Objective Questions

Multiple Choice Questions:

1. According to Galileo's experiment for a double inclined plane that are smooth, when a ball is released from rest on one of the planes rolls down and climb up the other of decreased slope, the final height of the ball is
(a) less than the initial height (b) more than the initial height
(c) equal to the initial height (d) more or less than the initial height

2. Which of the Newton's laws of motion explain the concept of inertia?
(a) First law (b) Second law (c) Third law (d) All of these

3. If a running bus stops suddenly, our feet stop due to friction, but the rest of the body continues to move forward due to
(a) momentum (b) force (c) inertia (d) impulse

4. Suppose the earth suddenly stops attracting objects placed near surface. A person standing on the surface of the earth will
(a) remain standing (b) fly up (c) sink into earth (d) either (b) or (c)

5. When a car is stationary, there is no net force acting on it. During pick-up, it accelerates. This happens due to
(a) net external force (b) net internal force
(c) may be external or internal force (d) None of the above

6. A smaller and a bigger iron balls are dropped from a small height on a glass pane placed on a table. Only bigger ball breaks the glass pane, because
(a) bigger ball transfers greater momentum than smaller
(b) bigger ball transfers lesser momentum than smaller
(c) bigger ball transfer equal momentum as smaller
(d) None of the above

7. A rocket is going upwards with accelerated motion. A man sitting in it feels his weight increased 5 times his own weight. If the mass of the rocket including that of the man is 1.0×10^4 kg, how much force is being applied by rocket engine? (Take, g = $10ms^{-2}$).
(a) 5 x10^4 N (b) 5x10^5 N (c) 5 x10^8 N (d) 2 x10^4 N

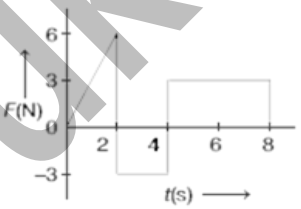
8. The motion of a particle of mass m is described by $y= ut + gt^2$ 1, find the force acting on the particle.
(a) Zero (b) mg (c) 2 mg (d) 3 mg

9. A bullet of mass 0.04 kg moving with a speed of 90 ms^{-1} enters a heavy wooden block and stopped after 3s. What is the average resistive force exerted by the block on the bullet?
(a) 1N (b) 1.2 N (c) 2 N (d) 3 N

10. A body of mass 6 kg is acted on by a force so that its velocity changes from $3ms^{-1}$ to 5 ms^{-1} , then change in momentum is
(a) 48 N-s (b) 24 N-s (c) 30 N-s (d) 12 N-s

11. A meter scale is moving with uniform velocity. This implies
(a) the force acting on the scale is zero, but a torque about the centre of mass can act on the scale
(b) the force acting on the scale is zero and the torque acting about centre of mass of the scale is also zero
(c) the total force acting on it need not be zero but the torque on it is zero
(d) Neither the force nor the torque needs to be zero

12. While launching a satellite of mass 10^4 kg, a force of 5 x 10^5 N is applied for 20s. The velocity attained by the satellite at the end of 20s, is
(a)4 km/s
(b)3 km/s
(c)1 km/s
(d)2 km/s



13. The momentum $\boldsymbol{\rho}$ (in kg-ms^{-1}) of a particle is varying with time t (in second) as $\boldsymbol{\rho}= 2 + 3t^2$. The force acting on the particle at t = 3 s will be
(a) 18 N (b) 54 N (c) 9 N (d) 15 N

14. A machine gun fires a bullet of mass 40 g with a velocity of 1200 ms^{-1} . The man holding it can exert a maximum force of 144 N on the gun. How many bullets can be fired per second at the most?
(a) Only one
(b) Three
(c) Can fire any number of bullets
(d) 144 x48

