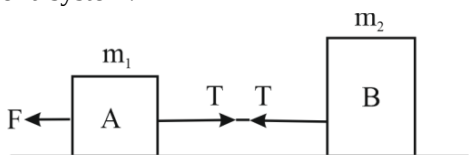
NEET UG (2024)
Physics
Quiz-11

SECTION - A

1. When a body is stationary
(1) There is no force acting on it
(2) The force acting on it is not in contact with it
(3) The combination of forces acting on it balances each other
(4) The body is in vacuum

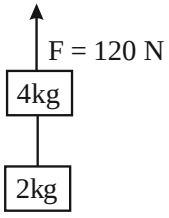
2. If a stone is thrown out of an accelerated train, then acceleration of the stone at any instant depends on
(1) Force acting on it at that instant
(2) Acceleration of the train
(3) Both (1) & (2)
(4) None of these

3. Which of the following is true about acceleration, for a system?



(1) Acceleration is more in A, when force is applied on A.
(2) Acceleration is more in B, when force is applied on B.
(3) Acceleration is same and does not depend on whether the force is applied on m_1 or m_2.
(4) Acceleration depends on the tension in the string.

4. Two blocks of masses 2 kg and 4 kg are attached by an inextensible light string as shown in the figure. If a force of 120 *N* pulls the blocks vertically upward, the tension in the string is (take g = 10 ms^{-2})

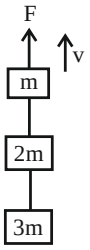


(1) 20 N (2) 15 N
(3) 35N (4) 40 N

5. A train is moving with a speed of 36 km/hour on a curved path of radius 200 m. If the distance between the rails is 1.5 m, the height of the outer rail with respect to inner rail is
(1) 1 m (2) 0.5 m
(3) 0.75 m (4) 0.075 m

6. The coefficient of static friction between two surfaces depends on
(1) The nature of the surface
(2) The shape of the surface in contact
(3) The area of contact
(4) All of above

7. 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 mass 2m (g is the acceleration due to gravity)



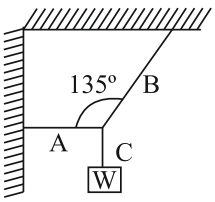
(1) 2 mg (2) 3 mg
(3) 6 mg (4) zero

8. The time required to stop a car of mass 800 kg. moving at a speed of 20 ms^{-1} over a distance of 25 m is
(1) 2 s (2) 2.5 s
(3) 4 s (4) 4.5 s

9. A particle is acted upon by a force of constant magnitude which is always perpendicular to the velocity of the particle. The motion of the particle takes place in a plane. If follows that
(1) its velocity is constant
(2) its acceleration is constant
(3) its kinetic energy is constant
(4) it moves in a straight line

10. A large force is acting on body for a short time. The impulse imparted is equal to the change in
(1) Acceleration (2) Momentum
(3) Energy (4) Force

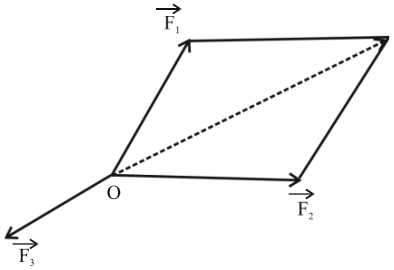
11. A block of weight W is supported by three strings as shown in figure Which of the following relation is true for tension in the strings? (Here T_1, T_2 and T_3 are the tension in the strings A, B and C respectively)



(1) $T_1=T_2$ (2) $T_1=T_3$
(3) $T_2=T_3$ (4) $T_1=T_2=T_3$

12. The same change in momentum about in *X* time needs *Y* force applied. Here, *X* and *Y* refer to
(1) longer, lesser (2) shorter, greater
(3) both (1) and (2) (4) longer, greater

13. Which equation holds true for the given figure?



(1) $\vec{F_1} - \vec{F_2} = \vec{F_3}$
(2) $\vec{F_1} + \vec{F_2} = \vec{F_3}$
(3) $\vec{F_1} + \vec{F_2} + \vec{F_3} = \vec{0}$
(4) $\vec{F_2} + \vec{F_3} = \vec{F_1}$

14. **Assertion:** Linear momentum of a body changes even when it is moving uniformly in a circle.
Reason: In uniform circular motion, velocity remains constant.
(1) Assertion is correct, reason is correct; reason is a correct explanation for assertion.
(2) Assertion is correct, reason is correct; reason is not a correct explanation for assertion.
(3) Assertion is correct, reason is incorrect.
(4) Assertion is incorrect, reason is correct.

15. When a particle is in uniform circular motion it does not have
(1) radial velocity and radial acceleration
(2) radial velocity and tangential acceleration
(3) tangential velocity and radial acceleration
(4) tangential velocity and transverse acceleration

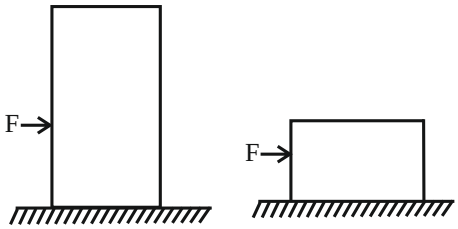
16. A particle moves in a circular orbit under the action of a central attractive force inversely proportional to the distance '*r*'. The speed of the particle is
(1) proportional to r^2
(2) independent of *r*
(3) proportional to *r*
(4) proportional to $\frac{1}{r}$

17. A particle describes uniform circular motion in a circle of radius 2 m. with the angular speed of 2 rad s^{-1}. The magnitude of the change in its velocity in $\frac{\pi}{2}$ s is
(1) 0 $m\ s^{-1}$ (2) $2\sqrt{2}\ ms^{-1}$
(3) 8 $m\ s^{-1}$ (4) 4 $m\ s^{-1}$

18. A stone of mass 2 kg is tied to a string of length 0.5 m. If the breaking tension of the string is 900 *N* then the maximum angular velocity, the stone can have in uniform circular motion is
(1) 30 rad s^{-1} (2) 20 rad s^{-1}
(3) 10 rad s^{-1} (4) 25 rad s^{-1}

19. The maximum velocity (in ms^{-1}) with which a car driver must traverse a flat curve radius 150 m and coefficient of friction 0.6 to avoid skidding is
(1) 60 (2) 30
(3) 15 (4) 25

20. A rectangular block is placed on a rough horizontal surface in two different ways as shown, then



(1) friction will be more in case (a)
(2) friction will be more in case (b)
(3) friction will be equal in both the case
(4) friction depends on the relation among its dimension

21. If the normal force is doubled, then coefficient of friction is
(1) halved (2) tripled
(3) doubled (4) not changed

22. Select the wrong statements (s) from the following.
I. Newton's laws of motion hold good for both inertial and non-inertial frames.
II. During explosion, linear momentum is conserved.
III. Force of friction is zero when no driving force applied.
(1) I only (2) II only
(3) I and II (4) II and III

23. Choose the correct statements(s) from the following.
I. Recoiling of a gun is an application of principle of conservation of linear momentum.
II. Explosion of a bomb is based on second law of motion.
(1) I only
(2) II only
(3) I and II
(4) None of these

24. A car is moving in a circular horizontal track of radius 10 m with a constant speed of 10 m/s. A bob is suspended from the roof of the car by a light wire of length 1.0 m. The angle made by the wire with the vertical is

(1) 0^o (2) $\frac{\pi}{3}$

(3) $\frac{\pi}{6}$ (4) $\frac{\pi}{4}$

25. A motorcar is moving with a velocity of 108 km/h and it takes 4 s to stop after the brakes are applied. Calculate the force exerted by the brakes on the motorcar if its mass along with the passengers is 1000 kg.

