PHYSICS

BOOKS - MHTCET PREVIOUS YEAR PAPERS AND PRACTICE PAPERS

FORCE

Example

1. If an electron is subjected to aforce of 10^{-25} N in an X-ray machine, then find out the time

taken by the electron to cover a distance of 0.2 m. Take mass of the electron 10^{-30} kg.

A. $2 \times 10^{-6} s$

B. $2 \times 10^{-2} s$

C. $2 \times 10^{-3} s$

D. $2 \times 10^{3} s$

Answer: C

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2. A position dependent force $F = 7 - 2x + 3x^2$ acts on a small body of mass 2 kg and displaced it from $x = 0$ to $x = 5m$. Calculate the work done in joule.

A. 138 J

B. 135 J

C. 136 J

D. 137 J

Answer: B

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3. Force F on a particle moving in a straight line varies with distance d as shown in the figure. Find the work done on the particle during its displacement of 12 m.

A. 15 J

B. 16 J

C. 13 J

D. 12 J

Answer: C

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4. The position (x) of a particle of mass 1 kg moving along X-axis at time t is given by $\left(x = \frac{1}{2}t^2\right)$ metre. Find the work done by force acting on it in time interval from $t = 0$ to $t = 3s$.

A. 4.2 J

B. 5.4 J

C. 4.6 J

D. 4.5 J

Answer: D

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5. Two particles of mass m and 2 m moving in opposite directions collide elastically with velocities v and 2v. Find their velocities after collision.

A. 0, 3v

B. 1, 3v

C. 0, 1v

D. 0, 4v

Answer: A

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6. Two point objects of mass 1.5 g and 2.5 g respectively are at a distance of 16 cm apart,

the centre of mass is at a distance x from the object of mass 1.5 g. Find the value of x.

A. 9 cm

B. 8 cm

C. 10 cm

D. 11 cm

Answer: C

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7. Find the torque of a force $F = \left(\hat{i} + 2\hat{j} - 3\hat{k}\right)N$ about a point O. The position vector of point of application of force about O is $r = \left(2\hat{i} + 3\hat{j} - \hat{k}\right)m.$

A. $\tau = \left(-7\hat{i} + 5\hat{j} + \hat{k}\right)Nm$

B. $\tau = \left(7\hat{i} - 5\hat{j} + \hat{k}\right)Nm$

C. $\tau = \left(-7\hat{i} + 8\hat{j} + \hat{k}\right)Nm$

D. $\tau = \left(-5\hat{i} + 7\hat{j} + \hat{k}\right)Nm$

Answer: A

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Exercise 1

1. Which of Newton's laws of motion explain the concept of inertia ?

A. Ist law

B. Iind law

C. IIIrd law

D. All of these

Answer: C

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2. A body of mass 6 kg is acted on a by a force so that its velocity changes from $3ms^{-1}$ to $5ms^{-1}$, then change in momentum is

A. 48 Ns

B. 24 Ns

C. 30 Ns

D. 12 Ns

Answer: D

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3. The momentum p (in kg ms^{-1}) of a particle is varying with time t (in second) as $p = 2 + 3t^2$. The force acting on the particle at $t = 3s$ will be

A. 18 N

B. 54 N

C. 9 N

D. 15 N

Answer: A

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4. A force $F = \left(6\hat{i} - 8\hat{j} + 10\hat{k}\right)$N produces acceleration of $\sqrt{2}ms^{-2}$ in a body. Calculate the mass of the body.

A. 10 kg

B. 8 kg

C. 12 kg

D. 9 kg

Answer: A

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5. A ball of mass 0.5 kg moving with a velocity of $2ms^{-1}$ strikes a wall normally and bounces back with the same speed. If the time of contact between the ball and the wall is one

millisecond, the average force exerted by the wall on the ball is

A. 2000 N

B. 1000 N

C. 5000 N

D. 125 N

Answer: A

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6. A body of mass 5 kg is moving with velocity of $v = \left(2\hat{i} + 6\hat{j}\right) ms^{-1}$ at t=0s. After time t=2s, velocity of body is $\left(10\hat{i} + 6\hat{j}\right)$, then change in momentum to body is

A. $40\hat{i}$ kgms^{-1}

B. $20\hat{i}$ kgms^{-1}

C. $30\hat{i}$ kgms^{-1}

D. $\left(50\hat{i} + 30\hat{j}\right)$ kgms^{-1}

Answer: A

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

A. 100 N

B. 115 N

C. 105 N

D. 135 N

Answer: C

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8. Three blocks of masses m_1, m_2 and m_3 are connected by massesless strings as shown on a frictionaless table. They are pulled with a force $T_3 = 40N$. If $m_1 = 10kg, m_2 = 6kg$ and $m_3 = 4$ kg, the tension T_2 will be

A. 20 N

B. 40 N

C. 10 N

D. 32 N

Answer: D

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9. Three blocks are placed at rest on a smooth inclined plane with force acting on m_1 parallel to the inclined plane. Find the contact force

between m_2 and m_3.

A. $\frac{(m_1+m_2+m_3)F}{m_3}$

B. $\frac{m_3F}{m_1+m_2+m_3}$

C. $F-(m_1+m_2)g$

D. None of these

Answer: B

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10. In the arrangement shown, the mass m will ascend with an acceleration (Pulley and rope are massless)

A. Zero

B. $\frac{g}{5}$

C. g

D. $2g$

Answer: B

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11. A block of mass 10 kg is suspended by three strings as shown in the figure. The tension T_2 is

A. $100N$

B. $\frac{100}{\sqrt{3}}N$

C. $\sqrt{3} \times 100N$

D. $50\sqrt{3}N$

Answer: D

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12. If impulse I varies time t as I $\left(kgms^{-1}\right) = 20t^2 - 40t.$

The change in momentum is minimum at :-

A. $t = 2s$

B. $t = 1s$

C. $t = \frac{1}{2}s$

D. $t = \frac{3}{2}s$

Answer: B

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13. An initially stationary device lying on a frictionless floor explodes into two pieces and slides acros the floor. One piece is moving in

A. positive y-direction

B. negative y-direction

C. negative x-direction

D. at angle from x-direction

Answer: C

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14. 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

Answer: A,D

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15. A bullet of mass 0.1 kg is fired with a speed of $100ms^{-1}$. The mass of gun being 50 kg. Then, the velocity of recoil becomes

A. $0.05ms^{-1}$

B. $0.5ms^{-1}$

C. $0.1ms^{-1}$

D. $0.2ms^{-1}$

Answer: D

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16. A gradener pushes a lawn roller through a distance 20 m. If he applies a force of 20 kg-wt in a direction inclined at 60° to the ground, the work done by him is

A. 1960 J

B. 196 J

C. 1.96 J

D. 196 kJ

Answer: A

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17. How much work must work be done by a force on 50 kg body in order to accelerate it in the direction of force from rest to $20ms^{-1}$ is 10 s?

A. $10^{-3}J$

B. $10^4 J$

C. $2 \times 10^3 J$

D. $4 \times 10^4 J$

Answer: B

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18. A force $\left(3\hat{i} + 4\hat{j}\right)$ acts on a body and displaces it by $\left(3\hat{i} + 4\hat{j}\right)m$. The work done by the force is

A. 10 J

B. 12 J

C. 16 J

D. 25 J

Answer: D

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19. Force acting on a particale is $\left(2\hat{i}+3\hat{j}\right)N$. Work done by this force is zero, when the

particle is moved on the line $3y + kx = 5$. Here value of k is $\left(\text{Work done } W = \vec{F} \cdot \vec{d}\right)$

A. 2

B. 4

C. 6

D. 8

Answer: A

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20. A force $F = Ay^2 + By + C$ acts on a body at rest in the Y-direction. The kinetic energy of the body during a displacement $y = -a$ to $y = a$ is

A. $\frac{2Aa^3}{3}$

B. $\frac{2Aa^3}{3} + 2Ca$

C. $\frac{2Aa^3}{3} + \frac{Ba^2}{2} + Ca$

D. None of the above

Answer: B

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21. The force F acting on a particle is moving in a straight line as shown in figure. What is the work done by the force on the particle in the 4 m of the trajectory?

A. 5 J

B. 10 J

C. 15 J

D. 2.5 J

Answer: C

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22. If the force acting on a body is inversely proportional to its speed, the kinetic energy of the body is

A. constant

B. directly proportional to time

C. inversely proportional to time

D. directly proportional to square of time

Answer: B

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23. The kinetic energy acquired by a body of mass m in travelling a certain distance starting from rest, under a constant force is

A. directly proportional to m

B. directly proportional to $\sqrt{m}$

C. inversely porportional to $\sqrt{m}$

D. independent of m

Answer: D

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24. Under the action of a force, a $2kg$ body moves such that its position x as a function of time is given by $x = \frac{t^3}{3}$ where x is in metre and t in second. The work done by the force in the first two seconds is .

A. 1600 J

B. 160 J

C. 16 J

D. 1.6 J

Answer: C

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25. An object of mass 5 kg is acted upon by a force that varies with position of the object as shown. If the object starts out from rest at a point $x = 0$. What is its speed at $x = 50m$.

A. $12.2ms^{-1}$

B. $18.2ms^{-1}$

C. $16.4ms^{-1}$

D. $20.4ms^{-1}$

Answer: A

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26. A block of mass 20 kg is moving in x-direction with a constant speed of $10ms^{-1}$. It is subjected to a retarding force

$F = (-0.1x)N$ during its travel from $x = 20m$ to $x = 30m$. Its final kinetic energy will be

A. 975 J

B. 450 J

C. 275 J

D. 250 J

Answer: A

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27. In an elastic collison

A. Both momentum and KE are conserved

B. Only momentum is conserved

C. Only KE is conserved

D. Neither KE nor momentum is conserved

Answer: A

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28. If a body of mass m collides head on, elastically with velocity u with another identical boday at rest. After collision velocty of the second body will be

A. zero

B. u

C. 2u

D. Data insufficient

Answer: B

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29. Two perfectly elastic particles A and B of equal masses travelling along a line joining them with velocities $15m/s$ and $10m/s$ respectively collide. Their velocities after the elastic collision will be (in m/s) respectively

A. $10ms^{-1}, 10ms^{-1}$

B. $15ms^{-1}, 15ms^{-2}$

C. $10ms^{-1}, 15ms^{-1}$

D. $15ms^{-1}, 10ms^{-1}$

Answer: C

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30. The collision of two balls of equal mass takes place at the origin of coordinates. Before collision, the components of velocities are ($v_x = 50cm^{-1}$, $v_y = 0$) and $\left(v_x = -40cm^{-1}\right.$ and $v_y = 30cms^{-1}$. The first ball comes to rest after collision. The velocity (components v_x and v_y respectively) of the second ball are

A. 10 and $30cms^{-1}$

B. 30 and $10cms^{-1}$

C. 5 and $15cms^{-1}$

D. 15 and $5cms^{-1}$

Answer: A

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31. A smooth sphere of mass M moving with velocity u directly collides elastically with another sphere of mass m at rest. After

collision their final velocities are V and v respectively. The value of v is

A. $\frac{2uM}{m}$

B. $\frac{2um}{M}$

C. $\frac{2u}{1+\frac{m}{M}}$

D. $\frac{2u}{1+\frac{M}{m}}$

Answer: C

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32. A body of mass m moving with velocity v collides head on with another body of mass 2 m which is initially at rest. The ratio of K.E. of colliding body before and after collision will be

A. $1:1$

B. $2:1$

C. $4:1$

D. $9:1$

Answer: D

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33. The position of centre of mass of system of particles at any moment does not depend on.

A. masses of the particles

B. internal forces on the particles

C. position of the particles

D. relative distance between the particles

Answer: B

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34. In a carbon monoxide molecule, the carbon and the oxygen atoms are separated by a distance $1.2 \times 10^{-10} m$. The distance of the centre of mass from the carbon atom is

A. $0.48 \times 10^{-10} m$

B. $0.51 \times 10^{-10} m$

C. $0.56 \times 10^{-10} m$

D. $0.69 \times 10^{-10} m$

Answer: D

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35. Two bodies of masses 1kg and 2kg are lying in xy plane at (-1,2) and (2,4) respectively. What are the coordinates of the center of mass?

A. $\left(1, \frac{10}{3}\right)$

B. $(1, 0)$

C. $(0, 1)$

D. None of the above

Answer: A

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36. Figure shows a composite system of two uniform rods of lengths as indicated. Then the coordinates of the centre of mass of the system of rods are

A. $\left(\frac{L}{2}, \frac{2L}{3}\right)$

B. $\left(\frac{L}{4}, \frac{2L}{3}\right)$

C. $\left(\frac{L}{6}, \frac{2L}{3}\right)$

D. $\left(\frac{L}{6}, \frac{L}{3}\right)$

Answer: C

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37. Three point masses m_1, m_2 and m_3 are placed at the corners of a thin massless rectangular sheet $(1.2m \times 1m)$ as shown. Centre of mass will be located at the point.

A. (0.8, 0.6) m

B. (0.6, 0.8) m

C. (0.4, 0.4) m

D. (0.5, 0.6) m

Answer: C

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38. The torque of a force $F = -6\hat{i}$ acting at a point $r = 4\hat{j}$ about origin will be

A. $-24\hat{k}$

B. $24\hat{k}$

C. $24\hat{j}$

D. $24\hat{i}$

Answer: B

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39. Moment of a force of megnitude 20 N acting along positive x direction at point (3m 0, 0) about the point (0, 2, 0) (in N-m) is :-

A. 20

B. 60

C. 40

D. 30

Answer: C

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40. The torque of force $F = -3\hat{i} + \hat{j} + 5\hat{k}$ acting on a point $r = 7\hat{i} + 3\hat{j} + \hat{k}$ about origin will be

A. $14\hat{i} - 38\hat{j} + 16\hat{k}$

B. $4\hat{i} + 4\hat{j} + 6\hat{k}$

C. $-14\hat{i} + 38\hat{j} - 16\hat{k}$

D. $-21\hat{i} + 3\hat{j} + 5\hat{k}$

Answer: A

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41. If angular momentum is conserved in a system whose moment of inertia is decreased, will rotational kinetic energy be conserved.

A. angular momentum is conserved

B. linear momentum is conserved

C. energy is conserved

D. angular momentum is not conserved

Answer: A

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Exercise 2 Miscellaneous Problems

1. A car of mass m starts from rest and acquires a velocity along east $v = v\hat{i}(v > 0)$ in two seconds Assuming the car moves with unifrom acceleration the force exerted on the car is .

A. $\frac{mv}{2}$ 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

Answer: B

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2. A cricket ball of mass $150g$ has an initial velocity $\left(3\hat{i}+4\hat{j}\right)ms^{-1}$ and a final velocity $v=-\left(3\hat{i}+4\hat{j}\right)ms^{-1}$ after beigh hit The

change in momentum (final momentum initial momentum) is (in kg ms^{-1})

A. zero

B. $-\left(0.45\hat{i}+0.6\hat{j}\right)$

C. $-\left(0.9\hat{i}+1.2\hat{j}\right)$

D. $-5\left(\hat{i}+\hat{j}\right)\hat{i}$

Answer: C

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3. Conservation of momentum in a collision between particles can be understood from

A. conservation of energy

B. Newton's first law only

C. Newton's second law only

D. Both Newton's second and third law

Answer: C

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4. A body of mass $2kg$ travels according to the law $x(t) = pt + qt^2 + rt^3$ where $p = 3ms^{-1}$, $q = 4ms^{-2}$ and $r = 5ms^{-3}$.

Find the force acting on the body at t=2 sec.

A. 136 N

B. 134 N

C. 158 N

D. 68 N

Answer: A

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5. A force $F = (10 + 0.5x)$ acts on a particle in the x-direction. What would be the work done by this force during a displacement from $x = 0$ to $x = 2m$ (F is in newton and x in metre)

A. 31.5 J

B. 63 J

C. 21 J

D. 42 J

Answer: C

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6. A block of mass 10 kg, moving in x-direction with a constant speed of $10ms^{-1}$, is subjected to a retarding force $F = 0.1 \times J/m$ during its travel from x=20 m to 30 m. Its final KE will be

A. 475 J

B. 450 J

C. 275 J

D. 250 J

Answer: A

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7. In the figure, pulleys are smooth and strings are massless, $m_1 = 1$ kg and $m_2 = \frac{1}{3}$ kg. To keep m_3 at rest, mass m_3 should be

A. 1 kg

B. $\frac{2}{3}$ kg

C. $\frac{1}{4}$ kg

D. 2 kg

Answer: A

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8. A block having mass m collides with an another stationary block having mass 2m. The lighter block comes to rest after collision. If

the velocity of first block is v, then the value is

coefficient of restitution will must be

A. 0.5

B. 0.4

C. 0.6

D. 0.8

Answer: A

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9. A uniform metal rod of length 1m is bent at 90°, so as to form two arms of equal length. The centre of mass of this bent rod is

A. on the bisector of the angle, $\left(\frac{1}{\sqrt{2}}\right)$ m from vertex

B. on the bisector of angle, $\left(\frac{1}{2\sqrt{2}}\right)$ m from vertex

C. on the bisector of the angle, $\left(\frac{1}{2}\right)$ m from vertex

D. on the bisector of the angle, $\left(\frac{1}{4\sqrt{2}}\right)$ m from vertex

Answer: D

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10. Three rods of the same mass are placed as shown in the figure. What wil be the coordinate of centre of mass of the system?

A. $\left(\frac{a}{2}, \frac{a}{2}\right)$

B. $\left(\frac{a}{\sqrt{2}}, \frac{a}{\sqrt{2}}\right)$

C. $\frac{2a}{3}, \frac{2a}{3}$

D. $\left(\frac{a}{3}, \frac{a}{3}\right)$

Answer: A

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11. The torque of a force $F = -2\hat{i} + 2\hat{j} + 3\hat{k}$ acting on a point $r = \hat{i} - 2\hat{k} + \hat{k}$ about

origin will be

A. $8\hat{i} + 5\hat{j} + 2\hat{k}$

B. $-8\hat{i} - 5\hat{j} - 2\hat{k}$

C. $8\hat{i} - 5\hat{j} + 2\hat{k}$

D. $-8\hat{i} + 5\hat{j} - 2\hat{k}$

Answer: B

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12. A door 1.6 m wide requires a force of 1N to be applied at the free and to open or close it. The force that is required at a point 0.4 m distance from the hinges for o[ening or closing the door is

A. 1.2 N

B. 3.6 N

C. 2.4 N

D. 4 N

Answer: D

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13. A 40 N block is supported by two ropes. One rope is horizontal and other makes an angle of 30° with the ceiling. The tension in the rope attached to the ceiling is approximately

A. 80 N

B. 40 N

C. $40\sqrt{3}N$

D. $\frac{40}{\sqrt{3}}N$

Answer: A

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14. A man of mass m stands on a platform of equal mass m and pulls himself by two ropes passing over pulleys as shown in figure. If he pulls each rope with a force equal to half his weight his upwards acceleration would be

A. $\frac{g}{2}$

B. $\frac{g}{4}$

C. g

D. zero

Answer: D

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15. A truck accelerates from speed v to 2v. Work done during this is

A. three times as the work done in accelerating it form rest to v

B. same as the work done in accelerating it form rest to v

C. four times as the work done in acceleration it from rest to v

D. less than the work done in acclerating it from rest to v

Answer: A

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16. A body of mass 0.25 kg is projected with muzzle velocity $100ms^{-1}$ from a tank of mass 100 kg. What is the recoil velocity of the tank?

A. $5ms^{-1}$

B. $25ms^{-1}$

C. $0.5ms^{-10}$

D. $0.25ms^{-1}$

Answer: D

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17. When a body of mass m_1 moving with uniform velocity $40ms^{-1}$ collides with another body of mass m_2 at rest, then the two together begin to move with uniform velocity of $30ms^{-1}$. The ratio of the masses (i.e., m_1/m_2) of the two bodies will be

A. $1:3$

B. $3:1$

C. $1:1.33$

D. $1:0.75$

Answer: B

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18. A uniform metal dise of radius R is taken and out of it a disc of diameter R is cut off from the end. The centre of the mass of the remaining part will be:

A. $\frac{R}{4}$ from the centre

B. $\frac{R}{3}$ from the centre

C. $\frac{R}{5}$ from the centre

D. $\frac{R}{6}$ from the centre

Answer: D

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19. A square plate of side 20 cm has uniform thickness and density. A circular part of diameter 8 cm is cut out symmetrically and shown in figure. The position of centre of mass

of the remaining portion is

A. at O_1

B. at O

C. 0.54 cm from O on the left hand side

D. None of the above

Answer: D

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