (c) 2y-9=0 (d) 2x-9=0
(v)	Find the coordinates of the point which divides the line segment joining A (1,1) and B(4,1) in the ratio 1:2 internally.[**Refer to front view**] (a) (1,2) (b) (2,1) (c) (3,2) (d) (2,2)

	OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
Q-1	The distance of a point from the y axis is called_____. (abscissa, ordinate)
Q-2	The distance between the two points is found by_____ formula. (Mid-point / Distance)
Q-3	If three points lie on the same straight line, they are termed as_____ points.(non-collinear/collinear)
Q-4	The distance of the point P(2,3) from the x-axis is____.
Q-5	The point (3,-1) lies in the _____ quadrant of the coordinate plane.
Q-6	Graph of the line x=a is a line parallel to the _____ axis.
Q-7	Abscissa is _____ to the right of the origin and _____ to the left of the origin.(negative, positive)
Q-8	The distance of the point P(-6,8) from the origin is _____units.
Q-9	The coordinates of a point on y- axis are _____.
Q-10	Any point on x-axis is of the form_____.
	SHORT ANSWER TYPE QUESTIONS
Q-1	Find the value of x for which the distance between the points P(4,-5) and Q(12,x) is 10 units.
Q-2	Find a point on x-axis which is equidistant from the points (7,6) and (-3,4).
Q-3	Find a point on y-axis which is equidistant from the points (-5,2) and (9,-2).
Q-4	Find a relation between x and y such that the point P(x,y) is equidistant from the points A(2,5) and B(-3,7).

Q-5	If the points A(4,3) and B(x,5) are on the circle with the centre O(2,3), find the value of x.
Q-6	In which ratio does the point P(2,-5) divide the line segment joining A(-3,5) and B(4,-9)?
Q-7	Find the ratio in which the point (x,1) divides the line segment joining the points (-3,5) and (2,-5). Also find the value of x.
Q-8	Find the coordinates of the point which divides the line segment joining the points (4,-3) and (8,5) in the ratio 3:1.
Q-9	The coordinates of the mid-point of the line segment joining the points (3p,4) and (-2,2q) are (5,p).Find the values of p and q.
Q-10	If the mid-points of the line segment joining the points A(3,4) and B(k,6) is P(x,y) and x+y-10=0, find the value of k.
	LONG ANSWER TYPE QUESTIONS
Q-1	Show that the points (5,6),(1,5),(2,1) and (6,2) are the vertices of a square.
Q-2	Prove that the diagonals of a rectangle bisect each other and are equal.
Q-3	The mid-points of the sides of a triangle are (3,4), (4,6) and (5,7). Find the coordinates of vertices of the triangle.
Q-4	Determine the ratio in which the line $2x + 3y - 5 = 0$ divides the line segment joining the points (8,-9) and (2,1). Also find the coordinates of the point of division.
Q-5	Find the coordinates of the point equidistant from three given points A(5,1), B(-3,-7) and C(7,-1).
Q-6	If a is the length of one of the sides of an equilateral triangle ABC, base BC lies on x-axis and vertex B is at the origin, find the coordinates of the vertices of the triangle.

Q-7	An equilateral triangle has one vertex at (3,4) and another at (-2,3). Find the coordinates of the third vertex.
Q-8	Find the length of the medians of the triangle whose vertices are (1,-1),(0,4) and (-5,3).
Q-9	If A(-2,1), B(a,0), C(4,b) and D(1,2) are the vertices of a parallelogram ABCD, find the values of a and b. Hence find the lengths of its sides.
Q-10	Show that the points A(a,a), B(-a,-a) and C(-√3 a,√3 a) are the vertices of an equilateral triangle.

CHAPTER-07

COORDINATE GEOMTERY

SOLUTION OF THE PROBLEM

	SOLUTIONS TO COMPETENCY BASED QUESTIONS
Ans-1	(b)3
Ans-2	(c)10
Ans-3	(b)8
Ans-4	(c)$5\sqrt{2}$
Ans-5	(b)-6,2
Ans-6	(b)$\pm$ 4
Ans-7	(c)(-4,2)
Ans-8	(b)-12
Ans-9	(b)3,-9
Ans-10	(c)$\sqrt{34}$
	SOLUTIONS TO CASE STUDIES/SOURCE BASED INTEGRATED QUESTIONS
Ans-1(i)	(d)(3,4) and (6,7)
(ii)	(c)(9,4) and (6,1)
(iii)	(b)3√2 units
(iv)	(b)6 units
(v)	(c)square
Ans-2(i)	(d)2 units
(ii)	(b)2 units

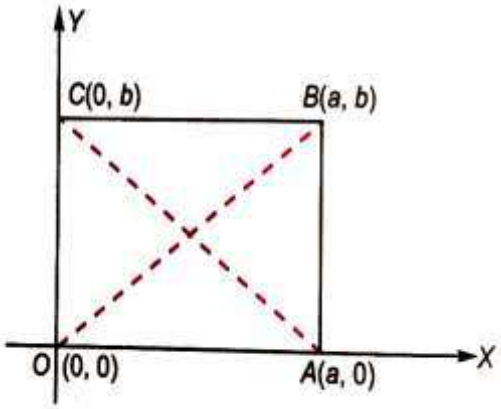
(iii)	(d)2√2 units
(iv)	(b)ABC forms an isosceles triangle.
(v)	(d)(√13 -√5) units
Ans-3(i)	(c) $(\frac{-2}{3},\frac{7}{3})$
(ii)	(d)(0,4)
(iii)	(c) $(\frac{1}{2},\frac{3}{2})$
(iv)	(a) $(\frac{-5}{2},\frac{3}{2})$
(v)	(c) $(\frac{-2}{3},\frac{7}{3})$
Ans-4(i)	(a)2
(ii)	(c)8
(iii)	(c)(5,5)
(iv)	(d)2:3
(v)	(b)try his luck to move towards city B
Ans-5(i)	(a)$(\frac{5}{2}, 4)$
(ii)	(b)5
(iii)	(c)√41
(iv)	(d)2x-9=0
(v)	(b)(2,1)
	SOLUTIONS TO OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
Ans-1	Abscissa

Ans-2	Distance
Ans-3	Collinear
Ans-4	2
Ans-5	Fourth
Ans-6	Y
Ans-7	Positive, negative
Ans-8	10
Ans-9	(0,y)
Ans-10	(x,0)
	SOLUTIONS TO SHORT ANSWER TYPE QUESTIONS
Ans-1	Given the points P(4,-5) and Q(12,x) such that PQ=10 , ⇨ $PQ^2 = 100$ $(12-4)^2 + (x + 5)^2 = 100$ $8^2 + (x + 5)^2 = 100$ $(x + 5)^2 = 100-64 = 36 = 6^2$ $x + 5 = 6$ or $x + 5 = -6$ $x = 1$ or $x = -11$
Ans-2	Let P(x,0) be a point on x-axis equidistant from the points A(7,6) and B(-3,4). Then, PA=PB ⇨ $PA^2 = PB^2$ ⇨ $(x-7)^2 +(0-6)^2=(x+3)^2 + (0-4)^2$ ⇨ $x^2 -14x +49+36=x^2 +6x+9+16$

	⇨ -20x=-60 ⇨ x=3 Hence, the required point is P(3,0).
Ans-3	Let P(0,y) be a point on y-axis equidistant from the points A(-5,2) and B(9,-2). Then, PA=PB ⇨ $PA^2 = PB^2$ ⇨ $(0+5)^2 +(y-2)^2=(0-9)^2 + (y+2)^2$ ⇨ $25+y^2 -4y +4=81+y^2 +4y+4$ ⇨ -8y=56 ⇨ y=-7 Hence, the required point is P(0,-7).
Ans-4	As the point P(x,y) is equidistant from the points A(2,5) and B(-3,7). So , PA=PB ⇨ $PA^2 = PB^2$ ⇨ $(x-2)^2 +(y-5)^2=(x+3)^2 + (y-7)^2$ ⇨ $x^2 +4-4x+y^2 +25-10y=x^2+9 +6x+y^2 +49-14y$ ⇨ 10x-4y+29=0 Hence it is the required relation between x and y.
Ans-5	As points A(4,3) and B(x,5) are on the circle, ⇨ OA=OB ⇨ $OA^2=OB^2$ ⇨ $(2-4)^2 +(3-3)^2 =(2-x)^2 + (3-5)^2$ ⇨ $4+0 = (2-x)^2 + 4$ ⇨ $(2-x)^2 =0$ ⇨ 2-x=0 x = 2
Ans-6	Let the point P(2,-5) divide AB in the ratio k:1. $\frac{4k-3}{k+1} = 2$

	⇨ 4k-3 =2k+2 ⇨ 2k=5 ⇨ K=$\frac{5}{2}$ Hence, the required ratio is 5:2
Ans-7	Let the point P(x,-1) divide the line segment AB joining the points A(-3,5) and B(2,-5) in the ratio k:1 Then , y-coordinate of P= $\frac{-5k+5}{k+1}$ = -1 ⇨ -5k+5=-k-1 ⇨ -4k=-6 ⇨ k = $\frac{3}{2}$ Hence, the required ratio is 3:2 Also , x =$\frac{3\times2+2\times(-3)}{3+2}$ = 0
Ans-8	Let P(x,y) be the required point. Using section formula, x =$\frac{3\times8+1\times4}{3+1}$ =7 , y= $\frac{3\times5+1\times(-3)}{3+1}$ =3 Hence, the required point is (7,3).
Ans-9	The coordinates of the mid-point of the line segment joining the points(3p,4) and (-2,2q) are $\left(\frac{3p-2}{2},\frac{4+2q}{2}\right)$ = (5,p) or $\left(\frac{3p-2}{2},q+2\right)$ =(5,p) ⇨ $\frac{3p-2}{2}$ =5 and q+2=p ⇨ 3p=10+2 and q=p-2 Hence , p =4 and q=4-2=2

Ans-10	The mid-point of the line-segment AB is $\left(\frac{3+k}{2},\frac{4+6}{2}\right)$ =(x,y) ⇨ X=$\frac{3+k}{2}$ and y=5 As x+y-10=0, so $\frac{3+k}{2}$ +5-10=0 ⇨ 3+k=10 Hence , k=7
	SOLUTIONS TO LONG ANSWER TYPE QUESTIONS
Ans-1	Let A(5,6), B(1,5), C(2,1), D(6,2) be the given vertices. Then, AB= $\sqrt{(1-5)^2+(5-6)^2}$ = $\sqrt{16+1}$ = $\sqrt{17}$ BC= $\sqrt{(2-1)^2+(1-5)^2}$ = $\sqrt{1+16}$ = $\sqrt{17}$ CD=$\sqrt{(6-2)^2+(2-1)^2}$= $\sqrt{16+1}$= $\sqrt{17}$ DA=$\sqrt{(5-6)^2+(6-2)^2}$ = $\sqrt{1+16}$ = $\sqrt{17}$ Diagonal, AC= $\sqrt{(2-5)^2+(1-6)^2}$ = $\sqrt{9+25}$ = $\sqrt{34}$ Diagonal , BD= $\sqrt{(6-1)^2+(2-5)^2}$ = $\sqrt{25+9}$ = $\sqrt{34}$ Clearly, AB=BC=CD=DA ⇨ The four sides of the quadrilateral ABCD are equal. AC=BD ⇨ The two diagonals of quadrilateral ABCD are equal. Hence , the quadrilateral ABCD is a square.
Ans-2	Let ,vertices of the rectangle OABC be O(0,0), A(a,0), B(a,b) and C(0,b) Mid-point of diagonal OB $\left(\frac{0+a}{2},\frac{0+b}{2}\right)$ = $\left(\frac{a}{2},\frac{b}{2}\right)$ Mid-point of diagonal AC $\left(\frac{a+0}{2},\frac{0+b}{2}\right)$ = $\left(\frac{a}{2},\frac{b}{2}\right)$

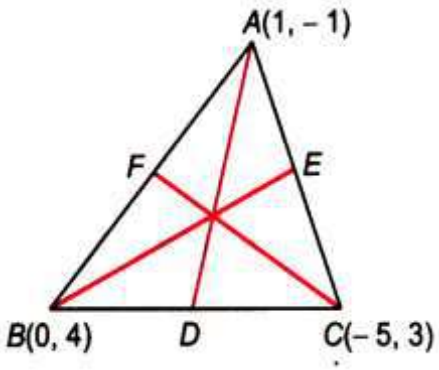
	⇨ The mid-point of both diagonals is the same. Diagonal OB $=\sqrt{(a-0)^2+(b-0)^2}$ $=\sqrt{a^2+b^2}$ Diagonal AC $=\sqrt{(a-0)^2+(0-b)^2}$ = $\sqrt{a^2+b^2}$ ⇨ Diagonal OB = Diagonal AC Hence, diagonals of a rectangle bisect each other and are equal. 
Ans-3	Let A(x_1,y_1), A(x_2,y_2) and C(x_3,y_3) be the vertices of ΔABC, and D(3,4), E(4,6) and F(5,7) be the mid-points of sides BC, CA and AB respectively. As D is the mid-point of BC, so $\frac{x_2+x_3}{2}$ =3 and $\frac{y_2+y_3}{2}$ = 4 ⇨ $x_2+x_3=6$ ……(i) ⇨ $y_2+y_3=4$ ……(ii) As E is the mid-point of CA, so $\frac{x_1+x_3}{2}$ =4 and $\frac{y_1+y_3}{2}$ = 6 ⇨ $x_1+x_3=8$ ……(iii) ⇨ $y_2+y_3=12$ ……(iv) As F is the mid-point of AB, so $\frac{x_1+x_2}{2}$ =5 and $\frac{y_1+y_2}{2}$ = 7 ⇨ $x_1+x_3=10$ ……(v) ⇨ $y_2+y_3=14$ ……(vi) Adding (i),(iii) and (v), we get $2(x_1+x_2+x_3) = 6+8+10$ ⇨ $x_1+x_2+x_3 = 12$ …….(vii) from (i) and (vii), $x_1=12-6 = 6$ from (iii) and (vii), $x_2=12-8 = 4$ from (v) and (vii), $x_3=12-10 = 2$

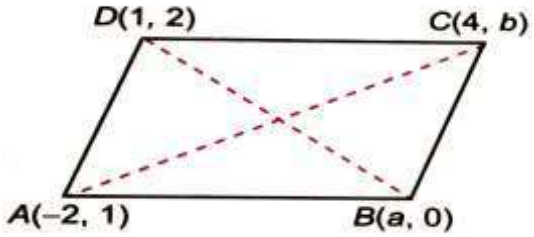
	Adding (ii), (iv) and (vi), we get $2(y_1 + y_2 + y_3) = 8+12+14$ ⇨ $y_1 + y_2 + y_3 = 17$ …….(viii) from (ii) and (viii), $y_1=17-8 = 9$ from (iv) and (viii), $y_2=17-12 = 5$ from (vi) and (viii), $y_3=17-14 = 3$ Hence, three vertices of ΔABC are A(6,9), B(4,5), C(2,3).
Ans-4	Let the line $2x + 3y - 5 = 0$ divide the line segment joining A(8,-9) and B(2,1) in the ratio k:1. Then the coordinates of the point of intersection P will be $\left(\frac{2k+8}{k+1}, \frac{k-9}{k+1}\right)$ As the point P lies on the line $2x + 3y - 5 = 0$, so $2\left(\frac{2k+8}{k+1}\right) + 3\left(\frac{k-9}{k+1}\right) - 5 = 0$ ⇨ $4k + 16 + 3k - 27 - 5k - 5 = 0$ ⇨ $2k = 16$ ⇨ $k=8$ Hence, the required ratio is 8:1. The coordinates of the point of division are $\left(\frac{2\times8+8}{8+1}, \frac{8-9}{8+1}\right) = \left(\frac{8}{3}, -\frac{1}{9}\right)$
Ans-5	Let P(x, y) be the point equidistant from the three points A(5,1), B(-3,-7) and C(7,-1). Then PA=PB=PC ⇨ $PA^2 + PB^2 + PC^2$ Taking $PA^2 = PB^2$ ⇨ $(x-5)^2 + (y-1)^2 = (x+3)^2 + (y+7)^2$ ⇨ $x^2 -10x +25 + y^2 -2y + 1 = x^2 +6x + 9 + y^2 +14y + 49$ ⇨ $-16x-16y =32$ ⇨ $x + y = -2$ …….(i)

	Now taking, $PB^2 = PC^2$ ⇨ $(x+3)^2 + (y+7)^2 = (x-7)^2 + (y+1)^2$ ⇨ $x^2+6x + 9 + y^2 +14y + 49 = x^2 -14x + 49 + y^2 +2y + 1$ ⇨ $20x+12y =-8$ ⇨ $5x + 3y=-2$ …….(ii) Multiplying (i) by 5 and then subtracting (ii), we get $2y=-8$ ⇨ $y=-4$ using value of y in (i),we get $x-4=-2$ ⇨ $x=2$ Hence, the required point is P(2,-4).
Ans-6	Let the coordinates of the vertices of equilateral triangle ABC be A(x,y), B(0,0) and C(a,0). AB=AC=BC=a (given) ⇨ $AB^2 = AC^2 = a^2$ ⇨ $(x-0)^2+(y-0)^2 =a^2$ and $(x-a)^2+(y-0)^2 =a^2$ ⇨ $x^2+y^2 =a^2$ ……(i) and $x^2 + a^2 -2ax +y^2 = a^2$ ⇨ $x^2 -2ax + y^2 = 0$ ⇨ $a^2 -2ax =0$ {using equation (i)} ⇨ $2ax =a^2$ or $x = \frac{a}{2}$ Putting this value of x in equation (i), we get $\frac{a^2}{4} + y^2 = a^2$ or $y^2 = \frac{3}{4} a^2$ ⇨ $y = \pm \frac{\sqrt{3}}{2} a$

	Hence, the coordinates of the vertices of ΔABC are A $\left(\frac{a}{2}, \frac{\sqrt{3}}{2}\ a\right)$, B(0,0) , C(a,0) OR A $\left(\frac{a}{2}, -\frac{\sqrt{3}}{2}\ a\right)$, B(0,0) C(a,0).
Ans-7	Let A(x,y), B(3,4) and C(-2,3) are the three vertices of an equilateral triangle. BC=AB=AC BC= $\sqrt{(-2-3)^2+(3-4)^2} = \sqrt{25+1} = \sqrt{26}$ AB = $\sqrt{(x-3)^2+(y-4)^2}$ As AB =BC ⇨ $AB^2 = BC^2$ ⇨ $(x-3)^2 + (y-4)^2 = 26$ ⇨ $X^2 + y^2 - 6x - 8y - 1 = 0$ …….(i) AC = $\sqrt{(x+2)^2+(y-3)^2}$ As AC =BC ⇨ $AC^2 = BC^2$ ⇨ $(x+2)^2 + (y-3)^2 = 26$ ⇨ $X^2 + y^2 + 4x - 6y - 13 = 0$ …….(ii) Subtracting (i) and (ii) 10x+2y-12=0 ⇨ y=6-5x ……(iii) ⇨ substituting the value of y in $(x-3)^2 + (y-4)^2 = 26$ $(x-3)^2 + (6-5x-4)^2 = 26$ ⇨ $x^2 + 9 - 6x + 4 + 25x^2 - 20x - 26 = 0$ ⇨ $26x^2 - 26x - 13 = 0$ x= $\frac{2\pm\sqrt{12}}{4} = \frac{1\pm\sqrt{3}}{2}$ substituting the value of x in equation (iii)

	$y = 6 - 5\left(\frac{1\pm\sqrt{3}}{2}\right)$ $\frac{12-5\mp\sqrt{3}}{2} = \frac{7\mp\sqrt{3}}{2}$ Hence, the third vertex has the coordinates $\left(\frac{1+\sqrt{3}}{2}, \frac{7-5\sqrt{3}}{2}\right)$ or $\left(\frac{1-\sqrt{3}}{2}, \frac{7+5\sqrt{3}}{2}\right)$
Ans-8	Co-ordinates of mod-point D of BC are $\left(\frac{0-5}{2}, \frac{4+3}{2}\right) = \left(\frac{-5}{2}, \frac{7}{2}\right)$ Co-ordinates of mid-point E of AC are $\left(\frac{1-5}{2}, \frac{-1+3}{2}\right) = \left(\frac{-4}{2}, \frac{2}{2}\right) = (-2,1)$ Co-ordinates of mid-point F of AB are $\left(\frac{1+0}{2}, \frac{-1+4}{2}\right) = \left(\frac{1}{2}, \frac{3}{2}\right)$ Median AD $= \sqrt{\left(1+\frac{5}{2}\right)^2 + \left(-1-\frac{7}{2}\right)^2}$ $= \sqrt{\left(\frac{7}{2}\right)^2 + \left(-\frac{9}{2}\right)^2}$ $= \sqrt{\frac{130}{4}} = \frac{\sqrt{130}}{2}$ Median BE $= \sqrt{(0+2)^2 + (4-1)^2}$ $= \sqrt{4+9}$ $= \sqrt{13}$ Median CF $= \sqrt{\left(-5-\frac{1}{2}\right)^2 + \left(3-\frac{3}{2}\right)^2}$



	$= \sqrt{\left(\frac{-11}{2}\right)^2 + \left(\frac{3}{2}\right)^2}$ $= \sqrt{\frac{130}{4}}$ $= \frac{\sqrt{130}}{2}$
Ans-9	The diagonals of a parallelogram Bisect each other. Mid-point of AC = Mid-point of BD  $\left(\frac{-2+4}{2}, \frac{1+b}{2}\right) = \left(\frac{a+1}{2}, \frac{0+2}{2}\right)$ ⇨ $\frac{a+1}{2} = \frac{2}{2} = 1$ ⇨ a=1 and $\frac{1+b}{2} = \frac{2}{2} = 1$ ⇨ b=1 using distance formula- AB = $\sqrt{(1+2)^2 + (0-1)^2}$ =$\sqrt{9+1}$ =$\sqrt{10}$ BC = $\sqrt{(4-1)^2 + (1-0)^2}$ =$\sqrt{9+1}$ =$\sqrt{10}$ The opposite sides of a parallelogram are equal. AB=CD =$\sqrt{10}$ units BC=AD =$\sqrt{10}$ units
Ans-10	The points A(a,a), B(-a,-a) and C(-√3 a, √3 a) are the vertices of ΔABC. Therefore , AB = $\sqrt{(-a-a)^2 + (-a-a)^2}$ =$\sqrt{4a^2 + 4a^2}$ =$\sqrt{8a^2}$ = 2√2 a

	BC = $\sqrt{\left(-\sqrt{3}a+a\right)^2+\left(\sqrt{3}a+a\right)^2}$ = $\sqrt{a^2(1-\sqrt{3})^2+a^2\ \ (1+\sqrt{3})^2}$ = a $\sqrt{(1-\sqrt{3})^2+(1+\sqrt{3})^2}$ = a $\sqrt{1+3-2\sqrt{3}+1+3+2\sqrt{3}}$ = a $\sqrt{8}$ = 2√2 a Clearly, AB = BC = AC = 2√2 a Hence, ΔABC is an equilateral triangle.

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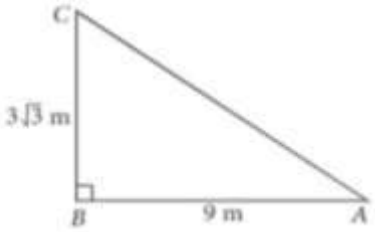
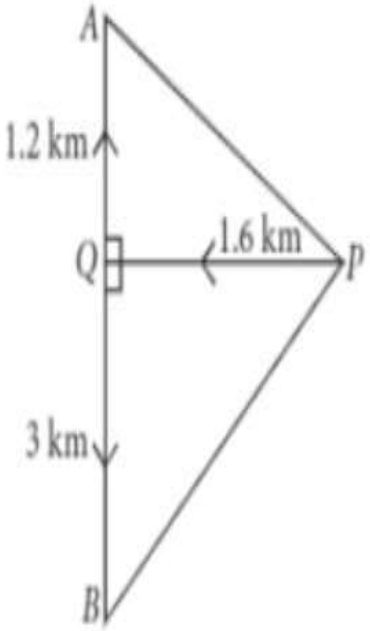
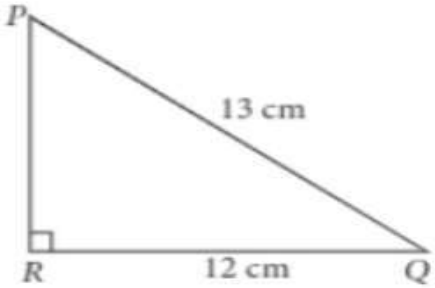
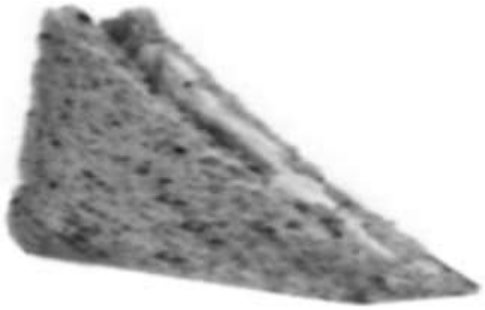
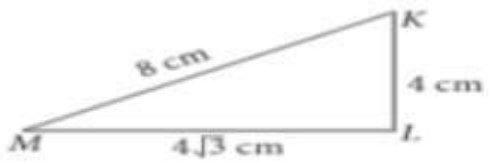
CHAPTER :08

INTRODUCTION TO TRIGONOMETRY

	COMPETENCY BASED QUESTIONS
Q1	In ΔABC, right-angled at B, AB = 5 cm and $\angle ACB = 30°$ then the length of the side AC is (a) $5\sqrt{3}$ (b) $2\sqrt{3}$ (c) 10 cm. (d) none of these
Q2	$9\sec^2 A - 9\tan^2 A =$ (a) 1 (b) 9 (c) 8 (d) 0
Q3	$\frac{1+\tan^2 A}{1+\cot^2 A} =$ (a) $\sec^2 A$ (b) -1 (c) $\cot^2 A$ (d) $\tan^2$ A
Q4	If cos A=$\frac{24}{25}$, then the value of sinA is (a) $\frac{24}{25}$ (b) $\frac{24}{25}$ (c)1 (d)none of these
Q 5	If sec 4A = cosec (A – 20°), where 4A is an acute angle, find the value of A. (a)22^0 (b) 25^0 (c) 26^0 (d) none of these
Q 6	In a right triangle ABC, right-angled at B, if tan A = 1, then the value of 2sin A cos A = (a) 0 (b) 1 (c) ½ (d) none of these
Q 7	If sin (A – B) = 1 and cos(A + B) = 1, then the value of A and B, respectively are (a)45° and 15° (b) 30° and 15° (c) 45° and 30° (d) none of these
Q 8	The value of $\sin 60^0 \cos 30^0 - \cos 60^0 \sin 30^0$ is (a)1 (b) –1 (c) 0 (d) none of these
Q 9	If sin 3A = cos (A – 26°), where 3A is an acute angle, find the value of A. (a) 29^0 (b) 30^0 (c) 26^0 (d) 36^0
Q10	The value of $2\cos^2 60^0 \square 3\sin^2 45^0 \square 3\sin^2 30^0 \square 2\cos^2 90^0$ is (a)1 (b) 5 (c) 5/4 (d) none of these

Q11	sin A = cosA is true when A = (a) 0° (b) 30° (c) 45° (d) any angle
	CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
Q 1	**Hide And Seek** Three friends- Megha,Kristi and Joya are playing hide and seek in a park. Megha and Kristi hide in the shrubs and Joya have to find both of them.If Position of three friends are at A,B and C respectively as shown in the the figure and forms a right angled triangle such that AB=9m, BC = $3\sqrt{3}$ m and $\angle B = 90^0$,then answer the following questions:  
(i)	The measure of ∠ A is (a)30^0 (b)45^0 (c)60^0 (d)none of these
(ii)	The measure of ∠ C is (a)30^0 (b)45^0 (c)60^0 (d)none of these
(iii)	The length of AC is (a)$2\sqrt{3}$m (b) $\sqrt{3}$m (c) $4\sqrt{3}$m (d) $6\sqrt{3}$ m
(iv)	Cos2A = (a) 0 (b) $\frac{1}{2}$ (c) $\frac{1}{\sqrt{2}}$ (d)$\frac{\sqrt{3}}{2}$
(v)	Sin($\frac{C}{2}$)= (a) 0 (b) $\frac{1}{2}$ (c) $\frac{1}{\sqrt{2}}$ (d)$\frac{\sqrt{3}}{2}$

Q2	**Two Flights**   Two airplanes leave an airport, one after the other. After moving on runway, one flies due North and other flies due south. The speed of two airplanes are 400km/hr. and 500km/hr. respectively. Considering PQ as runway and A and B are any two points in the path followed by two planes, then answer the following questions:
(i)	Find tanθ , $\angle APQ = \theta$ (a) $\frac{3}{4}$ (b) $\frac{1}{2}$ (c) $\frac{1}{\sqrt{2}}$ (d) $\frac{\sqrt{3}}{2}$
(ii)	Find cotB (a) $\frac{3}{4}$ (b) $\frac{15}{4}$ (c) $\frac{3}{8}$ (d) $\frac{15}{8}$
(iii)	Find tanA (a) 2 (b) $\sqrt{2}$ (c) $\frac{4}{3}$ (d) $\frac{2}{\sqrt{3}}$
(iv)	Find secA (a) 1 (b) $\frac{2}{3}$ (c) $\frac{4}{3}$ (d) $\frac{5}{3}$
(v)	Find cosecB (a) $\frac{17}{8}$ (b) $\frac{8}{17}$ (c) $\frac{12}{5}$ (d) $\frac{5}{12}$

Q3	**Bird House**   Naveen-a student of class X, has to make a project on 'Introduction to trigonometry'. He decides to make a bird house which is triangular in shape. He uses cardboard to make the bird house as shown in the figure. Considering the front side of bird house as right angled triangle PQR, $\angle R = 90^0$,answer the following questions:
(i)	If $\angle PQR = \theta$, then cosθ= (a) $\frac{12}{5}$ (b) $\frac{5}{12}$ (c) $\frac{12}{13}$ (d) $\frac{13}{12}$
(ii)	If $\angle PQR = \theta$, then secθ= (a) $\frac{12}{5}$ (b) $\frac{5}{12}$ (c) $\frac{12}{13}$ (d) $\frac{13}{12}$
(iii)	The value of $\frac{tan\theta}{1+tan^2\theta}$ = (a) $\frac{12}{5}$ (b) $\frac{5}{12}$ (c) $\frac{12}{13}$ (d) $\frac{13}{12}$
(iv)	The value of $cot^2\theta$ - $cosec^2\theta$ = (a) 0 (b) -1(c) 1 (d) 2
(v)	The value of $sin^2\theta + cos^2\theta$ = (a) 0 (b) -1(c) 1 (d) 2
Q4	**Sandwich making**   Neeta's brother is feeling so hungry and so thought to eat something. He looked in to fridge and found some bread pieces. He decided to make a sandwich. He cut the piece of bread diagonally and found that it forms a right angled triangle, with sides 4cm, 4√3cm and 8cm.