(1) –7500 (2) 8500

(3) 6500 (4) 2500

26. A particle rests on the top of a hemisphere or radius R. Find the smallest horizontal velocity that must be imparted to the particle if it is to leave the hemisphere without sliding down is

(1) $\sqrt{gR}$ (2) $\sqrt{2gR}$

(3) $\sqrt{3gR}$ (4) $\sqrt{5gR}$

27. A body whose momentum is constant must have constant

(1) velocity
(2) force
(3) acceleration
(4) All of the above

28. In an explosion, a body break up into two pieces of unequal masses. In this

(1) both parts will have numerically equal momentum
(2) lighter part will have more momentum
(3) heavier part will have more momentum
(4) both parts will have equal kinetic energy

29. The coefficient of friction between the rubber tyres and the road way is 0.25. The maximum speed with which a car can be driven round a curve of radius 20 m without skidding is (g = 10 m/s^2)

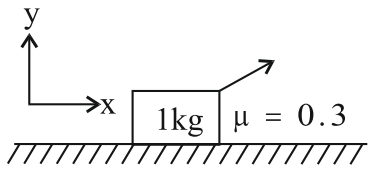
(1) 5 m/s (2) 7 m/s

(3) 10 m/s (4) 14 m/s

30. **Assertion:** On a rainy day, it is difficult to drive a car or bus at high speed.
Reason: The value of coefficient of friction is lowered due to wetting of the surface.

(1) Both assertion and reason are correct and reason is correct explanation of assertion
(2) Both assertion and reason are correct and reason is not correct explanation of assertion
(3) Only assertion is true but reason is false
(4) Both assertion and reason are false

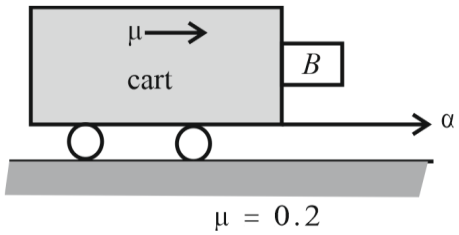
31. A force $\vec{F} = \hat{i} + 4j$ acts on the block shown. The force of friction acting on the block is



(1) $-\hat{i}$ (2) $18\hat{i}$

(3) $-2.4\hat{i}$ (4) $-3\hat{i}$

32. If μ be the coefficient of friction between the block and the cart, horizontal acceleration of the cart that is required to prevent block B from falling is:



(1) $\frac{\mu}{g}$ (2) $\frac{g}{\mu}$

(3) g (4) $(\mu^2 + 1)g$

33. A cyclist bends while taking turn in order to

(1) reduce friction
(2) provide required centripetal force
(3) reduce apparent weight
(4) reduce speed

34. The retarding acceleration of 7.35 ms^{-2} due to frictional force stops the car of mass 400 kg travelling on a road. The coefficient of friction between the tyre of the car and the road is

(1) 0.55 (2) 0.75

(3) 0.70 (4) 0.65

35. A hammer weighing 3 kg strikes the head of nail with a speed of 2 ms^{-1} drives it by 1 cm into the wall. The impulse imparted to the wall is

(1) 6 Ns (2) 3 Ns

(3) 2 Ns (4) 12 Ns

SECTION-B

36. Two monkeys of mass 10 kg and 8 kg are moving along a vertical rope which is light and inextensible, the former climbing up with an acceleration of $2m/s^2$ while the later coming down with a uniform velocity of 2m/s. Find the tension (in newtons).

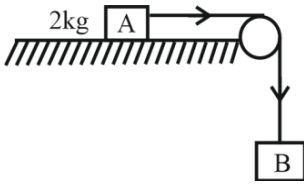
(1) 200 N (2) 150 N
(3) 300 N (4) 100 N

37. A body of mass 0.2 kg is rotated along a circle of radius 0.5 m in horizontal plane with uniform speed 3 m/s. The centripetal force on that body is:
(1) 3.6 N (2) 4.6 N
(3) 6.6 N (4) 5.6 N

