

Q1 A gun applied a force F on a bullet which is given by

$F = (100 - 0.5 \times 10^5 t)$ N The bullet emerges out with speed 400 m/s. Then find out the impulse exerted till force on the bullet becomes zero

- (A) 0.2 Ns
- (B) 0.3 Ns
- (C) 0.1 Ns
- (D) 0.4 Ns

Q2 For the arrangement shown in the figure, the reading of spring balance is

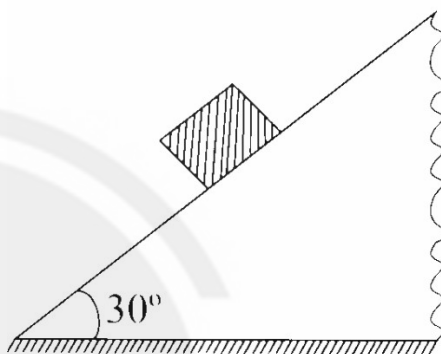


- (A) 50 N
- (B) 100 N
- (C) 150 N
- (D) None of the above

Q3 A particle starts its motion from rest under the action of a constant force. If the distance covered in first 10 seconds is S_1 and that covered in the first 20 seconds is S_2 , then;

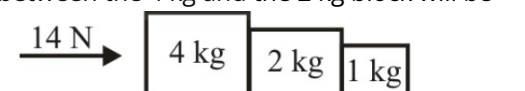
- (A) $S_2 = 2S_1$
- (B) $S_2 = 3S_1$
- (C) $S_2 = 4S_1$
- (D) $S_2 = S_1$

Q4 A block of certain mass is placed on a rough inclined plane. The angle between the plane and the horizontal is 30° . The coefficients of static and kinetic frictions between the block and the inclined plane are 0.6 and 0.5 respectively. Then, the magnitude of the acceleration of the block is [Take $g = 10 \text{ ms}^{-2}$]



- (A) 2 ms^{-2}
- (B) Zero
- (C) 0.196 ms^{-2}
- (D) 0.67 ms^{-2}

Q5 Three blocks of masses 4 kg, 2 kg, 1 kg respectively are in contact on a frictionless table as shown in the figure. If a force of 14 N is applied on the 4 kg block, the contact force between the 4 kg and the 2 kg block will be



- (A) 2 N
- (B) 6 N
- (C) 8 N
- (D) 14 N

Q6 A body is accelerated by applying a force of 30 N. The change in the momentum of the body after 2s is:

- (A) $7.5 \text{ kg} - \text{m/s}$
- (B) $30 \text{ kg} - \text{m/s}$
- (C) $120 \text{ kg} - \text{m/s}$
- (D) $60 \text{ kg} - \text{m/s}$



Q7 A body is said to be in equilibrium if all the forces acting on it
 (A) are in the same direction
 (B) are equal in magnitude
 (C) have zero resultant
 (D) can be arranged in pair

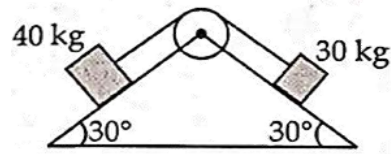
Q8 A boy of mass 40 kg is climbing a vertical pole at a constant speed. If the coefficient of friction between his palms and the pole is 0.8 and $g = 10 \text{ m/s}^2$, the horizontal force that he is applying on the pole is
 (A) 300 N (B) 400 N
 (C) 500 N (D) 600 N

Q9 A wooden block of mass 10 kg is moving with an acceleration of 3 ms^{-2} on a rough floor. If the coefficient of friction is 0.3, then the applied force on it is ($g = 10 \text{ ms}^{-2}$)
 (A) 10 N (B) 30 N
 (C) 80 N (D) 60 N

Q10 A block of mass 2 kg is placed on the floor. The coefficient of static friction is 0.4. If a force of 2.8 N is applied on the block parallel to the floor, the force of friction between the block and the floor is ($g = 10 \text{ ms}^{-2}$)
 (A) 2.8 N
 (B) 2 N
 (C) 8 N
 (D) zero