	On the basis of above information, answer the following questions:
(i)	Find $\angle M$ = (a) 30^0(b) 60^0 (c) 45^0(d)None of these
(ii)	Find $\angle K$ = (a) 30^0(b) 60^0 (c) 45^0(d)None of these
(iii)	Find the value of tan M= (a) 1 (b)$\sqrt{3}$ (c) $\frac{4}{3}$ (d)$\frac{1}{\sqrt{3}}$
(iv)	The value of $\frac{tan^2\theta-1}{1+tan^2\theta}$ = ….. if $\theta=45^0$ (a) 1 (b) –1 (c) 0 (d) 2
(V)	sec^2M - 1 = (a) tanM (b) tan2M (c) $\tan^2$M (d) 2
	OBJECTIVE TYPE QUESTIONS
Q 1	The minimum value of $2\sin^2\theta + 3\cos^2\theta$
(i)	0
(ii)	3
(iii)	2
(iv)	1
Q 2	$\tan^2$ A + $\cot^2$ A = …….
(i)	$\sec^2$ A cosec^2 A – 2
(ii)	$\sec^2$ A cosec^2 A – 1
(iii)	$\sec^2$ A cosec^2 A
(iv)	1- $\sec^2$ A cosec^2 A
Q3	If sin A = 3/4 , value of cos A and tan A
(i)	$\sqrt{7}$/4, 3/$\sqrt{7}$
(ii)	0,0
(iii)	¼, 1
(iv)	1,0

	OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
Q 1	Trigonometry is the study of relationships between the _____ and _____.
Q 2	$\frac{\text{Side Opposite to } \angle A}{\text{Side adjacent to } \angle A}$ = …….
Q 3	$\frac{\text{Side adjacent to } \angle A}{\text{hypotenuse}}$ = …….
Q 4	$2\sin^2 45^0$ = …….
Q 5	If triangle ABC , $\angle C = 90^0$ then value of cos(A+B)=…..
Q 6	In a right angled triangle the side opposite to right angle is called……
Q 7	$\text{Sec}^2 60° - 1$=……..
Q 8	Write the maximum value of sinθ=……..
Q 9	In a right angled triangle ABC right angled at B. If AB is opposite side, BC is adjacent side and AC is hypotenuse. Find the trigonometric ratios?
Q 10	In a right angled triangle ABC right angled at B. If AB is opposite side, BC is adjacent side and AC is hypotenuse. Find the trigonometric ratios?
	SHORT ANSWER TYPE QUESTIONS
Q 1	If tan θ + cot θ = 5, find the value of tan2θ + cotθ
Q 2	If sec 2A = cosec (A – 27°) where 2A is an acute angle, find the measure of ∠A
Q 3	If tan α = $\sqrt{3}$ and tan β = 1/√3, 0 < α, β < 90°, find the value of cot (α + β).
Q 4	If sin θ – cos θ = 0, find the value of sin4 θ + cos4 θ
Q 5	If sec θ + tan θ = 7, then evaluate sec θ – tan θ.
Q6	Evaluate: $\frac{1-cot^2\ 45^0}{1+sin^2\ 90^0}$ =
Q 7	If cosec θ = 5/4, find the value of cot θ.
Q 8	What happens to value of cos when increases from 0° to 90°?
Q9	Evaluate: tan 15° . tan 25° , tan 60° . tan 65° . tan 75° – tan 30°
Q10	Express cot 75° + cosec 75° in terms of trigonometric ratios of angles between 0° and 30°.
	LONG ANSWER TYPE QUESTIONS
Q 1	If x = p sec θ + q tan θ and y = p tan θ + q sec θ, then prove that $x^2 - y^2 = p^2 - q^2$.

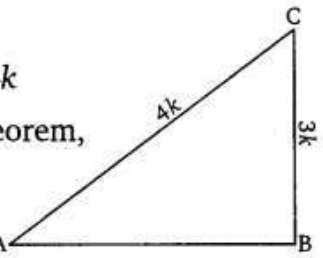
Q 2	Prove the following identity: $\frac{sin^3\ \theta + cos^3\ \theta}{sin\theta + cos\theta}$ = 1 – sin θ . cos θ
Q 3	*If* x = a cos θ – b sin θ and y = a sin θ + b cos θ, then prove that $a^2 + b^2 = x^2 + y^2$
Q 4	If cos x = cos 40° . sin 50° + sin 40°. cos 50°, then find the value of x.
Q5	If sin θ = 1/2, then show that 3 cos θ – 4 $\cos^3$ θ = 0
Q6	If 5 sin θ = 4, prove that $\frac{1}{\cos\theta} + \frac{1}{\cot\theta} = 3$
Q7	Evaluate: $\frac{\sin(50^\circ+\theta) - \cos(40^\circ-\theta)}{\sin 40^\circ . \operatorname{cosec} 40^\circ} + \frac{\tan 1^\circ . \tan 40^\circ . \tan 50^\circ . \tan 89^\circ}{4(\cos^2 29^\circ + \cos^2 61^\circ)}$
Q8	$\frac{\sin\theta - \cos\theta}{\sin\theta + \cos\theta} + \frac{\sin\theta + \cos\theta}{\sin\theta - \cos\theta} = \frac{2}{2sin^2\theta - 1}$, prove it.
Q9	If tan θ = ab, prove that $\frac{a\sin\theta - b\cos\theta}{a\sin\theta + b\cos\theta}$ equals to $\frac{a^2 - b^2}{a^2 + b^2}$
Q10	Prove the identity: (sec A – cos A). (cot A + tan A) = tan A . sec A

CHAPTER :08

INTRODUCTION TO TRIGONOMETRY

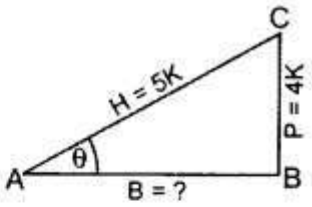
SOLUTIONS OF THE PROBLEM

	SOLUTIONS TO COMPETENCY BASED QUESTIONS
Q 1	10cm
Q 2	9
Q 3	$\tan^2 A$
Q 4	None of these
Q 5	A= 22^0
Q 6	1
Q 7	None of these
Q 8	0
Q 9	A = 29^0
Q 10	5/4
Q 11	A = 45^0
	SOLUTIONS TO CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
Q1	**Hide and seek** (i) angle A = 30^0 (ii) angle C = 60^0 (iii) AC = $6\sqrt{3}$m (iv) cos 2A = ½ because angle A = 30^0 and cos 2A= cos (2X30^0) = cos 60^0 = ½ (v)sin(C/2)= sin 30^0 = 1/2
Q2	**Two Flights** (i) $\tan\theta$ = 3/4 (ii) cotB= 15/8 (iii) tanA = 4/3 (iv) $\tan^2 A + 1 = \sec^2 A$ therefore secA= 5/3 (v)cosec B = $\sqrt{cot^2 B + 1}$ = 17/8
Q3	**Bird House** (i) PR = 5cm therefore cosθ= 12/13 (ii) secθ= 13/12 (iii) tanθ= 5/12 ∴ The value of $\frac{tan\theta}{1+tan^2\theta}$ = 60/169 (iv) cotθ= 12/5 , cosecθ= 13/5 ∴ The value of $cot^2\theta - cosec^2\theta$ =-1 (v)$\sin^2\theta+\cos^2\theta$=1 (using identity)

	SOLUTIONS TO OBJECTIVE TYPE QUESTIONS
Q1	Let $x = 2\sin^2\theta + 3\cos^2\theta$ $\Rightarrow x = 2\sin^2\theta + 2\cos^2\theta + \cos^2\theta$ $\Rightarrow x = 2(\sin^2\theta + \cos^2\theta) + \cos^2\theta$ $\Rightarrow x = 2 + \cos^2\theta$ [since $\sin^2\theta + \cos^2\theta = 1$] Therefore x will be the minimum when $\cos\theta = 0$. i.e. minimum value of x will 2
Q2	Solution: $\tan^2 A + \cot^2 A = \sec^2 A \operatorname{cosec}^2 A - 2$ L.H.S. $= \tan^2 A + \cot^2 A$ $= \frac{\sin^2 A}{\cos^2 A} + \frac{\cos^2 A}{\sin^2 A}$ $= \frac{\sin^4 A + \cos^4 A}{\sin^2 A \cos^2 A}$ $= \frac{(\sin^2 A + \cos^2 A)^2 - 2\sin^2 A \cos^2 A}{\sin^2 A \cos^2 A}$ $= \frac{(1)^2 - 2\sin^2 A \cos^2 A}{\sin^2 A \cos^2 A}$ $= \frac{1 - 2\sin^2 A \cos^2 A}{\sin^2 A \cos^2 A}$ $= \frac{1}{\sin^2 A \cos^2 A} - \frac{2\sin^2 A \cos^2 A}{\sin^2 A \cos^2 A}$ $= \operatorname{cosec}^2 A \sec^2 A - 2 = \sec^2 A \operatorname{cosec}^2 A - 2$ = R.H.S.
Q3	If sin A = 3/4 , calculate cos A and tan A. Solution: Given: $\sin A = \frac{3}{4} = \frac{BC}{AC}$ Let $BC = 3k$ and $AC = 4k$ Then by Pythagoras' Theorem, $AB^2 = AC^2 - BC^2$ $= (4k)^2 - (3k)^2$ $= 16k^2 - 9k^2 = 7k^2$  $\Rightarrow AB = k\sqrt{7}$ $\therefore \cos A = \frac{AB}{AC} = \frac{\sqrt{7}k}{4k} = \frac{\sqrt{7}}{4}$ and $\tan A = \frac{BC}{AB} = \frac{3k}{\sqrt{7}k} = \frac{3}{\sqrt{7}}$

	SOLUTIONS TO OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
Q1	Sides and angles
Q2	tan A
Q3	Cos A
Q4	1
Q5	0
Q6	hypotenuse
Q7	3
Q8	1
Q9	cosecA
Q10	Sec A
	SOLUTIONS TO SHORT ANSWER TYPE QUESTIONS
Q1	$\tan\theta + \cot\theta = 5$ … (Given) $\tan^2\theta + \cot^2\theta + 2\tan\theta\cot\theta = 25$ … [Squaring both sides $\tan^2\theta + \cot^2\theta + 2 = 25$ $\therefore \tan^2\theta + \cot^2\theta = 23$
Q2	$\sec 2A = \text{cosec}(A - 27°)$ $\text{cosec}(90° - 2A) = \text{cosec}(A - 27°)$ …[$\because \sec\theta = \text{cosec}(90° - \theta)$ $90° - 2A = A - 27°$ $90° + 27° = 2A + A$ $\Rightarrow 3A = 117°$ $\therefore \angle A = 117^0/3 = 39°$
Q3	$\tan\alpha = \sqrt{3} = \tan 60°$ …(i) $\tan\beta = 1/\sqrt{3} = \tan 30°$ …(ii) Solving (i) & (ii), $\alpha = 60°$ and $\beta = 30°$ $\therefore \cot(\alpha + \beta) = \cot(60° + 30°) = \cot 90° = 0$
Q4	$\sin\theta - \cos\theta = 0 = \sin\theta = \cos\theta$ $\Rightarrow \sin\theta\cos\theta = 1 \Rightarrow \tan\theta = 1 \Rightarrow \theta = 45°$ Now, $\sin^4\theta + \cos^4\theta$ $= \sin^4 45° + \cos^4 45°$ $= (1/\sqrt{2})^4 + (1/\sqrt{2})^4 = 1/4 + 1/4 = 2/4 = 1/2$
Q5	We know that, $\sec^2\theta - \tan^2\theta = 1$ $(\sec\theta + \tan\theta)(\sec\theta - \tan\theta) = 1$ $(7)(\sec\theta - \tan\theta) = 1$ …[$\sec\theta + \tan\theta = 7$; (Given) $\therefore \sec\theta - \tan\theta = 1/7$

Q6	Evaluate: $\frac{1-cot^2\ 45^0}{1+sin^2\ 90^0}$ = … answer = 0
Q7	We know that, $\cot^2\theta = \text{cosec}^2\theta - 1$ $\cot^2\theta = 9/16 \therefore \cot\theta = 3/4$
Q8	cos 0° = 1, cos 90° = 0 When θ increases from 0° to 90°, the value of cos θ decreases from 1 to 0.
Q9	tan 15°. tan 25°, tan 60°. tan 65°. tan 75° – tan 30° = tan(90° – 75°) tan(90° – 65°). $3-\sqrt{}$. tan 65°. tan 75° – $13\sqrt{}$ $= \cot 75^\circ . \cot 65^\circ . \sqrt{3} . \frac{1}{\cot 65^\circ} \cdot \frac{1}{\cot 75^\circ} - \frac{1}{\sqrt{3}}$ $= \sqrt{3} - \frac{1}{\sqrt{3}}$ …[∵ tan(90°–A) = cot A, tan B = 1/cot B $= \frac{3-1}{\sqrt{3}} = \frac{2}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{2\sqrt{3}}{3}$
Q10	cot 75° + cosec 75° = cot(90° – 15°) + cosec(90° – 15°) = tan 15° + sec 15° …[cot(90°-A) = tan A cosec(90° – A) = sec A
	SOLUTIONS TO LONG ANSWER TYPE QUESTIONS
Q1	L.H.S. = $x^2 - y^2$ = $(p \sec\theta + q \tan\theta)^2 - (p \tan\theta + q \sec\theta)^2$ = $p^2 \sec\theta + q^2 \tan^2\theta + 2pq \sec^2 \tan^2 -(p^2 \tan^2\theta + q^2 \sec^2\theta + 2pq \sec\theta \tan\theta)$ = $p^2 \sec\theta + 2 \tan^2\theta + 2pq \sec\theta \tan\theta - p^2 \tan^2\theta - q^2 \sec\theta - 2pq \sec\theta \tan\theta$ = $p^2(\sec^2\theta - \tan^2\theta) - q^2(\sec?^2\theta - \tan^2\theta)$ = = $p^2 - q^2$ …[$\sec^2\theta - \tan^2\theta = 1$ = R.H.S.
Q2	$\textbf{L.H.S.} = \frac{\sin^3\theta + \cos^3\theta}{\sin\theta + \cos\theta}$ $= \frac{(\sin\theta + \cos\theta)(\sin^2\theta + \cos^2\theta - \sin\theta\cos\theta)}{(\sin\theta + \cos\theta)}$ …[∵ $a^3 + b^3 = (a+b)(a^2 + b^2 - ab)$ $= 1 - \sin\theta\cos\theta = \textbf{R.H.S.}$ …[∵ $\sin^2\theta + \cos^2\theta = 1$
Q3	R.H.S. = $x^2 + y^2$ = $(a \cos\theta - b \sin\theta)^2 + (a \sin\theta + b \cos\theta)^2$ = $a^2\cos^2\theta + b^2 \sin^2\theta - 2ab \cos\theta \sin\theta + a^2 \sin^2\theta + b^2 \cos^2\theta + 2ab \sin\theta \cos\theta$ = $a^2(\cos^2\theta + \sin^2\theta) + b^2 (\sin^2\theta + \cos^2\theta)$ = $a^2 + b^2$ = L.H.S. …[∵ $\cos^2\theta + \sin^2\theta = 1$
Q4	cos x = cos 40° sin 50° + sin 40° cos 50° cos x = cos 40° sin(90° – 40°) + sin 40°.cos(90° – 40°) cos x = $\cos^2$ 40° + $\sin^2$ 40° cos x = 1 …[∵ $\cos^2$ A + $\sin^2$ A = 1 cos x = cos 0° ⇒ x = 0°

Q5	$\sin\theta = \sin 30° \Rightarrow \theta = 30°$ L.H.S $= 3\cos\theta - 4\cos^3\theta$ $= 3\cos 30° - 4\cos^3(30°)$ $= 3\left(\frac{\sqrt{3}}{2}\right) - 4\left(\frac{\sqrt{3}}{2}\right)^3 = \frac{3\sqrt{3}}{2} - 4\left(\frac{3\sqrt{3}}{8}\right)$ $= \frac{3\sqrt{3}}{2} - \frac{3\sqrt{3}}{2} = 0 =$ **R.H.S.**
Q6	Given: $5\sin\theta = 4$ $\therefore \quad \sin\theta = \frac{4}{5}$ $\frac{P}{H} = \frac{4}{5}$  Here, P = 4K, H = 5K In rt. ΔABC, $P^2 + B^2 = H^2$ **...[by Pythagoras' theorem** $(4K)^2 + B^2 = (5K)^2$ $B^2 = 25K^2 - 16K^2 = 9K^2$ $B = +3K$ **...[∵ Base (B) cannot be -ve** $\sec\theta = \frac{1}{\cos\theta} = \frac{H}{B} = \frac{5K}{3K} = \frac{5}{3}$ $\tan\theta = \frac{P}{B} = \frac{4K}{3K} = \frac{4}{3}$ **L.H.S.** $= \frac{1}{\cos\theta} + \frac{1}{\cot\theta}$ $= \sec\theta + \tan\theta$ $= \frac{5}{3} + \frac{4}{3} = \frac{9}{3} = 3 =$ **R.H.S. ...(Hence proved)**

Q7

$$\frac{\sin(50^\circ+\theta)-\cos(40^\circ-\theta)}{\sin 40^\circ \cdot \operatorname{cosec} 40^\circ} + \frac{\tan 1^\circ.\tan 40^\circ.\tan 50^\circ.\tan 89^\circ}{4(\cos^2 29^\circ+\cos^2 61^\circ)}$$

$$= \frac{\sin[90^\circ-(40^\circ-\theta)]-\cos(40^\circ-\theta)}{\sin 40^\circ.\operatorname{cosec}40^\circ} + \frac{\tan 1^\circ.\tan 40^\circ \tan(90^\circ-40^\circ)\tan(90^\circ-1^\circ)}{4(\cos^2 29^\circ+\cos^2(90^\circ-29^\circ))}$$

$\because 50^\circ+\theta = 90^\circ-40^\circ+\theta = 90^\circ-(40^\circ-\theta)$ ...

$$= \frac{\cos(40^\circ-\theta)-\cos(40^\circ-\theta)}{\sin 40^\circ.\operatorname{cosec}\ 40^\circ} + \frac{\frac{1}{\cot 1^\circ}\times\frac{1}{\cot 40^\circ}\cot 40^\circ\cot 1^\circ}{4[\cos^2 29^\circ+\sin^2\ 29^\circ]}$$

$\because \sin(90^\circ-A)=\cos A,\ \tan(90^\circ-A)=\cot A,\ \tan A=\frac{1}{\cot A},\ \sin^2A+\cos^2A=1$ ...

$$\Rightarrow\ 0+\frac{1}{4(1)}=\frac{1}{4}$$

Q8

$$\text{L.H.S.} = \frac{\sin\theta-\cos\theta}{\sin\theta+\cos\theta}+\frac{\sin\theta+\cos\theta}{\sin\theta-\cos\theta}$$

$$= \frac{(\sin\theta-\cos\theta)^2+(\sin\theta+\cos\theta)^2}{(\sin\theta+\cos\theta)(\sin\theta-\cos\theta)}$$

$$= \frac{\sin^2\theta+\cos^2\theta-2\sin\theta\cos\theta+\sin\theta^2+\cos^2\theta+2\sin\theta\cos\theta}{\sin^2\theta-\cos^2\theta}$$

$$\Rightarrow\ \frac{1+1}{\sin^2\theta-(1-\sin^2\theta)}=\frac{2}{\sin^2\theta-1+\sin^2\theta}$$

$$= \frac{2}{2\sin^2\theta-1} = \text{R.H.S.} \quad \text{...(Hence proved)}$$

Q9	Solution: $\textbf{L.H.S.} = \frac{a\sin\theta - b\cos\theta}{a\sin\theta + b\cos\theta}$ $= \frac{\frac{a\sin\theta}{\cos\theta} - \frac{b\cos\theta}{\cos\theta}}{\frac{a\sin\theta}{\cos\theta} + \frac{b\cos\theta}{\cos\theta}} = \frac{a\tan\theta - b}{a\tan\theta + b}$ ...[Dividing num. and deno. by cos θ $= \frac{a\left(\frac{a}{b}\right) - b}{a\left(\frac{a}{b}\right) + b}$ ...[$\because$ tan θ = $\frac{a}{b}$ ... [Given $= \frac{\frac{a^2}{b} - b}{\frac{a^2}{b} + b} = \frac{\frac{a^2 - b^2}{b}}{\frac{a^2 + b^2}{b}} = \frac{a^2 - b^2}{a^2 + b^2}$ = R.H.S.
Q10	Solution: L.H.S.= (sec A – cos A) (cot A + tan A) $= \left(\frac{1}{\cos A} - \cos A\right)\left(\frac{\cos A}{\sin A} + \frac{\sin A}{\cos A}\right)$ $= \left(\frac{1 - \cos^2 A}{\cos A}\right)\left(\frac{\cos^2 A + \sin^2 A}{\sin A \cos A}\right)$ $= \frac{\sin^2 A}{\cos A} \times \frac{1}{\sin A \cos A} = \frac{\sin A}{\cos A} \times \frac{1}{\cos A}$ ...[$\because$ $\cos^2 A + \sin^2 A = 1$ = tan A . sec A = R.H.S.

