



ANNUAL EXAMINATION-2023-24

Date:19-02-2024

Time: 3 hours

Class 11

MATHEMATICS MS

Max.Marks:

1.

SECTION - A		
1.	If $A = \{1,3,5\}$, how many elements $P(A)$ has (a) 8	1
2.	A =set of letters of the word DELHI B =set of letters of the word DOLL. Find $A-B$ (b) $\{E,H,I\}$	1
3.	If $P = \{1,3\}$, $Q = \{2,3,5\}$, find the number of relations from P to Q (a) 64	1
4.	If $R = \{(x, y) : x, y \in Z, x^2 + y^2 = 64\}$, then, write R in roster form (a) $R = \{(0, 8), (0, -8), (8, 0), (-8, 0)\}$	1
5.	$A = \{1,2\}$, $B = \{2,3,4\}$, $C = \{4,5\}$. Find $A \times (B \cap C)$ (d) $\{(1,4), (2,4)\}$	1
6.	Find the value of $2\sin 750^\circ \sin 150^\circ$ (c) $1/2$	1
7.	Find the radian measure of $-37^\circ 30'$ (b) $-5\pi/24$ radian	1
8.	Find the value of $\sin(-1125)$ (c) $-1/\sqrt{2}$	1
9.	Let $x, y \in R$, then $x+iy$ is a non real complex number if (d) $y \neq 0$	1
10.	If $x+iy = \sqrt{\frac{1+i}{1-i}}$, then find $x^2 + y^2$ b)	1
11.	If $-3x + 17 < -13$ then (a) $x \in (10, \infty)$	1

12.	If x, y and b are real numbers and $x < y, b < 0$, then (d) $\frac{x}{b} > \frac{y}{b}$	1
13.	$nC_{12} = nC_8$, then n is equal to (a) 20 (b) 12 (c) 6 (d) 30	1
14.	The total number of terms in the expansion of $(x + a)^{100} + (x - a)^{100}$ after simplification is (a) 50	1
15.	If in a G.P, $a_3 + a_5 = 90$ and $r = 2$, find first term of the G.P (a) $9/2$	1
16.	Evaluate $\lim_{x \rightarrow 1} \frac{\sqrt{1+x} - \sqrt{1-x}}{1+x}$ (d) $1/\sqrt{2}$	1
17.	The mean deviation of data 3, 10, 10, 4, 7, 10, 5 from the mean is (c) 2.57	1
18.	The standard deviation of data 6, 5, 9, 13, 12, 8 and 10 is (a) $\sqrt{\frac{52}{7}}$	1
19.	Assertion (A) : When a coin is tossed .Let A=event of getting head and B= event of getting tail. A and B are mutually exclusive and exhaustive Reason (R) : $A \cap B = \{\}$ and $A \cup B = S$ ANS:a	1
20.	Assertion (A) :The set of all points on the circumference of a circle is finite Reason (R) : Circle is a collection of infinite points in a plane whose distance from the centre is constant ANS: d	1
SECTION - B		
21.	Find the degree measure of the angle subtended at the centre of a circle of radius 100cm by an arc of length 22cm (use $\pi = 22/7$) ANS:12 Degree 36 minutes OR Find the value of $\cot(-15\pi/4)$. Ans: $\cot(\pi/4) = 1$	2
22.	Find the centre and radius of the circle $x^2 + y^2 - 8x + 10y - 12 = 0$ ANS: Centre (4,-5) radius = $\sqrt{53}$ OR Find the equation of the circle with centre (1,1) and radius $\sqrt{2}$ ANS: $(x-1)^2 + (y-1)^2 = 2$ $x^2 + y^2 - 2x - 2y = 0$	2

23.	Find the equation of set of points P such that $PA^2+PB^2=2K^2$, where A and B are the points (3,4,5) and (-1,3,-7)? ANS: $2X^2 + 2y^2+2z^2-4x-14y + 4z= 109 + 2k^2$	2
24.	$f(x)=\begin{cases} 2x + 3, & x \leq 0 \\ 3(x + 1), & x > 0 \end{cases}$ find $\lim_{x \rightarrow 1} f(x)$ ANS: $\lim_{x \rightarrow 1} f(x) 3(x + 1) = 6$	2
25.	Evaluate $\lim_{x \rightarrow 2} \frac{3x^2-x-10}{x^2-4}$ ANS: $\lim_{x \rightarrow 2} \frac{(x-2)(3x+5)}{(x-2)(x+2)} = 11/4$	2
SECTION C		
26.	Find the domain and range of the function $f(x)= \sqrt{9 - x^2}$ Ans: Domain [-3 , 3] Range [0,3]	3
27.	Express the following expression in the form of a+ib $\frac{(3 + i\sqrt{5})(3 - i\sqrt{5})}{(\sqrt{3} + \sqrt{2}i) - (\sqrt{3} - i\sqrt{2})}$ Ans: $\frac{7\sqrt{2}}{2} i$ <p style="text-align: center;">OR</p> Find the conjugate of $\frac{(3-2i)(2+3i)}{(1+2i)(2-i)}$ Ans: $63/25 + 16/25 i$	3
28.	Solve $\frac{x}{4} < \frac{(5x-2)}{3} - \frac{7x-3}{5}$ Ans: (4,∞) <p style="text-align: center;">OR</p> Find all pairs of consecutive odd natural numbers ,both of which are larger than 10,such that their sum is less than 40 Ans: $x > 10$ & $x < 19$ 11,13 : 13,15 : 15,17 : 17,19	3
29.	Find $(x+y)^4 + (x-y)^4$.Hence evaluate $(\sqrt{3}+\sqrt{2})^4 + (\sqrt{3}-\sqrt{2})^4$ Ans: $2x^4+ 12x^2y^2+ 2y^4$ 98	3
30.		3

	<p>Find the foci, the vertices ,the length of major axis, the length of minor axis, the eccentricity and the length of the latus rectum of the ellipse $36x^2 + 4y^2 = 144$</p> <p>Ans: $\frac{x^2}{4} + \frac{y^2}{36} = 1$, $a = 6$ $b = 2$ $c = \sqrt{32}$</p> <p>i)F(0, $\pm\sqrt{32}$) iv)4 ii)V(0, ± 6) v) $2\sqrt{2} / 3$ iii) 12 vi) 4/3</p>	
31.	<p>Find the derivative of $y = x \sin x$ using first principle</p> $= \lim_{h \rightarrow 0} \frac{(x + h)(\sin x \cos h + \cos x \sin h) - x \sin x}{h}$ $= \lim_{h \rightarrow 0} \frac{x(\sin x \cos h + \cos x \sin h) + h(\sin x \cos h + \cos x \sin h) - x \sin x}{h}$ $= \lim_{h \rightarrow 0} \frac{x \sin x \cos h + x \cos x \sin h + h(\sin x \cos h + \cos x \sin h) - x \sin x}{h}$ $= \lim_{h \rightarrow 0} \frac{x \sin x \cos h - x \sin x + x \cos x \sin h + h(\sin x \cos h + \cos x \sin h)}{h}$ $= \lim_{h \rightarrow 0} \frac{x \sin x (\cos h - 1) + x \cos x \sin h + h(\sin x \cos h + \cos x \sin h)}{h}$ $= \lim_{h \rightarrow 0} \frac{x \sin x (\cos h - 1) + x \cos x \sin h + h(\sin x \cos h + \cos x \sin h)}{h}$ $= \lim_{h \rightarrow 0} \left(\frac{x \sin x (\cos h - 1)}{h} + \frac{x \cos x \sin h}{h} + \frac{h(\sin x \cos h + \cos x \sin h)}{h} \right)$ $= \lim_{h \rightarrow 0} \frac{x \sin x (\cos h - 1)}{h} + \lim_{h \rightarrow 0} \frac{x \cos x \sin h}{h} + \lim_{h \rightarrow 0} (\sin x \cos h + \cos x \sin h)$	3

$$= -x \sin x \lim_{h \rightarrow 0} \frac{(1 - \cos h)}{h} + x \cos x \lim_{h \rightarrow 0} \frac{\sin h}{h} + \lim_{h \rightarrow 0} (\sin x \cos h + \cos x \sin h)$$