15. A cricket ball of mass 150 g has an initial velocity u = (3î + 4 ĵ) ms^{-1} and a final velocity v = — (3î + 4 ĵ) ms^{-1} , after being hit. The change in momentum (final momentum — initial momentum) is (in $kgms^{-1}$)
(a) zero (b) -(0.4 5 ĵ + 0.6 ĵ) (c)-(0.9 î+ 1.2ĵ) (d) -5 (î + ĵ) î

16. The force F acting on a particle of mass m is indicated by the force-time graph shown below. The change in momentum of the particle over the time interval from 0 to 8s is
(a) 24 N-s (b) 20 N-s (c) 12 N-s (d) 6 N-s

17. *A particle of mass m is moving in a straight line with momentum ρ. Starting at time t = 0, a force* F = kt acts in the same direction on the moving particle during time interval T, so that its momentum changes from ρ to 3ρ . Here, k is a constant. The value of $T$is
(a)$\sqrt{\frac{2\rho}{k}}$ (b) $2\sqrt{\frac{\rho}{k}}$ (c) $\sqrt{\frac{2k}{\rho}}$ (d) $2\sqrt{\frac{k}{\rho}}$

18. A constant retarding force of 50 N is applied to a body of mass 20 kg moving initially with a speed of 15 ms'. How long time does the body take to stop?
(a) 6 s (b) 8 s (c) 9 s (d) 10 s

19. A batsman hits back at ball straight in the direction of the bowler without changing its initial speed of 12 ms'. If the mass of the ball is 0.15 kg, find the impulse imparted to the ball. (Assume linear motion of the ball)
(a) 1.8 N-s (b) 3.6 N-s (c) 3.6 N-m (d) 1.8 N-m

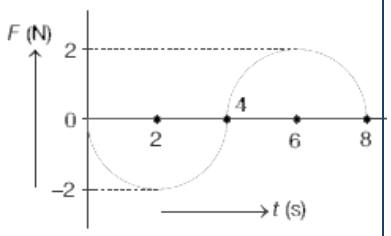
20. The force-time (*F-t*) graph for linear motion of a body initially at rest is shown in figure. The segments shown are circular, the linear momentum gained m 4 s is -2
(a) 8 N-s (b) 4πn N-s (c) 2π N-s (d) 8π N-s

21. Every action has an equal and opposite reaction, which suggests that
(a) action and reaction always act on different bodies
(b) the forces of action and reaction cancel to each other
(c) the forces of action and reaction cannot cancel to each other
(d) Both (a)and (c)

22. An initially stationary device lying on a frictionless floor explodes into two pieces and slides across the floor. One piece is moving in positive x-direction then other piece is moving in
(a) positive y-direction (b) negative y- direction
(c) negative x-direction (d) at angle from x-direction

23. A shell of mass 200 g is fired by a gun of mass 100 kg. If the muzzle speed of the shell is 80 m/s, calculate the recoil speed of the gun.
(a) 16 cm/s (b) 18 m/s (c) 4 m/s (d) 16 m/s

24. In equilibrium of particle when net external force of the particle is zero. Then, the particle is
(a) at rest
(b) moving with uniform velocity
(c) moving with uniform acceleration
(d) Both (a)and (b)



25. Two forces $F_1 = 3\,\hat{i} - 4\,\hat{j}$ and $F_2 = 2\,\hat{i} - 3\,\hat{j}$ are acting upon a body of mass 2 kg. Find the force F_3 which when acts on the body will make it stable.
(a) $5\,\hat{i} + 7\,\hat{j}$ (b) $-5\,\hat{i} - 7\,\hat{j}$ (c) $-5\,\hat{i} + 7\,\hat{j}$ (d) $5\,\hat{i} - 7\,\hat{j}$

26. Two equals forces are acting at a point with an angle of 60° between them. If the resultant force is equal to $40\sqrt{3}$ N, the magnitude of each force is
(a) 40 N (b) 20 N (c) 80 N (d) 30 N

27. A hockey player is moving northward and suddenly turns westward with the same speed to avoid an opponent. The force that acts on the player is
(a) frictional force along westward (b) muscle force along southward
(c) frictional force along south-west (d) muscle force along south-west

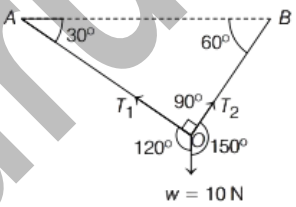
28. Three concurrent coplanar forces 1 N, 2 N and 3 N are acting along different directions on a body can keep the body in equilibrium, if

(a) 2 N and 3 N act at right angle
(b) 1N and 2 N act at acute angle
(c) 1 N and 2 N act at right angle
(d) Cannot be possible

29. Three blocks with masses m, $2m$ and $3m$ are connected by strings, as shown in the figure. After an upward force F is applied on block m, the masses move upward at constant speed v. What is the net force on the block of acceleration due to mass $2m$? (Take, g is the gravity)

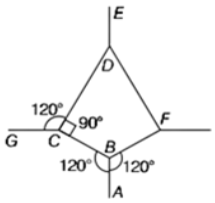
(a) Zero
(b) 2 mg
(c)3 mg
(d)6 mg

30. A ball of mass 1 kg hangs in equilibrium from a two strings OA and OB as shown in figure. What are the tensions in strings OA and OB? (Take, g = 10 ms^{-2}) A



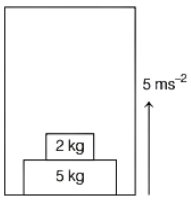
(a) 5N,5N
(b) $5\sqrt{3}$ N,$5\sqrt{3}$ N
(c) 5 N,5, $\sqrt{3}$ N
(d) 5, $\sqrt{3}$ N,5N

31. Given figure is the part of a horizontally stretched structure. Section AB is stretched with a force of 10 N. The tension in the sections BC and BF, are



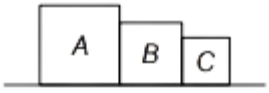
(a) 10 N. 11N
(b) 10 N, 6 N
(c) 10 N. 10 N
(d) Cannot be calculated due to insufficient data

32. Find the force exerted by 5 kg block on floor of lift, as shown in figure. (Take, g = 10ms^{-2})



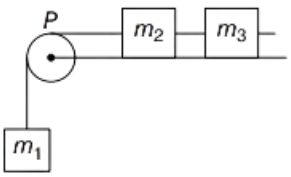
(a) 100 N
(b) 115 N
(c) 105 N
(d) 135 N

33. Three blocks A, B and C of masses 4 kg, 2 kg and 1 kg respectively, are in contact on a frictionless surface, as shown in the figure. If a force of 14 N is applied on the 4 kg block, then the contact force between A and B is



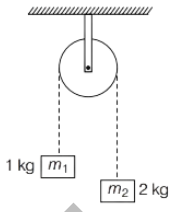
(a) 2 N
(b) 6 N
(c) 8 N
(d) 18 N

34. A system consists of three masses m_1,m_2, and m_3, connected by a string passing over a pulley P. The mass m, hangs freely and m_2 and m_3 are on a rough horizontal table (the coefficient of friction $=\mu$). The pulley is frictionless and of negligible mass. The downward acceleration of mass m_1, is (Assume, $m_1 = m_2, =m_3, = m$)



(a) $\frac{g(1-g\mu)}{g}$ (b) $\frac{2g\mu}{3}$ (c) $\frac{g(1-2\mu)}{3}$ (d) $\frac{g(1-g\mu)}{2}$

35. Two masses $m_1 = 1$ kg and $m_2 = 2$ kg are connected by a light inextensible string and suspended by means of a weightless pulley as shown in figure. Assuming that both the masses start from rest, the distance travelled by 2 kg mass in 2 s is



(a) $\frac{20}{9}$ m (b) $\frac{40}{9}$ m
(c) $\frac{20}{9}$ m (d) $\frac{1}{3}$ m

36. If a box is lying in the compartment of an accelerating train and box is stationary relative to the train. What force cause the acceleration of the box?
(a) Frictional force in the direction of train
(b) Frictional force in the opposite direction of train
(c) Force applied by air
(d) None of the above

37. A box of mass 2 kg is placed on the roof of a car. The box would remain stationary until the car attains a maximum acceleration. Coefficient of static friction between the box and the roof of the car is 0.2 and g =10 m^{-2}. The maximum acceleration of the car, for the box to remain stationary, is
(a) 8 ms^{-2} (b) 6 ms^{-2} (c) 4 ms^{-2} (d) 2 ms^{-2}

38. A car of mass m starts from rest and acquires a velocity along east, $v = v\,\hat{\imath}(v > 0)$ in two seconds. Assuming the car moves with uniform acceleration, the force exerted on the car is
(a) $\frac{mv}{2}$ as eastward and is exerted by the car engine
(b) $\frac{mv}{2}$ eastward and is due to the friction on the tyres exerted by the road
(c) more than $\frac{mv}{2}$ eastward exerted due to the engine and overcomes the friction of the road
(d) $\frac{mv}{2}$ exerted by the engine

39. A particle of mass 2 kg is moving on a circular path of radius 10 m with a speed of 5 ms^{-1} and its speed is increasing at a rate of 3 ms^{-1}. Find the force acting on the particle.
(a) 5 N (b) 10 N (c) 12 N (d) 14 N

40. Two stones of masses$m$ and $2m$ are whirled in horizontal circles, the heavier one in a radius $\frac{r}{2}$ and the lighter one in a radius r. The tangential speed of lighter stone is n times that of the value of heavier stone, when they experience same centripetal forces. The value of n is
(a) 2 (b) 3 (c) 4 (d) 1

41. If a car is moving in uniform circular motion, then what should be the value of velocity of a car, so that car will not moving away from the circle?
(a) v $< \sqrt{\mu_s Rg}$ (b) v $\leq \sqrt{\mu_s Rg}$
(c) v $< \sqrt{\mu_k Rg}$ (d) None of these

42. A person is driving a vehicle at a uniform speed of 5 ms^{-1}on a level curved track of radius 5 m. The coefficient of static friction between tyres and road is 0.1. Will the person slip while taking the turn with the same speed? (Take, g = 10 ms^{-2})
(a) A person will slip, if $V^2 = 5\ m^2 s^{-2}$

(b) A person will slip, if $V^2 > 5\ m^2s^{-2}$
(c) A person will slip, HO $V^2 < 5\ m^2s^{-2}$'
(d) A person will not slip, if $V^2 > 5\ m^2s^{-2}$

43. A circular racetrack of radius 300 m is banked at an angle of 15°. If the coefficient of friction between the wheels of the race car and the road is 0.2. Find optimum speed of the race car to avoid wear and tear on its tyres and maximum permissible speed to avoid slipping.
(Take, g = 9.8 $ms^{-2}$and tan 15° = 0.27)
(a) V_0=48 ms^{-1}, V_{max}, = 60 ms^{-1}
(b) V_0=28.1 ms^{-1}, V_{max}, = 38.1 ms^{-1}
(c) V_0=62.2 ms^{-1}, V_{max}, = 73.4 ms^{-1}
(d) None of the above

44. A car is moving in a circular horizontal track of radius 10.0 m with a constant speed of 10.0 ms^{-1}. A plumb bob is suspended from the roof of the car by a light rigid rod of length 10.0 m. The angle made by the rod with the track is (Take, g = 10 ms^{-2})
(a) zero (b) 30° (c) 45° (d) 60°

45. Inertia of an object is directly dependent on ……..
(a) impulse (b)momentum (c) mass (d)density

46. A body with mass 5kg is acted upon by a force F = $(-3\,\hat{i} + 4\,\hat{j})$ N. If its initial velocity at t = 0 is u = $(6\hat{i} — 12\hat{j})$, ms^{-1} , the time at which it will just have a velocity along the Y-axis is
(a) never (b) 10 s (c) 2 s (d) 15 s