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CHAPTER : 09

SOME APPLICATIONS OF TRIGONOMETRY

	COMPETENCY BASED QUESTIONS
Q1	A pole 6 m high casts a shadow $2\sqrt{3}$ m long on the ground, then the Sun's elevation is – (A) 60° (B) 45° (C) 30° (D) 90°
Q2	If the length of the shadow of a tower is increasing, then the angle of elevation of the sun - (A) is also increasing (B) is decreasing (C) remains unaffected (D) Don't have any relation with length of shadow
Q3	The angle of elevation of the top of a tower is 30°. If the height of the tower is doubled, then the angle of elevation of its top will (A) also get doubled (B) will get halved (C) will be less than 60 degree (D) None of these
Q4	If the height of a tower and the distance of the point of observation from its foot,both, are increased by 10%, then the angle of elevation of its top - (A) increases (B) decreases (C) remains unchanged (D) have no relation.
Q5	A ladder 15 metres long just reaches the top of a vertical wall. If the ladder makes an angle of 60° with the wall, then the height of the wall will be - (A) 7.5m (B) 7.7m (C) 8.5m (D) 8.8m
Q6	An observer 1.5 metres tall is 20.5 metres away from a tower 22 metres high. Determine the angle of elevation of the top of the tower from the eye of the observer. (A) 30° (B) 45° (C) 60° (D) 90°
Q7	If a man standing on a platform 3 metres above the surface of a lake observes a cloud and its reflection in the lake, then the angle of elevation of the cloud is - (A) equal to the angle of depression of its reflection. (B) double to the angle of depression of its reflection

	(C) not equal to the angle of depression of its reflection (D) information insufficient
Q8	If two towers of height h1 and h2 subtend angles of 60° and 30° respectively at the midpoint of the line joining their feet, then the value of h1: h2 is – (A) 1:3 (B) 1:2 (C) 2:1 (D) 3:1
Q9	The angle of elevation of the top of a tower 30 m high from the foot of another tower in the same plane is 60°, then the distance between the two towers is: (A) 10√3 m (B) 15√3 m (C) 12√3 m (D) 36 m
Q10	There are two windows in a house. A window of the house is at a height of 1.5 m above the ground and the other window is 3 m vertically above the lower window. Ram and Shyam are sitting inside the two windows. At an instant, the angle of elevation of a balloon from these windows are observed as 45° and 30° respectively. Find the height of the balloon from the ground. (A) 7.598m (B) 8.269m (C) 7.269m (D) 8.598 m
	CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
Q1	In a village, group of people complained for an electric fault in their area. On their complained, an electrician reached village to repair an electric fault on a pole of height 5m. She needs to reach a point 1.3m below the top of the pole to undertake the repair work (see the adjoining figure). She used ladder, inclined at an angle of q to the horizontal such that cosθ = 0.5, to reach the required position.
(i)	The angle of elevation θ is - (a) 60° (b) 30° (c) 45° (d) 90°
(ii)	The length BD is - (a) 3m (b) 3.5m (c) 3.7m (d)4m
(iii)	The length of the ladder (take √3 = 1.73) is - (a) 4 m (b) 4.3 m (c) 4.2 m (d) 4.28 m

(iv)	How far from the foot of the pole should she place the foot of the ladder? (a) 2 m (b) 2.14 m (c) 2.2 m (d) 2.28 m
(v)	If the height of pole and distance BD is doubled, then what will be the length of the ladder? (a) 8 m (b) 8.6 m (c) 8.56 m (d) 8.28m
Q2	A group of students of class X visited India Gate on an education trip. The teacher and students had interest in history as well. The teacher narrated that India Gate, official name Delhi Memorial, originally called All-India War Memorial, monumental sandstone arch in New Delhi, dedicated to the troops of British India who died in wars fought between 1914 and 1919.The teacher also said that India Gate, which is located at the eastern end of the Rajpath (formerly called the Kingsway), is about 138 feet (42 metres) in height.
(i)	What is the angle of elevation if they are standing at a distance of 42m away from the monument? a) 30° b) 45° c) 60° d) 0°
(ii)	They want to see the tower at an angle of 60°. So, they want to know the distance where they should stand and hence find the distance. a) 25.24 m b) 20.12 m c) 42 m d) 24.64m
(iii)	If the altitude of the Sun is at 60°, then the height of the vertical tower that will cast a shadow of length 20 m is – a) 20√3 m b) 20/√3 m c) 15/√3 m d) 15√3 m
(iv)	The ratio of the length of a rod and its shadow is 1:1. The angle of elevation of the Sun is – a) 30° b)45° c) 60° d) 90°

(v)	The angle formed by the line of sight with the horizontal when the object viewed is below the horizontal level is – a) corresponding angle b) angle of elevation c) angle of depression d) complete angle
Q3	A Satellite flying at height h is watching the top of the two tallest mountains in Uttarakhand and Karnataka, them being Nanda Devi (height 7,816m) and Mullayanagiri (height 1,930 m). The angles of depression from the satellite, to the top of Nanda Devi and Mullayanagiri are 30° and 60° respectively. If the distance between the peaks of two mountains is 1937 km , and the satellite is vertically above the midpoint of the distance between the two mountains.
(i)	The distance of the satellite from the top of Nanda Devi is – a) 1139.4 km b) 577.52 km c) 1937 km d) 1025.36 km
(ii)	The distance of the satellite from the top of Mullayanagiri is – a) 1139.4km b) 577.52 km c) 1937 km d) 1025.36 km
(iii)	The distance of the satellite from the ground is – a) 1139.4 km b) 577.52 km c) 1937 km d) 1025.36 km
(iv)	What is the angle of elevation if a man is standing at a distance of 7816m from Nanda Devi? a) 30° b) 45° c) 60° d) 0°
(v)	If a mile stone very far away from, makes 45 to the top of Mullanyangiri montain . So, find the distance of this mile stone form the mountain. a) 1118.327 km b) 566.976 km c) 1937 km d) 1025.36 km
Q4	Radio towers are used for transmitting a range of communication services including radio and television. The tower will either act as an antenna itself or support one or more antennas on its structure,

	including microwave dishes. They are among the tallest human-made structures. There are 2 main types: guyed and self-supporting structures. On a similar concept, a radio station tower was built in two sections A and B . Tower is supported by wires from a point O . Distance between the base of the tower and point O is 36 m. From point O , the angle of elevation of the top of section B is 30° and the angle of elevation of the top of section A is 45°. On the basis of the above information, answer the following questions:
(i)	What is the height of the section B ? (a) $12\sqrt{3}$ m (b) $12\sqrt{2}$ m (c) $8\sqrt{3}$ m (d) $4\sqrt{2}$m
(ii)	What is the height of the section A ? (a) $12(2-\sqrt{2})$ (b) $24(2-\sqrt{2})$ (c) $12(3-\sqrt{3})$ (d) $24(3-\sqrt{3})$
(iii)	What is the length of the wire structure from the point O to the top of section A ? (a) $32\sqrt{2}$ m (b) $24\sqrt{3}$ m (c) $28\sqrt{3}$ m (d) $36\sqrt{2}$ m
(iv)	What is the length of the wire structure from the point O to the top of section B ? (a) $12\sqrt{3}$ m (b) $24\sqrt{3}$ m (c) $28\sqrt{3}$ m (d) $16\sqrt{3}$ m
(v)	What is the angle of depression from top of tower to point O ? (a) 30° (b) 45° (c) 15° (d) 75°
Q5	A clinometer is a tool that is used to measure the angle of elevation, or angle from the ground, in a right - angled triangle. We can use a clinometer to measure the height of tall things that you can't possibly reach to the top of, flag poles, buildings, trees. Ravish got a clinometer from school lab and started the measuring elevation angle in surrounding. He saw a building on which society logo

	is painted on wall of building. From a point P on the ground level, the angle of elevation of the roof of the building is 45°. The angle of elevation of the centre of logo is 30° from same point. The point P is at a distance of 24 m from the base of the building. On the basis of the above information, answer the following questions:
(i)	What is the height of the building logo from ground ? (a) $8\sqrt{2}$ m (b) $4\sqrt{3}$ m (c) $8\sqrt{3}$ m (d) $4\sqrt{2}$ m
(ii)	What is the height of the building from ground ? (a) $24(3-\sqrt{3})$m (b) $8\ (3-\sqrt{3})$ m (c) 24 m (d) 32 m
(iii)	What is the aerial distance of the point P from the top of the building ? (a) $24\sqrt{3}$ m (b) $24\sqrt{2}$ m (c) $32\sqrt{3}$m (d) $32\sqrt{2}$ m
(iv)	If the point of observation P is moved 9 m towards the base of the building, then the angle of elevation θ of the logo on building is given by (a)$\tan\theta=\sqrt{3}$ (b)$\tan\theta=2/\sqrt{3}$ (c)$\tan\theta=1/2$ (d)$\tan\theta=8\sqrt{3}/15$
(v)	In above case the angle of elevation φ of the top of building is given by (a)$\tan\varphi=1.6$ (b)$\tan\varphi=1.5$ (c)$\tan\varphi=0.75$ (d)$\tan\varphi=0.8$
	OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
	Write 'True' or 'False' (que no 1 to 4) -
Q1	If the length of the shadow of a tower is increasing, then the angle of elevation of the sun is also increasing.
Q2	If a man standing on a platform 3 metres above the surface of a lake observes a cloud and its reflection in the lake, then the angle of elevation of the cloud is equal to the angle of depression of its reflection.

Q3	The angle of elevation of the top of a tower is 30°. If the height of the tower is doubled, then the angle of elevation of its top will also be doubled.
Q4	If the height of a tower and the distance of the point of observation from its foot, both, are increased by 10%, then the angle of elevation of its top remains unchanged.
	Fill in the blanks (que no 5 to 8) -
Q5	The …… is the line drawn from the eye of an observer to the point in the object viewed by the observer.
Q6	The ……. of the point viewed is the angle formed by the line of sight with the horizontal when the point being viewed is above the horizontal level
Q7	The …… of a point on the object being viewed is the angle formed by the line of sight with the horizontal when the point is below the horizontal level
Q8	The …….. of an object or the …….. distance between two distant objects can be determined with the help of trigonometric ratios.
	Instructions (que no 9 & 10) - In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as: (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A). (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A). (c) Assertion (A) is true but reason (R) is false.

	(d) Assertion (A) is false but reason (R) is true.
Q9	Assertion (A): If the angle of elevation of Sun, above a perpendicular line (tower) decreases, then the shadow of tower increases. Reason (R): It is due to decrease in slope of the line of sight.
Q10	Assertion (A): When we move towards the object, angle of elevation decreases. Reason (R): As we move towards the object, it subtends large angle at our eye than before.
	SHORT ANSWER TYPE QUESTIONS
Q1	Find the angle of elevation of the sun when the shadow of a pole h metres high is $\sqrt{3}$ h metres long.
Q2	A ladder 15 metres long just reaches the top of a vertical wall. If the ladder makes an angle of 60° with the wall, find the height of the wall.
Q3	Two pillars of equal heights are on either side of a road, which is hundred metres wide. The angles of elevation of the tops of the pillars are 60° and 30° at a point on the road between the pillars. Find the position of the point between the pillars?
Q4	From a point on the ground, the angles of elevation of the bottom and top of a water tank kept on the top of the 30 m high building are 30° and 45° respectively. Find the height of the water tank?
Q5	From the top of a multi-storeyed building, 90m high, the angles of depression of the top and the bottom of a tower are observed to be 30° and 60° respectively. Find the height of the tower?
Q6	Two ships are there in the sea on either side of a lighthouse in such a way that the ships and the base of the lighthouse are in the same straight line. The angles of depression of two ships as observed from

	the top of the lighthouse are 60° and 45° . If the height of the lighthouse is 200m, find the distance between the two ships.
Q7	From the top of a 300 metre high light-house, the angles of depression of two ships, which are due south of the observer and in a straight line with its base, are 60° and 30° .Find their distance apart?
Q8	A Statue, 1.6 m tall, stands on the top of a pedestal. From a point on the ground, the angle of elevation of the top of the statue is 60° and from the same point, the angle of elevation of the top of the pedestal is 45° . Find the height of the pedestal? (Use $\sqrt{3} = 1.73$)
Q9	A peacock is sitting on the top of a tree. It observes a serpent on the ground making an angle of depression of 30° . The peacock with the speed of 300 metre/ minute catches the serpent in 12 seconds. What is the height of the tree?
Q10	An aero plane, at an altitude of 1200 m, finds that two ships are sailing towards it in the same direction. The angles of depression of the ships as observed from the aeroplane are 60° and 30° respectively. Find the distance between the two ships?
	LONG ANSWER TYPE QUESTIONS
Q1	A spherical balloon of radius r subtends an angle θ at the eye of an observer. If the angle of elevation of its centre is φ, find the height of the centre of the balloon.
Q2	From a balloon vertically above a straight road, the angles of depression of two cars at an instant are found to be 45° and 60°. If the cars are 100 m apart, find the height of the balloon.
Q3	The angle of elevation of a cloud from a point h metres above the surface of a lake is θ and the angle of depression of its reflection in the lake is φ. Find the height of the cloud above the lake.

Q4	The angle of elevation of the top of a tower from certain point is 30°. If the observer moves 20 metres towards the tower, the angle of elevation of the top increases by 15°. Find the height of the tower.
Q5	The angle of elevation of the top of a tower from two points distant s and t from its foot are complementary. Find the height of the tower.
Q6	The shadow of a tower standing on a level plane is found to be 50 m longer when Sun's elevation is 30° than when it is 60°. Find the height of the tower.
Q7	A vertical tower stands on a horizontal plane and is surmounted by a vertical flag staff of height h. At a point on the plane, the angles of elevation of the bottom and the top of the flag staff are α and β, respectively. Find the height of the tower.
Q8	The angle of elevation of the top of a tower 30 m high from the foot of another tower in the same plane is 60° and the angle of elevation of the top of the second tower from the foot of the first tower is 30°. Find the distance between the two towers and also the height of the other tower.
Q9	From the top of a tower h m high, the angles of depression of two objects, which are in line with the foot of the tower are α and β (β > α). Find the distance between the two objects.
Q10	The angle of elevation of the top of a vertical tower from a point on the ground is 60° . From another point 10 m vertically above the first, its angle of elevation is 45° . Find the height of the tower.

CHAPTER-09

SOME APPLICATIONS OF TRIGONOMETRY

SOLUTIONS OF THE PROBLEM

	SOLUTIONS TO COMPETENCY BASED QUESTIONS
Ans 1	(A) 60°
Ans 2	(B) is decreasing
Ans3	(C) will be less than 60 degree
Ans4	(C) remains unchanged
Ans5	(A) 7.5m
Ans6	(B) 45°
Ans7	(C) not equal to the angle of depression of its reflection
Ans8	(D) 3:1
Ans9	(A) $10\sqrt{3}$ m
Ans10	(D) 8.598 m
	SOLUTIONS TO CASE STUDIES/ SOURCE BASEDINTEGRATED QUESTIONS
Ans1	
(i)	(a) 60°
(ii)	(c) 3.7m
(iii)	(d) 4.28 m
(iv)	(b) 2.14 m
(v)	(c) 8.56 m
Ans2	
(i)	b) 45°
(ii)	a) 25.24 m

(iii)	a) $20\sqrt{3}$ m
(iv)	b)45°
(v)	a) corresponding angle
Ans3	
(i)	a) 1139.4 km
(ii)	c) 1937 km
(iii)	b) 577.52 km
(iv)	b) 45°
(v)	c) 1937 km
Ans4	
(i)	(a) $12\sqrt{3}$ m
(ii)	(c) $12(3-\sqrt{3})$
(iii)	(d) $36\sqrt{2}$ m
(iv)	(b) $24\sqrt{3}$ m
(v)	(b) 45°
Ans5	
(i)	(c) $8\sqrt{3}$ m
(ii)	(c) 24 m
(iii)	(b) $24\sqrt{2}$ m
(iv)	(d) $\tan\theta = 8\sqrt{3}/15$
(v)	(a) $\tan\varphi = 1.6$
	SOLUTIONS TO OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
Ans 1	False

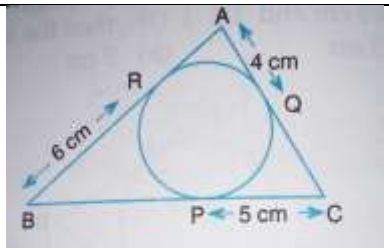
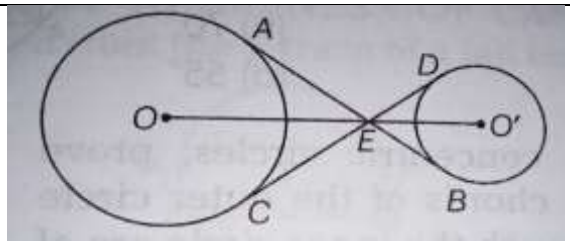
Ans 2	False
Ans3	False
Ans4	True
Ans5	line of sight
Ans6	angle of elevation
Ans7	angle of depression
Ans8	height or length, distance
Ans9	(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
Ans10	(d) Assertion (A) is false but reason (R) is true.
	SOLUTIONS TO SHORT ANSWER TYPE QUESTIONS
Ans 1	30°
Ans 2	15/2 m
Ans3	25 m
Ans4	30(√3-1)
Ans5	60 metres
Ans6	315.33 m
Ans7	200√3 m
Ans8	2.2 m (approx…)
Ans9	30m
Ans10	800√3 m
	SOLUTIONS TO LONG ANSWER TYPE QUESTIONS
Ans 1	r sin φ cosec θ/2
Ans 2	50 (3 + √3) m.
Ans3	h(tan φ + tan θ)/ (tan φ - tan θ)

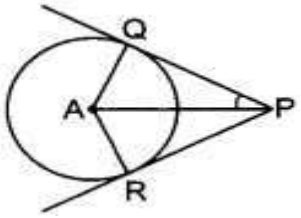
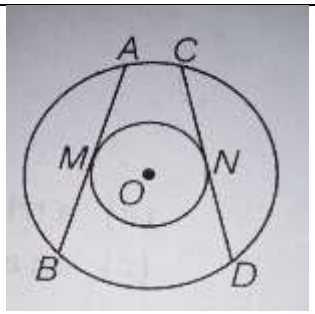
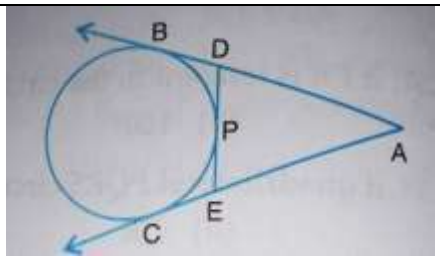
Ans4	10 (√3 +1) m
Ans5	√st
Ans6	25√3 m
Ans7	h tanα/(tanβ-tanα)
Ans8	10√3 m; 10 m
Ans9	h (cot α – cot β)
Ans10	5 (√3+3) m

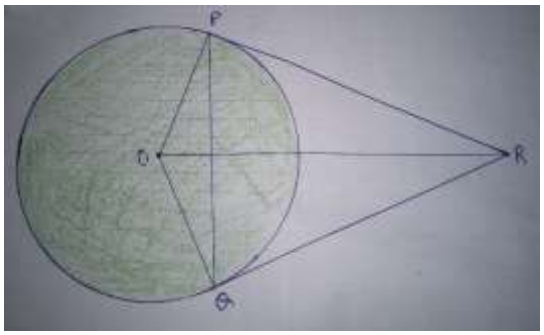
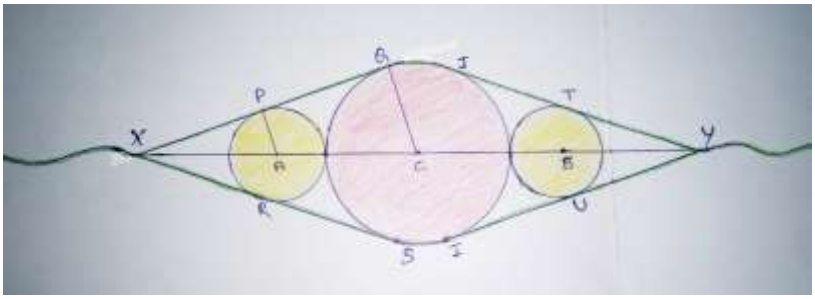
----------x----------x----------x----------

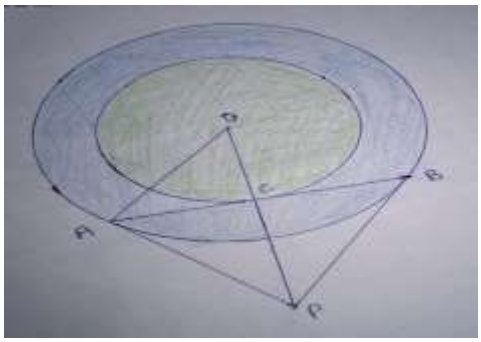
CHAPTER : 10

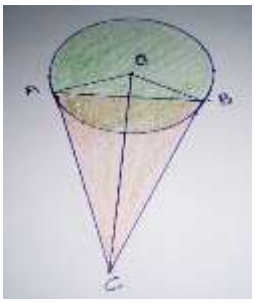
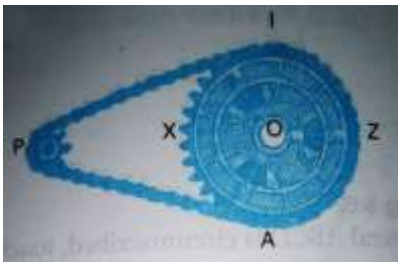
CIRCLE

	COMPETENCY BASED QUESTIONS
Q1	Two balls of equal size are touching each other externally at point C and AB is common tangent to the balls. Then ∠ ACB= ? (a) 60^0 (b) 45^0 (c) 30^0 (d) 90^0
Q2	Radha and Shyama were arguing that how many parallel tangents can a circle have ? Can you help them ? (a) 1 (b) 2 (c) infinite (d) none of these
Q3	 Three friends Ram,Shyam and Rahim are playing in a triangular park in which there is a circular rose garden as shown in the fig. Three friends are standing at points A,B and C respectively.By the information given in the figure, can you calculate perimeter of the park ? (a) 30 cm (b) 60cm (c) 45cm (d) 15cm
Q4	If four sides of the quadrilateral ABCD are tangents to a circle , then (a) AC+AD=BD+CD (c) AB+CD=BC+AD (b) AB+CD=AC+BC (d)AC+AD=BC+DB
Q 5	AP and AQ are tangents drawn from a point A to a circle with centre O and radius 9 cm. If OA=15 cm, then AP+AQ= (a) 12cm (b) 18cm (c) 24cm (d) 36cm
Q 6	 If common tangents AB and CD of two wheels with centre O and O' intersect at E, then find OEO'=? (a) a triangle (b) a line (c) an arc (d) none of these

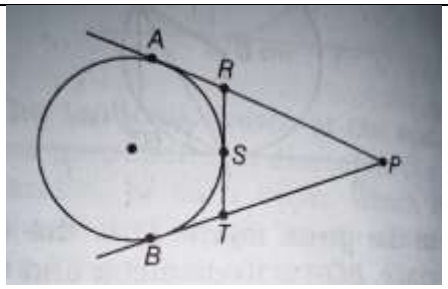
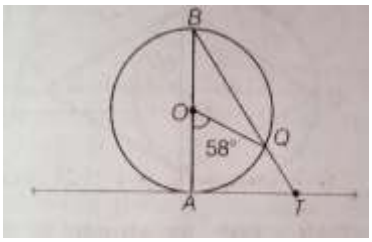
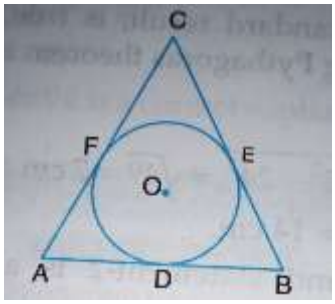
Q 7	 PQ and PR are two tangents from P to a circle with centre A . If ∠QAR=130^0, find ∠ QPR=? (a) 40^0 (b) 50^0 (c)60^0 (d)20^0
Q 8	 In two concentric circles, if length of one chord AB touching inner circle is 12cm then find the length of chord CD ? (a) 10cm (b) 15cm (c) 12cm (d) 6cm
Q 9	The length of the tangent from a point which is at a distance of 10cm from the centre of the circle having radius 6cm is ? (a) 8cm (b) 10cm (c) 4cm (d)16cm
Q10	 If AB= 14cm and PE=5cm, then AE=? (a) 7cm (b) 8cm (c) 19cm (d)9cm
	CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
Q 1	In a city, a circular park is situated with centre O. There are two exit gates P and Q which are at equal distance from a tree (say R) outside the park. Lines PR and QR are tangents to the circular park. If radius

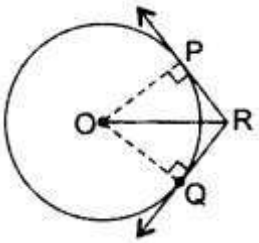
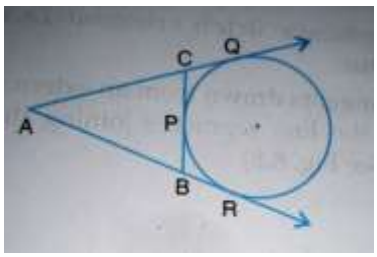
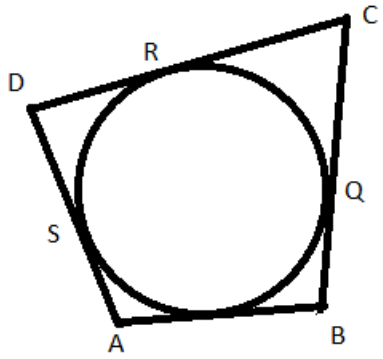
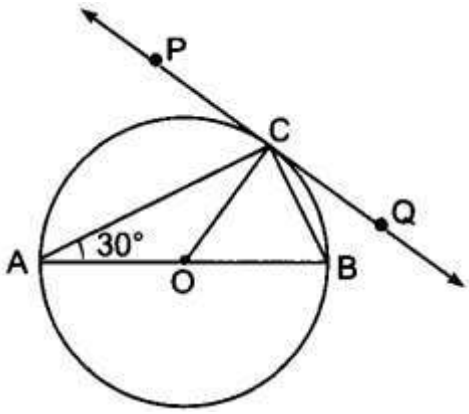
	of circular park is 15 meter and distance of centre to the tree is 25 meter then answer the following questions ? 
(i)	What is the distance between gate P and tree R? (a)10meter (b) 15 meter (c) 20 meter (d) 25 meter
(ii)	Find $\angle$ OPR=? (a)60^0 (b) 90^0 (c) 120^0 (d) none of these
(iii)	What is the area of Δ ROQ ? (a)120 m^2 (b)140 m^2 (c) 150 m^2 (d) 180m^2
(iv)	If $\angle$PRQ = 30^0 then find $\angle$ POQ=? (a)120^0 (b) 130^0 (c) 150^0 (d)180^0
(v)	Find $\angle$ OPQ=? (a)10^0 (b) 15^0 (c) 20^0 (d) 25^0
Q 2	Raksha Bandhan, is a popular annual rite, or ceremony, which is celebrated in South Asia, and in other parts of the world significantly influenced by Hindu culture. On this day, sisters of all ages tie a talisman, or amulet, called the rakhi, around the wrists of their brothers, symbolically protecting them, receiving a gift in return, and traditionally investing the brothers with a share of the responsibility of their potential care. Krishna made up a rakhi for his brother Sumit using three circles of radius 2cm,4cm and 2cm respectively. Figure for the same is given below: 

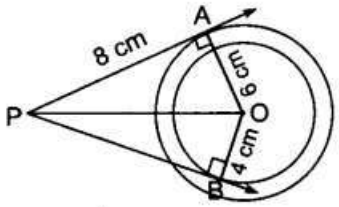
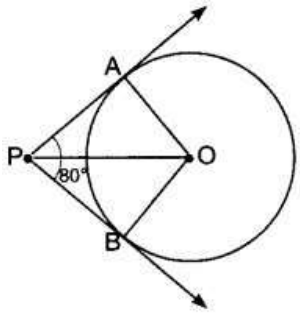
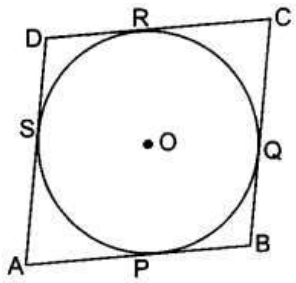
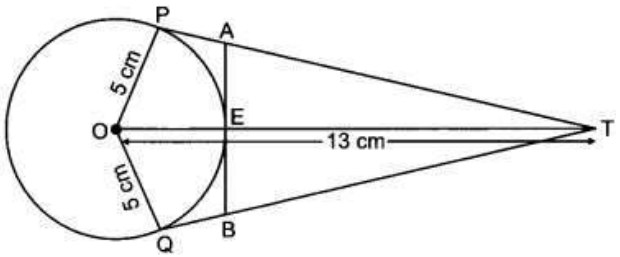
	Based on this information answer the following questions?
(i)	Length of AB =? (a)8cm (b)10cm (c)12cm (d) 14cm
(ii)	If PQ, RS, JT and IU are tangents to the circles as shown in the fig. then ∠ QPA=? (a)∠ PAC (b) ∠ PQC (c) ∠ QCA (d) ∠ PAX
(iii)	Find CX? (a)9cm (b)10cm (c) 12cm (d)8cm
(iv)	Find approximate value of QX=? (a)9 cm (b) 9.8cm (c) 10.6cm (d)12cm
(v)	If ∠PXR=40^0 ,find ∠ PAX=? (a)40^0 (b)60^0 (c)65^0 (d)70^0
Q 3	A sea is in the shape of a circle of radius 10km. A concentric circular island is also made up artificially to attract the tourists. If radius of island is 8km then answer the following questions ? 
(i)	Find the length of the chord AB of larger circle which touch the smaller circle? (a)6km (b)12km (c) 18km (d) 9km
(ii)	Find ∠OCA=? (a)80^0 (b) 85^0 (c)90^0 (d) 95^0
(iii)	A person is standing at a point P outside the sea such that AP and BP are tangents to the sea. Can you find the distance of the person from centre of the sea. (a)10km (b)10.5km (c) 12km (d) 12.5km
(iv)	Find AP=? (a)7.5 km (b) 8km (c)8.5km (d) 9km

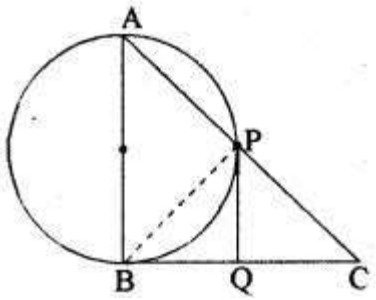
(v)	If ∠ APB=40^0 find ∠AOP? (a)40^0 (b)60^0 (c)70^0 (d)80^0
Q 4	A child is playing with a cone and ball. He is throwing the ball upward and try to catch it in the cone. When he get tired ,he sat down on the floor and start thinking about the 2D shape of the ball inside the cone and draw it on a paper as shown below. Based on the figure answer the following questions? 
(i)	If AB abd BC are tangents to the ball then which type of triangle is ΔABC? (a)equilateral (b) isoceless (c) scalen (d) none of these
(ii)	If ∠ACB=30^0,then find ∠OBC=? (a)70^0 (b) 75^0 (c)80^0 (d) 90^0
(iii)	If OC=10cm, AC=8cm , find the radius of the ball ? (a)4cm (b)5cm (c) 6cm (d)8cm
(iv)	Find ∠OCB + ∠OBA=? (a)10^0 (b) 15^0 (c)20^0 (d) 30^0
(v)	If AC= 21cm and BC=x^2+5 , then x=? (a)8cm (b)16cm (c) 9cm (d)4cm
Q 5	The chain and gears of bicycle or motorcycle or belt around pulleys are some real life illustrations of tangents to the circle. One such fig is shown below in which PI and PA are tangents to the gears of bicycle. Based on the information exibit in fig. answer the fillowing questions? 
(i)	If PI=20cm then PA=? (a)20cm (b)12cm (c)14cm (d)15cm

(ii)	If PO=16cm then IA=? (a)12cm (b)15cm (c)20cm (d)24cm
(iii)	If $\angle IPA=20^0$ find $\angle POI$=? (a)60^0 (b) 70^0 (c)80^0 (d)90^0
(iv)	PI=2x + 8, then x=? (a)6cm (b) 8cm (c) 10cm (d) 12cm
(v)	If arc IZA subtend an angle of 260^0 at the centre of the circle, then IPA=? (a)60^0 (b)70^0 (c)80^0 (d)90^0
	OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
Q 1	Tangent lines at the end point of the diameter of a circle are parallel. (true/false)
Q 2	Tangent to a circle intersect the circle at how many points?
Q 3	How many tangents are parallel to a given secant.
Q 4	The tangent at any point of circle is perpendicular to the …….through the point of contact.
Q 5	……to a circle is a line that intersect circle at only one point.
Q 6	AB and CD are common tangents to two circles, if radii of the two circles are equal, then AB = CD.(true/false)
Q 7	The lengths of tangents drawn from an external point to a circle are not equal.(true/false)
Q 8	The common point of a tangent to a circle with the circle is called _____
Q 9	Two tangents TP and TQ are drawn to a circle with Centre O from an external point T. Then $\angle$ PTQ = …….. $\angle$ OPQ.
Q 10	Parallelogram circumscribing a circle is a rhombus.(true/false)
	SHORT ANSWER TYPE QUESTIONS
Q 1	Two tangents TP and TQ are drawn to a circle with Centre O from an external point T. Prove that $\angle PTQ=2\ \angle OPQ$
Q 2	Ram prepared a model for rain water harvesting . in the following fig. PA and PB are the pipes touching the circular pond. If the perimeter of ΔPRT is 86cm ,then determine the length of each pipe.