Q11 The SI unit of inertia is
 (A) kg
 (B) $\text{kg m}^2 \text{ s}^{-2}$
 (C) kg m s^{-2}
 (D) No units

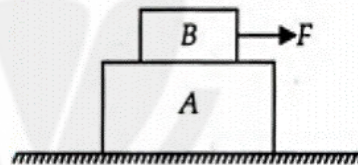
Q12 Two masses of 40 kg and 30 kg are connected by weightless string passing over a frictionless pulley is shown in the figure. The tension in the string will be



(A) 168 N (B) 188 N
 (C) 268 N (D) 368 N

Q13 What is the speed of mass 100 g having kinetic energy of 20 J?
 (A) 10 m/s (B) 15 m/s
 (C) 20 m/s (D) 25 m/s

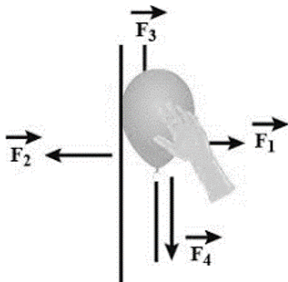
Q14 Block A of mass 35 kg is resting on a frictionless floor. Another block B of mass 7 kg is resting on it as shown in figure. The coefficient of static friction between the blocks is 0.5, while coefficient of kinetic friction is 0.4. If a force of 100 N is applied to block B, acceleration of block will be (Take $g = 10 \text{ ms}^{-2}$)



(A) 0.8 ms^{-2} (B) 2.4 ms^{-2}
 (C) 0.4 ms^{-2} (D) 4.4 ms^{-2}



- Q15** In the figure shown, a balloon is pressed against a wall. It is in equilibrium and maximum compressed state $\vec{F}_1 =$ force of balloon on hand of man; $\vec{F}_2 =$ force of balloon on wall; $\vec{F}_3 =$ friction; $\vec{F}_4 =$ weight of balloon. Choose the correct statement.



- (A) \vec{F}_1 and \vec{F}_2 are action reaction pairs.
 (B) \vec{F}_3 and \vec{F}_4 are action reaction pairs
 (C) \vec{F}_2 and \vec{F}_3 are action reaction pairs
 (D) \vec{F}_4 and gravitational force exerted by balloon on earth are action reaction pairs

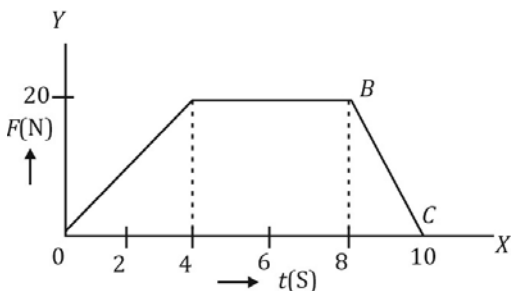
- Q16** Speed of two identical cars are u and $4u$ at a specific instant. The ratio of the respective distances in which the two cars are stopped from that instant is:

- (A) 16 : 1 (B) 16 : 4
 (C) 1 : 8 (D) 1 : 16

- Q17** The ratio of weights of a man inside a lift when it is stationary and when it is going down with a uniform acceleration 'a' is 3:2. The value of 'a' will be ($a < g$, $g =$ acceleration due to gravity)

- (A) $3/2 g$ (B) $g/3$
 (C) g (D) $2/3 g$

- Q18** A body of mass 5 kg is acted on by a net force F which varies with time t as shown in the given figure. Then the net momentum in S.I. units gained by the body at the end of 10 seconds is



- (A) 0 (B) 100
 (C) 140 (D) 200

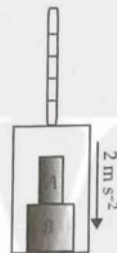
- Q19** A player caught a cricket ball of mass 150 g moving at a rate of $20 m/s$. If the catching process is completed in $0.1 s$, the force of the ball on the player is equal to:

- (A) 3 N (B) 300 N
 (C) 30 N (D) 150 N

- Q20** A block of mass m is moving on rough horizontal surface with momentum p . The coefficient of friction between the block and surface is μ . The distance covered by block before it stops is [$g =$ acceleration due to gravity]

- (A) $\frac{2\mu M^2 g}{p^2}$ (B) $\frac{p}{2\mu M g}$
 (C) $\frac{2\mu M g}{p}$ (D) $\frac{p^2}{2\mu M^2 g}$

- Q21** The elevator shown in figure is descending, with an acceleration of $2 m s^{-1}$. The mass of the block A is 0.5 kg and the mass of the block B is 1 kg. The force exerted by the block A on the block B is (Take $g = 10 m s^{-2}$)



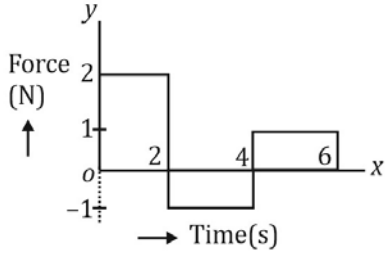
- (A) 2 N
 (B) 4 N
 (C) 6 N
 (D) 8 N

- Q22** newton-second is the unit of:

- (A) Velocity
 (B) Angular momentum
 (C) Momentum
 (D) Energy



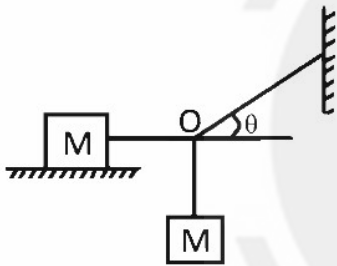
Q23 A force time graph for a linear motion is shown in figure where the segments are rectangular.



The linear momentum gained between 0 and 6 s is

- (A) - 2 Ns
- (B) Zero Ns
- (C) +2 Ns
- (D) 4 Ns

Q24 A wooden block of mass M lies on a rough floor. Another wooden block of the same mass is hanging from the point O through strings as shown in the figure. To achieve equilibrium, the co-efficient of static friction between the block on the floor with the floor itself is

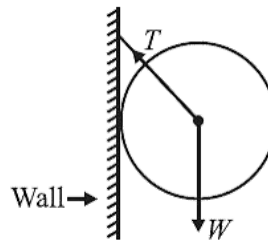


- (A) $\mu = \cot \theta$
- (B) $\mu = \sin \theta$
- (C) $\mu = \tan \theta$
- (D) $\mu = \cos \theta$

Q25 Which one among the following is the correct for resultant of balanced forces?

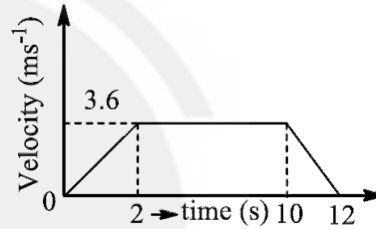
- (A) It is zero
- (B) It is non-zero
- (C) It varies continuously
- (D) None of the above

Q26 A uniform disc of weight W and radius 1 m is being held from its centre by a string of length 2 m attached to a frictionless wall as shown in the figure. The tension in the string will be



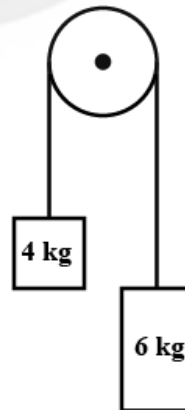
- (A) $\frac{3W}{4}$
- (B) $\frac{2W}{\sqrt{3}}$
- (C) $\frac{3W}{\sqrt{3}}$
- (D) $\frac{5W}{\sqrt{3}}$

Q27 An elevator is going up. The variation in the velocity of the elevator is as given in the graph. What is the height to which the elevator takes the passengers?