38. There are different types of inertia called
I. Inertia of rest
II. Inertia of motion
III. Inertia of direction.
IV. Inertia of shape
Choose the correct option.
(1) I and II (2) I, II and III
(3) I, II, III and IV (4) None of these

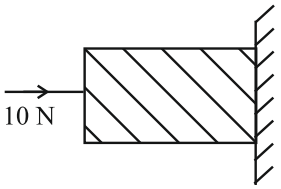
39. A ball of mass 10 g moving perpendicular to the plane of the wall strikes it and rebounds in the same line with the same velocity. If the impulse experienced by the wall is 0.54 Ns, the velocity of the ball is
(1) 27 ms^{-1} (2) 3.7 ms^{-1}
(3) 54 ms^{-1} (4) 37 ms^{-1}

40. The coefficient of static friction μ_s , between block A of mass 2 kg and the table as shown in the figure is 0.2. What would be the maximum mass value of block B so that the two blocks do not move? The string and the pulley are assumed to be smooth and massless ($g = 10\ m/s^2$)



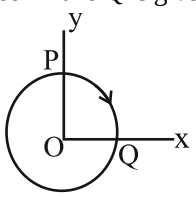
(1) 0.4 kg (2) 2.0 kg
(3) 4.0 kg (4) 0.2 kg

41. A horizontal force of 10 N is necessary to just hold a block stationary against a wall. The coefficient of friction between the block and the wall is 0.2. The weight of the block is



(1) 20 *N* (2) 50 *N*
(3) 100 *N* (4) 2 *N*

42. A particle moves in a circle of radius 4 cm clockwise at constant speed 2 cm/s. If x and y are unit acceleration vector along X and Y-axis respectively (in cm/s^2). The acceleration of the particle at the instant half way between P and Q is given by

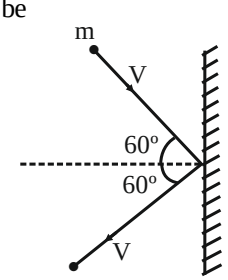


(1) $-4(x+y)$ (2) $4(x+y)$
(3) $-\frac{(x+y)}{\sqrt{2}}$ (4) $\frac{(x-y)}{4}$

43. A particle moves in a circle of radius 30 cm. Its linear speed is given by: $v = 2t$, where t in second and v in m/s. Find out its radial and tangential acceleration at t =3 sec respectively.
(1) 220 m/sec^2, 50 m/sec^2
(2) 110 m/sec^2, 5 m/sec^2
(3) 120 m/sec^2, 2 m/sec^2
(4) 110 m/sec^2, 10 m/sec^2

44. No force is required for
(1) an object moving in straight line with constant velocity
(2) an object moving in circular path
(3) an object moving with constant acceleration
(4) an object moving in elliptical path.

45. A rigid ball of mass m strikes a rigid wall at 60º and gets reflected without loss of speed as shown in the figure. The value of impulse imparted by the wall on the ball will be



(1) mv (2) 2mv
(3) $\frac{mv}{2}$ (4) $mv\sqrt{3}$

46. A person of mass 60 kg is inside a lift of mass 940 kg and process the button on control panel. The lift starts moving upwards with an acceleration 1.0 m/s^2. If g = 10m /s^2 the tension in the supporting cable is

(1) 9680 N (2) 11000 N

(3) 1200 N (4) 8600 N

47. The mass of a lift is 2000 kg. When the tension in the supporting cable is 28000 N, then its acceleration is

(1) 30 ms^{-2} downwards

(2) 4 ms^{-2} upwards

(3) 4 ms^{-2} downwards

(4) 14 ms^{-2} upwards

48. An object of mass 3 kg is at rest. If a force $F = \left(6t^2\hat{i} + 4t\hat{j}\right)$ N is applied on the object, then the velocity of the object at t = 3 s is

(1) $18\hat{i} + 3\hat{j}$ (2) $18\hat{i} + 6\hat{j}$

(3) $3\hat{i} + 18\hat{j}$ (4) $18\hat{i} + 4\hat{j}$

49. A player takes 0.1 s in catching a ball of mass 150 g moving with velocity of 20 m/s. The force imparted by the ball on the hands of the player is

(1) 0.3 N (2) 3 N

(3) 30 N (4) 300 N

50. A constant retarding force of 50 N is applied to a body of mass 20 kg moving initially with a speed of 15 ms^{-1}. How long does the body take to stop?