47. If impulse I varies with time t as $F(\text{kg}ms^{-1}) = 20t^2 — 20t$. The change in momentum is minimum at
(a) t =2s (b) t =1s (c) t= $\frac{1}{2}$s (d) t= $\frac{3}{2}$s

48. The force which is dissipative in nature is ……..
(a) electrostatic force (b) magnetic force
(c) gravitational force (d) frictional force

49. Suppose a light-weight vehicle (say, a small car) and a heavy weight vehicle (say, a loaded truck) are parked on a horizontal road. Then, which of the following statement is correct?
(a) Much greater force is needed to push the truck.
(b) Equal force is needed to push the truck and car.
(c) No force is required to move the vehicles.
(d) None of the above

50. Which one of the following statements is incorrect?
(a) Frictional force opposes the relative motion.
(b) Limiting value of static friction is directly proportional to normal reaction.
(c) Rolling friction is smaller than sliding friction.
(d) Coefficient of sliding friction has dimensions of length.

51. If no external force acts on particle, then which of the following statement is incorrect about particle?
(a) Particle may be at rest.
(b) Particle moves with uniform velocity on linear path.
(c) Particle moves with uniform speed on circle.
(d) None of the above

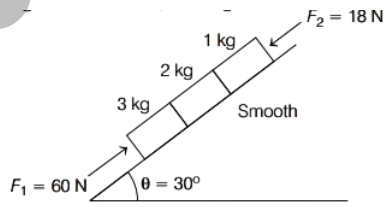
52. Match the Column **I** (type of friction) with Column **II** (value of p) and select the correct option from the codes given below.

	Column I		Column II
A.	Static friction	p.	μ is highest
B.	Rolling friction	q.	μ is moderate
C.	Kinetic friction	r.	μ is lowest

Codes

A	B	C	
(a) r	q	p	(b) P q r
(c) p	r	q	(d) q r p

53. In the diagram shown in figure, match the Column **I** with Column **II** and select the correct option from the codes given below. (Take, g = 10 ms^{-2})



	Column I		Column II
A.	Acceleration of 2 kg block	p.	8 (SI unit)
B.	Net force on 3 kg block	q.	25 (SI unit)
C.	Normal reaction between 2 kg and 1 kg	r.	2 (SI unit)
D.	Normal reaction between 3 kg and 2 kg	s.	None

Codes

A	B	C	D	
(a) r	s	q	s	
(b) r	q	s	p	
(c) P	q	r	s	
(d) p	q	q	s	

Assertion-Reasoning MCQs

For question numbers 54 to 64, two statements are given-one labeled ***Assertion (A)*** *and the other labelled* ***Reason (R).*** *Select the correct answer to these questions from the codes (a), (b), (c) and (d) are as given below*
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false and R is also false.

54. Assertion Aristotle stated that an external force is required to keep a body in motion.
Reason Opposing forces are always present in the natural world.

55. Assertion A body is momentarily at rest but no force is acting on it at that time.
Reason When a force acts on a body, it may not have some acceleration.

56. Assertion At the microscopic level, all bodies are made up of charged constituents (like nuclei and electrons) and various contact forces exist between them.
Reason These forces are due to elasticity of bodies, molecular collisions and impacts, etc.

57. Assertion If force is not parallel to the velocity of the body, but makes some angle with it, it changes the component of velocity along the direction of force.
Reason The component of velocity parallel to the force remains unchanged.

58. Assertion If we consider system of two bodies A and B as a whole, F,4„ and FA, are internal forces of the system (A + B). They add to give a null force.
Reason Internal forces in a body or a system of particles cancel away in pairs.

59. Assertion It is not always necessary that external agency of force is in contact with the object while applying force on object.
Reason A stone released from top of a building accelerates downward due to gravitational pull of the earth.