Using

$$\lim_{h \rightarrow 0} \frac{\sin h}{h} = 1 \quad \& \quad \lim_{h \rightarrow 0} \frac{(1 - \cos h)}{h} = 0$$

$$= -x \sin x (0) + x \cos x (1) + (\sin x \cos 0 + \cos x \sin 0)$$

$$= 0 + x \cos x + \sin x \times 1 + \cos x \times 0$$

$$= 0 + x \cos x + \sin x + 0$$

$$= x \cos x + \sin x$$

OR

$$b) y = \frac{\sin x + \cos x}{\sin x - \cos x}$$

find $\frac{dy}{dx}$

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

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

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

Using $(a + b)^2 = a^2 + b^2 + 2ab$

$(a - b)^2 = a^2 + b^2 - 2ab$

$$= \frac{-[(\sin^2 x + \cos^2 x - 2 \sin x \cos x) + (\sin^2 x + \cos^2 x + 2 \sin x \cos x)]}{(\sin x - \cos x)^2}$$

$$= \frac{-(2\sin^2 x + 2\cos^2 x - 0)}{(\sin x - \cos x)^2}$$

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

$$= \frac{-2(1)}{(\sin x - \cos x)^2}$$

$$= \frac{-2}{(\sin x - \cos x)^2} \quad (l)$$

SECTION D

32. Prove that $\cos 2x \cos\left(\frac{x}{2}\right) - \cos 3x \cos\left(\frac{9x}{2}\right) = \sin 5x \sin\left(\frac{5x}{2}\right)$

5

$$\cos 2x \cos \frac{x}{2}$$

Replacing x with $2x$ and y with $\frac{x}{2}$

$$= \frac{1}{2} \left(\cos \left(2x + \frac{x}{2} \right) + \cos \left(2x - \frac{x}{2} \right) \right)$$

$$= \frac{1}{2} \left(\cos \left(\frac{4x + x}{2} \right) + \cos \left(\frac{4x - x}{2} \right) \right)$$

$$= \frac{1}{2} \left(\cos \left(\frac{5x}{2} \right) + \cos \left(\frac{3x}{2} \right) \right)$$

$$\cos 3x \cos \frac{9x}{2}$$

Replacing x with $3x$ and y with $\frac{9x}{2}$

$$= \frac{1}{2} \left(\cos \left(3x + \frac{9x}{2} \right) + \cos \left(3x - \frac{9x}{2} \right) \right)$$

$$= \frac{1}{2} \left(\cos \left(\frac{6x + 9x}{2} \right) + \cos \left(\frac{6x - 9x}{2} \right) \right)$$

$$= \frac{1}{2} \left(\cos \left(\frac{15x}{2} \right) + \cos \left(\frac{-3x}{2} \right) \right)$$

$$= \frac{1}{2} \left(\cos \left(\frac{5x}{2} \right) + \cos \left(\frac{3x}{2} \right) \right) - \frac{1}{2} \left(\cos \left(\frac{15x}{2} \right) + \cos \left(\frac{3x}{2} \right) \right)$$

$$= \frac{1}{2} \left(\cos \left(\frac{5x}{2} \right) + \cos \left(\frac{3x}{2} \right) - \cos \left(\frac{15x}{2} \right) - \cos \left(\frac{3x}{2} \right) \right)$$

$$= \frac{1}{2} \left(\cos \left(\frac{5x}{2} \right) - \cos \left(\frac{15x}{2} \right) + \cos \left(\frac{3x}{2} \right) - \cos \left(\frac{3x}{2} \right) \right)$$

$$= \frac{1}{2} \left(\cos \left(\frac{5x}{2} \right) - \cos \left(\frac{15x}{2} \right) + 0 \right)$$

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$$= \frac{1}{2} \left(\cos \left(\frac{5x}{2} \right) - \cos \left(\frac{15x}{2} \right) \right)$$

$$= \frac{1}{2} \left(-2 \sin \left(\frac{\frac{5x}{2} + \frac{15x}{2}}{2} \right) \cdot \sin \left(\frac{\frac{5x}{2} - \frac{15x}{2}}{2} \right) \right)$$

$$= -\sin \left(\frac{5x + 15x}{2 \times 2} \right) \cdot \sin \left(\frac{5x - 15x}{2 \times 2} \right)$$

$$= -\sin \left(\frac{20x}{4} \right) \cdot \sin \left(\frac{-10x}{4} \right)$$

$$= -\sin(5x) \cdot \sin \left(\frac{-5x}{2} \right)$$

OR

Prove that $\cos^2 x + \cos^2 \left(x + \frac{\pi}{3} \right) + \cos^2 \left(x - \frac{\pi}{3} \right) = \frac{3}{2}$

33. Consider the points A (-2,-3) and B(1,6)
- Find the equation of the line passing through A and B
 - Find slope of above line
 - Find the equation of the line passing through (2,1) and perpendicular to AB
 - Find the foot of the above perpendicular to AB