(1) 1 sec (2) 2 sec

(3) 4 sec (4) 6 sec

1. (3)

From Newton's second law is $\Sigma F_i = 0$ then the body is in translational equilibrium.

NCERT TOPIC 5.3, PAGE NO. 90

2. (1)

No force is required for an object moving in straight line with constant velocity or for non-acceleration motion.

NCERT TOPIC 5.9, PAGE NO. 100

3. (3)

$a = \dfrac{F}{m_1 + m_2}$ So the acceleration is same whether the force is applied on m_1 or m_2

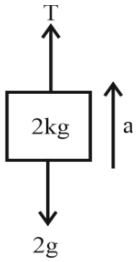
NCERT TOPIC 5.5, PAGE NO. 93

4. (4)

Acceleration of system

$a = \frac{F-4g-2g}{4+2} = \frac{120-60}{6}$

$= 10\ ms^{-2}$



FBD of block

$T - 2g = 2a$

$T = 2 (a + g) = 2 (10+10)$

$T = 40\ N$

NCERT TOPIC 5.5, PAGE NO. 93

5. (4)

Tan θ = $\dfrac{v^2}{rg}$, tan θ = $\dfrac{H}{1.5}$, r = 200 m b = 1.5 m

V = 36 km/hour = $36 \times \left(\dfrac{5}{18}\right) = 10$ m/s.

Putting these values, we get H = 0.075 *m.*

NCERT TOPIC 5.5, PAGE NO. 93

6. (1)

The frictional force is the force applied by the surface on the object to move across it. Static friction is the frictional force that exists between the stationary object and the surface on which is resting.

NCERT TOPIC 5.9.1, PAGE NO. 102

7. (4)

$\because$ v = constant

So, a = 0, hence $F_{net} = ma = 0$

NCERT TOPIC 5.7, PAGE NO. 98

8. (2)

As we know, $S = \left(\dfrac{u+v}{2}\right)t$

$\left(\dfrac{0+20}{2}\right)t = 25 \quad \therefore t = 2.5s$

NCERT TOPIC 5.3, PAGE NO. 90

9. (3)

It is a case of uniform circular motion in which velocity and acceleration vectors change due to change in direction. As the magnitude of velocity remains constant, the kinetic energy is constant.

NCERT TOPIC 5.4, PAGE NO. 92

10. (2)

If a large force F acts for a short time dt the impulse imparted I is

$I = F\,dt = \dfrac{dp}{dt}dt$

I = dp = change in momentum

NCERT TOPIC 5.6, PAGE NO. 96

11. (2)

Tension will be same in A & C hence $T_1 = T_3$

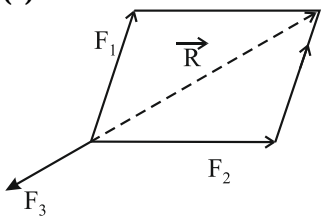
NCERT TOPIC 5.10, PAGE NO. 104

12. (3)

Impulse = Short time large force

NCERT TOPIC 5.7, PAGE NO. 98

13. (3)



Equilibrium under three concurrent forces F_1, F_2 and F_3 requires that vector sum of the three forces is zero

$F_1 + F_2 + F_3 = 0$

$\vec{R} = \vec{F_1} + \vec{F_2}$

$\vec{F_3} = -\vec{R}$ (in eqbm)

$\therefore\ \vec{F_3} = -\left(\vec{F_1} + \vec{F_2}\right)$

$\therefore\ \vec{F_1} + \vec{F_2} + \vec{F_3} = 0$

NCERT TOPIC 5.9, PAGE NO. 100

14. (3)

In uniform circular motion, the direction of motion changes, therefore velocity changes.

As $P = mv$ therefore momentum of a body also changes in uniform circular motion.

NCERT TOPIC 5.7, PAGE NO. 98

15. (2)

NCERT TOPIC 5.10, PAGE NO. 104

16. (2)

Centripetal force, $F = \frac{mv^2}{r}$, so $F \propto \frac{1}{r}$ so, v is independent or r.

NCERT TOPIC 5.10, PAGE NO. 104

17. (3)

Given, $\omega = 2 rads^{-1}$, r = 2 m, t = $\frac{\pi}{2} s$

Angular displacement, $\theta = \omega t = 2 \times \frac{\pi}{2} = \pi$ rad

Linear velocity, $v = r \times \omega = 2 \times 2 = 4\ ms^{-1}$

$\therefore$ change in velocity, $\Delta v = 2v$

$\sin \frac{\theta}{2} = 2 \times 4 \times \sin\left(\frac{\pi}{2}\right) = 8\ ms^{-1}$

NCERT TOPIC 5.10, PAGE NO. 104

18. (1)

As $T = mr\omega^2$

or $\omega^2 = \frac{T}{mr} = \frac{900}{2 \times 0.5} = 900 \Rightarrow \omega = 30\ rads^{-1}$

NCERT TOPIC 5.10, PAGE NO. 104

19. (2)

For negotiating a circular curve on a levelled road, the maximum velocity of the car is $v_{max} = \sqrt{urg}$

Here $\mu = 0.6$, $r = 150$ m $g = 9.8$

$\therefore v_{max} = \sqrt{0.6 \times 150 \times 9.8} \simeq 30 m/s$

NCERT TOPIC 5.9.1, PAGE NO. 102

20. (3)

Friction does not depend on area of surface in contact.

NCERT TOPIC 5.9.1, PAGE NO. 102

21. (4)

Coefficient of friction is independent of normal force.

NCERT TOPIC 5.9.1, PAGE NO. 102

22. (1)

Newton's law of motion are applicable only for inertial frames. All reference frames present on surface of earth are supposed to be inertial frame of reference.

NCERT TOPIC 5.4, PAGE NO. 92

23. (1)

According to third law of motion bullet experiences a force F then, give experiences an equal and opposite force F. According to second law, $F\Delta t$ is change in momentum of the bullet, then $-F\Delta t$ is change in momentum of the gun. Since initially both are at rest, the final momentum = 0. $\therefore$ $P_b + P_g = 0$. Thus the total momentum of (bullet + gun) is conserved.

NCERT TOPIC 5.7, PAGE NO. 98

24. (4)

Given speed = 10 m/s, radius r = 10 m

Angle made by the wire with the vertical

$\tan\theta = \frac{v^2}{rg} = \frac{10^2}{10 \times 10} = 1 \Rightarrow \theta = 45^o = \frac{\pi}{4}$

NCERT TOPIC 5.10, PAGE NO. 104

25. (1)

Initial velocity =108 km/h = 30 m/s,

Final Velocity = 0 m/s

Use the Equation of motion and find

$a = -30/4 = -7.5\ m/s^2$

Now, F = ma

Solve and get F = –7500 N (-ve sign means, the force by brakes applied opposite of the motion.

NCERT TOPIC 5.11, PAGE NO. 106

26. (1)

The velocity should be such that the centripetal acceleration is equal to the acceleration due to gravity

$\frac{v^2}{R} = g$ or $v = \sqrt{gR}$

NCERT TOPIC 5.10, PAGE NO. 104

27. (1)

It works on the principle of conservation of linear momentum.

NCERT TOPIC 5.7, PAGE NO. 98

28. (1)

If m_1, m_2 are masses and u_1, u_2 are velocity then by conservation of momentum $m_1u_1 + m_2u_2 = 0$ or $|m_1u_1| = |m_2u_2|$

NCERT TOPIC 5.7, PAGE NO. 98

29. (2)

$\mu mg = \frac{mv^2}{r}$ or $v = \sqrt{\mu gr}$

or $v = \sqrt{(0.25 \times 9.8 \times 20)} = 7\ m/s$

NCERT TOPIC 5.9.1, PAGE NO. 102

30. (1)

On a rainy day, the roads are wet. Wetting of roads lowers the coefficient of friction between the types and the road. Therefore, grip on a road of car reduces and thus chances of skidding increase.

NCERT TOPIC 5.9.1, PAGE NO. 102

31. (1)

Limiting friction o F_L = (0.3) (1) (g)

= 3 N

x-component or horizontal component of force F =1N

hence this much of magnitude will act in backward direction due to friction.

NCERT TOPIC 5.9.1, PAGE NO. 102

32. (2)

mg = μN = μma

$\therefore \quad a = \frac{g}{\mu}$

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33. (2)

The cyclist bends while taking turn in order to provide necessary centripetal force.

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34. (2)

As we know, coefficient of friction $\mu = \frac{F}{N}$

$\Rightarrow \mu = \frac{ma}{mg} = \frac{a}{g}$ (a = 7.35 ms^{-2} given)

$\therefore \mu = \frac{7.35}{9.8} = 0.75$

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35. (1)

As we know, |impulse| = |change in momentum|

$= |p_2 - p_1|$

$= |0 - mv_1| = |0 - 3 \times 2| = 6Ns$

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36. (1)

$T = T_1 + T_2 = m_1 (g+a) + m_2 g$

10 (10+2) + 8 (10) = 120+80 = 200 N

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37. (1)

Given,

m = 0.2kg, R= 0.5 m, and v = 3m/s

Therefore, $F_c = = \frac{mv^2}{R} = \frac{(0.2)(3^2)}{(0.5)} = 3.6\,N$

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38. (2)

There are three types of inertia.

Inertia of rest: This resistance of a body to change its state of rest is called inertia of rest.

Inertia of motion: The resistance of a body to change its state of motion is called inertia of motion. Inertia of direction: The resistance of a body to change its direction of motion is called inertia of direction.

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39. (1)

As the ball, m = 10 g = 0.01 kg rebounds after striking the wall

$\therefore$ Change in momentum = mv $(-mv)$ = $2\,mv$

Impulse = Change in momentum = $2mv$

$\therefore \quad v = \frac{\text{Impulse}}{2m} = \frac{0.54\,N\,s}{2 \times 0.01\,kg} = 27\,ms^{-1}$

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40. (1)

$m_B g = \mu_s m_A g$

$\Rightarrow \quad m_B = \mu_s m_A$

or $m_B = 0.2 \times 2 = 0.4$ kg

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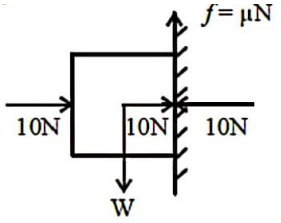
41. (4)

For the block to remain stationary with wall



$f = W$

$\mu N = W$

$0.2 \times 10 = W \Rightarrow W = 2N$

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42. (3)

$a = \frac{v^2}{r} = 1\ cm/s$. Centripetal acceleration directed towards the centre. Its magnitude = 1 Unit vector at the mid-point on the path between *P* and *Q* is – $\frac{(x+y)}{\sqrt{2}}$

NCERT TOPIC 5.10, PAGE NO. 104

43. (3)

Given; r = 30 cm = 0.3 m and V = 2t

Radial acceleration at t = 3 sec

$$a_r = \frac{v^2}{r} = \frac{4t^2}{0.3} = \frac{4\times(3)^2}{0.3} = 120\,m/s^2$$

And tangential acceleration

$$a_t = \frac{dv}{dt} = 2\,m/s^2$$

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44. (1)

No force is required for an object moving in straight line with constant velocity or for non-accelerated motion.

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45. (1)

As we know that, impulse is imparted due to change in perpendicular components of momentum of ball

$J = \Delta p = mv_1 = mv_1$

$= mv\cos 60^o - (-mv\cos 60^o)$

$= 2\ mv\cos 60^o = 2mv \times \frac{1}{2} = mv$

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46. (2)

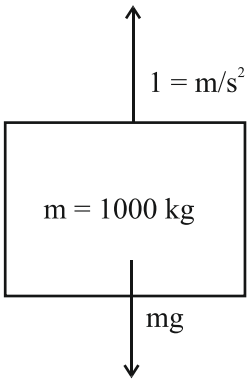
Total mass (m)

= Mass of lift + Mass of person

= 940 +60 = 1000 kg

So, from the free body diagram

$T - mg = ma$



Hence, T = 1000 × (10 +1) = 1000 ×11

T = 11000 N

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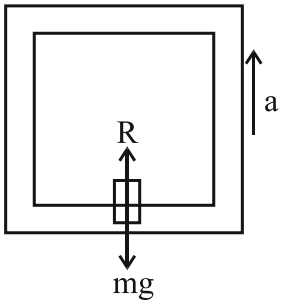
47. (2)

Here, lift is accelerating upward at the rate of a



Hence, equation of motion is written as

$R - mg = ma$

$28000 - 20000 = 2000a \qquad [\because\ g = 10\ ms^{-2}]$

$\Rightarrow a = \frac{8000}{2000} = 4ms^{-2}$ *upwards*

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48. (2)

According to Newton's 2nd law, force applied on an object it equal to rate of change of momentum.

i.e., $\vec{F} = \frac{d\vec{p}}{dt}$

Or $\vec{F} = m\frac{d\vec{v}}{dt}$ -------(i)

Given, m = 3 kg, t = 3 s, $\vec{F} = \left(6t^2\hat{i} + 4t\,j\right)N$

Substituting these values in Eq (i)

We get

$$\left(6t^2\hat{i} + 4t\,j\right) = 3\frac{d\vec{v}}{dt}$$

Or $dv = \frac{1}{3}(6t^2\hat{\imath} + 4t\hat{\jmath})dt$

Now, taking integration of both sides, we get

$\int_0^v d\vec{v} = \int_0^t (6t^2\hat{\imath} + 4t\hat{\jmath})dt$

$\vec{v} = \frac{1}{3}\int_0^t \left(6t^2\hat{i} + 4t\,j\right)dt$

But t = 3 (given)

$\therefore \quad \vec{v} = \frac{1}{3}\int_0^3 \left(6t^2\hat{i} + 4t\,j\right)dt$

or $\vec{v} = \frac{1}{3}\left[\frac{6t^3}{3}\hat{\imath} + \frac{4t^2}{2}\hat{\jmath}\right]_0^3$

or $\vec{v} = \frac{1}{3}\left[2(3)^3\hat{\imath} + 2(3)^2\hat{\jmath}\right]$

or $\vec{v} = \frac{1}{3}\left[54\hat{\imath} + 18\hat{\jmath}\right] = 18\hat{\imath} + 6\hat{\jmath}$

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49. (3)

Force imparted = rate of change of momentum

$$F = \frac{\Delta p}{\Delta t} \Rightarrow F = \frac{p_1 - p_2}{\Delta t} \text{ or } \frac{m(v_1 - v_2)}{\Delta t}$$

Here, mass of body m = 150 g = 0.150 kg,

v_1 = 20 m/s,

$v_2 = 0$

Time taken, Δt = 0.1 s

$$\therefore \quad F = \frac{0.150 \times (20 - 0)}{0.1} = 30N$$

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50. (4)

Here m = 20kg, F = –50 N

(Retardation force)

As $F = ma$

Using equation,

$$a = \frac{F}{m} = \frac{-50}{20} = -2.5 ms^{-2}$$

Given Now,

$v = u + at$

$u = 15 ms^{-1}$, $v = 0$

$0 = 15 + (-2.5)t$

$t = 6\ s$

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