60. Assertion A seasoned cricketer allows a longer time for his hands to stop the ball, while catching the ball. His hand is not hurt.

Reason The novice (new player) keeps his hand fixed and tries to catch the ball almost instantly. He needs to provide a much greater force to stop the ball instantly and these hurts.

61. Assertion Product of distance and velocity (i.e. momentum) is basic to the effect of force on motion.
Reason Same force for same time causes the same change in momentum for different bodies.

62. Assertion Newton's third law of motion is applicable only when bodies are in motion.
Reason Newton's third law does not apply to all types of forces, e.g. gravitational, electric, or magnetic forces, etc.

63. Assertion Angle of repose is equal to angle of limiting friction.
Reason When a body is just at the point of motion, the force of friction of this stage is called as limiting friction.

64. Assertion A body of mass 1 kg is making 1 rps in a circle of radius 1 m. Centrifugal force acting on it is $4\pi^2$N. **Reason** Centrifugal force is given by F=$\frac{mv}{r}$

Case Based MCOs

Direction Answer the questions from 65-69 on the following case. Momentum and Newton's Second Law of Motion Momentum of a body is the quantity of motion possessed by the body. It depends on the mass of the body and the velocity with which it moves. When a bullet is fired by a gun, it can easily pierce human tissue before coming to rest resulting in casualty. The same bullet fired with moderate speed will not cause much damage. The greater the change in

momentum in a given time, the greater is the force that needs to be applied. The second law of motion refers to the general situation, where there is a net external force rating on the body.

65. A satellite in force-free space sweeps stationary interplanetary dust at a rate $\frac{dM}{dt}=av$, where M the mass, v is the dt velocity of satellite and a is a constant. What is the deceleration of the satellite?

(a) $\frac{-2av^2}{M}$ (b) $\frac{-av^2}{M}$ (c) $-av^2$ (d) $\frac{av^2}{M}$

66. A body of mass 5 kg is moving with velocity of v = (2 î+ 6 ĵ) ms^{-1} at $t = 0$ s. After time $t = 2$ s, velocity of body is (10 î+ 6 ĵ) ms^{-1} , then change in momentum of body is

(a) 40 î kg - ms^{-1} (b) 20 î kg - ms^{-1} (c) 30 î kg - ms^{-1} (d) (50 î + 30 ĵ) kg- ms^{-1}

67. A cricket ball of mass 0.25 kg with speed 10 m/s collides with a bat and returns with same speed with in 0.01s. The force acted on bat is

(a) 25 N (b) 50N (c) 250N (d) 500N

68. A stationary bomb explodes into three pieces. One piece of 2 kg mass moves with a velocity of 8 ms^{-1} at right angles to the other piece of mass 1 kg moving with a velocity of 12 ms^{-1} . If the mass of the third piece is 0.5 kg, then its velocity is

(a) 10ms^{-1} (b) 20ms^{-1} (c) 30 ms^{-1} (d) 40 ms^{-1}

69. A force of 10 N acts on a body of mass 0.5 kg for 0.25s starting from rest. What is its momentum now?

(a) 0.25 N/s (b) 2.5 N/s (c) 0.5 N/s (d) 0.75 N/s

Direction Answer the questions from 70-74 on the following case.

Conservation of Momentum:

This principle is a consequence of Newton's second and third laws of motion. In an isolated system (i.e. a system having no external force), mutual forces (called internal forces) between pairs of particles in the system causes momentum change in individual particles. Let a bomb be at rest, then its momentum will be zero. If the bomb explodes into two equal parts, then the parts fly off in exactly opposite directions with same speed, so that the total momentum is still zero. Here, no external force is applied on the system of particles (bomb).

