



LAWS OF MOTION

Q.1. The proper use of lubricants cannot reduce

velocity of the particle, the motion of the particle takes place in a plane. It follows that

- (a) velocity is constant
- (b) acceleration is constant
- (c) its Kinetic energy is constant
- (d) it moves in parabolic path

Q.11. a cylinder rolls up in an inclined plane reach some height and rolls down. (without slipping through out motions) the directions of frictional force acting on the cylinders are

- (a) up the plane while ascending and down while descending
- (b) Up in both cases
- (c) down while ascending and up while descending
- (d) down the plane in both cases

Q.12. Mark the correct statements

1. The electromagnetic force between two protons is always greater than the gravitation force.
 2. Nuclear force between two protons is greater than the electromagnetic force between them
- (a) Only 1 (b) both 1 and 2 (c) only 2 (d) neither 1 nor 2

Q.13. Identify the incorrect statement about Action and Reaction

- (a) they act on different bodies
- (b) action is cause and reaction is effect
- (c) have equal magnitude and opposite direction
- (d) action and reaction are actually forces which acts at same instant. Either can be taken as action or reaction.

Q.14. Two billiard balls A and B of mass 50 g each and moving in opposite directions with speed of 5 m/s each, collide and rebound with the same speed. If the collision lasts for 10^{-3} s , which of the following statements are true

- (a) the change in momentum of each ball is 0.25 kg m/s and the force on each ball is 250N
- (b) the impulse imparted to each ball is 0.25 kg m/s and the force on each ball is 25×10^{-5} N.

(c) the impulse imparted to each ball is 0.5 N.

(d) Impulse and change in momentum are equal and opposite.

Q.15. Two weights w and W are suspended to the two ends of a string on a frictionless pulley. When the pulley is pulled up with an acceleration g , then the tension in the string is

- (a) $(w + W)/2$ (b) $w \cdot W / (w + W)$ (c) $2 w \cdot W / (w + W)$ (d) $4 w \cdot W / (w + W)$

Q.16. Diwali rocket is ejecting 50 g of gases per second at a velocity of 400 m/s. The accelerating force on the rocket is

- (a) 22 dyne (b) 20 N (c) 20 dyne (d) zero

Q.17. Sand is being dropped on a conveyor belt at the rate of M kg/s. The force necessary to keep the belt moving with a constant velocity v m/s will be

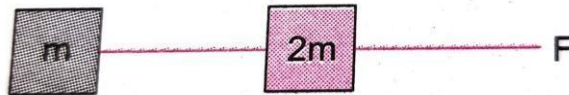
- (a) Mv (b) $2 Mv$ (c) $Mv/2$ (d) zero

Q.18. A block is kept on a frictionless inclined plane with angle of inclination x . The plane is given an acceleration a to keep the block at rest. Then a is equal to

- (a) g (b) $g \tan x$ (c) $g / \tan x$ (d) $g / \sin x$

Q.19. The tension in the string connecting the two blocks of masses m and $2m$ is

- (a) $F/3$ (b) $F/6$
(c) $F/2$ (d) $2F$



Q.20. A ball of mass 0.2 kg is thrown vertically upwards by applying a force by hand. If the hand moves 0.2 m while applying force and the ball goes upto 2m height, find the magnitude of force, take $g = 10 \text{ m/s}^2$

- (a) 4 N (b) 20N (c) 22 N (d) 16 N

Q.21. A bullet of mass 0.05 kg moving with a speed of 80 m/s enters a wooden block and is stopped after a distance of 0.40 m. the average resistive force exerted by the block on the bullet is

- (a) 300 N (b) 20 N (c) 400N (d) 40 N

Q.22. An object of mass 5 kg is attached to the hook of a spring balance and the balance is suspended vertically from the roof of a lift. The reading on the spring balance, when the lift is going up with an acceleration of 0.25 m/s^2 ($g = 10 \text{ m/s}^2$)

- (a) 51.25 N (b) 48.75 N (c) 52.75 N (d) 47.25N

Q.23. A body of mass 2 kg moves with an acceleration of 3 m/s. the change in momentum in one second is

- (a) 6 kg m/s (b) $\frac{2}{3}$ kgm/s (c) $\frac{3}{2}$ kg m/s (d) zero

Q.24. A balloon has 5 g of air. A small hole is pierced into it. The air escapes at a uniform rate with a velocity of 4 cm/s. if the balloon shrinks completely in 2.5 s, then the average force acting on the balloon is