- (A) 3.6 m
- (B) 28.8 m
- (C) 36.0 m
- (D) 72.0 m

Q28 Two bodies of mass 4 kg and 6 kg are tied to the ends of a massless string. The string passes over a pulley which is frictionless (see figure). The acceleration of the system in terms of acceleration due to gravity g is



- (A) $g/2$
- (B) $g/5$
- (C) $g/10$
- (D) g



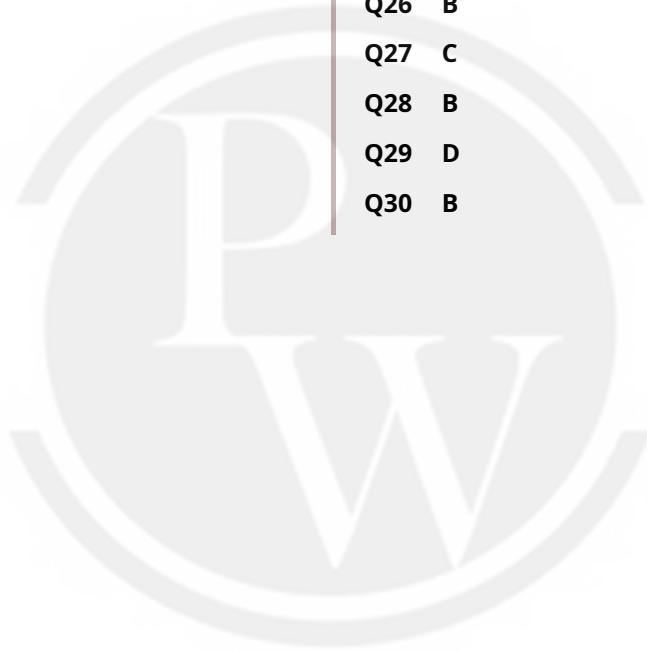
- Q29** A body moves a distance of 5 m along a straight line under the action of a force of 15 N. If work done by this force is 45 J, the angle which the force makes with the direction of motion with the horizontal is
- (A) 37° (B) 30°
(C) 60° (D) 53°

- Q30** A monkey of mass 20 kg is holding a vertical rope. The rope will not break, when a mass of 25 kg is suspended from it but will break, if the mass exceeds 25 kg. What is the maximum acceleration with which the monkey can climb up along the rope? (Take $g = 10\text{m/s}^2$)
- (A) 25 m/s^2 (B) 2.5 m/s^2
(C) 5 m/s^2 (D) 10 m/s^2



Answer Key

Q1	C	Q16	D
Q2	D	Q17	B
Q3	C	Q18	C
Q4	B	Q19	C
Q5	B	Q20	D
Q6	D	Q21	B
Q7	C	Q22	C
Q8	C	Q23	D
Q9	D	Q24	A
Q10	A	Q25	A
Q11	D	Q26	B
Q12	A	Q27	C
Q13	C	Q28	B
Q14	A	Q29	D
Q15	D	Q30	B



Hints & Solutions

Note: scan the QR code to watch video solution

Q1 Text Solution:

Given, Force applied by gun,

$$F = (100 - 0.5 \times 10^5 t) \text{ N}$$

Speed of bullet, $v = 400 \text{ m/s}$

when $F = 0$

$$\Rightarrow 100 - 0.5 \times 10^5 t = 0 \Rightarrow t = 2 \times 10^{-3} \text{ s}$$

\therefore Impulse, $I = \int F dt$

$$= \int_0^{2 \times 10^{-3}} (100 - 0.5 \times 10^5 t) dt$$

$$= \left[100t - 0.5 \times 10^5 \frac{t^2}{2} \right]_0^{2 \times 10^{-3}}$$

$$= 100 \times 2 \times 10^{-3} - \frac{0.5 \times 10^5}{2} \times 4 \times 10^{-6} - 0$$

$$= 0.2 - 0.1 = 0.1 \text{ N s}$$

Video Solution:



Q2 Text Solution:

$$a = \frac{10g - 5g}{15} = \frac{1}{3}g$$

$$T_1 = m_1 a + m_1 g = \frac{200}{3} \text{ N}$$

Video Solution:



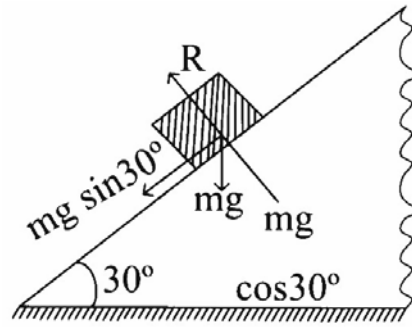
Q3 Text Solution:

$$S \propto t^2 \Rightarrow \frac{S_1}{S_2} = \left(\frac{10}{20} \right)^2 \Rightarrow S_2 = 4S_1$$

Video Solution:



Q4 Text Solution:



From the diagram, frictional force

$$f_s = \mu R = \mu mg \cos 30^\circ$$

$$= 0.6 \times mg \times \frac{\sqrt{3}}{2}$$

$$= 0.3\sqrt{3}mg = 0.5196 mg$$

Magnitude of force pulling the block along the plane downward,

$$F' = mg \sin 30^\circ = mg/2 = 0.5mg$$

Since $f_s > F'$

Hence, block will not move.

$$\therefore a = 0$$

Video Solution:



Q5 Video Solution:



Q6 Text Solution:

$$F = \frac{dp}{dt} \Rightarrow dp = 30 \times 3 = 60 \text{ kg m/s}$$

Video Solution:



Q7 Text Solution:

have zero resultant

Video Solution:



Q8 Text Solution:

Given that, $\mu = 0.8$, $g = 10 \text{ m/s}^2$

$$m = 40 \text{ kg}$$

$$f = \mu N$$

$$mg = \mu N$$

$$N = \frac{40 \times 10}{0.8}$$

$$N = \frac{4000}{8}$$

$$N = 500 \text{ N}$$

Video Solution:



Q9 Text Solution:

$$f = \mu N$$

$$f = \mu mg$$

$$= 0.3 \times 10 \times 10 = 30 \text{ N}$$

$$F - f = ma$$

$$F - 30 = 10 \times 3$$

$$F = 60 \text{ N}$$

Video Solution:



Q10 Text Solution:

$$f_s = \mu_s mg = 0.4 \times 2 \times 10 = 8 \text{ N}$$

As the applied force of 2.8 N is less than $f_s (=8 \text{ N})$ so the block

Does not move

since the static friction is self-adjusting,

Frictional force = applied force = 2.8 N

Video Solution:



Q11 Text Solution:

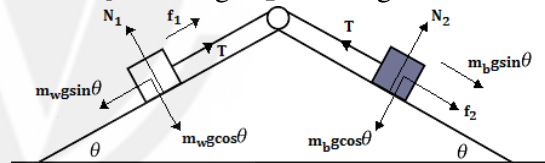
Inertia has no units and no dimension.

Video Solution:



Q12 Text Solution:

Here, $m_1 = 40 \text{ kg}$, $m_2 = 30 \text{ kg}$



Let T be the tension in the string and a is the acceleration of the system of two masses.

Their equations of motion are

$$m_1 a = m_1 g \sin 30^\circ - T$$

$$m_2 a = T - m_2 g \sin 30^\circ$$

Adding (i) and (ii), we get

$$(m_1 + m_2)a = (m_1 - m_2)g \sin 30^\circ$$

$$(40 + 30)a = (40 - 30)9.8 \times \frac{1}{2} = 49$$

$$a = \frac{49}{70} = 0.7 \text{ m/s}^2$$

From (ii),

$$T = m_2 a + m_2 g \sin 30^\circ$$

$$= 30 \times 0.7 + 30 \times 9.8 \times \frac{1}{2}$$

$$= 21 + 147 = 168 \text{ N}$$

Video Solution:





Q13 Text Solution:

It is given that the kinetic energy (K.E) is

$$K \cdot E = 20 \text{ J}$$

We also know that, kinetic energy is given by the formula $= \frac{1}{2}mv^2$ where m is mass and v is velocity of the body.