70. A bullet of mass 10 g is fired from a gun of mass 1 kg with recoil velocity of gun 5 m/s. The muzzle velocity will be

(a) 30 km/min (b) 60 km/min (c) 30 m/s (d) 500 m/s

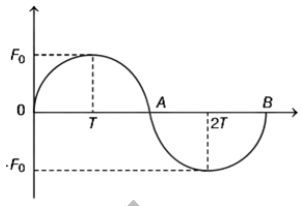
71. A shell of mass 10 kg is moving with a velocity of 10 $ms^{-1}$when it blasts and forms two parts of mass 9 kg and 1 kg respectively. If the first mass is stationary, the velocity of the second is

(a) 1 $m\ s^{-1}$ (b) l0 $m\ s^{-1}$ (c) 100 $m\ s^{-1}$ (d) 1000 $m\ s^{-1}$

72. A bullet of mass 0.1 kg is fired with a speed of 100 ms". The mass of gun being 50 kg, then the velocity of recoil becomes

(a) 0.05 $m\ s^{-1}$ (b) 0.5 $m\ s^{-1}$ (c) 0.1 ms^{-1} (d) 0.2 ms^{-1}

73. A unidirectional force F varying with time T as shown in the figure acts on a body initially at rest for a short duration $2T$. Then, the velocity acquired by the body is



(a) $\frac{\pi F_0 T}{4\,m}$ (c) $\frac{\pi F_0 T}{2\,m}$

(b) $\frac{F_0 T}{4\,m}$ (d) zero

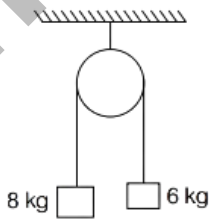
74. Two masses of M and $4M$ are moving with equal kinetic energy. The ratio of their linear momenta is

(a)1:8 (b)1:4 (c)1:2 (d)4 :1

Direction *Answer the questions from 75-79 on the following case.*

Force of Friction on Connected Bodies

When bodies are in contact, there are mutual contact forces satisfying the third law of motion. The component of contact force normal to the surfaces in contact is called normal reaction. The component parallel to the surfaces in contact is called friction. In the above figure, 8 kg and 6 kg are hanging stationary from a rough pulley and are about to move. They are stationary due to roughness of the pulley.



75. Which force is acting between pulley and rope?

(a) Gravitational force (b) Tension force

(c) Frictional force (d) Buoyant force is

76. The normal reaction acting on the

(a) 8 g (b) 6 g (c) 2 g (d) 14 g

77. The tension is more on side having

(a) 8 kg (b) 6 kg (c) Same on both (d) Nothing can be said

78. The force of friction acting on the rope

(a)20 N (b)30 N (c)40 N (d)50 N

79. Coefficient of friction of the pulley is

(a) $\frac{1}{6}$ (b) $\frac{1}{7}$ (c) $\frac{1}{5}$ (d) $\frac{1}{4}$

ANSWERS

Multiple Choice Questions:

1. (c) 2. (a) 3. (c) 4. (a) 5. (a) 6. (a) 7. (b)

8. (c) 9. (b) 10. (d) 11. (b) 12. (c) 13. (a) 14. (b) 15. (c) 16. (c) 17. (b) 18. (a) 19. (b)

20. (c) 21. (d) 22. (c) 23. (a) 24. (d) 25. (c) 26. (a) 27. (c) 28. (d) 29. (a) 30. (c) 31. (c)

32. (c) 33. (b) 34. (c) 35. (c) 36. (a) 37. (d) 38. (b) 39. (a) 40. (a) 41. (b) 42. (b) 43. (b)

44. (c) 45. (c) 46. (b) 47. (c) 48. (d) 49. (a) 50. (d) 51. (c) 52. (c) 53. (a)

Assertion-Reasoning MCQs:

54. (a) 55. (d) 56. (a) 57. (c) 58. (c) 59. (c) 60. (b)

61. (d) 62. (d) 63. (a) 64. (c)

Case Based MCQs:

65. (d) 66. (a) 67. (d) 68. (d) 69. (b) 70. (d)

71. (c) 72. (d) 73. (d) 74. (c) 75. (c) 76. (d)

77. (a) 78. (a) 79. (b)