Ans: a) $3x - y + 3 = 0$

b) $m = 3$

c) $-1/3$

d) $x = -2/5 \quad y = 9/5$

OR

Consider equation of the straight line $3x + 4y - 12 = 0$

- Reduce the equation in to intercept form

b) Find the slope of the above line
 c) Find the distance of the above line from the origin
 d) Find the distance of the above line from the line $6x+8y-18=0$

34. Find the sum of the following $7+77+777+7777+\dots$

$$= 7(1 + 11 + 111 + \dots \text{ upto } n \text{ terms})$$

Multiplying & dividing by 9

$$= \frac{7}{9}[9(1 + 11 + 111 + \dots \text{ upto } n \text{ term})]$$

$$= \frac{7}{9}[9 + 99 + 999 + 9999 + \dots \text{ upto } n \text{ terms}]$$

$$= \frac{7}{9}[(10 - 1) + (100 - 1) + (1000 - 1) + \dots \text{ upto } n \text{ terms}]$$

$$= \frac{7}{9}[(10 + 100 + 1000 + \dots n \text{ terms}) - 1 - 1 - 1 - \dots \text{ upto } n \text{ terms}]$$

$$= \frac{7}{9}[(10 + 100 + 1000 + \dots n \text{ terms}) - \underbrace{(1 + 1 + 1 + \dots \text{ upto } n \text{ terms})}_{n \text{ times}}]$$

$$= \frac{7}{9}[(10 + 100 + 1000 + \dots n \text{ terms}) - n \times 1]$$

$$= \frac{7}{9}[(10 + 100 + 1000 + \dots n \text{ terms}) - n]$$

Now substituting this value in (1)

$$\text{Sum} = \frac{7}{9}[(10 + 10^2 + 10^3 + \dots \text{ upto } n \text{ terms}) - n]$$

$$\text{Sum} = \frac{7}{9} \left[\frac{10(10^n - 1)}{9} - n \right]$$

Thus, $7, 77, 777, 7777, \dots \text{ upto } n \text{ terms} = \frac{7}{9} \left[\frac{10(10^n - 1)}{9} - n \right]$

35. The diameter of the circles (in mm) drawn in a design are given below

Diameters	33-36	37-40	41-44	45-48	49-52
No: of circles	15	17	21	22	25

Calculate the mean, variance and standard deviation of the circles

ANS: Mean = 43.5
 Variance =

	$\text{Mean } \bar{x} = A + \frac{\sum_{i=1}^5 f_i u_i}{N} \times h$ $= 42.5 + \frac{25}{100} \times 4 = 43.5$ $\text{Variance } (\sigma^2) = \frac{h^2}{N^2} \left[N \sum_{i=1}^5 f_i u_i^2 - \left(\sum_{i=1}^5 f_i u_i \right)^2 \right]$ $= \frac{16}{10000} [100 \times 199 - (25)^2]$ $= \frac{16}{10000} [19900 - 625]$ $= \frac{16}{10000} \times 19275$ $= 30.84$ <p>\therefore Standard deviation (σ) = 5.55</p>		
SECTION E			
36.	<p>Case-Study 1</p> <p>In a class, 18 students took physics, 23 students took chemistry and 24 students took mathematics. Of these 13 took both chemistry and mathematics, 12 took both physics and chemistry and 11 took both physics and mathematics. If 6 students offered all the three subjects, find:</p> <ol style="list-style-type: none"> Total no. of students in the class. 35 How many took chemistry but not mathematics. 10 How many took exactly one of the three subjects. 11 How many took only Mathematics. 6 		4
37.	<p>Case-Study 2</p> <p>How many words can be formed out of the letters of the word HEXAGON? In how many of them will all the vowels : 7!</p> <ol style="list-style-type: none"> come together? $5! \times 3! = 720$ never come together? $= 7! - 5! \times 3! = 4320$ 		4
38.	<p>Case-Study 3</p> <p>One of the 4 persons John, Rita, Aslam or Gurpreet will be promoted next month. Consequently the sample space consists of four elementary outcomes $S = \{\text{John promoted, Rita promoted, Aslam promoted, Gurpreet promoted}\}$. You are told that the chances of John's promotion is same that of Gurpreet, Rita's chances of promotion are twice as likely as John. Aslam's chances are four times that of John</p> <ol style="list-style-type: none"> What is the probability that John got promoted? $1/8$ What is the probability that Rita got promoted? $1/4$ Find the probability that either John promoted or Gurpreet promoted? $1/8 + 1/8 = 1/4$ 		4