	
Q 3	A point P is 26 cm away from the centre O of a circle and the length of the tangent drawn from P to the circle is 24 cm. Find the radius of the circle?
Q 4	Two concentric circles are of radii 5 cm and 3 cm. Find the length of the chord of the larger circle which touches the smaller circle.
Q 5	In the given fig. AB is diameter of the circle with centre O and AT is tangent . If $\angle AOQ=58^0$, Find $\angle ATQ$. 
Q 6	If tangents PA and PB from a point P to a circle with centre O are inclined to each other at angle of 80°, then $\angle POA$ is equal to?
Q 7	The sides AB, BC and CA of a triangle ABC touch a circle at D, E and F respectively. If DA = 6 cm, BD = 5 cm and AC = 14 cm, find the length of BC (in cm).  13CM
Q 8	TP and TQ are the two tangents to a circle with center O so that angle $\angle POQ = 130^0$. Find $\angle PTQ$.
Q 9	The sides AB, BC and CA of a triangle ABC touch a circle at P, Q and R respectively. If AP = 4 cm, BQ = 3 cm and CR = 5 cm, find the perimeter of ΔABC (in cm).
Q 10	Two concentric circles are of radii 7 cm and r cm respectively, where r > 7. A chord of the larger circle, of length 48 cm, touches the smaller circle. Find the value of r.

	LONG ANSWER TYPE QUESTIONS
Q 1	Two tangents RQ and RP are drawn from an external point R to the circle with centre O. If ∠PRQ = 120°, then prove that OR = PR + QR. 
Q 2	AR, AQ and BC are tangents to the circle. If AB = 10 cm, AC = 12 cm and BC = 8 cm, then calculate the length of AR (in cm). 
Q 3	**A quadrilateral ABCD is drawn to circumscribe a circle as shown in the figure. Prove that AB + CD = AD + BC** 
Q 4	If PQ is a tangent at a point C to a circle with centre O. If AB is a diameter and ∠CAB = 30°, find ∠PCA. 
Q 5	In Fig. there are two concentric circles of radii 6 cm and 4 cm with centre O. If AP is a tangent to the larger circle and BP to the smaller

	circle and length of AP is 8 cm, find the length of BP. 
Q 6	If tangents PA and PB from a point P to a circle with centre O are inclined to each other at angle of 80°, then find ∠POA. 
Q 7	The difference between the radii of the smaller circle and the larger circle is 7 cm and the difference between the areas of the two circles is 1078 sq. cm. Find the radius of the smaller circle.
Q 8	Prove that the parallelogram circumscribing a circle is a rhombus. 
Q 9	In Fig. O is the centre of a circle of radius 5 cm. T is a point such that OT = 13 cm and OT intersects circle at E. If AB is a tangent to the circle at E, find the length of AB, where TP and TQ are two tangents to the circle.  **Fig. 8.50**

Q 10	The circle drawn with side AB of a right angled triangle ABC as diameter intersects the hypotenuse AC at P. Prove that the tangent to the circle at point P intersects the side BC. 

CHAPTER-10

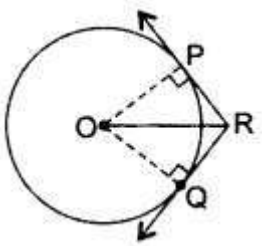
CIRCLE

SOLUTIONS OF THE PROBLEM

	SOLUTIONS TO COMPETENCY BASED QUESTIONS
Ans 1	(d) 90^0
Ans 2	(b)2
Ans 3	(a)30cm
Ans 4	(c)AB+CD=BC+AD
Ans 5	(b)24cm
Ans 6	(b) a line
Ans 7	(b) 50^0
Ans 8	(c) 12cm
Ans 9	(a) 8cm
Ans10	(d) 9cm
	SOLUTIONS TO CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
Ans 1	
(i)	(c) 20 meter
(ii)	(b) 90^0
(iii)	(c) 150 m^2
(iv)	(c) 150^0
(v)	(b) 15^0
Ans 2	
(i)	(c)12cm
(ii)	(b) $\angle$ PQC
(iii)	(a)9cm
(iv)	(b) 9.8cm

(v)	(d)70^0
Ans 3	
(i)	(b)12km
(ii)	(c)90^0
(iii)	(d) 12.5km
(iv)	(a)7.5 km
(v)	(c)70^0
Ans 4	
(i)	(b) isosceles
(ii)	(b) 75^0
(iii)	(c) 6cm
(iv)	(d) 30^0
(v)	(d)4cm
Ans 5	
(i)	(a)20cm
(ii)	(d)24cm
(iii)	(c)80^0
(iv)	(a)6cm
(v)	(c)80^0
	SOLUTIONS TO OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
Ans 1	True
Ans 2	One
Ans 3	Two
Ans 4	Radius
Ans 5	Tangent
Ans 6	True

Ans 7	False
Ans 8	Point of contact
Ans 9	2
Ans10	True
	SOLUTIONS TO SHORT ANSWER TYPE QUESTIONS
Ans 1	Here ΔTPQ is an isosceles triangle. So $\angle TPQ=\angle TQP=1/2(180-\angle PTQ)=90^0-\angle PTQ/2$ $\angle$ OPQ=$\angle$OPT-$\angle$TPQ $=90-(90-\angle PTQ/2)$ $=\angle PTQ/2$ So $\angle PTQ=2\angle OPQ$
Ans 2	Length of each pipe=1/2(perimeter of triangle PRT) =1/2(86) =43cm
Ans 3	Length of tangent=24cm OP=26cm Radius of circle= $\sqrt{(26^2-24^2)}$ =10cm
Ans 4	Length of chord =2($\sqrt{(5^2-3^2)}$) = 2x 4 =8
Ans 5	$\angle AOQ=2\ \angle ABQ$ SO $\angle ABQ=\frac{58}{2}=29^0$ $\angle ATQ=180^0-\angle TAB-\angle ABT$ $=180^0-90^0-29^0$ $=61^0$
Ans 6	$\angle POA=\frac{1}{2}(180^0-\angle APB)$ $=\frac{1}{2}(180^0-80^0)$ $=50^0$

Ans 7	DA=AF=6cm BE=BD=5cm AC=14cm CF=AC-AF =14-6 =8cm BC=CE+BE =CF+BE =8+5 =13cm
Ans 8	$\angle PTQ=180^0-\angle POQ$ $=180^0-130^0$ $=50^0$
Ans 9	Perimeter of $\Delta ABC=2(AP+BQ+CR)$ $=2(4+3+5)$ $=2x12$ $=24cm$
Ans10	$r=\sqrt{(7^2+24^2)}$ $=\sqrt{(49+576)}$ $=\sqrt{625}$ $=25cm$
	SOLUTIONS TO LONG ANSWER TYPE QUESTIONS
Ans 1	$\angle OPR = 90°$ PR = RQ … [Tangents drawn from an external point are equal $\angle PRO = 1/2\ \angle PRQ = 1/2 \times 120° = 60°$ Now, In ΔOPR,  $\Rightarrow \angle OPR + \angle POR + \angle ORP = 180°$ $\Rightarrow 90° + \angle POR + 60° = 180°$

	⇒ ∠POR + 150° = 180° ⇒ ∠POR = 30° ⇒ sin 30° = PR/OR ⇒ 1/2=PR/OR ⇒ OR = 2PR ⇒ OR = PR + QR (∵ PR = RQ)
Ans 2	AR=$\frac{1}{2}$(Perimeter of ABC) = $\frac{1}{2}$(12+8+10) =15
Ans 3	DR = DS BP = BQ AP = AS CR = CQ Since they are tangents on the circle from points D, B, A, and C respectively. Now, adding the LHS and RHS of the above equations we get, DR + BP + AP+ CR = DS + BQ + AS + CQ By rearranging them we get, (DR + CR) + (BP + AP) = (CQ + BQ) + (DS + AS) By simplifying, AD + BC = CD + AB
Ans 4	∠ACB = 90° (Angle in the semicircle) ∠CAB = 30° (given) In ΔABC, 90° + 30° + ∠ABC = 180° ⇒ ∠ABC = 60° Now, ∠PCA = ∠ABC (Angles in the alternate segment) ∴ ∠PCA = 60°
Ans 5	OA = 6 cm, OB = 4 cm, AP = 8 cm $OP^2 = OA^2 + AP^2 = 36 + 64 = 100$ ⇒ OP = 10 cm $BP^2 = OP^2 – OB^2 = 100 – 16 = 84$ ⇒ BP = 2√21 cm
Ans 6	∵ PA and PB are tangents to a circle with centre O, ∴ OA ⊥ AP and OB ⊥ PB i.e., ∠APB = 80°, ∠OAP = 90°, and ∠OBP = 90° Now, in quadrilateral OAPB, we have ∠APB + ∠PBO + ∠BOA + ∠OAP = 360° ⇒ 80° + 90° + ∠BOA + 90^o = 360°

	⇒ 260° + ∠BOA = 360° ∴ ∠BOA = 360° – 260° ⇒ ∠BOA = 100° Now, in ΔPOA and APOB we have OP = OP (Common) OA = OB (Radii of the same circle) ∠OAP = ∠OBP = 90° ∴ ΔPOA ≅ APOB (RHS congruence condition) ⇒ ∠POA = ∠POB (CPCT) Now, ∠POA = 1/2 (∠BOA) = 1/2 × 100 = 50°
Ans 7	Given: $r_2 - r_1 = 7$ ($r_2 > r_1$) …(i) and $\pi(r_2^2 - r_1^2) = 1078$ $\pi (r_2 - r_1)(r_2 + r_1) = 1078$ $\pi (r_2 + r_1) = 1078$ [(From equation (i)] $\Rightarrow r_2 + r_1 = \frac{1078X7}{22} = 49$…(ii) Adding (i) and (ii), we get $2r_2 = 56$ $\Rightarrow r_2 = 28$ cm $r_1 = 21$ cm [From equation (ii)] ∴ Radius of smaller circle = 21 cm.
Ans 8	Let ABCD be a parallelogram such that its sides touch a circle with centre O. We know that the tangents to a circle from an exterior point are equal in length. Therefore, we have AP = AS [Tangents from A] BP = BQ [Tangents from B] …. (ii) CR = CQ [Tangents from C] …. (iii) And DR = DS [Tangents from D] …. (iv) Adding (i), (ii), (iii) and (iv), we have (AP + BP) + (CR + DR) = (AS + DS) + (BQ + CQ) AB + CD = AD + BC AB + AB = BC + BC [∵ ABCD is a parallelogram ∴ AB = CD, BC = DA] 2AB = 2BC ⇒ AB = BC Thus, AB = BC = CD = AD Hence, ABCD is a rhombus.
Ans 9	In right ΔPOT $PT = \sqrt{OT^2 - OP^2}$ $PT = \sqrt{169 - 25} = 12$ cm and TE = 8 cm Let PA = AE = x (Tangents from an external point to a circle are equal) In right ΔAET $TA^2 = TE^2 + EA^2$

	$\Rightarrow (12 - x)^2 = 64 + x^2$ $\Rightarrow 144 + x^2 - 24x = 64 + x^2$ $\Rightarrow x = 80/24$ $\Rightarrow x = 3.3$ cm Thus, AB = 6.6 cm
Ans10	AB is a diameter of the circle. $\therefore \angle APB = 90°$ (Angle in a semi-circle is a right angle) $\therefore \angle APB + \angle BPC = 180°$ $\therefore 90° + \angle BPC = 180°$ $\therefore \angle BPC = 90°$ …. (i) $\because$ In $\triangle ABC$ $\angle ABC = 90°$ $\therefore \angle BAC + \angle ACB = 90°$ …. (ii) ($\because$ The sum of the three angles of a triangle is 180°.) From equations (i) and (ii) $\angle BPC = \angle BAC + \angle ACB$ or $\angle BPQ + \angle CPQ = \angle BAC + \angle ACB$ …. (iii) But $\angle BPQ = \angle BAC$ (Angle in the alternate segment) $\therefore$ From equation (iii) $\angle CPQ = \angle ACB$ $\Rightarrow \angle CPQ = \angle PCQ$ ($\because \angle ACB = \angle PCQ$) $\therefore PQ = QC$ …. (iv) Again PQ= QB …. (v) (Tangent lines drawn from an external point to a circle are equal.) $\therefore$ From equations (iv) and (v) QC= QB Hence, PQ intersects BC.

----------X----------X----------X----------

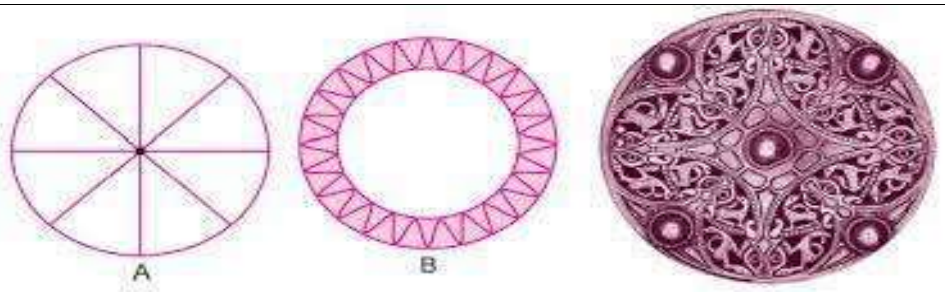
CHAPTER : 12

AREAS RELATED TO CIRCLES

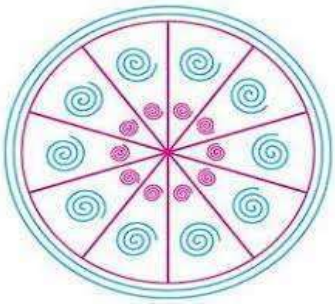
	COMPETENCY BASED QUESTIONS
Q1	If θ is the angle (in degrees) of a sector of a circle of radius r, then area of the sector is a) $\frac{\pi r^2\theta}{360^0}$ b) $\frac{\pi r^2\theta}{180^0}$ c) $\frac{2\pi r\theta}{360^0}$ d) $\frac{2\pi r\theta}{180^0}$
Q2	Area of the largest triangle that can be inscribed in a semi-circle of radius r units is a) $r^2\ sq\ units$ b) $\frac{1}{2}r^2\ sq\ units$ c) $2r^2\ sq\ units$ d) $\sqrt{2}r^2\ sq\ units$
Q3	If the circumference of a circle and the perimeter of a square are equal, then (A) Area of the circle = Area of the square (B) Area of the circle > Area of the square (C) Area of the circle < Area of the square (D) Nothing definite can be said about the relation between the areas of the circle and square.
Q4	The radii of two circles are 4cm and 3 cm respectively. The diameter of the circle having area equal to the sum of the areas of the two circles (in cm) is : a) 5

	b) 7 c) 10 d) 14
Q 5	Which constant ratio is denoted by π (pi) ? a) $\frac{diameter}{circumference}$ b) $\frac{area}{circumference}$ c) $\frac{circumference}{diameter}$ d) $\frac{area}{diameter}$
Q 6	The minute hand of a clock is 14 cm long. The area described by it on the face of clock in 5 minutes is a) 51.33 sq cm b) 15.33 sq cm c) 21.15 sq cm d) 12.35 sq cm
Q 7	**Assertion :** Two circles touch externally. If their radii are 11 cm and 3cm, the distance between their centers is 14cm. Which of the following is the **correct reason** for above assertion ; a) When two circles touch externally the distance between their centers is equal to the sum of their radii. b) When two circles touch externally the distance between their centers is equal to the difference of their radii. c) When two circles touch externally the distance between their centers is equal to the product of their radii. d) When two circles touch externally the distance between their centers is equal to the division of their radii.
Q 8	Find the area of largest circle that can be drawn inside the given rectangle of length 'a' cm and breadth 'b' cm. (a>b) a) $\frac{a^2\pi}{4}$ b) $\frac{b^2\pi}{2}$ c) $\frac{b^2\pi}{4}$

<table>
<tr><td></td><td>d) $\frac{a^2\pi}{2}$</td></tr>
<tr><td>Q 9</td><td>If the radius of a circle is 3.5 cm. Which of the is not matched correctly;
<table>
<tr><td>Column I</td><td>Column II</td></tr>
<tr><td>a) Area of circle</td><td>$38.5cm^2$</td></tr>
<tr><td>b) Area of quadrant of circle</td><td>$9.625\ cm^2$</td></tr>
<tr><td>c) Circumference of circle</td><td>$44cm$</td></tr>
<tr><td>d) Area of largest square inscribed in the circle</td><td>$24.5cm^2$</td></tr>
</table></td></tr>
<tr><td>Q10</td><td>The ratio of area of two circles whose ratio of circumference is 3:1 will be
a) 3:1
b) 1:3
c) 1:9
d) 9:1</td></tr>
<tr><td>Q11</td><td>The area of the square is same as the area of circle. What will be ratio of their perimeters
a) 1:1
b) $\pi:\sqrt{2}$
c) $2:\sqrt{\pi}$
d) None of these</td></tr>
<tr><td>Q12</td><td>On increasing the diameter of circle by 40%, its area will be increased by
a) 40%
b) 80%
c) 96%
d) 45%</td></tr>
<tr><td></td><td>CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS</td></tr>
<tr><td>Q 1</td><td>A brooch is a small piece of jewellery which has a pin at the back so it can be fastened on a dress, blouse or coat. Designs of some brooch are shown below. Observe them carefully.</td></tr>
</table>

	 **Design A**: Brooch A is made with silver wire in the form of a circle with diameter 28mm. The wire used for making 4 diameters which divide the circle into 8 equal parts. **Design B**: Brooch b is made two colours - Gold and silver. Outer part is made with Gold. The circumference of silver part is 44mm and the gold part is 3mm wide everywhere.
(i)	**Refer to Design A** The total length of silver wire required is a) 180 mm b) 200 mm c) 250 mm d) 280 mm
(ii)	The area of each sector of the brooch is a) 44 sq mm b) 52 sq mm c) 77 sq mm d) 68 sq mm
(iii)	**Refer to Design B** The circumference of outer part (golden) is a) 48.49 mm b) 82.2 mm c) 72.50 mm d) 62.86 mm
(iv)	The difference of areas of golden and silver parts is a) 18π b) 44π c) 51π d) $64\ \pi$

(v)	A boy is playing with brooch B. He makes revolution with it along its edge. How many complete revolutions must it take to cover 80 mm ? a) 2 b) 3 c) 4 d) 5
Q 2	A horse is tied to a peg at one corner of a square shaped grass field of sides 15m by means of a 5m long rope (see the given figure). 
(i)	What is the area of the grass field ? a) $225m^2$ b) 225m c) $255m^2$ d) 15m
(ii)	The area of that part of the field in which the horse can graze . a) $19.625m^2$ b) $19.265m^2$ c) $19m^2$ d) $78.5m^2$
(iii)	The grazing area if the rope were 10m long instead of 5m. a) 7.85 m^2 b) 785 m^2 c) 225 m^2 d) 78.5 m^2

(iv)	The increase in the grazing area if the rope were 10m long instead of 5m. a) 58.758 m^2 b) 58.875 m^2 c) 58 m^2 d) 78.5 m^2
(v)	The given problem is based on which concept? a) Coordinate geometry b) Area related to circles c) Circle d) None of these
Q 3	**A brooch is made with silver wire in the form of a circle with diameter 35 mm. The wire is also used in making 5 diameters which divide the circle into 10 equal sectors as shown in Fig .** 
(i)	What is the radius of the circle ? a) 35/2 mm b) 5/2 mm c) 35mm d) 10mm
(ii)	What is the circumference of the brooch ? a) 100mm b) 110 mm c) 50mm d) 10mm

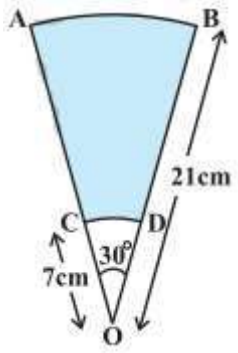
(iii)	What is the total length of silver wire required ? a) 528 mm b) 825mm c) 285mm d) 852mm
(iv)	What is the area of the each sector of the brooch ? a) 385/2 mm^2 b) 358/2 mm^2 c) 585/2 mm^2 d) 385/4 mm^2
(v)	The given problem is based on which mathematical concept? a) Construction b) Area related to circles c) Circle d) None of these
Q 4	It is a clock that uses a pendulum, a swinging weight, as its timekeeping element. From its invention in 1656 by Christiaan Huygens, the pendulum clock was the world's most precise timekeeper, accounting for its widespread use. Their greater accuracy allowed for the faster pace of life which was necessary for the Industrial Revolution. The home pendulum clock was replaced by less-expensive, synchronous, electric clocks in the 1930s and 40s. Pendulum clocks are now kept mostly for their decorative and antique value.

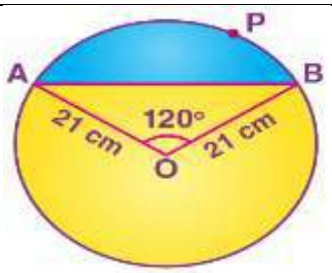
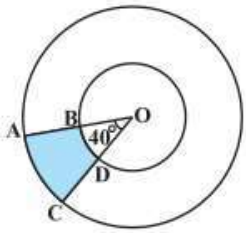
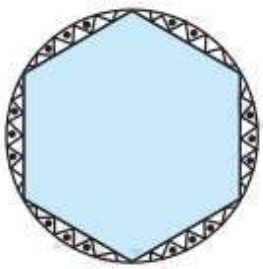
	 Dhriti bought a pendulum clock for her living room. the clock contains a small pendulum of length 45 cm. the minute hand and hour hand of the clock are 14 cm and 6 cm long respectively
(i)	What is the area swept by the minute hand in 14 minutes? (a) 72.4 cm^2 (b) 59.4 cm^2 (c) 86.4 cm^2 (d) 68.4 cm^2
(ii)	What is the angle described by hour hand in 10 minutes? (a) 5° (b) 10° (c) 12° (d) 14°
(iii)	What is the distance covered by the tip of hour hand in 3.5 hours? (a) 11 cm (b) 12 cm (c) 14 cm (d) 18 cm

(iv)	If the tip of pendulum covers a distance of 66 cm in complete oscillation, what is the angle described by pendulum at the centre? (a) 68° (b) 42° (c) 56° (d) 48°
(v)	Concept used for finding the area swept by the minute hand. a) Area of sector b) Area of segment c) Perimeter of sector d) None of the above
Q 5	Raju put a fence around a circular field and the total cost came upto rs. 6000 at Rs. 30 per metre. He now wants to plough the field .  using the information given , answer the following questions :
(i)	What is the perimeter of field? a) 200m b) 220m c) 240m d) 234.5m
(ii)	What is the radius of field ? a) 31.81m b) 33m c) 35.4m d) 234.5m

(iii)	What is the area of the field ? a) 3180.18 m^2 b) 2180.18 m^2 c) 5180.18 m^2 d) 3024 m^2
(iv)	Find the cost of ploughing the field at the rate of Rs. 0.50 per m^2 a) Rs. 1590 b) Rs. 2500 c) Rs. 3180 d) Rs. 4183
(v)	Find the cost of ploughing the field at the rate of Rs. 1.50 per m^2. a) Rs. 4770 b) Rs. 5670 c) Rs. 3180 d) Rs. 4183
	OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
Q 1	Area of a sector of a circle with radius any angle with degrees measures is _____.
Q 2	The ratio between the circumference and area of a circle of radius 5cm is _____.
Q 3	A chord of a circle of radius 6cm makes an angle 60^0 at the center. Area of minor segment made by the chord is _____.
Q 4	If the radius of a circle is $\frac{7}{\sqrt{\pi}}$ cm, then the area of the circle is _____.
Q 5	The length of an arc of a sector of a circle with radius *r* and angle θ _____.
Q 6	Perimeter of a quadrant of a circle of radius *r* _____.

Q 7	the number of revolutions made by a circle of radius r to cover a distance s is $\frac{s}{2\pi r}$. (true /false)
Q 8	Area of a segment of a circle is less than the area of its corresponding sector . (True / False)
Q 9	If the perimeter and the area of a circle are numerically equal , then the radius of the circle is 2units . (True/False)
Q 10	$154cm^2$ is the area of circle whose circumference is 44cm. (True/False)
	SHORT ANSWER TYPE QUESTIONS
Q 1	Find the circumference of a circle whose area is $301.84cm^2$.
Q 2	The wheel of a motor cycle is of radius 35 cm. How many revolutions per minute must the wheel make so as to keep a speed of 66 km/h?
Q 3	Find the area of the sector of a circle of radius 5 cm, if the corresponding arc length is 3.5 cm.
Q 4	Find the area of a sector of a circle of radius 28 cm and central angle 45°.
Q 5	If the perimeter of a semicircular protractor is 66 cm, find the diameter of the protractor. $(Take\ \pi = 22/7)$.
Q 6	The inner circumference of a circular track is 220 m. The track is 7 m wide everywhere. Calculate the cost of putting up a fence along the outer circle at the rate of ₹2 per metre.
Q 7	A chord of a circle of radius 10 cm subtends a right angle at the centre. Find the area of the corresponding major sector. (Use π = 3.14)
Q 8	The area of a sector is one-twelfth that of the complete circle. Find the angle of the sector.

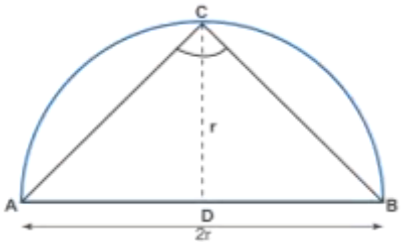
Q 9	Prove that the area of a circular path of uniform width h surrounding a circular region of radius r is $\pi h(2r + h)$.
Q 10	An arc of a circle of length 5π cm bounds a sector whose area is $20\pi\ cm^2$. Then,find the radius of the circle .
	LONG ANSWER TYPE QUESTIONS
Q 1	Fig. depicts an archery target marked with its five scoring regions from the centre outwards as Gold, Red, Blue, Black and White. The diameter of the region representing Gold score is 21 cm and each of the other bands is 10.5 cm wide. Find the area of each of the five scoring regions. 
Q 2	The cost of fencing a circular field at the rate of Rs. 24 per metre is Rs. 5280. The field is to be ploughed at the rate of Rs. 0.50 per m^2. Find the cost of ploughing the field (Take π = 22/7).
Q 3	Calculate the perimeter of an equilateral triangle if it inscribes a circle whose area is 154 cm^2 .
Q 4	A square is inscribed in a circle. Calculate the ratio of the area of the circle and the square.
Q 5	Find the difference of the areas of two segments of a circle formed by a chord of length 5 cm subtending an angle of 90° at the centre.
Q 6	**AB and CD are respectively arcs of two concentric circles of radii 21 cm and 7 cm and centre O (see Fig.). If ∠AOB = 30°, find the area of the shaded region.** 
Q 7	Find the area of the segment AYB shown in the figure, if the radius of the circle is 21 cm and ∠ AOB = 120°. (Use π = 22/7).

	
Q 8	Find the area of the shaded region in Fig., if radii of the two concentric circles with centre O are 7 cm and 14 cm, respectively and AOC = 40°. 
Q 9	A round table cover has six equal designs as shown in Fig. 12.14. If the radius of the cover is 28 cm, find the cost of making the designs at the rate of ₹ 0.35 per cm^2 . (Use $\sqrt{3} = 1.7$) 
Q 10	The diameters of the front and rear wheels of a tractor are 80 cm and 2 m respectively. Find the number of revolutions that a rear wheel makes to cover the distance which the front wheel covers in 800 revolutions.

CHAPTER-12

AREA RELATED TO CIRCLE

SOLUTIONS OF THE PROBLEM

	SOLUTIONS TO COMPETENCY BASED QUESTIONS
Ans 1	a) $\frac{\pi r^2 \theta}{360^0}$
Ans 2	a) $r^2\ sq\ units$ **Solution:** Given, radius of semicircle is r units. AB is the diameter AB = 2r units the sides of the triangle AB = 2r CD = r  ∠ACB = 90° Area of triangle = (1/2) × base × height Area of triangle ACB = (1/2) × AB × CD = (1/2) × 2r × r = r² square units
Ans 3	**b)** Area of the circle > Area of the square
Ans4	c) 10cm Let r1=4cm&r2=3cm Now, area of new circle =$\pi r_1^2 + \pi r_2^2$ $r = 5cm$ ∴ Diameter of new circle ==10cm.

Ans 5	a) $\frac{circumference}{diameter}$
Ans 6	a) 51.33 sq cm
Ans 7	a) When two circles touch externally the distance between their centers is equal to the sum of their radii.
Ans 8	a) $\frac{b^2\pi}{4}$
Ans 9	a) Area of largest square inscribed in the circle — $24.5cm^2$
Ans10	d) 9:1
Ans 11	$\pi : \sqrt{2}$
Ans 12	Let 'd' be the original diameter of a circle. Original Radius of circle ,r = d/2 Area of original circle, A = **πr²** A = π × (d/2)² A = πd²/4 **Area of original circle = πd²/4** **New diameter ,D = d + 40% of d** [Given diameter of a circle is increased by 40%] D = d + (40/100) × d D = d + 0.4d D = 1.4 d Radius of new circle ,R = D/2 = 1.4d/2 **= 0.7 d** New area of a circle ,A1 = πR² A1 = π(0.7d)² A1 = π × 0.49d² **New area of a circle = π × 0.49d²** Change in are**a = A1 - A** = π × 0.49d² - πd²/4

	= πd²(0.49 - ¼) = πd²(0.49 × 4 - 1)/4 = πd²(1.96 - 1)/4 = πd²(0.96)/4 **Change in area = 0.24 πd²** **Percentage increase in area = (change in area/ original area) × 100** = (0.24 πd²/πd²/4) × 100 = (0.24 πd² × 4 /πd²) × 100 = (0.24 × 4) × 100 = 0.96 × 100 **= 96 %** Percentage increase in area = 96% **Hence, its area increased by 96 %.**
	SOLUTIONS TO CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
Ans 1 i)	B) Total length of wire = length of 4 diameter + circumference of circle = 4*28 + 2*22/7*14 =112+88 =200mm
ii)	c)77 sq cm Area of each sector of brooch = $\frac{1}{8} \times area\ of\ brooch$
iii)	d)62.86 mm
iv)	c) 51π
v)	C) 4

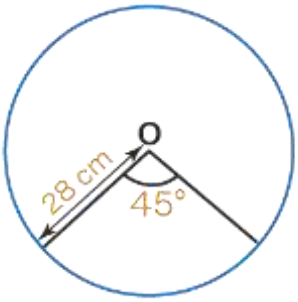
	Circumference of silver part of brooch =44cm $2\pi r = 44$ $r = 7\ mm$ Radius of whole brooch = 10mm Circumference of outer edge = $2\pi r$ $= 2 \times \frac{22}{7} \times 10$ = 440/7 mm ATQ, $n.2\pi r = 80\pi$ n=4
Ans 2 i)	A) 225m^2
ii)	a) 19.625m^2 Explanation: The horse can graze a sector of 90^0 in a circle of 5m radius. Use formula for sector.
iii)	d)78.5m^2
iv)	b) 58.875m^2
v)	b)Area related to circles
Ans 3 i)	a) 35/2 mm
ii)	b) 110mm
iii)	c) 285 mm
iv)	c)585/4 sq mm
v)	a) Area related to circles
Ans 4 i)	length of the minute hand = 9 cm Area swept by the minute hand in 14 minutes= area of the sector

	angle created by the minute hand in 14 min = 360 ×14/60 =84 Area swept by the minute hand in 10 min = (84/360)×πr² =(7/30)×3.14×9² = 59.4 cm²
ii)	angle described by the hour hand in 10 min Since in 12 hrs angle described by hour hand = 360⁰ then in 1 hrs = 360/12 in 60 minutes= 360/12 = 30 in 10 minutes= 30×10/60 = 5⁰
iii)	Distance covered by the tip of the hour hand in 3.5 hrs = perimeter of the sector created Angle described in 3.5 hrs = 360×3.5/12 = 105⁰ Distance covered= (105/360) × 2 πr =(105/360)× 2 ×(22/7)× 6 =11
vi)	The tip of pendulum covers a distance of 66 cm in complete oscillation That means 2 × arc length= 66 2 × (angle sustained by the pendulum/360)× 2πr =66 2 × (a/360) × 2× 22/7×45=66 A = (66×7×360)/(2×2×22×45)

	A= 42^0
v)	Area swept by the minute hand = Area of the sector
Ans 5 **i)**	Total cost of fencing = Rs. 6000 Cost for fencing for 1 meter = Rs. 30 Perimeter of the field (circumference of the fiel) = total cost of fencing/cost for 1 meter = 6000/30 = 200 meter
ii)	circumference = 200 $2\pi r = 200$ $r = 200/2\pi$ $r = 100 \times 7/22$ $r = 31.81\, meter$
iii)	Area of the field = area of the cricle = пr² =п×100²/п² = 100²/п = 70000/22 =3181.81 m²
iv)	Cost of ploughing the field = area of the field×cost per meter² = 3181.81×0.50 = Rs. 1590.9
V)	Cost of ploughing field @ 1.50/ m²

	= 3181.81×1.50 = Rs. 4773
	SOLUTIONS TO OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
Ans 1	Area of a sector of a circle with radius any angle with degrees measures is **_____$\frac{\pi r^2\theta}{360^0}$_____.**
Ans 2	The ratio between the circumference and area of a circle of radius 5cm is _____**2:5_____.**
Ans 3	A chord of a circle of radius 6cm makes an angle 60^0 at the center. Area of minor segment made by the chord is $\mathbf{3(2\pi - 3\sqrt{3})}$**.**
Ans4	If the radius of a circle is $\frac{7}{\sqrt{\pi}}$ cm, then the area of the circle is **_____49cm^2_____.**
Ans 5	The length of an arc of a sector of a circle with radius *r* and angle θ **_____$\frac{2\pi r\theta}{360^0}$_____.**
Ans 6	Perimeter of a quadrant of a circle of radius *r* _____$\mathbf{2r + \pi r/2}$____.
Ans 7	The number of revolutions made by a circle of radius r to cover a distance s is $\frac{s}{2\pi r}$. **TRUE**
Ans 8	Area of a segment of a circle is less than the area of its corresponding sector . **FALSE**
Ans 9	If the perimeter and the area of a circle are numerically equal , then the radius of the circle is 2units . **TRUE**
Ans 10	$154cm^2$ is the area of circle whose circumference is 44cm. (True/False)
	SOLUTIONS TO SHORT ANSWER TYPE QUESTIONS
Ans 1	Solution: ⇒ Area of circle =301.84cm2 [Given]

	⇒ Area of circle =π r^2 ⇒ 301.84=722× r^2 ⇒ r^2 = 22301.84×7 ⇒ r^2 = 96.04 ∴ r = 9.8cm ⇒ Circumference of circle =2πr ∴ **Circumference of circle =2×722×9.8=61.6cm**
Ans 2	1 revolution of the wheel = Circumference of the wheel = 2πr = 2 × (22/7) × 35 = 220 cm Speed of the wheel = 66 km/hr = (66×1000×100)/60 cm/min = 110000 cm/min ∴ Number of revolutions in 1 min = 110000/220 = 500
Ans 3	We are given the radius of the circle as 5 cm and the length of the arc is 3.5 cm. If the length of the arc is L cm and radius of circle is Rcm, then the area of the sector formed is given by $\frac{LR}{2}$ Substitute the values of L and R to calculate the area of the sector
Ans 4	Given, central angle, θ = 45° Radius of circle, r = 28 cm We have to find the area of a sector of a circle. Area of sector = πr²θ/360° = (22/7)(28)²(45°/360°) = (22)(28)(4)(1/8) = (22)(28)(1/2) = (11)(28) = 308 cm²

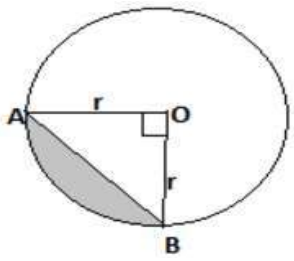


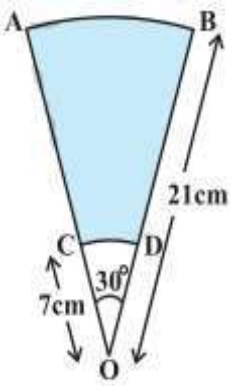
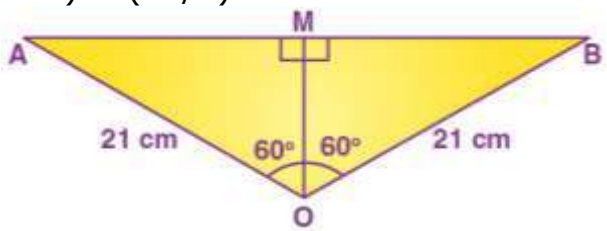
	Therefore, the area of the sector is 308 cm².
Ans5	Solution: Let the radius of the protractor be r cm. Then, Perimeter = 66 cm = πr + 2r = 66 [∴ Perimeter of a semicircle = πr + 2r] Put the values in linear equation and solve $r = \frac{77}{6} cm \ \ and\ diameter = \frac{77}{3} cm$
Ans 6	Solution: Let the inner and outer radii of the circular track berm and R m respectively. Then, Inner circumference = 2πr = 220 m So r =35m Since the track is 7 m wide everywhere. Therefore, R = Outer radius = r + 7 = (35 + 7)m = 42 m ∴ Outer circumference = 2πR = 2 × 227 × 42m = 264m Rate of fencing = ₹ 2 per metre ∴ Total cost of fencing = (Circumference × Rate) = ₹(264 × 2) = ₹ 528
Ans 7	**Solution:** AB be the chord which is subtending an angle 90° at the center O. radius (r) of the circle = 10 cm Area of minor sector = (90/360°)×πr² = (¼)×(22/7)×10² Or, Area of minor sector = 78.5 cm² Area of major sector = Area of circle – Area of minor sector = (3.14×10²)-78.5 = 235.5 cm²

Ans8	Let r be the radius of the circle and 0 be the central angle of the sector of the circle Then area of circle = πr^2 ATQ $\therefore \frac{\pi r^2 \theta}{360} = \frac{1\pi r^2}{12}$ So $\theta = 30^0$
Ans 9	Inner radius = r Outer radius = r + h So, area of the path $=\pi(r+h)^2-\pi r^2$ $=\pi[(r+h)^2-r^2]$ $=\pi(r+h+r)(r+h-r)$ $=\pi h(2r+h)$
Ans 10	Arc $=5\pi$ Area of sector = 20π Since , $area = \frac{lr}{2}$ Hence the radius of the circle is 8cm
	SOLUTIONS TO LONG ANSWER TYPE QUESTIONS
Ans 1	The radius of 1st circle, r_1 = 21/2 cm (as diameter D is given as 21 cm) So, area of gold region = $\pi r_1^2 = \pi(10.5)^2 = 346.5$ cm^2 Now, it is given that each of the other bands is 10.5 cm wide, So, the radius of 2nd circle, r_2 = 10.5cm+10.5cm = 21 cm Thus, ∴ Area of red region = Area of 2nd circle − Area of gold region = $(\pi r_2^2-346.5)$ cm^2 $= (\pi(21)^2 - 346.5)$ cm^2 = 1386 − 346.5

	= 1039.5 cm^2 Similarly, The radius of 3rd circle, r_3 = 21 cm+10.5 cm = 31.5 cm The radius of 4th circle, r_4 = 31.5 cm+10.5 cm = 42 cm The Radius of 5th circle, r_5 = 42 cm+10.5 cm = 52.5 cm For the area of n^{th} region, A = Area of circle n – Area of circle (n-1) ∴ Area of blue region (n=3) = Area of third circle – Area of second circle = π$(31.5)^2$ – 1386 cm^2 = 3118.5 – 1386 cm^2 = 1732.5 cm^2 ∴ Area of black region (n=4) = Area of fourth circle – Area of third circle = π$(42)^2$ – 1386 cm^2 = 5544 – 3118.5 cm^2 = 2425.5 cm^2 ∴ Area of white region (n=5) = Area of fifth circle – Area of fourth circle = π$(52.5)^2$ – 5544 cm^2 = 8662.5 – 5544 cm^2 = 3118.5 cm^2
Ans 2	Length of the fence (in metres) = Total cost/Rate = 5280/24 = 220 So, the circumference of the field = 220 m If r metres is the radius of the field, then 2πr = 220

	$2 \times (22/7) \times r = 220$ $r = (220 \times 7)/ (2 \times 22)$ $r = 35$ Hence, the radius of the field = 35 m Area of the field = πr^2 $= (22/7) \times 35 \times 35$ $= 22 \times 5 \times 35$ m^2 = 3850 sq. m. Cost of ploughing 1 m^2 of the field = Rs. 0.50 So, the total cost of ploughing the field = 3850 × Rs. 0.50 = Rs. 1925
Ans 3	Radius of the incircle r = Area of triangle/semi-perimeter In the question, it is given that area of the incircle = 154 cm^2 So, $\pi \times r^2 = 154$ Or, r = 7 cm Now, assume the length of each arm of the equilateral triangle to be "x" cm So, the semi-perimeter of the equilateral triangle = (3x/2) cm And, the area of the equilateral triangle = $(\sqrt{3}/4) \times x^2$ We know, r = Area of triangle/semi-perimeter So, $r = [x^2(\sqrt{3}/4)/ (3x/2)]$ $=> 7 = \sqrt{3}x/6$ Or, $x = 42/\sqrt{3}$ Multiply both numerator and denominator by $\sqrt{3}$ So, $x = 42\sqrt{3}/3 = 14\sqrt{3}$ cm

	Now, the perimeter of an equilateral triangle will be = 3x = 3 × 14√3 = 72.7 cm.
Ans4	Let "r" be the radius of the circle and "d" be the length of each diagonal of the square. We know, Length of the diagonal of a square = side (s) × √2 So, d = 2r And, s × √2 = 2r Or, s = √2r We know, the area of the square = s^2 Thus, the area of the square = $(\sqrt{2}r)^2 = 2r^2$ Now, the area of the circle = π × r^2 ∴ Area of the circle : area of the square = π × r^2 : $2r^2$ = π : 2 So, the ratio of the area of the circle and the square is π : 2.
Ans 5	**Solution**  Let r be the radius of the circle and AB be the chord, which subtend angle of 90 at centre O. AB = 5 cm in the right angled triangle OAB, using Pythagoras theorem: **find value of r** **r=$5/\sqrt{2}$ cm** **The area of the minor segment (shaded area) = area of the sector OAB - area of the triangle OAB**

	and **The area of the major segment = area of the circle - area of the minor segment** $\frac{25}{4}(\pi + 2)cm^2$
Ans 6	Radius of the larger circle, R = 21 cm Radius of the smaller circle, r = 7 cm Angle made by sectors of both concentric circles = 30°  Area of the larger sector = (30°/360°)×πR² cm² = (1/12)×(22/7)×21² cm² = 231/2cm² Area of the smaller circle = (30°/360°)×πr² cm² = 1/12×22/7×7² cm² =77/6 cm² Area of the shaded region = (231/2) – (77/6) cm² = 616/6 cm² = 308/3cm²
Ans 7	Area of the segment AYB = Area of sector OAYB – Area of Δ OAB …..(1) Area of the sector OAYB = (120/360) × (22/7) × 21 × 21 = 462 cm² ……(2)  Draw OM ⊥ AB. OA = OB (radius) Therefore, by RHS congruence, Δ AMO ≅ Δ BMO. M is the mid-point of AB and ∠ AOM = ∠ BOM = (1/2) × 120° = 60°

	Let OM = x cm In triangle OMA, OM/OA = cos 60° x/21 = ½ x = 21/2 OM = 21/2 cm Similarly, AM/OA = sin 60° AM/21 = √3/2 AM = 21√3/2 cm AB = 2 AM = 2 (21√3/2) = 21√3 cm Area of triangle OAB = (½) × AB × OM = (½) × 21√3 × (21/2) = (441/4)√3 cm^2 ……..(3) From (1), (2) and (3), Area of the segment AYB = [462 – (441/4)√3] cm^2
Ans 8	Angle made by sector = 40°, Radius the inner circle = r = 7 cm, and Radius of the outer circle = R = 14 cm We know, Area of the sector = (θ/360°)×πr^2 So, Area of OAC = (40°/360°)×πr^2 cm^2 = 68.44 cm^2 Area of the sector OBD = (40°/360°)×πr^2 cm^2 = (1/9)×(22/7)×7^2 = 17.11 cm^2 Now, area of the shaded region ABDC = Area of OAC – Area of the OBD

	= 68.44 cm^2 – 17.11 cm^2 = 51.33 cm^2
Ans 9	Total number of equal designs = 6 AOB= 360°/6 = 60° Radius of the cover = 28 cm Cost of making design = ₹ 0.35 per cm^2 Since the two arms of the triangle are the radii of the circle and thus are equal, and one angle is 60°, ΔAOB is an equilateral triangle. So, its area will be $(\sqrt{3}/4)\times a^2$ sq. units Here, a = OA ∴ Area of equilateral ΔAOB = $(\sqrt{3}/4)\times 28^2$ = 333.2 cm^2 Area of sector ACB = $(60°/360°)\times \pi r^2$ cm^2 = 410.66 cm^2 So, area of a single design = area of sector ACB – area of ΔAOB = 410.66 cm^2 – 333.2 cm^2 = 77.46 cm^2 ∴ Area of 6 designs = 6×77.46 cm^2 = 464.76 cm^2 So, total cost of making design = 464.76 cm^2 ×Rs.0.35 per cm^2 = Rs. 162.66
Ans 10	Radius of front wheel =40cm=25 m Circumference of the front wheel =(2п×25) m=4п5 Distance covered by the front wheel in 800 revolutions =(4п5×800)m=(640п) m Radius of the rear wheel = 1 m Circumference of the rear wheel =(2п×1)=2п m Therefore, Required number of revolution $=\frac{640\pi}{2\pi} = 320$

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CHAPTER: 13

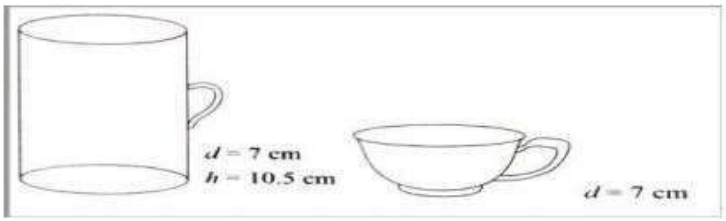
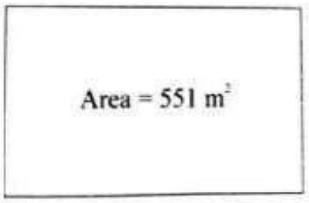
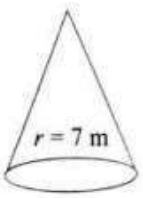
SURFACE AREA AND VOLUMES

	COMPETENCY BASED QUESTIONS
Q1	**If a cone is cut parallel to the base of it by a plane in two parts, then the shape of the top of the cone will be a:** (a) Sphere (b) Cube (c) Cone itself (d) Cylinder
Q2	**If r is the radius of the sphere, then the surface area of the sphere is given by;** (a) $4 \pi r^2$ (b) $2 \pi r^2$ (c) πr^2 (d) $4/3 \pi r^2$
Q3	**If we change the shape of an object from a sphere to a cylinder, then the volume of cylinder will** (a) Increase (b) Decrease (c) Remains unchanged (d) Doubles
Q4	**Fifteen solid spheres are made by melting a solid metallic cone of base diameter 2cm and height 15cm. The radius of each sphere is:** (a) ½ (b) ¼ (c) $1/\sqrt[3]{2}$ (d) $1/\sqrt[3]{4}$

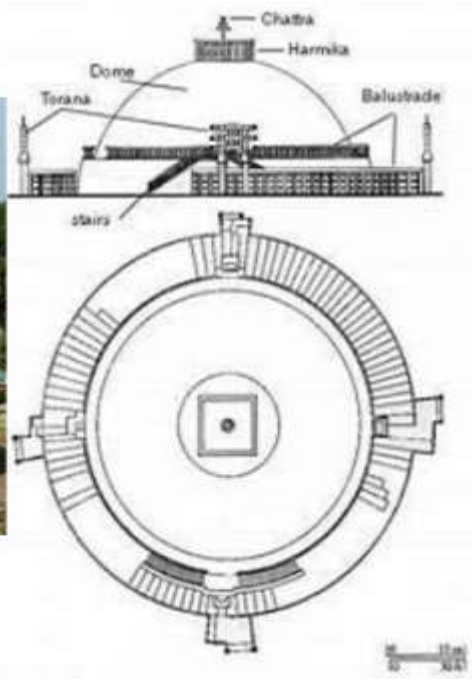
Q 5	**The radius of the top and bottom of a bucket of slant height 35 cm are 25 cm and 8 cm. The curved surface of the bucket is:** (a) 4000 sq.cm (b) 3500 sq.cm (c) 3630 sq.cm (d) 3750 sq.cm
Q 6	**If a cylinder is covered by two hemispheres shaped lid of equal shape, then the total curved surface area of the new object will be** (a) $4\pi rh + 2\pi r^2$ (b) $4\pi rh - 2\pi r^2$ (c) $2\pi rh + 4\pi r^2$ (d) $2\pi rh + 4\pi r$
Q 7	**A tank is made of the shape of a cylinder with a hemispherical depression at one end. The height of the cylinder is 1.45 m and radius is 30 cm. The total surface area of the tank is:** (a) 30 m (b) 3.3 m (c) 30.3 m (d) 3300 m
Q 8	**If we join two hemispheres of same radius along their bases, then we get a:** (a) Cone (b) Cylinder (c) Sphere (d) Cuboid
Q 9	A cylindrical pencil sharpened at one edge is the combination of

	(a) a cone and a cylinder (b) frustum of a cone and a cylinder (c) a hemisphere and a cylinder (d) two cylinders
Q10	A hollow cube of internal edge 22 cm is filled with spherical marbles of diameter 0.5 cm and it is assumed that 1/8 space of the cube remains unfilled. Then the number of marbles that the cube can accommodate is (a) 142296 (b) 142396 (c) 142496 (d) 142596
Q 11	A solid piece of iron in the form of a cuboid of dimensions 49 cm × 33 cm × 24 cm, is moulded to form a solid sphere. The radius of the sphere is (a) 21 cm (b) 23 cm (c) 25 cm (d) 19 cm
Q 12	The diameters of the two circular ends of the bucket are 44 cm and 24 cm. The height of the bucket is 35 cm. The capacity of the bucket is (a) 32.7 litres (b) 33.7 litres (c) 34.7 litres (d) 31.7 litres
Q 13	Two identical solid cubes of side a are joined end to end. Then the total surface area of the resulting cuboid is

	(a) $12a^2$ (b) $10a^2$ (c) $8a^2$ (d) $11a^2$
Q 14	A solid cylinder of radius r and height h is placed over another cylinder of same height and radius. The total surface area of the shape so formed is (a) $4\pi rh + 4\pi r^2$ (b) $2\pi rh + 4\pi r^2$ (c) $2\pi rh + 2\pi r^2$ (d) $4\pi rh + 2\pi r^2$
Q 15	The number of shots each having diameter 3 cm can be made from a cuboidal lead solid of dimensions 9 cm × 11 cm × 12 cm is approximately equal to (a) 84 (b) 90 (c) 92 (d) 80
Q 16	Two identical solid hemispheres of equal base radius r cm are stuck together along their bases. The total surface area of the combination is (a) $6\pi r^2$ (b) $5\pi r^2$ (c) $4\pi r^2$ (d) $3\pi r^2$
	CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
Q 1	Adventure camps are the perfect place for the children to practice decision making for themselves without parents and teachers guiding

	their every move. Some students of a school reached for adventure at Sakleshpur. At the camp, the waiters served some students with a welcome drink in a cylindrical glass and some students in a hemispherical cup whose dimensions are shown below. After that they went for a jungle trek. The jungle trek was enjoyable but tiring. As dusk fell, it was time to take shelter. Each group of four students was given a canvas of area 551m2 . Each group had to make a conical tent to accommodate all the four students. Assuming that all the stitching and wasting incurred while cutting, would amount to 1m2 , the students put the tents. The radius of the tent is 7m.      
(i)	The volume of cylindrical cup is a) 295.75 cm^3 b) 7415.5 cm^3 c) 384.88 cm^3 d) 404.25 cm^3

(ii)	The volume of hemispherical cup is a) 18.67 cm^3 b) 89.83 cm^3 c) 172.25 cm^3 d) 210.60 cm^3
(iii)	Which container had more juice and by how much? a) Hemispherical cup, 195 cm^3 b) Cylindrical glass, 207 cm^3 c) Hemispherical cup, 280.85 cm^3 d) Cylindrical glass, 314.42 cm^3
(iv)	The height of the conical tent prepared to accommodate four students is a) 18m b) 10m c) 24m d) 14m
(v)	How much space on the ground is occupied by each student in the conical tent a) 54 m^2 b) 38.5 m^2 c) 86 m^2 d) 24 m^2

Q 2	  The Great Stupa at Sanchi is one of the oldest stone structures in India, and an important monument of Indian Architecture. It was originally commissioned by the emperor Ashoka in the 3rd century BCE. Its nucleus was a simple hemispherical brick structure built over the relics of the Buddha. .It is a perfect example of combination of solid figures. A big hemispherical dome with a cuboidal structure mounted on it. (Take π = 22/7)
(i)	Calculate the volume of the hemispherical dome if the height of the dome is 21 m – a) 19404 cu. m b) 2000 cu .m c) 15000 cu. M d) 19000 cu. M

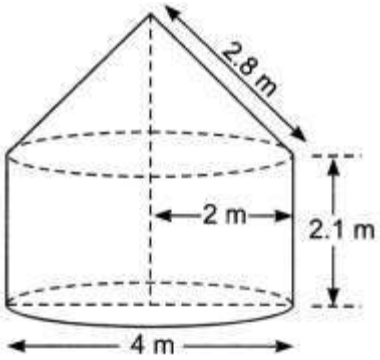
(ii)	The formula to find the Volume of Sphere is - a) 2/3 πr^3 b) 4/3 πr^3 c) 4 πr^2 d) 2 πr^2
(iii)	The cloth require to cover the hemispherical dome if the radius of its base is 14m is a) 1222 sq.m b) 1232 sq.m c) 1200 sq.m d) 1400 sq.m
(iv)	The total surface area of the combined figure i.e. hemispherical dome with radius 14m and cuboidal shaped top with dimensions 8m 6m 4m is a)1200 sq. m b) 1232 sq. m c) 1392 sq.m d) 1932 sq. m
(v)	The volume of the cuboidal shaped top is with dimensions mentioned in question 4 a) 182.45 m^3 b) 282.45 m^3 c) 292 m^3 d) 192 m^3

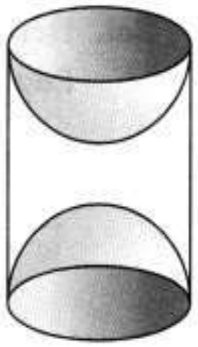
Q 3	On a Sunday, your Parents took you to a fair. You could see lot of toys displayed, and you wanted them to buy a RUBIK's cube and strawberry ice-cream for you. Observe the figures and answer the questions: -  
(i)	The length of the diagonal if each edge measures 6cm is a) $3\sqrt{3}$ b) $3\sqrt{6}$ c) $\sqrt{12}$ d) $6\sqrt{3}$
(ii)	Volume of the solid figure if the length of the edge is 7cm is a)256 cm^3 b) 196 cm^3 c) 343 cm^3 d) 434 cm^3
(iii)	What is the curved surface area of hemisphere (ice cream) if the base radius is 7cm? a) 309 cm^2 b) 308 cm^2 c) 803 cm^2 d) 903 cm^2

(iv)	Slant height of a cone if the radius is 7cm and the height is 24 cm___ a) 26cm b) 25 cm c) 52 cm d) 62cm
(v)	The total surface area of cone with hemispherical ice cream is a) 858 cm^2 b) 885 cm^2 c) 588 cm^2 d) 855 cm^2
Q 4	To make the learning process more interesting, creative, and innovative, Amayra's class teacher brings clay in the classroom, to teach the topic Surface Areas and Volumes. With clay, she forms a cylinder of radius 6 cm and height 8 cm. Then she molds the cylinder into a sphere and asks some questions to students.  
(i)	The radius of the sphere so formed is (a) 4 cm (b) 6 cm (c) 7 cm (d) 8 cm
(ii)	The volume of the sphere so formed is (a) 905.14 cm^3 (b) 903.27 cm^3 (c) 1296.5 cm^3 (d) 1156.63 cm^3

(iii)	Find the ratio of the volume of the sphere to the volume of a cylinder. (a) 2 : 1 (b) 1 : 2 (c) 1 : 1 (d) 3 : 1
(iv)	Total surface area of the cylinder is (a) 528 cm^2 (b) 756 cm^2 (c) 625 cm^2 (d) 636 cm^2
(v)	During the conversion of a solid from one shape to another the volume of new shape will (a) be an increase (b) be decrease (c) remain unaltered (d) be double
Q 5	One day Rinku was going home from school, saw a carpenter working on wood. He found that he is carving out a cone of same height and same diameter from a cylinder. The height of the cylinder is 24 ern and base radius is 7 cm. While watching this, some questions came into Rinkus mind. Help Rinku to find the answer of the following questions. 
(i)	After carving out cone from the cylinder, (a) Volume of the cylindrical wood will decrease. (b) Height of the cylindrical wood will increase. (c) Volume of cylindrical wood will increase. (d) Radius of the cylindrical wood will decrease.

(ii)	Find the slant height of the conical cavity so formed. (a) 28 cm(b) 38 cm(c) 35 cm(d) 25 cm
(iii)	The curved surface area of the conical cavity so formed is (a) 250 cm^2(b) 550 cm^2 (c) 350 cm^2 (d) 450 cm^2
(iv)	External curved surface area of the cylinder is (a) 876 cm^2 (b) 1250 cm^2 (c) 1056 cm^2(d) 1025 cm^2
(v)	Volume of conical cavity is (a) 1232 cm^3(b) 1248 cm^3(c) 1380 cm^3 (d) 999 cm^3
	OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
Q 1	The length of the diagonal of a cube that can be inscribed in a sphere of radius 7.5 cm is_____ .
Q 2	The volume of a hemisphere is _____ of the volume of a cylinder if its height and radius are same as of cylinder.
Q 3	If the volume and the surface area of a solid sphere are numerically equal, then its radius is_____.
Q 4	Solid figures are _____ while plane figures are _____.
Q 5	If the heights af the two cylinders are equal and their radii is in the ratio 7:5 then the ratio of their volumes is_____.
Q 6	If the total surface area of a cube is $\frac{50}{3}$ m^2 , then its side is $\frac{5}{3}$ m . (T/F)
Q 7	If we double the radius of a hemisphere, then its surface area also gets doubled. (T/F)
Q 8	Area is the length of boundary of the plane closed figure. (T/F)
Q 9	A solid ball is exactly fitted into cubical box of side a. the volume of the cube is $\frac{4}{3}\pi\, a^3$.(T/F)
Q 10	If the base area and volume of the cone are numerically equal then its height is 3 cm.(T/F)

	SHORT ANSWER TYPE QUESTIONS
Q 1	A canal is 300 cm wide and 120 cm deep. The water in the canal is flowing at a speed of 20 km/h. How much area will it irrigate in 20 minutes if 8 cm of standing water is desired?
Q 2	Two cones have their heights in ratio 1 : 3 and radii in the ratio 3 :1. What is the ratio of their volumes?
Q 3	A cubical ice-cream brick of edge 22 cm is to be distributed among some children by filling ice-cream cones of radius 2 cm and height 7 cm up to its brim. How many children will get the ice cream cones?
Q 4	Three cubes of a metal whose edges are in the ratio 3:4:5 are melted and converted into a single cube whose diagonal is $12\sqrt{3}$ cm. Find the edges of the three cubes.
Q 5	Find the number of solid spheres each of diameter 6 cm that can be made by melting a solid metal cylinder of height 45 cm and diameter 4 cm.
Q 6	A cone of height 24 cm and radius of base 6 cm is made up of modelling clay. A child reshapes it in the form of a sphere. Find the radius of the sphere.
Q 7	A medicine capsule is in the shape of a cylinder with two hemispheres stuck to each of its ends (Fig). The length of the entire capsule is 14 mm and the diameter of the capsule is 5 mm. Find its surface area. 
Q 8	A wooden article was made by scooping out a hemisphere from each end of a solid cylinder, as shown in Fig. If the height of the cylinder is

	10 cm, and its base is of radius 3.5 cm, find the total surface area of the article. 
Q 9	Mayank made a bird-bath for his garden in the shape of a cylinder with a hemispherical depression at one end (Fig). The height of the cylinder is 1.45 m and its radius is 30 cm. 30 cm Find the total surface area of the bird-bath. [Take π = $\frac{22}{7}$]
Q 10	A juice seller was serving his customers using glasses. The inner diameter of the cylindrical glass was 5 cm, but the bottom of the glass had a hemispherical raised portion which reduced the capacity of the glass. If the height of a glass was 10 cm, find the apparent capacity of the glass and its actual capacity. (Use π = 3.14).
	LONG ANSWER TYPE QUESTIONS
Q 1	Rasheed got a playing top (lattu) as his birthday present, which surprisingly had no colour on it. He wanted to colour it with his crayons. The top is shaped like a cone surmounted by a hemisphere. The entire top is 5 cm in height, and the diameter of the top is 3.5 cm. Find the area he has to colour. (Take π = 22/7)
Q 2	Mayank made a bird-bath for his garden in the shape of a cylinder with a hemispherical depression at one end, as shown in the figure. The height of the cylinder is 1.45 m, and its radius is 30 cm. Find the total surface area of the bird-bath. (Take π = 22/7)

Q 3	2 cubes each of volume 64 cm^3 are joined end to end. Find the surface area of the resulting cuboid.
Q 4	A tent is in the shape of a cylinder surmounted by a conical top. If the height and diameter of the cylindrical part are 2.1 m and 4 m respectively, and the slant height of the top is 2.8 m, find the area of the canvas used for making the tent. Also, find the cost of the canvas of the tent at the rate of Rs. 500 per m^2. (Note that the base of the tent will not be covered with canvas.)
Q 5	A solid toy is in the form of a hemisphere surmounted by a right circular cone. The height of the cone is 2 cm, and the diameter of the base is 4 cm. Determine the volume of the toy. If a right circular cylinder circumscribes the toy, find the difference between the volumes of the cylinder and the toy. (Take π = 3.14)
Q 6	Selvi's house has an overhead tank in the shape of a cylinder. This is filled by pumping water from a sump (an underground tank) which is in the shape of a cuboid. The sump has dimensions 1.57 m × 1.44 m × 95cm. The overhead tank has a radius of 60 cm and a height of 95 cm. Find the height of the water left in the sump after the overhead tank has been completely filled with water from the sump which had been full. Compare the capacity of the tank with that of the sump. (Use π = 3.14)
Q 7	Metallic spheres of radii 6 cm, 8 cm and 10 cm, respectively, are melted to form a single solid sphere. Find the radius of the resulting sphere.
Q 8	A copper wire, 3 mm in diameter is wound about a cylinder whose length is 12 cm and diameter 10 cm, so as to cover the curved surface of the cylinder. Find the length and mass of the wire, assuming the density of copper to be 8.88 g per cm^3.
Q 9	A cistern, internally measuring 150 cm x 120 cm x 110 cm has 129600 cm^3 of water in it. Porous bricks are placed in the water until the cistern is full to the brim. Each brick absorbs one-seventeenth of its own

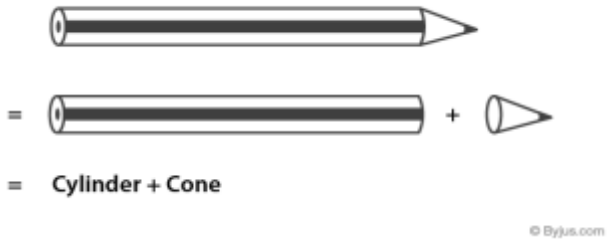
	volume of water. How many bricks can be put in without overflowing the water, each brick being 22.5 cm x 7.5 cm x 6.5 cm?
Q 10	Determine the ratio of the volume of a cube to that of a sphere which with exactly fit inside the cube.

CHAPTER: 13

SURFACE AREAS AND VOLUME

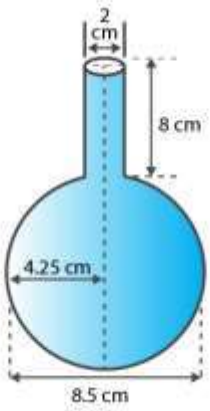
SOLUTIONS OF THE PROBLEM

	SOLUTIONS TO COMPETENCY BASED QUESTIONS
Ans 1	**(c) Cone itself** Explanation: If we cut a cone into two parts parallel to the base, then the shape of the upper part remains the same.
Ans 2	(a) $4 \pi r^2$ If r is the radius of the sphere, then the surface area of the sphere is given by $4 \pi r^2$.
Ans 3	**(c) Remains unchanged**
Ans 4	**(d) $1/\sqrt[3]{4}$** Explanation: Volume of 15 spheres = Volume of a cone $15 \times (4/3) \pi r^3 = \frac{1}{3} \pi r^2 h$ $5 \times 4 \pi r^3 = \frac{1}{3} \pi 1^2 (15)$ $20r^3 = 5$ $r^3 = 5/20 = \frac{1}{4}$ $r = 1/\sqrt[3]{4}$
Ans 5	**(c) 3630 sq.cm** Explanation: Curved surface of bucket = $\pi(R_1 + R_2)$ x slant height (l) Curved Surface = (22/7) x (25 + 8) x 35 CSA = 22 x 33 x 5 = 3630 sq.cm.
Ans 6	**(c) $2\pi rh + 4\pi r^2$** Explanation: Curved surface area of cylinder = $2\pi rh$ The curved surface area of hemisphere = $2\pi r^2$ Here, we have two hemispheres.

	So, total curved surface area = $2\pi rh + 2(2\pi r^2) = 2\pi rh + 4\pi r^2$
Ans 7	**(b) 3.3 m** Explanation: Total surface area of tank = CSA of cylinder + CSA of hemisphere $= 2\pi rh + 2\pi r^2 = 2\pi r(h + r)$ $= 2 \times 22/7 \times 30(145 + 30)\ cm^2$ $=33000\ cm^2$ $= 3.3\ m^2$
Ans 8	**(c) Sphere** If we join two hemispheres of same radius along their bases, then we get a Sphere.
Ans 9	(a) a cone and a cylinder A cylindrical pencil sharpened at one edge is the combination of a cone and a cylinder. 
Ans10	(a) 142296 Explanation: Volume of cube = 223 = 10648 cm^3 Volume of cube that remains unfilled = (1/8) × 10648 = 1331 cm^3 volume occupied by spherical marbles = 10648 − 1331 = 9317 cm^3 Radius of the spherical marble = 0.5/2 = 0.25 cm = 1/4 cm Volume of 1 spherical marble = (4/3) × (22/7) × (1/4)3 = 11/168 cm^3 Numbers of spherical marbles = n = 9317 × (11/168) = 142296

Ans11	(a) 21 cm Explanation: For the given cuboid, Length, l = 49 cm Breadth, b = 33 cm Height, h = 24 cm Volume of cube = 49 × 33 × 24 cm3 Let r be the radius of the sphere. Volume of sphere = 4/3 πr^3 Volume of cuboid = volume of sphere moulded 49 × 33 × 24 = 4/3 πr^3 $\Rightarrow \pi r^3 = 29106$ $\Rightarrow r^3 = 29106 \times (22/7)$ $\Rightarrow r^3 = 9261$ $\Rightarrow r^3 = (21)^3$ $\Rightarrow r = 21$ cm Hence, the radius of sphere is 21 cm
Ans12	(a) 32.7 litres Explanation: Given, The height of the bucket = h = 35 cm Diameter of one circular end of bucket = 44 cm Then the radius R = 22 cm Diameter of another end = 24 cm Then the radius r = 12 cm

	We know that Volume of the bucket = $(1/3)\pi h[R^2 + r^2 + Rr]$ $= (1/3) \times (22/7) \times 35 \times [(22)^2 + (12)^2 + 22 \times 12]$ $= (35/3) \times (22/7) \times (484 + 144 + 264)$ $= (5 \times 22 \times 892)/3$ $= 32706.6\ cm^3$ $= 32.7$ litres.
Ans13	(b) $10a^2$ Explanation: The total surface area of a cube having side a = $6a^2$ If two identical faces of side a are joined together, then the total surface area of the cuboid so formed is $10a^2$.
Ans14	: (d) $4\pi rh + 2\pi r^2$ Explanation: We know that, The total surface area of cylinder = $2\pi rh + 2\pi r^2$ When one cylinder is placed over the other cylinder of same height and radius, then height of the new cylinder will be 2h and radius will be r. Thus, the total surface area of the shape so formed = $2\pi r(2h) + 2\pi r^2 = 4\pi rh + 2\pi r^2$
Ans15	(a) 84 Explanation: Volume of cuboidal lead solid = 9 cm × 11 cm × 12 cm = $1188\ cm^3$ Radius of lead shot = 3/2 cm = 1.5 cm Volume of each shot = $(4/3)\pi r^3$ $= (4/3) \times (22/7) \times 1.5 \times 1.5 \times 1.5$ $= 14.143\ cm^3$ Number of lead shots can be made = 1188/14.143 = 84 (approx.)

Ans16	(c) $4\pi r^2$ Explanation: When two hemispheres are joined together along their bases, a sphere of the same base radius is formed. Curved Surface Area of a sphere = $4\pi r^2$  Now, the volume of this vessel = Volume of cylinder + Volume of a sphere $= \pi \times (1)^2 \times 8 + (4/3)\ \pi\ (4.25)^3$ $= 25.12 + 321.6$ $= 346.67\ cm^3$
	SOLUTIONS TO CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
1(i)	d) 404.25 cm^3
(ii)	b) 89.83 cm^3
(iii)	d) Cylindrical glass, 314.42 cm^3
(iv)	c) 24m
(v)	b) 38.5 m^2
2(i)	a) 19404 cu. M
(ii)	b) $4/3\ \pi r^3$

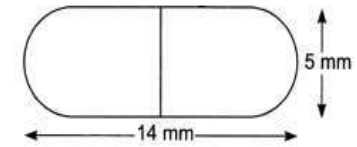
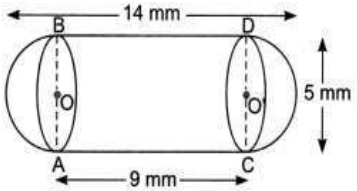
(iii)	b) 1232 sq.m
(iv)	c) 1392 sq.m
(v)	d) 192 m^3
3(i)	d) $6\sqrt{3}$
(ii)	c) 343 cm^3
(iii)	b) 308 cm^2
(iv)	b) 25 cm
(v)	a) 858 cm^2
4(i)	(b) 6 cm
(ii)	(a) 905.14 cm^3
(iii)	(c) 1 : 1
(iv)	(a) 528 cm^2
(v)	(c) remain unaltered
5(i)	(b) Height of the cylindrical wood will increase.
(ii)	(a) 28 cm
(iii)	(c) 350 cm^2
(iv)	(a) 876 cm^2
(v)	(c) 1380 cm^3

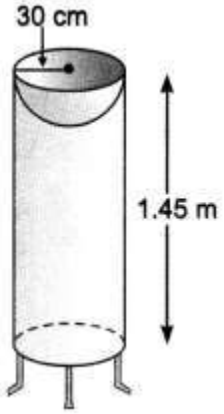
	SOLUTIONS TO OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
Ans 1	15 cm
Ans 2	$\frac{2}{3}$

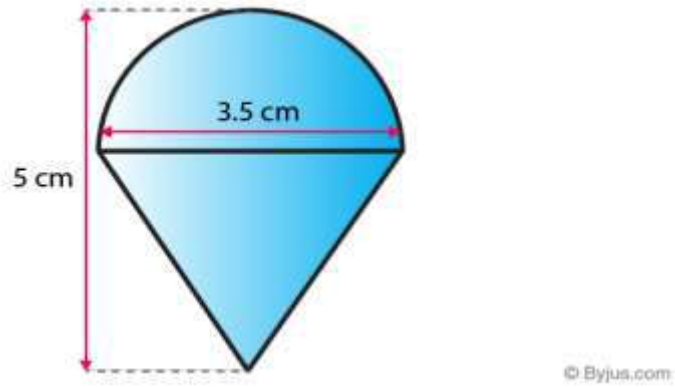
Ans 3	3 units
Ans 4	3 dimensional, 2-dimensional
Ans 5	49:25
Ans 6	True
Ans 7	False
Ans 8	False
Ans 9	False
Ans10	True
	SOLUTIONS TO SHORT ANSWER TYPE QUESTIONS
Ans 1	The volume of water flows in the canal in one hour = width of the canal × depth of the canal × speed of the canal water = 3 × 1.2 × 20 × 1000 m^3 = 72000 m^3 In 20 minutes the volume of water = (72000 × 20)/ 60 = 24000 m^3 Area irrigated in 20 minutes, if 8 cm, i.e., 0.08 m standing water is required =24000/0.08 = 300000 m^2 = 30 hectares
Ans 2	Given, Ratio of heights of two cones = 1 : 3 Ratio of radii = 3 : 1 Let h and 3h be the height of two cones.

	Also, 3r and r be the corresponding radii of cones. So, $r_1 = 3r$, $h_1 = h$, $r_2 = r$, $h_2 = 3h$. Ratio of volumes = $[(1/3)\pi r_1^2 h_1]/ [(1/3)\pi r_2^2 h_2]$ $= [(3r)^2 h]/[r^2 (3h)]$ $= (9r^2h)/(3r^2h)$ $= 3/1$ Hence, the ratio of volumes = 3 : 1
Ans 3	Let n be the number of ice-cream cones. Volume of cubical ice-cream brick = 22 cm × 22 cm × 22 cm Radius of cone = r = 2 cm Height of cone = h = 7 cm Volume of cone = $(1/3)\pi r^2 h = (1/3) \times (22/7) \times 2 \times 2 \times 7$ So, n × Volume of one cone = Volume of cubical ice-cream brick $n \times (1/3) \times (22/7) \times 2 \times 2 \times 7 = 22 \times 22 \times 22$ $n \times (1/3) \times 4 = 22 \times 22$ $n = (22 \times 22 \times 3)/4$ n = 363 Therefore, 363 children will get the ice cream cones.
Ans 4	Let the edges of three cubes (in cm) be 3x, 4x and 5x, respectively. Volume of the cubes after melting is = $(3x)^3 + (4x)^3 + (5x)^3 = 216x^3$ cm^3 Let a be the side of a new cube so formed after melting.

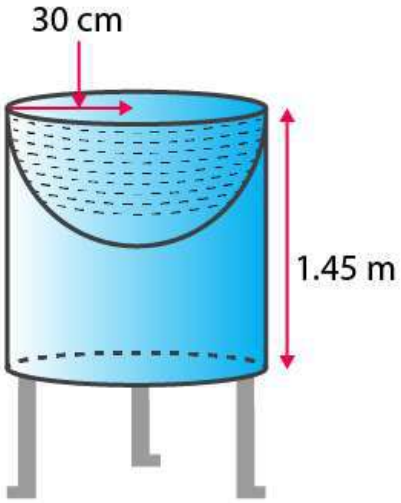
	Therefore, $a^3 = 216x^3$ So, $a = 6x$ Given that, diagonal of a single cube = $12\sqrt{3}$ cm i.e. $\sqrt{(a^2 + a^2 + a^2)} = 12\sqrt{3}$ $a\sqrt{3} = 12\sqrt{3}$ Therefore, $a = 12$ Thus, $12 = 6x$ $x = 2$ Now, $3x = 3 \times 2 = 6$ $4x = 4 \times 2 = 8$ $5x = 5 \times 2 = 10$ Therefore, the edges of the three cubes are 6 cm, 8 cm and 10 cm, respectively.
Ans 5	Given, Diameter of solid sphere = 6 cm Diameter of cylinder = 4 cm Height of cylinder = h = 45 cm Radius of sphere = $r_1 = 6/2 = 3$ cm Radius of cylinder = $r_2 = 4/2 = 2$ cm Let n be the number of spheres. n × Volume of one sphere = Volume of cylinder $n \times (4/3)\pi r_1^3 = \pi r_2^2 h$ $n \times (4/3) \times (22/7) \times 3 \times 3 \times 3 = (22/7) \times 2 \times 2 \times 45$

	n × 9 = 45 n = 45/9 n = 5
Ans 6	The volume of cone = (⅓) × π × 6 × 6 × 24 cm^3 If r is the radius of the sphere, then its volume is (4/3) πr^3. Since the volume of clay in the form of the cone and the sphere remains the same, we Have (4/3) πr^3 = (⅓) × π × 6 × 6 × 24 cm^3 $r^3 = 3 \times 3 \times 24 = 3^3 \times 2^3$ So, r = 3 × 2 = 6
Ans 7	Let the radius and height of the cylinder be r cm and h cm respectively. Then, $r = \frac{5}{2}\text{ mm} = 2.5\text{ mm}$ and $h = \left(14 - 2\times\frac{5}{2}\right)\text{mm} = 9\text{ mm}$ Also, radius of hemisphere $r = \frac{5}{2}$ mm Now, Surface area of the capsule Curved surface of cylinder + Surface area of two hemispheres $= 2\pi rh + 2 \times 2\pi r^2 = 2\pi r\,(h + 2r)$ $= 2\times\frac{22}{7}\times\frac{5}{2}\times\left(9 + 2\times\frac{5}{2}\right) = 2\times\frac{22}{7}\times\frac{5}{2}\times 14 = 220\text{ mm}^2$  
Ans 8	Solution: We have, r = 3.5 cm and h = 10 cm Total surface area of the article = Curved surface area of cylinder + 2 × Curved surface area of hemisphere = 2πrh + 2 × $2\pi r^2$ = 2πr (h + 2r)

	$= 2 \times \frac{22}{7} \times 3.5 \times (10 + 2 \times 3.5)$ $= 2 \times \frac{22}{7} \times 3.5 \times 17 = 374 \text{ cm}^2$
Ans 9	 Let h be height of the cylinder, and r be the common radius of the cylinder and hemisphere. Then, the total surface area of the bird-bath = Curved surface area of cylinder + Curved surface area of hemisphere $= 2\pi rh + 2\pi r^2 = 2\pi r (h + 2r)$ $= 2 \times \frac{22}{7} \times 30 (145 + 30) \text{ cm}^2 = 33{,}000 \text{ cm}^2 = 3.3 \text{ m}^2$
Ans10	 Since, the inner diameter of the glass = 5 cm and height = 10 cm, the apparent capacity of the glass = $\pi r^2 h$ $= (3.14 \times 2.5 \times 2.5 \times 10) \text{ cm}^3 = 196.25 \text{ cm}^2$ But the actual capacity of the glass is less by the volume of the hemisphere at the base of the glass. i.e., it is less by $\frac{2}{3} \pi r^3$ $= \frac{2}{3} \times 3.14 \times 2.5 \times 2.5 \times 2.5 \text{ cm}^3$

	= 32.71 cm So, the actual capacity of the glass = Apparent capacity of glass – Volume of the hemisphere = (196.25 – 32.71) cm^3 = 163.54 cm^3
	SOLUTIONS TO LONG ANSWER TYPE QUESTIONS
Ans 1	 TSA of the toy = CSA of hemisphere + CSA of cone Curved surface area of the hemisphere = 1/ 2 ($4\pi r^2$) = $2\pi r^2$ = $2(22/7)\times (3.5/2) \times (3.5/2)$ = 19.25 cm^2 Height of the cone = Height of the top – Radius of the hemispherical part = (5 – 3.5/2) cm = 3.25 cm Sant height of the cone (l) (approx.) Therefore, CSA of cone = πrl = $(22/7) \times (3.5/2) \times 3.7$ = 20.35 cm^2 Hence, the surface area of the top = $[2(22/7)\times (3.5/2) \times (3.5/2) + (22/7) \times (3.5/2) \times 3.7]$ cm^2 = $(22/7) \times (3.5/2) (3.5+3.7)$ cm^2 = $(11/2) \times (3.5 + 3.7)$ cm^2 = 39.6 cm^2 (approx.)

Ans 2



Solution:

Let h be the height of the cylinder and r be the common radius of the cylinder and hemisphere. Then, the total surface area of the bird-bath = CSA of cylinder + CSA of the hemisphere

$= 2\pi rh + 2\pi r^2$

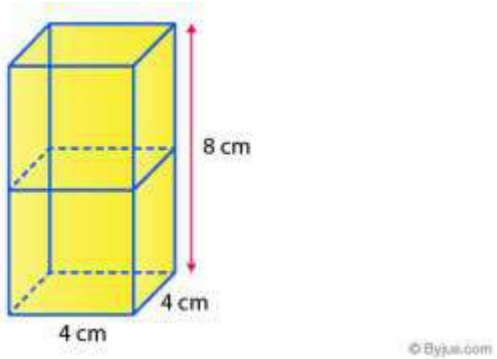
$= 2\pi\, r(h + r)$

$= 2\,(22/7) \times 30 \times (145 + 30)\ cm^2$

$= 33000\ cm^2 = 3.3\ m^2$

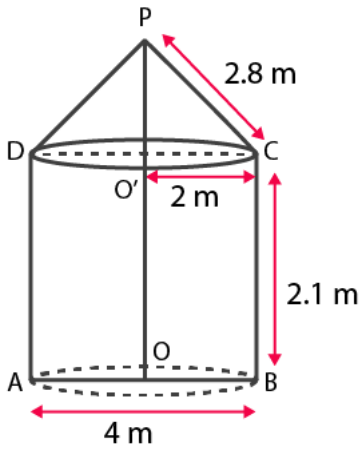
Ans 3

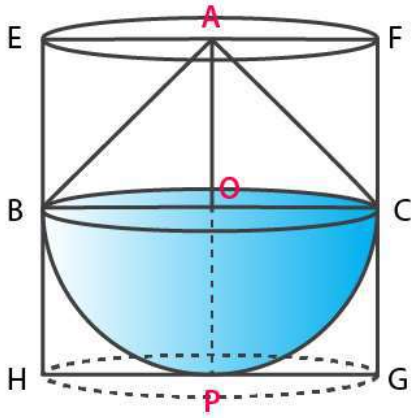
The diagram will obtain as below:



Given,

The Volume (V) of each cube is = 64 cm^3

	This implies that $a^3 = 64\ cm^3$ ∴ The side of the cube, i.e. a = 4 cm Also, the breadth and length of the resulting cuboid will be 4 cm each while its height will be 8 cm. So, the surface area of the cuboid (TSA) = 2(lb + bh + lh) Now, by putting the values, we get, $= 2(8\times4 + 4\times4 + 4\times8)\ cm^2$ $= (2 \times 80)\ cm^2$ Hence, TSA of the cuboid = $160\ cm^2$
Ans 4	It is known that a tent is a combination of a cone and a cylinder, as shown below.  From the question, we know that The diameter = D = 4 m l = 2.8 m (slant height) The radius of the cylinder is equal to the radius of the cylinder So, r = 4/2 = 2 m Also, we know the height of the cylinder (h) is 2.1 m

	So, the required surface area of the given tent = surface area of the cone (the top) + surface area of the cylinder (the base) $= \pi rl + 2\pi rh$ $= \pi r (l+2h)$ Now, substituting the values and solving it we get the value as 44 m^2 ∴ The cost of the canvas at the rate of Rs. 500 per m^2 for the tent will be = Surface area × cost/ m^2 = 44 × 500 So, Rs. 22000 will be the total cost of the canvas.
Ans 5	 Let BPC be the hemisphere and ABC be the cone standing on the base of the hemisphere as shown in the above figure. The radius BO of the hemisphere (as well as of the cone) =(½) × 4 cm = 2 cm. So, volume of the toy = (⅔) πr^3 + (⅓) $\pi r^2 h$ = (⅔) × 3.14 × 2^3 + (⅓)× 3.14 × 2^2 × 2 = 25.12 cm^3 Now, let the right circular cylinder EFGH circumscribe the given solid.

	The radius of the base of the right circular cylinder = HP = BO = 2 cm, and its height is EH = AO + OP = (2 + 2) cm = 4 cm So, the volume required = volume of the right circular cylinder – the volume of the toy = $(3.14 \times 2^2 \times 4 - 25.12)$ cm^3 = 25.12 cm^3 Hence, the required difference between the two volumes = 25.12 cm^3
Ans6	The volume of water in the overhead tank equals the volume of the water removed from the sump. Now, the volume of water in the overhead tank (cylinder) = $\pi r^2 h$ = $3.14 \times 0.6 \times 0.6 \times 0.95$ m^3 The volume of water in the sump when full = $l \times b \times h = 1.57 \times 1.44 \times 0.95$ m^3 The volume of water left in the sump after filling the tank = $[(1.57 \times 1.44 \times 0.95) - (3.14 \times 0.6 \times 0.6 \times 0.95)]$ $m^3 = (1.57 \times 0.6 \times 0.6 \times 0.95 \times 2)$ m^3 Height of the water left in the sump = (volume of water left in the sump)/ $(l \times b)$ = $(1.57 \times 0.6 \times 0.6 \times 0.95 \times 2)/ (1.57 \times 1.44)$ = 0.475 m = 47.5 cm Capacity of tank / Capacity of sump = $(3.14 \times 0.6 \times 0.6 \times 0.95)/ (1.57 \times 1.44 \times 0.95)$ = 1/ 2

	Therefore, the capacity of the tank is half the capacity of the sump.
Ans7	For Sphere 1: Radius (r_1) = 6 cm ∴ Volume (V_1) = (4/3) × π× r_1^3 For Sphere 2: Radius (r_2) = 8 cm ∴ Volume (V_2) = (4/3) × π × r_2^3 For Sphere 3: Radius (r_3) = 10 cm ∴ Volume (V_3) = (4/3) × π× r_3^3 Also, let the radius of the resulting sphere be "r" Now, Volume of resulting sphere = V_1 + V_2 + V_3 (4/3)× π× r^3 = (4/3)× π× r_1^3 + (4/3)× π× r_2^3 + (4/3) × π× r_3^3 $r^3 = 6^3 + 8^3 + 10^3$ r^3 = 1728 r = 12 cm
Ans 8	Abbreviation: CSA = Curved Surface Area TSA = Total Surface Area V = Volume Number of rounds to cover 12 cm, i.e. 120 mm = $\frac{120}{3}$ = 40 Here, Diameter = 10 cm, Radius $(r)=\frac{10}{2}$ cm Length of the wire in completing one round = $2\pi r = 2\pi \times 5 = 10\pi$ cm Length of the wire in completing 40 rounds = $10\pi \times 40 = 400\pi$ cm

	Radius of the copper wire = $\frac{3}{2}$ mm = $\frac{3}{20}$ cm $\therefore$ Volume of wire = $\pi\left(\frac{3}{20}\right)^2(400\pi)$ = 9π cm^3 $\therefore$ Mass of the wire = $9\times(3.14)^2\times8.88$ = 787.98 g
Ans 9	Volume of cistern = 150 x 120 x 110 = 1980000 cm^3 Volume of water = 129600 cm^3 $\therefore$ Volume of cistern to be filled = 1980000 – 129600 = 1850400 cm^3 Volume of a brick = 22.5 x 7.5 x 6.5 = 1096.875 cm^3 Let n bricks be needed. Then, water absorbed by n bricks = $n\times\frac{1096.875}{17}$ cm^3 $\therefore$ $n=\frac{1850400\times17}{16\times1096.875}$ = 1792 (approx.)
Ans10	. Let the radius of the sphere which fits exactly into a cube be r units. Then length of each edge of cube = 2r units Let V_1 and V_2 be the volumes of the cube and sphere Then $V_1=(2r)^3$ $V_2=\frac{4}{3}\pi r^3$ $\frac{V_1}{V_2}=\frac{8r^3}{\frac{4}{3}\pi r^3}=\frac{6}{\pi}$ $V_1:V_2=6:\pi$

----------X----------X----------X----------

CHAPTER: 14

STATISTICS

<table>
<tr><th></th><th>COMPETENCY BASED QUESTIONS</th></tr>
<tr><td>Q1</td><td>The median of set of 9 distinct observations is 20.5. If each of the largest 4 observations of the set is increased by 2, then the median of the new set
(a) is increased by 2
(b) is decreased by 2
(c) is two times of the original number
(d) Remains the same as that of the original set</td></tr>
<tr><td>Q2</td><td>While computing mean of grouped data, we assume that the frequencies are
(a) evenly distributed over all the classes
(b) centred at the classmarks of the classes
(c) centred at the upper limits of the classes
(d) centred at the lower limits of the classes</td></tr>
<tr><td>Q3</td><td>Amit grows cucumbers in his farm. He collects some of them and measures their lengths and represents his data.

<table><tr><th>Length (in mm)</th><th>Number of cucumbers</th></tr><tr><td>110 – 120</td><td>10</td></tr><tr><td>120 – 130</td><td>18</td></tr><tr><td>130 – 140</td><td>12</td></tr><tr><td>140 – 150</td><td>n</td></tr><tr><td>150 – 160</td><td>26</td></tr><tr><td>160 – 170</td><td>11</td></tr><tr><td>170 – 180</td><td>19</td></tr></table>
When calculated using assumed mean method, Amit gets the mean length of the cucumber as 147.25 cm.

Which of the following statement is true?

(a) There are a smaller number of cucumbers of length (140 – 150) mm than of length (120 – 130) mm.
(b) There are a smaller number of cucumbers of length (140 – 150) mm than of length (170 – 180) mm.</td></tr>
</table>

(c) There are a greater number of cucumbers of length (140 – 150) mm than of length (150 – 160) mm.

(d) There are a greater number of cucumbers of length (140 – 150) mm than of length (130 – 140) mm

Q4 The times, in seconds, taken by 150 athletes to run a 110 m hurdle race are tabulated below:

Class	13.8-14	14-14.2	14.2-14.4	14.4-14.6	14.6-14.8	14.8-15
Frequency	2	4	5	71	48	20

The number of athletes who completed the race in less then 14.6 seconds is

(a)11 (b)71 (c)82 (d) 130

Q 5 In a frequency distribution, the mid value of a class is 10 and the width of the class is 6. The lower limit of the class is :

(A) 6 (B) 7 (C) 8 (D) 12

Q 6 The class marks of a frequency distribution are given as follows :

15, 20, 25, ...

The class corresponding to the class mark 20 is :

a. 12.5 - 17.5 b. 17.5 - 22.5

c. 18.5 - 21.5 d. 19.5 - 20.5

Q 7 There are 50 numbers. Each number is subtracted from 53 and the mean of the numbers so obtained is found to be –3.5.

The mean of the given numbers is :

(A) 46.5 (B) 49.5 (C) 53.5 (D) 56.5

Q 8	The relationship between mean, median and mode for a moderately skewed distribution is a) mode = median – 2 mean (b) mode = 3 median – 2 mean (c) mode = 2 median – 3 mean (d) mode = median – mean
Q 9	A car travels from city A to city B, 120 km apart at an average speed of 50 km/h. It then makes a return trip at an average speed of 60 km/h. It covers another 120 km distance at an average speed of 40 km/h. The average speed over the entire 360 km will be (a) 50km/h (b) 120km/h (c) $\frac{1800}{37}$ km/h (d) None of these
Q10	Let m be the mid-point and l be the upper class limit of a class in a continuous frequency distribution. The lower class limit of the class is : (A) 2m + l (B) 2m – l (C) m – l (D) m – 2l
	CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
Q.1	Transport department of a city wants to buy some Electric buses for the city. For which they wants to analyse the distance travelled by existing public transport buses in a day. 

	The following data shows the distance travelled by 60 existing public transport buses in a day. Daily distance travelled (in km): 200-209 | 210-219 | 220-229 | 230-239 | 240-249 Number of buses: 4 | 14 | 26 | 10 | 6 Based on the above information, answer the following questions.
(i)	The upper limit of a class and lower limit of its succeeding class is differ by a. 9 b. 1 c.10 d. None of these
(ii)	The median class is (a) 229.5239.5 (b) 230-239 (c) 220-229 (d) 219.5-229.5
(iii)	The median of the distance travelled is (a) 222 km (b) 225 km (c) 223 km (d) none of these
(iv)	If the mode of the distance travelled is 223.78 km, then mean of the distance travelled by the bus is (a) 225 km (b) 220 km (c) 230.29 km (d) 224.29 km
Q .2	An electric scooter manufacturing company wants to declare the mileage of their electric scooters. For this, they recorded the mileage (km/ charge) of 50 scooters of the same model. Details of which are given in the following table. Mileage (km/charge): 100-120 | 120-140 | 140-160 | 160-180 Number of scooters: 7 | 12 | 18 | 13

<table>
<tr><td></td><td> 
Based on the above information, answer the following questions.</td></tr>
<tr><td>(i)</td><td>The average mileage is

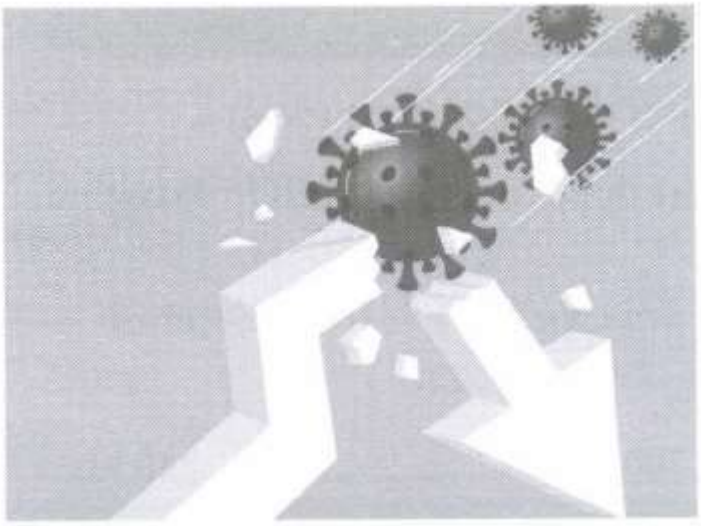
a. 140km/crg b.150km/crg c.130km/crg d. 144.8km/crg</td></tr>
<tr><td>(ii)</td><td>The modal value of the given data is

(a) 150 (b) 150.91 (c) 145.6 (d) 140.9</td></tr>
<tr><td>(iii)</td><td>The median value of the given data is

(a) 140 (b) 146.67 (c) 130 (d) 136.6</td></tr>
<tr><td>(iv)</td><td>Assumed mean method is useful in determining the

(a) Mean (b) Median (c) Mode (d) All of these</td></tr>
<tr><td>(v)</td><td>The manufacturer can claim that the mileage for his scooter is

a.144km/crg b. 155km/crg c. 165km/crg d. 175km/crg</td></tr>
<tr><td>Q .3</td><td>Household income in India was drastically impacted due to the COVID-19 lockdown. Most of the companies decided to bring down the salaries of the employees by 50%.
The following table shows the salaries (in percent) received by 25 employees during lockdown.
<table><tr><td>Salaries received (in percent)</td><td>50-60</td><td>60-70</td><td>70-80</td><td>80-90</td></tr><tr><td>Number of employees</td><td>9</td><td>6</td><td>8</td><td>2</td></tr></table></td></tr>
</table>

	 Based on the above information, answer the following questions.
(i)	Total number of persons whose salary is reduced by more than 30%, is (a) 10 (b) 20 (c) 25 (d) 15
(ii)	Total number of persons whose salary is reduced by utmost 40%, is (a) 15 (b) 10 (c) 16 (d) 8
(iii)	The modal class is a.50-60 b.60-70 c.70-80 d.80-90
(iv)	The median class of the given data is a.50-60 b.60-70 c.70-80 d.80-90
(v)	The empirical relationship between mean, median and mode is a. 3 Median = Mode + 2 Mean b. 3 Median = Mode - 2 Mean c. Median = 3 Mode - 2 Mean d. Median = 3 Mode + 2 Mean
Q .4	COVID-19 Pandemic The COVID-19 pandemic, also known as coronavirus pandemic, is an ongoing pandemic of coronavirus disease caused by the transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) among humans.

The following tables shows the age distribution of case admitted during a day in two different hospitals

Table 1

Age (in years)	5-15	15-25	25-35	35-45	45-55	55-65
No. of cases	6	11	21	23	14	5

Table 2

Age (in years)	5-15	15-25	25-35	35-45	45-55	55-65
No. of cases	8	16	10	42	24	12

(i) Refer to table 1

The average age for which maximum cases occurred is

a) 32.24 b) 34.36 c) 36.82 d) 42.24

(ii) The upper limit of modal class is

a) 15 b) 25 c) 35 d) 45

(iii) **The mean of the given data is**

a) 26.2 b) 32.4 c) 33.5 d) 35.4

(iv) Refer to table 2

The mode of the given data is

a) 41.4 b) 48.2 c) 55.3 d)64.6

(v)	The median of the given data is a) 32.7 b) 40.2 c) 42.3 d) 48.6
Q.5	A petrol pump owner wants to analyse the daily need of diesel at the pump. For this he collected the data of vehicles visited in 1 hr. The following frequency distribution table shows the classification of the number of vehicles and quantity of diesel filled in them.

Diesel Filled (in Litres)	3-5	5-7	7-9	9-11	11-13
Number of vehicles	5	10	10	7	8

Based on the above data, answer the following questions.

(i)	Which of the following is correct? (a) If x_i and f_i are sufficiently small, then direct method is appropriate choice for calculating mean. (b) If x_i and f_i are sufficiently large, then direct method is appropriate choice for calculating mean. (c) If x_i and f_i are sufficiently small, then assumed mean method is appropriate choice for calculating mean. (d) None of the above.
(ii)	Average diesel required for a vehicle is (a) 8.15 litres (b) 6 litres (c) 7 litres (d) 5.5 litres
(iii)	If approximately 2000 vehicles comes daily at the petrol pump, then how much litres of diesel the pump should have? (a) 16200 litres (b) 16300 litres (c) 10600 litres (d) 15000 litres
(iv)	The sum of upper and lower limit of median class is (a) 22 (b) 10 (c) 16 (d) none of these
(v)	If the median of given data is 8litres, then mode will be equal to (a) 7.5 litres (b) 7.7 litres (c) 5.7 litres (d) 8 litres

<table>
<tr><td></td><td>OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)</td></tr>
<tr><td>Q .1</td><td>The mean of 50 numbers is 18, the new mean will be …….. if each observation is increased by 4</td></tr>
<tr><td>Q .2</td><td>The sum of deviations of a set of values {a,b,c,d,e,f,g.h.i……} n items measured from 26 is -10 and the sum of deviations of the values from 20 is 50. The value of n is …… And mean of the items is …….</td></tr>
<tr><td>Q .3</td><td>The curve drawn by taking upper limits along x-axis and cumulative frequency along y-axis is…….(less than ogive /more than ogive)</td></tr>
<tr><td>Q .4</td><td>he mean of five numbers is 40. If one number is excluded, their mean becomes 28. The excluded number is…….</td></tr>
<tr><td>Q .5</td><td>The mode is always one of the numbers in data. (True/False)</td></tr>
<tr><td>Q .6</td><td>The mean is one of the numbers in data. (True/False)</td></tr>
<tr><td>Q .7</td><td>The median is always one of the numbers in data. (True/False)</td></tr>
<tr><td>Q .8</td><td>The data 6, 4, 3, 8, 9, 12, 13, 9 has mean 9. (True/False)</td></tr>
<tr><td>Q .9</td><td>The abscissa of the point of intersection of the less than type and of the more than type cumulative frequency curves of a grouped data gives its</td></tr>
<tr><td>Q10</td><td>If the arithmetic mean of x, x + 3, x + 6, x + 9 and x + 12 is 10, then x = ?</td></tr>
<tr><td></td><td>SHORT ANSWER TYPE QUESTIONS</td></tr>
<tr><td>Q .1</td><td>The following table shows the weekly wages drawn by number of workers in a factory, find the median of the following data.
<table>
<tr><td>Weekly wages (in Rs.)</td><td>0-100</td><td>100-200</td><td>200-300</td><td>300-400</td><td>400-500</td></tr>
<tr><td>No. of workers</td><td>40</td><td>39</td><td>34</td><td>30</td><td>45</td></tr>
</table></td></tr>
<tr><td>Q .2</td><td>The A.M of the following distribution is 47. Determine the value of P.
<table>
<tr><td>Classes</td><td>0-20</td><td>20-40</td><td>40-60</td><td>60-80</td><td>80-100</td></tr>
<tr><td>Frequency</td><td>8</td><td>15</td><td>20</td><td>P</td><td>5</td></tr>
</table></td></tr>
</table>

Q .3 For the following distribution,

Class	0-5	5-10	10-15	15-20	20-25	
Frequency	10	15	12	20	9	

the sum of lower limits of the median class and modal class is…….

Q .4 Consider the following distribution

Marks obtained	Number of students
More than or equal to 0	63
More than or equal to 10	58
More than or equal to 20	55
More than or equal to 30	51
More than or equal to 40	48
More than or equal to 50	42

the frequency of the class 30-40 is?

Q .5 Find the median of the following data:

Marks	Frequency
Less than 10	0
Less than 30	10
Less than 50	25
Less than 70	43
Less than 90	65
Less than 110	87
Less than 130	96
Less than 150	100

Q 6 The class marks of a frequency distribution are 104,114,124,134,144,154,164. Find the class size and class intervals.

Q 7 Find the mean of the following distribution

x	5	10	15	20	25
f	4	12	20	28	36

Q 8 The mean weight per student in a group of 7 students is 55 kg. The individual weights of 6 of them in kg are 52, 54, 55, 53, 56, 54. Find the weight of the seventh student.

Q 9 Given are the scores (out of 25) of 9 students in a Monday test : 14, 25, 17, 22, 20, 19, 10, 8 and 23 Find the mean score and median score of the data.

Q 10 Obtain the mean of the following distribution and also find the mode.

Marks obtained (out of 60)	5	15	20	35	40	45	50	60
No. of students	7	10	6	8	12	3	5	4

LONG ANSWER TYPE QUESTIONS

Q 1 Following table shows the daily pocket allowances given to the children of a multi-story building. The mean of the pocket allowances is Rs. 18. Find out the missing frequency.

Class Interval	11-13	13-15	15-17	17-19	19-21	21-23	23-25
Frequency	3	6	9	13	?	5	4

Q 2 The percentage of marks obtained by 100 students in an examination are given below:

Marks	30-35	35-40	40-45	45-50	50-55	55-60	60-65
Frequency	14	16	18	23	18	8	3

Determine the median percentage of marks.

Q 3

The following frequency distribution gives the monthly consumption of electricity of 68 consumers of a locality.

Monthly consumption (in units)	Number of consumers
65 – 85	4
85-105	5
105-125	13
125-145	20
145-165	14
165-185	8
185-205	4

Find the median, mean and mode of the data and compare them.

Q 4

In a retail market, fruit vendors were selling mangoes kept in packing boxes. These boxes contained varying number of mangoes. The following was the distribution of mangoes according to the number of boxes.

Number of mangoes	**50 – 52**	**53 – 55**	**56 – 58**	**59 – 61**	**62 – 64**
Number of boxes	15	110	135	115	25

Find the mean number of mangoes kept in a packing box. Which method of finding the mean did you choose?

Q 5

Thirty women were examined in a hospital by a doctor and the number of heartbeats per minute was recorded and summarised as follows. Find the mean heartbeats per minute for these women, choosing a suitable method.

Number of heart beats per minute	65-68	68-71	71-74	74-77	77-80	80-83	83-86
Number of women	2	4	3	8	7	4	2

Q 6

A survey regarding the heights (in cm) of 51 girls of Class X of a school was conducted and the following data were obtained:

Height (in cm)	Number of girls
Less than 140	4
Less than 145	11
Less than 150	29
Less than 155	40
Less than 160	46
Less than 165	51

Find the median height.

Q 7	If the median of a distribution given below is 28.5 then, find the value of an x &y.

Class Interval	Frequency
0-10	5
10-20	X
20-30	20
30-40	15
40-50	Y
50-60	5
Total	60

Q 8	The following table shows the distribution of weights of 100 candidates appearing for a competition. Determine the modal weight.

Weight (in kg)	50–55	55–60	60–65	65–70	70–75	75–80
No. of candidates	13	18	45	16	6	2

Q 9	The following data gives the information on the observed lifetimes (in hours) of 225 electrical components:

Lifetimes (in hours)	0 – 20	20 – 40	40 – 60	60 – 80	80 – 100	100 – 120
Frequency	10	35	52	61	38	29

Determine the modal lifetimes of the components.

Q 10	A student noted the number of cars passing through a spot on a road for 100 periods each of 3 minutes and summarized it in the table given below. Find the mode of the data:

Number of cars	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80
Frequency	7	14	13	12	20	11	15	8

CHAPTER: 14

STATISTICS

SOLUTION OF THE PROBLEM

	SOLUTIONS TO COMPETENCY BASED QUESTIONS
Ans 1	(d) Remains the same as that of the original set. Hint: No. of observations = 9 ∴ median = 5th observation ∵ The largest four observations are increased ∴ 5th observation remains unchanged.
Ans 2	(b) centred at the classmarks of the classes
Ans 3	Option d is correct
Ans 4	(c) 82 Explanation: The number of athletes who completed the race in less than 14.6 seconds = 2 + 4 + 5 + 71 = 82
Ans 5	Consider x and y as the upper and lower class limit in a frequency distribution. It is given that Mid value of a class=10 $(x + y)/2 = 10$ By cross multiplication $x + y = 20$ …. (1) Width of a class=6 $x - y = 6$ …. (2) By adding both the equations

	2x = 20 + 6 2x = 26 (Dividing both sides by 2) x = 13 Substitute x value in equation (1) 13 + y = 20 y = 20 – 13 ,y = 7 Therefore, the lower limit of the class is 7.
Ans 6	We know that Width = 5 Class marks = 20 We can calculate Lower limit = 20 - 5/2= (40 - 5)/2= 35/2= 17.5 In the same way Upper limit = 20 + 5/2= (40 + 5)/2= 45/2= 22.5 Therefore, the class corresponding to the class mark 20 is 17.5 - 22.5.
Ans 7	Correct option is B) ⇒ Total observation is 50 ⇒ Let sum of 50 number be x ∴ $\frac{x-(50\times53)}{50}=-3.5$ ∴ $x-2650=-3.5\times50$ ∴ $x-2650=-175$ ∴ $x=-175+2650$ ∴ $x=2475$ ⇒ Original mean = $\frac{2475}{50}$ =49.5

<table>
<tr><td>Ans 8</td><td>(b) mode = 3 median – 2 mean</td></tr>
<tr><td>Ans 9</td><td>Answer: c</td></tr>
<tr><td>Ans 10</td><td>Correct option is B)

Let a be lower class limit, l is the upper class limit and m is the mid-point
then, mid-point m= $\frac{a+1}{2}$
Therefore, a=2m−l</td></tr>
<tr><td></td><td>SOLUTIONS TO CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS</td></tr>
<tr><td>Ans 1</td><td>(i) (b): The upper limit of a class and the lower class of its succeeding class differ by 1.
(ii) (d) : Here, class intervals are in inclusive form. So, we first convert them in exclusive form. The frequency distribution table in exclusive form is as follows:

<table>
<tr><td>Class interval</td><td>Frequency (f_i)</td><td>Cumulative frequency (c.f)</td></tr>
<tr><td>199.5-209.5</td><td>4</td><td>4</td></tr>
<tr><td>209.5-219.5</td><td>14</td><td>18</td></tr>
<tr><td>219.5-229.5</td><td>26</td><td>44</td></tr>
<tr><td>229.5-239.5</td><td>10</td><td>54</td></tr>
<tr><td>239.5-249.5</td><td>6</td><td>60</td></tr>
</table>
Here, Σfi i.e., N=60 Here, Σfi i.e., N=60
⇒N/2=30

Now, the class interval whose cumulative frequency is
just greater than 30 is 219.5 - 229.5.
∴∴ Median class is 219.5 - 229.5.
(iii) (d)
Median of the distance travelled is 224.12 km
(iv) (d): We know, Mode = 3 Median - 2 Mean</td></tr>
<tr><td>Ans 2</td><td>☐ Given frequency distribution table can be drawn as:</td></tr>
</table>

Class interval	Class mark	Frequency (f_i)	$x_i f_i$	c.f
100-120	110	7	770	7
120-140	130	12	1560	19
140-160	150	18	2700	37
160-180	170	13	2210	50
Total		50	7240	

(i) (d): Clearly, average mileage

=7240/50=144.8 km/ charge

(ii) (b)

(iii) (b) : Here N/2=50/2=25 and the corresponding class whose cumulative frequency is just greater than

25 is 140-160.

Here, l = 140, c.f = 19, h = 20 and f= 18

Median $=l+(\frac{\left(\frac{n}{2}\right)-c.f.}{f})\times h$

=146.67

(iv) (a) : Assumed mean method is useful in determining the mean.

(v) (a): Since, Mean = 144.S, Mode = 150.91 and Median = 146.67 and minimum of which is 144 approx, therefore manufacturer can claim the mileage for his scooter 144 km/charge.

Ans 3

(i) (d): Required number of persons = 9 + 6 = 15

(ii) (c): Required number of persons = 6 + 8 + 2 = 16

(iii) (a) : 50-60 is the modal class as the maximum frequency is 9.

(iv) (b) : The cumulative frequency distribution table for the given data can be drawn as :

Salaries received (in percent)	Number of employees (f_i)	Cumulative frequency c.f
50-60	9	9
60-70	6	9 + 6 = 15
70-80	8	15 + 8 = 23

	80-90	2	23 + 2 = 25
	Total	∑fi=25∑fi=25	

Here, N/2=25/2=12.5

The cumulative frequency just greater than 12.5 lies in the interval 60-70.

Hence, the median class is 60-70.

(v) (a): We know, Mode = 3 Median - 2 Mean

∴ 3 Median = Mode + 2 Mean.