$$\frac{1}{2}mv^2 = 20$$

as, $m = 100 \text{ g} = \frac{100}{1000} \text{ kg}$

$$K \cdot E = \frac{1}{2} \times \left(\frac{100}{1000}\right)v^2 = 20$$

$$v^2 = 400$$

$$v = 20 \text{ m/s}$$

Video Solution:



Q14 Text Solution:

Here, $m_A = 35 \text{ kg}; m_B = 7 \text{ kg},$

$$\mu_s = 0.5, \mu_k = 0.4$$

$$F = 100 \text{ N}, g = 10 \text{ m s}^{-2}$$

Static frictional force on B

$$f_s = \mu_s m_B g = 0.5 \times 7 \times 10 = 35 \text{ N}$$

As F

$> f_s$, therefore A and B will move in the same direction

i.e. of applied force, but with different accelerations.

Dynamic frictional force on B

$$f_k = \mu_k m_B g = 0.4 \times 7 \times 10 = 28 \text{ N}$$

This will oppose the motion of B and cause the motion of A.

For B, the equation of motion is

$$F - f_k = m_B a_B$$

$$100 - 28 = 7a_B \text{ or } a_B = \frac{72}{7} = 10.3 \text{ m s}^{-2}$$

For A, the equation of motion is

$$m_A a_A = f_k$$

$$35a_A = 28 \text{ or } a_A = \frac{28}{35} = 0.8 \text{ ms}^{-2}$$

Video Solution:



Q15 Text Solution:

Gravitational force exerted by earth on ballon and gravitational force exerted by balloon on earth are action- reaction pairs.

Video Solution:



Q16 Text Solution:

Stopping distance

$$\propto u^2$$

$$\Rightarrow \frac{S_1}{S_2} = \frac{u^2}{(4u)^2} = \frac{1}{16}$$

$$\Rightarrow S_1 : S_2 = 1 : 16$$

Video Solution:



Q17 Text Solution:

When the lift is stationary the weight of the man is $w_0 = mg$

The weight of the man when the lift is moving downward with acceleration a is $w = mg - ma$

$$\frac{w_0}{w} = \frac{3}{2} \text{ (given)}$$

$$\frac{mg}{mg - ma} = \frac{3}{2}$$

$$\frac{mg}{m(g - a)} = \frac{3}{2}$$

$$2g = 3g - 3a$$

$$g = 3a$$

$$a = \frac{g}{3}$$

Video Solution:



Q18 Text Solution:

$$\text{Force} = \frac{\text{Change in momentum}}{\text{Time}} \quad \text{or} \quad \text{Change in momentum} = \text{force} \times \text{time}$$

$$= \frac{\text{area}}{\text{of trapezium}}$$

$$OABC = \frac{(10+4) \times 20}{2} = 140 \text{ kgm/s}$$

Video Solution:**Q19 Text Solution:**

$$F = \frac{dp}{dt} = \frac{mv - 0}{dt} = \frac{0.150 \times 20}{0.1} = 30 \text{ N}$$

Video Solution:**Q20 Text Solution:**

Using kinematic relation,

$$v^2 = u^2 - 2as \dots (i)$$

The momentum p is given by

$$p = Mu$$

$$u = \frac{p}{m}$$

and acceleration is given as $a = \mu g$

Substituting values in Eq. (i), we get

$$0 = u^2 - 2as \quad \left(\because \text{final velocity, } v = 0 \right)$$

$$0 = \left(\frac{p}{M} \right)^2 - 2\mu g s$$

$$\left(\frac{p}{M} \right)^2 = 2\mu g s$$

$$\Rightarrow s = \frac{p^2}{2M^2 \mu g}$$

Video Solution:**Q21 Text Solution:**

From free body diagram of block A,

$$0.5g - N = 0.5 \times 2 \quad \text{or} \quad N = 0.5g - 0.5 \times 2$$

$$= 0.5(10 - 2) = 4 \text{ N}$$

Video Solution:**Q22 Text Solution:**

Impulse = change in momentum = $F \times t$

So, the unit of momentum will be equal to *newton-second*

Video Solution:**Q23 Text Solution:**

Momentum gained = Force \times time = Algebraic sum of the areas enclosed by force time graph with time axis = 4Ns.