- (a) 2 dyne (b) 2 N (c) 8 dyne (d) 8 N

Q.25. If n bullets each of mass m are fired with a velocity v per second from a gun, the force required to hold the gun in position is

- (a) nmv (b) $nmv/2$ (c) $(n+1)mv$ (d) n^2mv

Q.26- same force act on two different bodies of different masses 3 kg and 5 kg initially at rest, the ratio of time required to attain same final velocity is

- (a) 3:5 (b) 5:3 (c) 25:9 (d) 9:25

Q.27- A bullet of mass 20 g has an initial speed of 1 m/s just before it starts penetrating a mud wall of thickness 20 cm. if the wall offers a mean resistance of 2.5×10^{-2} N, the speed of the bullet after emerging from the other side of wall is close to

- (a) 0.4 m/s (b) 0.1 m/s (c) 0.3 m/s (d) 0.7 m/s

Q.28. A particle moving with velocity v is acted by three forces shown by triangle PQR. The velocity of the particle will be

- (a) increases
 (b) decreases
 (c) remains constant
 (d) change according to the smallest force



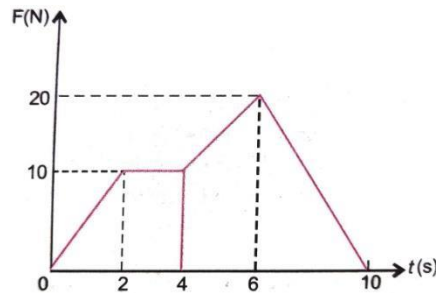
Q.29. a boy was sitting on the back of a horse. The horse suddenly started running, the boy

- (a) fell in forward direction (b) fell in backward direction
 (c) remains in the sitting position without experiencing any force

(d) None of these

Q.30. A particle of mass 2 kg is initially at rest. A force acts on it whose magnitude changes with time. The force time graph is shown below. The velocity of the particle after 10 s is

- (a) 10 m/s
 (b) 20 m/s
 (c) 26 m/s
 (d) 50 m/s



Q.31. A shell is fired from a canon with a velocity v at an angle of x with the horizontal direction. At the highest point in its path, it explodes into two pieces of equal masses. One of the pieces retraces its path to the canon. The speed of the other piece immediately after the explosion is

- (a) $3v \cos x$ (b) $v \cos x$ (c) $2v \cos x$ (d) zero

Q.32. a body is sliding down an incline plane having angle x . if the coefficient is u , the acceleration of the body down the inclined plane is

- (a) $g(\cos x - u \sin x)$ (b) $g(\sin x - u \cos x)$
 (c) $g(\sin x + u \cos x)$ (d) $g(\cos x + u \sin x)$

Q.33. A block of mass 2 kg rests on a horizontal surface. If a horizontal force of 5 N is applied on the block, coefficients of static and kinetic frictions are 0.4 and 0.2 respectively. the frictional force on it is

- (a) 20 N (b) zero (c) 8 N (d) 5 N

Q.34. A block of mass 2 kg is lying on an inclined plane, inclined to the horizontal at 30° . The coefficient of friction is 0.7, then magnitude of frictional force acting on the block will be

- (a) 1109 N (b) 11.9 N (c) 0.119 N (d) 119 N

Q.35. The coefficient of static friction between block A of mass 2 kg and table as shown in figure is 0.2. the maximum value of mass of block B so that both block are stationary is ($g = 10 \text{ m/s}^2$) and assume that string and pullies are massless and smooth.

- (a) 0.2 kg (b) 0.4 kg (c) 2.0 kg (d) 4.0 kg

Q.36. A force of 49 N is just able to move a block of mass 10 kg on a rough horizontal surface. The coefficient of friction is

- (a) 0 (b) 0.5 (c) 0.7 (d) 1

Q.37. A block of mass m is in contact with cart C as shown in the figure. The coefficient of static friction between the block and the cart is u . the acceleration a of the that will prevent the block from falling satisfies

- (a) $a > mg/u$ (b) $a > g/u$ (c) $a \geq g/u$ (d) $a < g/ u$

Q.38. Two iron blocks of equal masses but with double surface area slide down an inclined plane with friction coefficient u . If the first block with surface area A experiences a friction force f , then the second block with surface area $2 A$ will experience a frictional force

- (a) $f/2$ (b) f (c) $2f$ (d) $4f$

Q.39. A car of mass 400kg is pulling a coach of mass 300kg with a force of 4500 N . if the coefficient of friction is 0.001 , what is tension

- (a) 2100 N (b) 2126 N (c) 1933N (d) 2750 N

Q.40. A body is moving with a velocity v on a horizontal surface of coefficient of friction u . it will come to rest after moving a distance s given by

- (a) $2g/uv^2$ (b) $v^2/2ug$ (c) v^2/ug (d) $2 v^2/ug$

Q.41. A block of mass 0.1 kg is held against a wall by applying a horizontal force of 5 N on the block. If the coefficient of friction between the block and wall is 0.5 , the magnitude of frictional force acting on the block is

- (a) 2.5 N (b) 0.98 N (c) 4.9 N (d) 0.49 N

Q.42. a wheel has angular acceleration of 3.0 rad/s^2 and an initial angular speed of 2.0 rad/s . in a time of 2 s , it has rotated through an angle of

- (a) 6 rad (b) 10 rad (c) 12 rad (d) 4 rad

Q.43. a car of mass 1000 kg moves on a circular track of radius 20m . if the coefficient of friction is 0.6 , then the maximum velocity with which the car can move is

- (a) 10.8 m/s (b) 24.2 m/s (c) 15 m/s (d) 18 m/s

Q.44. When the velocity is doubled, the banking angle should be

- (a) halved (b) $\frac{1}{4}$ times (c) 4 times (d) 8 times

Q.45. The maximum velocity (in m/s) with which a car driver must traverse a flat curve of radius 150 m and coefficient of friction 0.6 to avoid skidding is

- (a) 60 (b) 30 (c) 15 (d) 25

Q.46. the motion of a rocket is based on the principle of conservation of

- (a) mass (b) kinetic energy (c) angular momentum (d) linear momentum

Q.47. Pick out the wrong statement

- (a) Newton's laws of motion hold good for both inertial and non inertial frames
(b) during explosion linear momentum is conserved
(c) area under force time graph gives the magnitude of impulse
(d) force of friction is zero when no driving force is applied.

Q.48. When a bicyclist pedals a bicycle at rest to bring in motion, the force of friction exerted by the ground on the two wheels is such that it acts

- (a) in forward direction on both wheels
(b) in backward direction on both wheels
(c) in forward direction on front wheel and backward direction on rear wheel
(d) in forward direction on rear wheel and backward direction on front wheel

Q.49. a car moves at a speed of 20 m/s on a banked road and describes an arc of a circle of radius $40\sqrt{3}$ m. The angle of banking in degrees is

- (a) 25 (b) 60 (c) 30 (d) 45

Q.50. A weight W rests on a rough horizontal surface. If the angle of friction is θ , the least force that will move the body along the surface will be

- (a) $W \cos\theta$ (b) $W \tan\theta$ (c) $W \cot\theta$ (d) $W \sin\theta$

Assertion Reasoning Questions

Directions: following 20 questions consist of two statements, each written as Assertion (A) and Reason(R). While answering these questions, you are required to choose any one of the following four responses.

- A. Both A and R are true and R is correct explanation of A
- B. A and R are true but R is not correct explanation of A
- C. A is true but R is not true
- D. A is not true but R is true

Q. 1. A: the apparent weight of body in an elevator moving with some downward acceleration is less than the actual weight of body.

R: the part of the weight is spent in producing downward acceleration when body is in elevator.

- (a) A (b) B (c) C (d) D

Q. 2. A: a horse has to pull a cart harder during the first few steps of its motion.

R: the first few steps are always difficult.

- (a) A (b) B (c) C (d) D

Q. 3. A: impulsive force is large and acts for a short time.

R: finite change in momentum should be produced by the force.

- (a) A (b) B (c) C (d) D

Q. 4. A: the driver in a vehicle moving with a constant speed on straight road is a non inertial frame of reference.

R: a reference frame, in which Newton's laws of motion are not applicable, are non inertial.

- (a) A (b) B (c) C (d) D

Q. 5. A: frictional forces are conservative forces.

R: potential energy can be associated with frictional forces.

- (a) A (b) B (c) C (d) D

Q. 6. A: a rocket moves forward by pushing the surrounding air backwards.

R: it drives the necessary thrust to move forward, according to Newton's third law of motion.

(a) A (b) B (c) C (d) D

Q. 7. A: A body remains at rest even if a number of external forces act on it.

R: external force acting on a body accelerates the body.

(a) A (b) B (c) C (d) D

Q. 8. A: the force of friction between narrow tyres and road is equal to the force of friction between the wider tyres and road.

R: force of friction opposes the relative motion of an object.

(a) A (b) B (c) C (d) D

Q. 9. A: body of mass 1 kg is making 1 revolution per second in a circle of radius 1 m. centrifugal force acting on it is $4\pi^2$ N

R: centrifugal force is given by $f = mv^2/r$

(a) A (b) B (c) C (d) D

Q. 10. A: a body can loop a vertical loop of radius r if it has a minimum velocity equal to $\sqrt{5gr}$ at the lowest point of vertical loop

R: the velocity of such a body at the highest point of vertical loop is zero.

(a) A (b) B (c) C (d) D

Q. 11. A: Impulse has the dimension of linear momentum

R: Impulse= force x time

(a) A (b) B (c) C (d) D

Q. 12. A: On a rainy day it is difficult to drive a vehicle at high speed

R: The coefficient of friction decreases due to wetting of the road.

(a) A (b) B (c) C (d) D

Q. 13. A: it is difficult to move a cycle along road with its brakes on.

R: Sliding friction is greater than rolling friction.

(a) A (b) B (c) C (d) D

Q. 14. A: Coefficient of friction between steel ice is very small.

R: steel melts ice very fast.

(a) A (b) B (c) C (d) D

Q. 15. A: Three concurrent forces acting on a body are represented by three sides of triangle taken in order.

R: the resultant of concurrent forces acting on a body is not zero.

(a) A (b) B (c) C (d) D

Q. 16. A: When a bomb explodes into two equal pieces, these two pieces fly at just right angle to each other.

R: linear momentum is conserved during explosion of bomb.

(a) A (b) B (c) C (d) D

Q. 17. A: a gun recoils when it fires a bullet.

R: action and reaction are equal and opposite and act of different objects.

(a) A (b) B (c) C (d) D

Q. 18. A: a net force acting on a body is constant, so the linear momentum of body will be constant.

R: because $f = dp/dt$

(a) A (b) B (c) C (d) D

Q. 19. A: Action and reaction forces do not cancel each other.

R: Action and reaction forces act on the same body.

(a) A (b) B (c) C (d) D

Q. 20. A: linear momentum of a body is vector quantity.

R: linear momentum has magnitude but no direction.

(a) A (b) B (c) C (d) D

Case Study based questions

PASSAGE-1

According to Newton's second law of motion, $F=ma$, where F is force required to produce an acceleration a in a body of mass m . if $a=0$, then $F=0$ i.e. no external force is required to move a body uniformly along a straight line. If a force act on a body for t seconds, the effect of force is given by impulse = $F \times t$ = change in linear momentum of body.

With the help of passage given above, chose the appropriate alternative for each of following questions:

Q.1. a cricket ball of mass 150 g is moving with a velocity of 12 m/s and is hit by a bat so that the ball is turned back with a velocity of 20m/s. if duration on contact between the ball and bat is 0.01 s the impulse of force is

- (a) 7.4 Ns (b) 4.8 Ns (c) 1.2 Ns (d) 4.7 Ns

Q.2. Average force exerted by the bat is

- (a) 480 N (b)120 N (c)1200 N (d)840 N

Q.3. The retardation of ball is

- (a) 1600 m/s² (b)320 m/s² (c)3200 m/s² (d)160 m/s²

Q.4. the force actin on the whose linear momentum changes by 20 kg m/s in 10 s is

- (a) 2 N (b)20 N (c)200 N (d)0.2 N

Q.5. An impulsive force of 100 N acts on a body for 1 s. What is the change in its linear momentum

- (a) 10 Ns (b) 100 Ns (c) 1000 Ns (d) 1 Ns

PASSAGE-2

Friction between any two surfaces in contact is the force that opposes the relative motion between them. The force of limiting friction (F) bwtween any two surfaces in contact is directly pproportional to the norma reaction R bwtween them i.e. $F \propto R$ or $F = \mu R$, where μ is coefficient of limiting friction. If x is angle of friction then $\mu = \tan x$.

With the help of passage given above, chose the appropriate alternative for each of following questions:

Q.1. the force of 49 N is just able to move a block of wood weight 10 kg on a rough horizontal surface. The coefficient of friction is

- (a) 0.5 (b) 4.9 (c) 10/49 (d) 49/9.8

Q.2. the angle of friction in the above question is

- (a) $34^{\circ} 26'$ (b) 30° (c) $26^{\circ} 34'$ (d) 45°

Q.3. What would be coefficient of friction if angle of friction is 30°

- (a) $\sqrt{3}$ (b) 5.77 (c) 1.577 (d) 0.577

Q.4. A horizontal force of 1.2 kgf is applied on a 1.5 kg block which rests on a horizontal surface. If the coefficient of friction is 0.3, force of friction is

- (a) 0.45 kgf (b) 1.2 kgf (c) 1.5 kgf (d) 0.3 kgf

Q.5. The acceleration produced in a block in the above question is

- (a) 9.8 m/s^2 (b) 0.3 m/s^2 (c) 1.5 m/s^2 (d) 4.9 m/s^2

PASSAGE-3

To verify the laws of limiting friction, we take two exactly identical rectangular blocks of wood A and B, each of same weight mg . each block is provided with a hook on one side. The block is placed on a horizontal table provided with a frictionless pulley on one side, fig 3.1. One end of a string is attached to the hook of the block. The string is then passed over the pulley and a pan is attached to the free end of the string. Any number of weights can be added to the pan.

We adjust the weights in the pan till the block just begins to move. The applied force P at this stage gives us a measure of force of limiting friction F . All blocks are similar. And all weights are similar. Carefully observe the blocks and number of weights in the pan and answer following question.

Block apply force equal to its weight on the table and in return table provides normal reaction R .

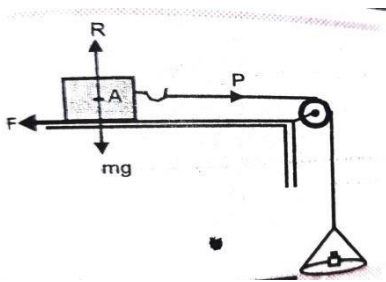


Fig. 3.1

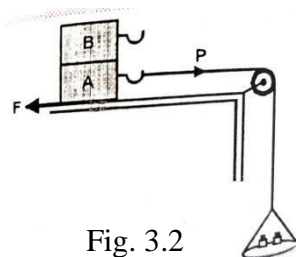


Fig. 3.2

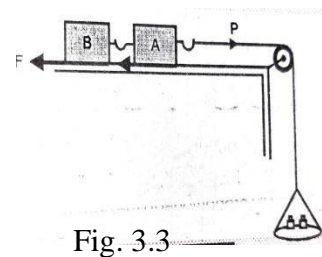


Fig. 3.3

Q. 1. Refer fig 3.1 and 3.2 it was observed that when only one block was placed, it could be just moved by placing one weight in pan and when two blocks were placed one over the other, then two weights were required to just move the blocks. This gives that

- (a) frictional force is directly proportional to the normal reaction.
- (b) frictional force is directly proportional to the square of normal reaction.
- (c) frictional force is inversely proportional to the normal reaction.
- (d) frictional force is inversely proportional to the square of normal reaction.

Q.2. It is evident from fig 3.1 and 3.2 that

- (a) $R = mg$ and $F = P$ and frictional force is directed in the direction of applied force
- (b) $R = mg$ and $F = P$ and frictional force is directed opposite to direction of applied force
- (c) $R = mg$ and $F = 1/P$ and frictional force is directed in the direction of applied force
- (d) $R = mg$ and $F = 1/P$ and frictional force is directed opposite to direction of applied force

Q.3. Refer to fig. 3.3, it was observed experimentally that same force was required to just bring the blocks in motion as it was needed in case of fig 3.2. This suggests that

- (a) force of friction is independent of the blocks
- (b) force of friction is always constant
- (c) force of friction depends on the total area of contact
- (d) force of limiting friction is independent of the apparent area of contact between the bodies, so long as the normal reaction R between them remains the same.

Q.4. Take the rectangular block A. Make one surface of A smooth and well polished and the opposite surface of A very rough. Find the force of limiting friction by putting weights when (i) rough surface is in contact with the table and (ii) when smooth surface is in contact with the table. We observe that more weight is required in case (i) than in case (ii). This suggests that

- (a) force of friction is directly proportional to the area of contact
- (b) force of friction is always equal to applied force
- (c) force of friction is independent of nature of surface
- (d) force of friction is more between rough surfaces than between smooth surfaces.

Q.5. if we take two blocks, one of wood and other of metal of same weight, Friction in either case is different. This proves that

- (a) force depends on the weight of the block
- (b) force of friction is always opposite to the applied force
- (c) force of frictions depends on the nature of material of the bodies in contact.
- (d) force of friction is directly proportional to the surface area of body.

PASSAGE-4

According to the principle of linear momentum, in an isolated system, the vector sum of linear momenta of all the bodies of the system is conserved and is not affected due to their mutual action and reaction. \vec{P} = constant.

According to *Newton's second law of motion*,
 $M \vec{a}_{c.m.}$ is equal to the external force \vec{F}

$$\therefore \text{From (22), } \frac{d\vec{P}}{dt} = \vec{F}$$

In case of an isolated system, no external force is acting on the system. i.e., $\vec{F} = 0$.

$$\text{From (23), } \frac{d\vec{P}}{dt} = 0$$

Hence $\vec{P} = \text{constant i.e.}$

$$m_1 \vec{v}_1 + m_2 \vec{v}_2 + \dots \dots m_n \vec{v}_n = \text{constant}$$

Based on this principle, we are able to explain the recoiling of a gun when a bullet is fired, flights of jet planes and rocket, Explosion on bomb etc. in all these cases if one part of system is moving one direction then the other part move in such a direction that total linear momentum may remain constant.

Based on above paragraph answer following questions:

Q.1. A stream of water flowing horizontally with a speed of 15 m/s gushes out of a tube of cross section area 0.01 m^2 , hits at a vertical wall and rebounds with same speed. What is force on the wall (density of water = 1000 kg / m^3)

- (a) 5400 N (b) 4000 N (c) 4500 N (d) 5000 N

Q.2. A gun weighing 10 kg fires a bullet of mass 30 g with a velocity of 330 m/s. with what velocity does the gun recoils?

(a) 2 m/s (b) -2 m/s (c) 0.99 m/s (d) -0.99 m/s

Q.3. a proton and an alpha particle are held at rest. Mass of alpha particle is four times the mass of proton and charge on it is twice the charge on proton. When they are released to move freely, alpha particle moves with velocity v then, the velocity of proton will be

(a) $2v$ (b) $-2v$ (c) $4v$ (d) $-4v$

Q.4. a bomb of mass m at rest explodes into two parts of masses $m/3$ and $2m/3$ which move opposite to each other. If the velocity of lighter part is v then the velocity of heavier part is

(a) $v/2$ (b) $-v/2$ (c) $v/3$ (d) $-v/3$

Q.5. a player caught a cricket ball of masses 150 g moving at the rate of 20 m/s. if the catching process is completed in 0.1 s, the force of the blow exerted by the ball on the hands of the player is

(a) 0.3 N (b) 30 N (c) 300 N (d) 3000N

Answer key

MCQs

Q.N.	ANSWER	Q.N.	ANSWER	Q.N.	ANSWER	Q.N.	ANSWER	Q.N.	ANSWER
1	b	11	b	21	c	31	a	41	B
2	b	12	b	22	a	32	b	42	B
3	c	13	b	23	a	33	d	43	A
4	d	14	c	24	c	34	b	44	C
5	d	15	d	25	a	35	b	45	B
6	b	16	b	26	a	36	b	46	D
7	b	17	a	27	d	37	c	47	A
8	a	18	b	28	c	38	b	48	D
9	a	19	a	29	b	39	c	49	C
10	c	20	c	30	d	40	b	50	B

ASSERTION REASONING

Q.N.	1	2	3	4	5	6	7	8	9	10
ANSWER	b	c	a	d	d	a	b	b	a	c
Q.N.	11	12	13	14	15	16	17	18	19	20
ANSWER	b	a	a	c	c	d	b	d	c	c

CASE STUDY BASED QUESTIONS: PASSAGE-1

Q.N.	1	2	3	4	5
ANSWER	b	a	c	a	b

PASSAGE-2

Q.N.	1	2	3	4	5
ANSWER	a	c	d	a	d

PASSAGE-3

Q.N.	1	2	3	4	5
ANSWER	a	b	d	d	d

PASSAGE-4

Q.N.	1	2	3	4	5
ANSWER	c	d	d	b	b