Ans 4

1. c) 36.82

2. d) 45

3. d) 35.4

4. a) 41.4

5. b) 40.2

Ans 5

(i) (a): If f_i and x_i are very small, then direct method is appropriate method for calculating mean.

(ii) (a) : The frequency distribution table from the given data can be drawn as :

Class	Class mark (x_i)	Frequency f_i	f_i x_i
3-5	4	5	20
5-7	6	10	60
7-9	8	10	80
9-11	10	7	70
11-13	12	8	96
Total		40	326

∴ Mean =Σfixi/Σfi=326/40=8.15 litres

(iii) (b) : If 2000 vehicles comes daily and average quantity of diesel required for a vehicle is 8.15 litres, then total quantity of diesel

	required = 2000 x 8.15 = 16300 litres (iv) (c) : Here N=40 and N/2=20 c.f for the distribution are 5, 15,25,32,40 Now, c.f just greater than 20 is 25 which is corresponding to the class interval 7-9. So median class is 7-9. ∴∴ Required sum of upper limit and lower limit = 7 + 9 = 16 (v) (b): We know, Mode = 3 Median -2 Mean = 3(8) - 2(8.15) = 24 - 16.3 = 7.7
	SOLUTIONS TO OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
1	24
2	10,25
3	less than ogive curve
4	88
5	True
6	False
7	True
8	False
9	Median
10	4
	SOLUTIONS TO SHORT ANSWER TYPE QUESTIONS
1	We have Weekly wages (in Rs.) | No. of workers (f) | C.F

0-100	49	40
100-200	39	79
200-300	34	113
300-400	30	143
400-500	45	188
	$N=\sum f=188$	

Now $\frac{N}{2}=\frac{188}{2}=94$ and this is in 200-300 class.

$\therefore$ Median class= 200-300

Here, $l_1=200,\ c=79,\ h=100,\ f=34,\ \frac{N}{2}=94$

We know that $Me=l_1+\frac{\frac{N}{2}-c}{F}\times h$

$=200+\frac{94-79}{34}\times 100$

$=200+\frac{1500}{34}$

$=200+\frac{750}{17}\Rightarrow 200+14.12$

$=244.12$

2. We have

Class Interval	Mid-value (x_i)	Frequency (f_i)	f_ix_i
0-20	10	8	80
20-40	30	15	450
40-60	50	20	1000
60-80	70	P	70P
80-100	90	5	450
		$\sum f_i=48+P$	$\sum f_ix_i=1980+70P$

	Since Mean, $\bar{x}=\frac{\sum f_i x_i}{\sum f_i}$ $\Rightarrow 47=\frac{1980+70P}{48+P}$ $\Rightarrow 2256+47P=1980+70P$ $\Rightarrow 70P-47P=2250-1980$ $\Rightarrow 23P=276$ $\Rightarrow P=\frac{276}{23}=12$ Thus, P = 12
3	C.F.=66, now N/2=33, which lies in the interval 10-15 therefore lower limit of the median class is 10. The highest frequency is 20. which lies in the interval 15-20. Therefore lower limit of modal class is 15. Hence required sum is 10+15=25.
4	Frequency in the class interval 30-40 is 3
5	76.36
6	Since the class marks are equally spaced. Class size = 114 – 104 = 10 If a is a class mark and h is size of class interval, then lower limit and upper limit of the class interval are $a-\frac{h}{2}$ and $a+\frac{h}{2}$ respectively. $\therefore$ We have $h = 10$ $\therefore$ Lower limit of first class interval $= 104-\frac{10}{2}=99$ Upper limit of first class interval $= 104+\frac{10}{2}=109$ $\therefore$ First class interval is 99 – 109 Hence, the class intervals are 99 – 109, 109 – 119, 119 – 129, 129 – 139, 139 – 149, 149 – 159, 159 – 169.
7	mean $(\bar{x}) = \frac{\Sigma fx}{\Sigma f}$ $= \frac{1900}{100} = 19$
8	61kg
9	Mean score 17.5

	Median 19 marks
10	Mean 30.73 Mode 40 marks
	SOLUTIONS TO LONG ANSWER TYPE QUESTIONS
1	Let the missing frequency = f, we have

Class interval	f_i	Mid-value	$u_i = \frac{x_i - a}{h} = \frac{x_i - 18}{2}$	f_iu_i
11-13	3	12	-3	-9
13-15	6	14	-2	-12
15-17	9	16	-1	-9
17-19	13	18	0	0
19-21	F	20	1	F
21-32	5	22	2	10
23-25	4	24	3	12
	$\sum f_i = 40 + f$			$\sum f_iu_i = f - 8$

Let assumed mean a = 18, Here h = 2

We know that mean $\bar{x} = a + \frac{\sum fixi}{\sum fi} \times h$

$\Rightarrow 18 = 18 + \frac{(f-8)}{40+f} \times 2$

$\Rightarrow 0 = f - 8$

$\Rightarrow f = 8$

Hence, missing frequency = 8

2

Class interval	Mid-value (x_i)	Frequency (f_i)	Deviation $d_i = x_i - a$	Product (f_id_i)
0-4	2	2	-12	-24
4-8	6	5	-8	-40
8-12	10	8	-4	-32
12-16	14	16	0	0

	16-20	18	14	4	56
	20-24	22	10	8	80
	24-28	26	8	12	96
	28-32	30	3	16	48
	Total		$\sum f_i = 66$		$\sum f_i d_i = 184$

We know that Mean $\bar{x} = a + \frac{\sum f_i d_i}{\sum f_i}$

$= 14 + \frac{184}{66}$

$= 14 + 2.866$

$= 16.866$

Therefore $\frac{n}{2} = 50$, which lies in the class 45-50

l_1(The lower limit of the median class) = 45

c(The cumulative frequency of the class preceding the median class) = 48

f(The frequency of the Median class)= 23

h(The class size) = 5

Median $= l_1 + \left[\frac{\frac{n}{2} - c}{f}\right] h$

$= 45 + \left(\frac{50 - 48}{23}\right) \times 5$

$= 45 + \frac{10}{23} = 45.4$

So, the median percentage of marks is 45.4

3	To find the class marks, the following relation is used. Taking 135 as assumed mean (a), di, ui, fiui are calculated according to step deviation

Monthly consumption (in units)	Number of consumers (f_i)	x_i class mark	$d_i = x_i - 135$	$u_i = \frac{d_i}{h}$	$f_i u_i$
65 – 85	4	75	– 60	– 3	–12
85 – 105	5	95	– 40	– 2	– 10
105 – 125	13	115	– 20	– 1	– 13
125 – 145	20	135	0	0	0
145 – 165	14	155	20	1	14
165 – 185	8	175	40	2	16
185 – 205	4	195	60	3	12
Total	68				7

$\sum f_i u_i = 7$

$\sum f_i = 68$

Class size $(h) = 20$

Mean, $\bar{x} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) \times h$

$= 135 + \frac{7}{68} \times 20$

$= 135 + \frac{140}{68}$

$= 137.058$

Mode -135.76

Median-137

4

It can be observed that class intervals are not continuous. There is a gap of 1 between two class intervals. Therefore, 1/2 has to be added to the upper class limit and 1/2 has to be subtracted from the lower class limit of each interval. Class size (h) of this data = 3 Taking 57 as assumed mean (a), di, ui, fiui are calculated as follows.

Class interval	f_i	x_i	$d_i = x_i - 57$	$u_i = \frac{di}{3}$	$f_i u_i$
49.5 – 52.5	15	51	– 6	– 2	– 30
52.5 – 55.5	110	54	– 3	– 1	– 110
55.5 – 58.5	135	57	0	0	0
58.5 – 61.5	115	60	3	1	115
61.5 – 64.5	25	63	6	2	50
Total	400				25

$\sum f_i = 400$

$\sum f_i u_i = 25$

$$\text{Mean, } \bar{x} = a + \left(\frac{\sum f_i u_i}{\sum f_i}\right) \times h$$

$$= 57 + \left(\frac{25}{400}\right) \times 3$$

$$= 57 + \frac{3}{16} = 57 + 0.1875$$

$$= 57.1875$$

$$= 57.19$$

5

From the given data, let us assume the mean as A = 75.5

x_i = (Upper limit + Lower limit)/2

Class size (h) = 3

Now, find the u_i and f_i u_i as follows:

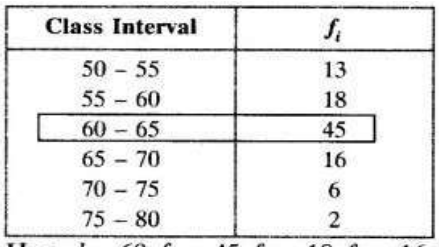
Class Interval	Number of women (f_i)	Mid-point (x_i)	$u_i = (x_i - 75.5)/h$	$f_i u_i$
65-68	2	66.5	-3	-6
68-71	4	69.5	-2	-8
71-74	3	72.5	-1	-3
74-77	8	75.5	0	0
77-80	7	78.5	1	7
80-83	4	81.5	2	8
83-86	2	84.5	3	6
	Sum f_i= 30			Sum $f_i u_i$ = 4

Mean = $\bar{x}$ = A + h$\sum f_i u_i$ /$\sum f_i$

	= 75.5 + 3×(4/30) 75.5 + 4/10 = 75.5 + 0.4 = 75.9 Therefore, the mean heartbeats per minute for these women is 75.9
6	To calculate the median height, we need to find the class intervals and their corresponding frequencies. The given distribution is of the less than type, 140, 145, 150,… ., 165 gives the upper limits of the corresponding class intervals. So, the classes should be below 140, 140 – 145, 145 – 150,… ., 160 – 165. Observe that from the given distribution, we find that there are 4 girls with height less than 140, i.e., the frequency of class interval below 140 is 4. Now, there are 11 girls with heights less than 145 and 4 girls with heights less than 140. Therefore, the number of girls with height in the interval of 140 – 145 is 11 – 4 = 7. Similarly, the frequency of 145 – 150 is 29 – 11 = 18, for 150 – 155, it is 40 – 29 = 11, and so on. So, our frequency distribution table with the given cumulative frequencies becomes:

Class intervals	Frequency	Cumulative frequency
Below 140	4	4
140-145	7	11
145-150	18	29
150-155	11	40
155-160	6	46
160-165	5	51

	Now n = 51. So, n/2 = 51/2 =25.5 This observation lies in class 145 – 150. Then, l (the lower limit) = 145, cf (the cumulative frequency of the class preceding 145 – 150) = 11, f (the frequency of the median class 145 – 150) = 18, h (the class size) = 5. Using the formula, $= l + (\frac{\frac{n}{2} - cf}{f}) \times h$ Median we have Median = 145 + 72.5/18 = 149.03. So, the median height of the girls is 149.03 cm. This means that the height of about 50% of the girls is less than this height, and 50% are taller than this height.7
7	From the given data, n = 60 Median of the given data = 28.5 Where, n/2 = 30 Median class is 20 – 30 with a cumulative frequency = 25 + x Lower limit of median class = 20, Cf = 5 + x , f = 20 & h = 10 Median =

	$= l + (\frac{\frac{n}{2} - cf}{f}) \times h$ Substitute the values 28.5=20+10(30−5−x)/20) 8.5 =(25-x)/2 17 = 25-x Therefore, x =8 Now, from cumulative frequency, we can identify the value of x + y as follows: Since, 60=5+20+15+5+x+y Now, substitute the value of x, to find y 60 = 5+20+15+5+8+y y = 60-53 y = 7 Therefore, the value of x = 8 and y = 7
8	 →Modal class interval Here, $l = 60, f_1 = 45, f_0 = 18, f_2 = 16, h = 5$ $\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h = 60 + \left(\frac{45 - 18}{2 \times 45 - 18 - 16}\right) \times 5 = 60 + \frac{135}{56} = 60 + 2.41 = 62.41$ Hence, mode = 62.41
9	From the data given above, it can be observed that the maximum class frequency is 61, belonging to class interval 60 − 80. Therefore, modal class = 60 − 80 Lower class limit (l) of modal class = 60 Frequency (f1) of modal class = 61

	Frequency (f0) of class preceding the modal class = 52 Frequency (f2) of class succeeding the modal class = 38 Class size (h) = 20 $\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h$ $= 60 + \left(\frac{61-52}{2(61)-52-38}\right)(20)$ $= 60 + \left(\frac{9}{122-90}\right)(20)$ $= 60 + \left(\frac{9 \times 20}{32}\right)$ $= 60 + \frac{90}{16} = 60 + 5.625$ $= 65.625$
10	From the given data, it can be observed that the maximum class frequency is 20, belonging to 40 – 50 class intervals. Therefore, modal class = 40 – 50 Lower limit (l) of modal class = 40 Frequency (f1) of modal class = 20 Frequency (f0) of class preceding modal class = 12 Frequency (f2) of class succeeding modal class = 11: Class size = 10 $\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h$ $= 40 + \left[\frac{20-12}{2(20)-12-11}\right] \times 10$ $= 40 + \left(\frac{80}{40-23}\right)$ $= 40 + \frac{80}{17}$ $= 40 + 4.7$ $= 44.7$

CHAPTER : 15

PROBABILITY

	CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
Q 1	Anita, Bina and Charu were fighting to get first chance in a game. 'Anita' says let us toss two coins. If both heads appear, Anita will take first chance. If both Tails appear 'Bina' will get it & if one head & one tail,'Charu' will get the first chance. 
(i)	What is the probability of 'Anita' getting the first chance? (a)1/4 (b)1/2 (c)1/3 (d)2/3
(ii)	What is the probability that 'Bina' gets the first chance? (a)1/4 (b)1/3 (c)1/2 (d)2/3
(iii)	What is the probability that 'charu' gets the first chance? (a)1/4 (b)1/3 (c)1/2 (d)2/3
Q2	Four persons are playing a bridge game forming teams each of two players. A deck of 52 playing cards is distributed around the table clockwise in such a way that each person gets 13 cards. 
(i)	Find the probability of the card drawn by each player with number 5 or 6. (a)2/13 (b) 11/13 (c) 1/13 (d) 12/13

(ii)	Find the probability of the card drawn by each player with number less than 8. (a) 6/13 (b) 5/13 (c) 7/13 (d) None of these
(iii)	Find the probability of the card drawn by each player with number between 2 and 9. (a) 7/13 (b) 5/13 (c) 6/13 (d) 3/13
(iv)	What is the probability that any one person gets queen of spade? (a) 1/3 (b) 1/4 (c) 1/2 (d) 1
Q 3	A particular term insurance company has two options in the application form before issuing the policy – Smoker or Non-smoker. As a smoker has more chance of getting lung disease and death chance is comparatively higher. So premium payment is more for a smoking person. Company gives a rider plan (i.e. for some critical diseases) along with normal term plan by paying some extra premium money. In a certain time period, company issues 100 policies of which 30% are for smokers and rest for non-smoker customers. Also, half the smokers and 2/5 th of non – smoking customers have purchased a rider plan along with a normal plan.  On the basis of above information give the answers of the following questions:
(i)	Find the probability that company issues policy for a smoker with rider plan
(ii)	Find the probability that company issues policy for a non- smoker without a rider plan.
(iii)	Find the probability that company issues policy for a smoker without a rider plan .
(iv)	Find the probability that company issues policy for a non-smoker with rider plan.
(v)	Compare the chance that a policy holder (without rider plan) has lung disease or not .

Q 4	Kite flying competition was held in the nearby society ground whose dimensions are 700m by 400m.There is a triangular park of area 400-metre square in the society ground, there is also a square pond of side 40 m in the corner of the ground. if William's kite is cut by John. 
(i)	what is the probability that the kite of William fall in the park.
(ii)	What is the probability that kite of William fall into the pond?
(iii)	What is the probability that kite of William fall in park or pond?
(iv)	What is the probability that kite of John fall into pond?
Q 5	During the admission procedure in a school, the number of students seeking admission is more than that of the seats available in the class so that school administration decides to organize a draw so that each student has equal possibility of getting admission in the school. The following category of students applied for admission. 

Service/ Social Category.	GEN	SC	OBC	ST	EWS
1	60	40	25	12	00
2	45	15	18	10	00
3	20	17	12	8	12
4	18	13	10	15	10
5	72	50	45	25	18
TOTAL	215	135	110	70	40

(i)	If all the admission forms are shuffled and one form is drawn randomly, what is the probability that an OBC student belonging to either of the categories 1,2,3 or 4 will get admission?
(ii)	If SC and ST category's admission forms are shuffled and one form is drawn randomly, what is the probability that student from service category 1either SC or ST will get admission?
(iii)	If General, SC, OBC and ST category's admission forms are shuffled and one form is drawn randomly, what is the probability that student from category-1 will get admission ?
(iv)	If EWS, SC and ST category's admission forms are shuffled and one form is drawn randomly, what is the probability that student either SC or EWS student from category-3 will get admission?
(v)	If General, SC, OBC and ST category's admission forms are shuffled and one form is drawn randomly, what is the probability that a student of EWS category will get admission?
	COMPETENCY BASED QUESTIONS (MCQs)
Q 1.	A ticket is drawn at random from a bag containing tickets numbered from 1 to 40. The probability that the selected ticket has a number which is a multiple of 5 is
(i)	$\frac{3}{5}$
(ii)	$\frac{1}{5}$
(iii)	$\frac{1}{3}$
(iv)	$\frac{4}{5}$
Q2	A lot consists of 144 ball pens of which 20 are defective and the others are good. Tanu will buy a pen if it is good but will not buy if it is defective. The shopkeeper draws one pen at random and gives it to her. The probability that she will buy that pen is
(i)	$\frac{5}{36}$
(ii)	$\frac{20}{36}$
(iii)	$\frac{31}{36}$
(iv)	$\frac{31}{144}$
Q 3.	A child has a die whose six faces show the letters as given below:

	<table><tr><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td></tr></table> The die is thrown once. The probability of getting a 'D' is
(i)	$\frac{1}{2}$
(ii)	$\frac{1}{3}$
(iii)	$\frac{1}{4}$
(iv)	$\frac{1}{6}$
Q4.	A girl calculates that the probability of her winning the first prize in a lottery is $\frac{8}{100}$. If 6,000 tickets are sold, how many tickets has she bought?
(i)	400
(ii)	750
(iii)	480
(iv)	240
Q5	The letters of the word SOCIETY are placed at random in a row. The probability of getting a vowel is
(i)	$\frac{1}{7}$
(ii)	$\frac{2}{7}$
(iii)	$\frac{3}{7}$
(iv)	$\frac{4}{7}$
Q6	Which of the following can be the probability of an event?
(i)	– 0.4
(ii)	1.004
(iii)	$\frac{18}{23}$
(iv)	$\frac{10}{7}$
Q7	The total events to throw three dice simultaneously is
(i)	6
(ii)	18

(iii)	81
(iv)	216
Q8	If the probability of an event is P, the probability of its complementary event will be:
(i)	P – 1
(ii)	P
(iii)	1 – p
(iv)	$1 - \frac{1}{P}$
Q9	A card is selected from a deck of 52 cards. The probability of its being a red face card is:
(i)	$\frac{3}{26}$
(ii)	$\frac{3}{13}$
(iii)	$\frac{2}{13}$
(iv)	$\frac{1}{2}$
Q10	Two players, Sangeeta and Reshma, play a tennis match. It is known that the probability of Sangeeta winning the match is 0.62. The probability of Reshma winning the match is
(i)	0.62
(ii)	0.38
(iii)	0.58
(iv)	0.42
	OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
Q 1	In the single throw of a die , what will be the probability of getting a number which is less than 7 _____?
Q 2	A coin is tossed twice , the probability of getting atleast a head is _____ .
Q 3	In a game of shooting if a person hits a target 7 times and missed it by 28 times , then the probability that he missed the target is _____ .
Q 4	A bag contains X white balls , 15 red balls and Y black balls. A ball is drawn at random from the bag . If the probability that the drawn ball is

	white , is 4/15 and that of red ball is 1/3 , then the values of X and Y are respectively _____ .
Q 5	One card is selected from a well shuffled deck of cards . The probability that it is a red jack is _____.
Q 6	The probability of getting a doublet when two different dice are tossed together is 1/6 (True /False)
Q 7	When two different dice tossed together , probability of getting a sum 10 is 5/6 (True /False) Q8. In a single throw of a pair of dice , the probability of getting a prime number on each dice is _____ .
Q 8	In a single throw of a pair of dice , the probability of getting a prime number on each dice is _____ .
Q 9	The probability expressed as a percentage of a particular occurrence can never be _____ or _____
Q 10	The probability of getting an odd number less than 3 when a die is thrown is 1/3 (True /False)
	SHORT ANSWER TYPE QUESTIONS
Q 1	The probability of selecting a red ball at random from a jar that contains only red , blue and orange balls is ¼ . The probability of selecting a blue ball at random from the same jar is 1/3 . If the jar contains 10 orange balls , find the total number of balls in the jar .
Q 2	Neha and Nisha are playing Balut game with two dice. Each has her own dice. Two different dice are thrown together. Find the probability of the number obtained: (i)even sum (ii)even product
Q 3	At the kitty party, some ladies decided to play the tambola game. They have a box with 90 cards A box contains cards, number 1 to 90. A card is drawn at random from the box. Find the probability that the selected card bear a : (1) Two digit number. (2) Perfect square number
Q 4	Ruhi's father organised a magic show in her birthday party. Various magics by magician are shown using coloured balls, Magician has a bag. That bag contains 15 white and some black balls. If the

<table>
<tr><td></td><td>probability of drawing a black ball from the bag is thrice that of drawing a white ball, find the number of black balls in the bag.</td></tr>
<tr><td>Q 5</td><td>Following are the marks obtained (Out of 50) by the students in a class
<table><tr><td>MARKS</td><td>Number of students</td></tr><tr><td>10-20</td><td>8</td></tr><tr><td>20-30</td><td>X</td></tr><tr><td>30-40</td><td>9</td></tr><tr><td>40-50</td><td>6</td></tr></table>One student from the class is selected at random. If the probability that his marks is 20 or more but less than 40, is 5/7 , then the value of x is ?</td></tr>
<tr><td>Q 6</td><td>Two coins are tossed 500 times and thw outcomes are recorded as below :
<table><tr><td>Number of tails</td><td>0</td><td>1</td><td>2</td></tr><tr><td>Frequency</td><td>120</td><td>175</td><td>205</td></tr></table>Based on this information, the probability for atleast 1 tail is ?</td></tr>
<tr><td>Q 7</td><td>In a medical examination of students of a class , the following blood groups are recorded:
<table><tr><td>Blood group</td><td>A</td><td>B</td><td>O</td><td>AB</td></tr><tr><td>Number of students</td><td>35</td><td>28</td><td>19</td><td>13</td></tr></table>A student is selected at random from the class . The probability that he/she has the blood group other than ‘O' is _____ ?</td></tr>
<tr><td>Q 8</td><td>One card is drawn from a well-shuffled deck of 52 cards. Calculate the probability that the card will
(i) be an ace,
(ii) not be an ace.</td></tr>
<tr><td>Q 9</td><td>An integer is chosen between 0 and 100. What is the probability that it is
(i) divisible by 7?
(ii) not divisible by 7?</td></tr>
<tr><td>Q 10</td><td>The probability of selecting a rotten apple randomly from a heap of 900 apples is 0.18. What is the number of rotten apples in the heap?</td></tr>
</table>

	LONG ANSWER TYPE QUESTIONS
Q 1	A bag contains 18 balls out of which x balls are red. (i) If one ball is drawn at random from the bag, what is the probability that it is not red? (ii) If 2 more red balls are put in the bag, the probability of drawing a red ball will be 9/8 times the probability of drawing a red ball in the first case. Find the value of x.
Q 2	Cards numbered 1 to 30 are put in a bag. A card is drawn at random. Find the probability that the drawn card is (i) prime number>7 (ii) not a perfect square.
Q 3	Two different dice are thrown together. Find the probability that the numbers obtained. (i)Have a sum less than 7. (ii) Have a product less than 16. (iii) Is a doublet of odd numbers.
Q 4	One card is drawn from a well shuffled deck of 52 cards. Find the probability of getting (a) Non face card (b) Black king or a Red queen (c) Spade card.
Q 5	Two dice are numbered 1, 2, 3, 4, 5, 6 and 1, 1, 2, 2, 3, 3, respectively. They are thrown, and the sum of the numbers on them is noted. Find the probability of getting each sum from 2 to 4separately.
Q 6	A card is drawn at random from a well shuffled deck of playing cards. Find the probability that the card drawn is (i) A card of spade or an ace. (ii) A black king. (iii) Neither a jack nor a king. (iv) Either a king or a queen.

Q 7	Five cards, the ten, jack, queen, king and ace of diamonds, are well shuffled with their faces downwards. One card is then picked up at random. (a) What is the probability that the drawn card is the queen? (b) If the queen is drawn and put aside, and a second card is drawn, find the probability that the second card is (i) an ace (ii) a queen.
Q 8	All the red face cards are removed from a pack of 52 playing cards. A card is drawn at random from the remaining cards, after reshuffling them. Find the probability that the drawn card is : (i) of red colour (ii) a queen (iii) an ace (iv) a face card
Q 9	Cards numbered from 11 to 60 are kept in a box. If a card is drawn at random from the box, find the probability that the number on the drawn card is: (i) an odd number (ii) a perfect square number (iii) divisible by 5 (iv) a prime number less than 20
Q 10	All the black face cards are removed from a pack of 52 playing cards. The remaining cards are well shuffled and then a card is drawn at random. Find the probability of getting a: (i) face card (ii) red card (iii) black card (iv) king

CHAPTER-15

PROBABILITY

SOLUTION OF THE PROBLEM

	SOLUTIONS TO CASE STUDIES/ SOURCE BASED INTEGRATED QUESTIONS
Ans 1	(1) ¼ (2) ¼ (3) ½
Ans2	(i)2/13 (ii)6/13 (iii) 6/13 (iv)1/4
Ans3	(i) 15/100 (ii)42/100 (iii) 15/100 (iv) 28/100 (v) 15/42
Ans4	(i)1/700 (ii)1/175 (iii)1/140 (iv) 0
Ans5	(i) 65/570 (ii)52/205 (iii) 137/450 (iv) 29/245 (v) 0
	SOLUTIONS TO COMPETENCY BASED QUESTIONS (MCQs)
Ans1	1/5
Ans2	31/36
Ans3	1/6
Ans4	480
Ans5	3/7
Ans6	$\frac{18}{23}$
Ans7	$(6)^3 = 216$
Ans8	(c) 1 – p
Ans9	(a) $\frac{3}{26}$
Ans10	(b) 0.38
	SOLUTIONS TO OBJECTIVE TYPE QUESTIONS (OTHER THAN MCQs)
Ans1	1
Ans2	¾
Ans3	4/5

Ans4	12 and 18
Ans5	1/26
Ans6	True
Ans7	False
Ans8	¼
Ans9	negative or more than 100%
Ans10	False
	SOLUTIONS TO SHORT ANSWER TYPE QUESTIONS
Ans1	24
Ans2	(i)½ (ii)3/4
Ans3	(i)81/90 (ii)9/90
Ans4	45
Ans5	26
Ans6	19/25
Ans7	4/5
Ans8	(i)1/13 (ii) 12/13
Ans9	(i) 14/99 (ii)85/99
Ans10	162
	SOLUTIONS TO LONG ANSWER TYPE QUESTIONS
Ans1	(i)1 - $\frac{x}{8}$ (ii)x= 8
Ans2	(i) 1/5 (ii)5/6
Ans3	(i)5/12 (ii) 25/36 (iii)1/12
Ans4	(a)10/13

	(b) 1/13 (c) 1/4
Ans5	1/18 ; 1/9 ; 1/6
Ans6	(i) 4/13 (ii) 1/26 (iii)11/13 (iv)2/13
Ans7	(a) 1/5 (b)(i) ¼ (ii) 0
Ans8	(i) 10/23 (ii) 1/23 (iii)2/23 (iv)3/13
Ans9	(i) ½ (ii) 2/25 (iii) 2/25 (iv) 4/25
Ans10	(i) 3/23 (ii) 13/23 (iii) 10/23 (iv)1/23

----------X----------THE END ----------X----------