Video Solution:**Q24 Text Solution:**

A wooden block of mass M rests on a rough floor, while another block of the same mass is suspended from a point O by strings. To maintain equilibrium, we need to determine the coefficient of static friction between the block on the floor and the floor itself.

From the figure and given conditions, we can use the following equations for equilibrium:

The vertical component of tension:

$$T \sin \theta = Mg \dots (i)$$

This equation accounts for the vertical force balance, where T is the tension in the string, and θ is the angle made by the string with the vertical.



The horizontal component of tension:

$$T \cos \theta = \mu Mg \quad \dots (ii)$$

Here, μ represents the coefficient of static friction.

To find μ , divide equation (ii) by equation (i):

$$\frac{T \cos \theta}{T \sin \theta} = \frac{\mu Mg}{Mg}$$

$$\cot \theta = \mu$$

Therefore, the coefficient of static friction is:

$$\mu = \cot \theta$$

Video Solution:



Q25 Text Solution:

Balanced forces- When two forces acting on an object are equal in size but act in opposite directions

they are called balanced forces.

$$\vec{F}_{\text{net}} = \vec{F}_1 - \vec{F}_2 \quad (\because \vec{F}_1 = \vec{F}_2)$$

$$F_{\text{net}} = \vec{F}_1 - \vec{F}_1$$

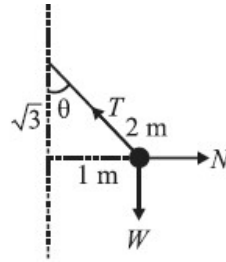
$$\vec{F}_{\text{net}} = 0$$

The resultant of balanced forces is zero

Video Solution:



Q26 Text Solution:



$$T \cos \theta = W$$

$$T \times \frac{\sqrt{3}}{2} = W$$

$$T = \frac{2W}{\sqrt{3}}$$

Video Solution:



Q27 Text Solution:

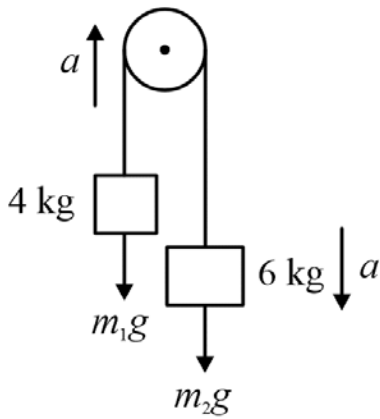
$$\text{Height} = \frac{1}{2}(12 + 8)3.6m = 36m$$

Video Solution:



Q28 Text Solution:

Given, $m_1 = 4 \text{ kg}$, $m_2 = 6 \text{ kg}$



From the above free body diagram, the relation for acceleration of the given system can be given as

$$a = \left(\frac{m_2 - m_1}{m_1 + m_2} \right) \cdot g = \left(\frac{6 - 4}{4 + 6} \right) \times g = \frac{g}{5}$$

Video Solution:



Q29 Text Solution:

Given, distance (displacement) travelled by body along the straight line = 5 m

Force applied = 15 N

Work done by force $W = 45 \text{ J}$

If both force and displacement are along the same direction.

Workdone $W = F \cdot s = 15 \times 5 = 75 \text{ J}$

But the given workdone is equal to 45 J

Therefore, the force is acting on a body by making an angle with direction of motion.

Let the angle be ' θ '

Then,

Workdone (W) = $Fs \cos\theta$

$$\cos \theta = \frac{W}{Fs} = \frac{45}{15 \times 5} = \frac{45}{75} = \frac{3}{5}$$

$$\theta = \cos^{-1} \left(\frac{3}{5} \right) = 53^\circ$$

Video Solution:



Q30 Text Solution:

2.5 m/s^2

Video Solution:

