

Class: 11
Subject: Physics
Topic: ASK15M11SA1
No. of Questions: 30

Q1. Galileo's experiment showed that if two bodies of unequal masses are dropped from the same height, the times required by them to reach the ground are equal. But if they are thrown vertically upwards with the same initial velocity, the ratio of the times required to reach the ground is equal to:

- (a) The ratio of their masses
- (b) Product of their masses
- (c) One
- (d) The inverse of their masses

Sol. (c)

Q2. Two bodies of different masses m_a and m_b are dropped from two different heights, viz; a and b . The ratio of time taken by the two to drop these distance, is:

- (a) $a : b$
- (b) $\frac{m_a}{m_b} : \frac{b}{a}$
- (c) $\sqrt{a} : \sqrt{b}$
- (d) $a^2 : b^2$

Sol. (c)

Q3. A ball is released from the top of height h metres. It takes T second to reach the ground. Where is the ball at the time $T/2$ sec?

- (a) At $(h/4)$ m from the ground
- (b) At $(h/2)$ m from the ground
- (c) At $(3h/4)$ m from the ground
- (d) Depends upon the mass and volume of the ball.

Sol. (c)

$$h = \frac{1}{2}gT^2, h' = 0 + \frac{1}{2}g\left(\frac{T}{2}\right)^2 = \frac{h}{4}$$

$\Rightarrow At \frac{3h}{4} m$ from the ground.

Q4. A bomb is released by a horizontally flying aeroplane. The trajectory of the bomb is a:

- (a) Straight line
- (b) Parabola
- (a) Hyperbola
- (b) Circle

Sol. (b)

Q5. If a body A of mass M is thrown with velocity v at an angle 30° to the horizontal and another body B of same mass is thrown at an angle of 60° to the horizontal, the ratio of range of A and B will be:

- (a) $1 : \sqrt{3}$
- (b) $\sqrt{3} : 1$
- (c) $1 : 3$
- (d) $1 : 1$

Sol. (d)

$$\text{Horizontal range, } R = \frac{2u^2 \sin \theta \cos \theta}{g}$$

Q6. It was calculated that a shell when fired from a gun with a certain velocity and at an angle of elevation $5\pi/36$ radians should strike a given target. In actual practice it was found that a hill just intervened in the trajectory. At what angle of elevation should the gun be fired to hit the target?

- (a) $\frac{5\pi}{36}$ radian
- (b) $\frac{7\pi}{36}$ radian
- (c) $\frac{11\pi}{36}$ radian
- (d) $\frac{13\pi}{36}$ radian

Sol. (d)

To hit the target, horizontal range should be same so angle of projection = $\frac{\pi}{2} - \frac{5\pi}{36} = \frac{13\pi}{36}$ radian.

Q7. A ball of mass M is thrown vertically upwards. Another ball of mass $2M$ is thrown at angle θ to vertical. Both of them stay in air for the same period of time. The heights attained by the two are in the ratio:

- (a) 1 : 2
- (b) 2 : 1
- (c) 1 : 1
- (d) 1 : $\cos \theta$

Sol. (c)

$$H_{max} = \frac{u^2 \sin^2 \theta}{2g} = \frac{g}{g} \left(\frac{2u \sin \theta}{g} \right)^2 = \frac{gT^2}{8}$$

Q8. At what angle to the horizontal should an object be project so that the maximum height reached is equal to half the horizontal range?

- (a) $\tan^{-1}(1)$
- (b) $\tan^{-1}(2)$
- (c) $\tan^{-1}(3)$
- (d) $\tan^{-1}(4)$

Sol. (b)

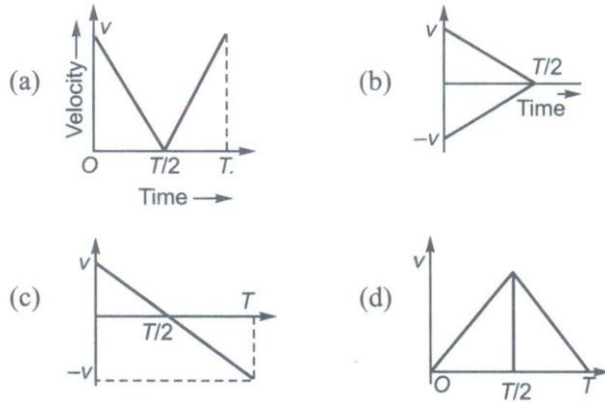
$$H_{max} = \frac{R}{2} \Rightarrow \frac{u^2 \sin^2 \theta}{2g} = \frac{2u^2 \sin \theta \cos \theta}{2g} \Rightarrow \tan \theta = 2$$

Q9. A body is dropped from a plane moving with constant horizontal velocity. The path of the body as seen by a person on the plane will be:

- (a) Straight line
- (b) Parabolic
- (c) Hyperbolic
- (d) None of these

Sol. (a)

Q10. A particle is thrown vertically upwards with a velocity v . It returns to the ground in time T . Which of the following graphs correctly represent the motion?



Sol. (b)

Q11. The velocity versus time graph of a body moving in a straight line is as follows. The distance travelled by the body in 5 sec, is...

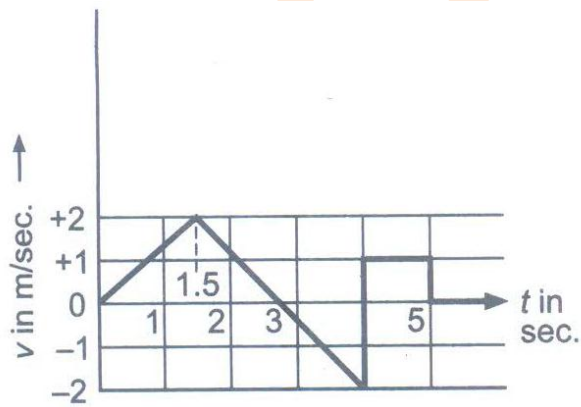


Fig. 5.76

- (a) 2 m
- (b) 3m
- (c) 4 m
- (d) 5m

Sol. (d)

$$\begin{aligned} \text{Distance travelled} &= \left| \frac{1}{2} (2)(3) \right| + \left| \frac{1}{2} (-2)(1) \right| + |1 \times 1| \\ &= 5 \text{ m} \end{aligned}$$

Q12. A body of mass 3 kg hits a wall at an angle of 60° and returns at the same angle. The impact time was 0.2 s. Calculate the force exerted on the wall:

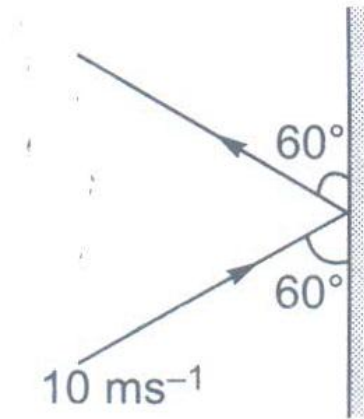


Fig. 6.142

- (a) $150\sqrt{3} \text{ N}$
- (b) $50\sqrt{3} \text{ N}$
- (c) 100 N
- (d) $75\sqrt{3} \text{ N}$

Sol. (a)

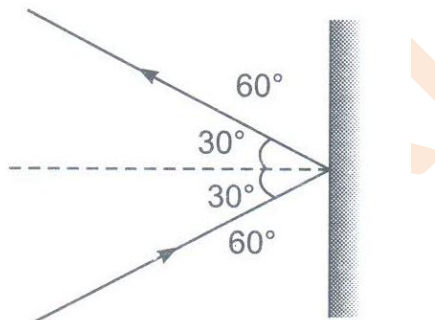


Fig. 6.180

$$F = \frac{\Delta p}{\Delta t} = \frac{2mv \cos 30^\circ}{\Delta t} = \frac{2 \times 3 \times 10 \times \frac{\sqrt{3}}{2}}{0.2} = 150\sqrt{3} \text{ N}$$

- Q13. Mass m_1 moves on a slope making an angle θ with the horizontal and its attached to mass m_2 by a string passing over a frictionless pulley as shown in Fig. 6.145. The coefficient of friction between m_1 and the sloping surface is μ .

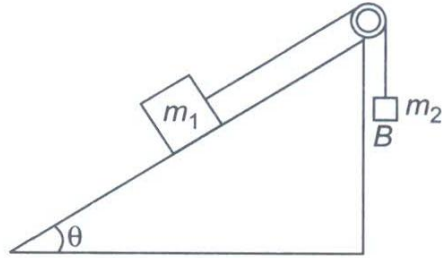


Fig. 6.145

Which of the following statement are true?

- (i) If $m_2 > m_1 \sin \theta$, the body will move up the plane.
 - (ii) If $m_2 > m_1 (\sin \theta + \mu \cos \theta)$, the body will move up the plane.
 - (iii) If $m_2 < m_1 (\sin \theta + \mu \cos \theta)$, the body will move up the plane.
 - (iv) If $m_2 < m_1 (\sin \theta - \mu \cos \theta)$, the body will move down the plane.
- (a) (i, ii)
 - (b) (ii, iii)
 - (c) (ii, iv)
 - (d) (i, ii, iii)

Sol. (c)

- Q14. Two blocks, 4 kg and 2kg are sliding down an incline plane as shown in Fig. 6.159. The acceleration of 2 kg block is:

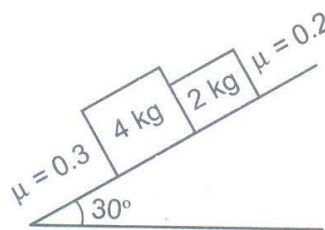


Fig. 6.159

- (a) 1.66 m/s^2
- (b) 2.66 m/s^2
- (c) 3.66 m/s^2
- (d) 4.66 m/s^2

Sol. (b)

Both block move together so,

$$a = \frac{(4+2)g \sin 30^\circ - 0.3(4g \cos 30^\circ) - 0.2(2g \cos 30^\circ)}{4+2}$$
$$= 2.66 \text{ m/s}^2$$

Q15. A conveyor belt is moving at a constant speed of 2 m/s. A box is gently dropped on it. The coefficient of friction between them is $\mu = 0.5$. The distance that the box will move relative to belt before coming to rest on it, taking $g = 10 \text{ ms}^{-2}$ is :

- (a) 0.4 m
- (b) 1.2 m
- (c) 0.6 m
- (d) Zero

Sol. (a)

By using $v^2 = u^2 + 2as$ where $v = 0$,

$$u = \frac{2m}{s}, a = -\mu g = -5 \text{ m/s}^2$$

$$\text{We have } 0^2 = (2)^2 + 2(-5)s \Rightarrow s = 0.4 \text{ m}$$

Q16. A chain is held on frictionless table with $(1/n)^{\text{th}}$ of its length hanging over the edge. If the chain has a length 'L' and a mass 'M', how much work is required to pull the hanging part back on the table?

- (a) $\frac{MgL}{8n^2}$
- (b) $\frac{MgL}{4n^2}$
- (c) $\frac{MgL}{2n^2}$
- (d) $\frac{MgL}{n^2}$

Sol. (c)

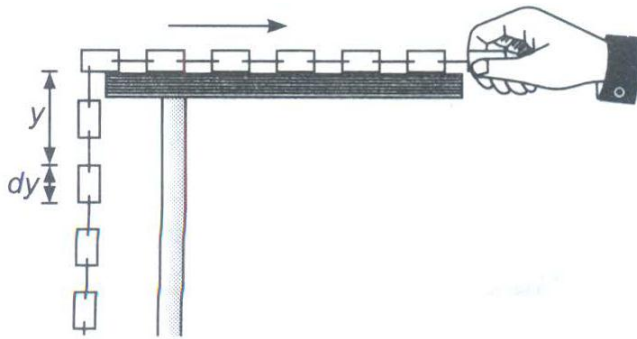


Fig. 7.7

The mass of the chain of length y will be ym and the force acting on it due to gravity will be mgy (assuming that y is the length of the chain hanging over the edge). So, the work done in pulling the dy length of the chain on the table

$$dW = F(-dy) \quad [\text{as } y \text{ is decreasing}]$$

$$\text{i.e. } dW = (mgy)(-dy) \quad [\text{as } F = mgy]$$

SO, the work done in pulling the hanging portion on the table.

$$W = - \int_{L/n}^0 mgy \, dy = \frac{mgL^2}{2n^2}$$

$$\text{or } W = \frac{MgL}{2n^2} \quad [\text{as } M = mL]$$

Q17. A vertical spring with force constant K is fixed on a table. A ball of mass m at a height above the free upper end of the spring falls vertically on the spring so that the spring is compressed by a distance d . The net work done in this process is:

(a) $mg(h-d) + \frac{1}{2}kd^2$

(b) $mg(h+d) + \frac{1}{2}kd^2$

(c) $mg(h+d) - \frac{1}{2}kd^2$

(d) $mg(h-d) - \frac{1}{2}kd^2$

Sol. (c)

Net work done = work done by gravitational force + work done by spring force

$$mg(h+d) - \frac{1}{2}kd^2$$

Q18. A body of mass 1 kg is thrown upwards with a velocity of 20 m/s. It momentarily comes to rest after attaining a height of 18 m. How much energy is lost due to air friction? ($g = 10 \text{ m/s}^2$)

- (a) 10 J
- (b) 20 J
- (c) 30 J
- (d) 40 J

Sol. (b)

By using work – energy theorem

$$W = \Delta KE$$

$$- mgh + W_{\text{friction}} = 0 - \frac{1}{2} mu^2$$

$$\Rightarrow W_{\text{friction}} = \frac{1}{2} mu^2 - mgh$$

$$= \frac{1}{2} (1)(20)^2 - (1 \times 10 \times 18) = 20 \text{ J}$$

Q19. Four identical thin rods each of mass M and length l , form a square frame. Moment of inertia of this frame about an axis through the centre of the square and perpendicular to its plane is:

- (a) $\frac{1}{3} Ml^2$
- (b) $\frac{4}{3} Ml^2$
- (c) $\frac{2}{3} Ml^2$
- (d) $\frac{13}{3} Ml^2$

Sol. (b)

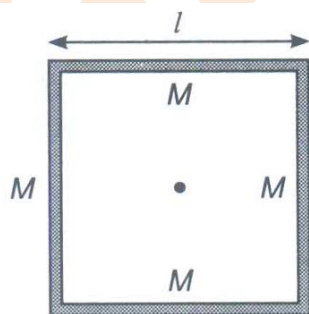


Fig. 10.141

$$I = 4 \left[\frac{Ml^2}{12} + M \left(\frac{l}{2} \right)^2 \right] = \frac{4}{3} Ml^2$$

Q20. From a circular disc of radius R and mass $9M$, a small disc of mass M and radius $\frac{R}{3}$ is removed concentrically. The moment of inertia of the remaining disc about an axis perpendicular to the disc passing through its centre is:

- (a) MR^2
- (b) $4MR^2$
- (c) $\frac{4}{9}MR^2$
- (d) $\frac{40}{9}MR^2$

Sol. (d)

Use parallel axis theorem

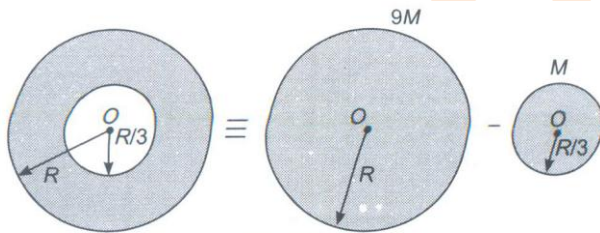


Fig. 10.142

$$I_0 = \frac{1}{2} (9M)R^2 - \frac{1}{2} (M) \left(\frac{R}{3} \right)^2 = \frac{40}{9} MR^2$$

Q21. In Fig. 10. 113, a cubical block is held stationary against a rough wall by applying a force F , then the incorrect statement among the following is:

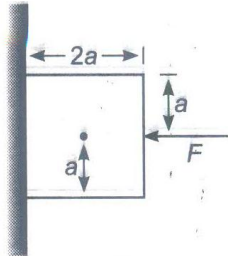


Fig. 10.113

- (a) Frictional force $f = mg$
- (b) $F = N$, N is normal reaction
- (c) F does not apply any torque
- (d) N does not apply any torque

Sol. (d)

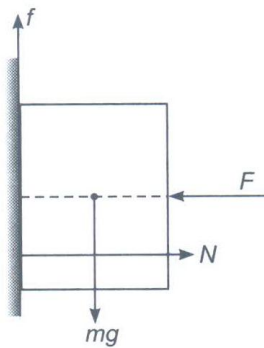


Fig. 10.153

$$f = mg$$

$$F = N$$

For equilibrium $F_{\text{net}} = 0$ and $\tau_{\text{net}} = 0$

For $\tau_{\text{net}} = 0, N$ Must apply torque.

Q22. A circular platform is mounted on a friction vertical axle. Its radius $R = 2\text{m}$ and its moment of inertia about the axle is 200 kgm^2 . It is initially in rest. A 50 kg man stands on the edge of platform and begins to walk along the edge at speed of 1 ms^{-1} relative to the ground. Time taken by the man to complete one revolution is:

- (a) $2\pi\text{s}$
- (b) $\frac{\pi}{2}\text{s}$
- (c) πs
- (d) $\frac{3\pi}{2}\text{s}$

Sol. (a)

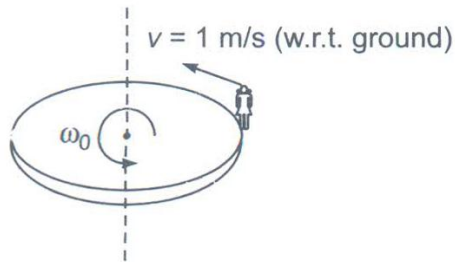


Fig. 10.165

MI of platform = 200 kg m^2

MI of man = $mR^2 = 200\text{ kg m}^2$

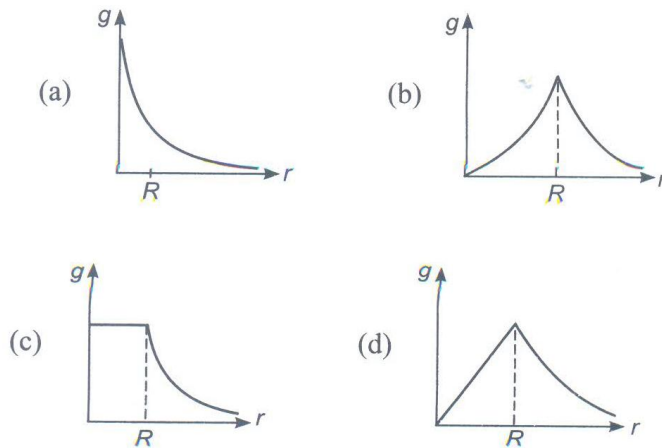
For system (Platform + man) by using COAM,

$$I_p \omega_0 = mvR \Rightarrow \omega_0 = \frac{50 \times 1 \times 2}{200} = \frac{1}{2}\text{ rad/s}$$

Angular velocity of man w.r.t platform = $\frac{v}{R} + \omega_0 = \frac{1}{2} + \frac{1}{2} = 1\text{ rad/s}$

Time taken = $\frac{2\pi}{1} = 2\pi\text{s}$

Q23. The dependence of acceleration due to gravity 'g' on the distance 'r' from the centre of the earth, assumed to be a sphere of radius R of uniform density is as shown in figure given below



Sol. (d)

Inside the earth $g \propto r$ and Outside the earth $g \propto \frac{1}{r^2}$

Q24. The current relationship for the dependence of change in acceleration due to gravity an angle of latitude ϕ , due to rotation of the earth is:

- (a) $\Delta g \propto \cos \phi$
- (b) $\Delta g \propto \cos^2 \phi$
- (c) $\Delta g \propto \cos^3 / 2 \phi$
- (d) $\Delta g \propto \frac{1}{\cos \phi}$

Sol. (b)

Q25. A particle of mass m is thrown upward from the surface of the earth, with a velocity u . The mass and the radius of the earth are respectively, M and R . G is gravitational constant and g is acceleration due to gravity on the surface of the earth. The minimum value of u so that the particle does not return back to earth, is:

- (a) $\sqrt{\frac{2GM}{R^2}}$
- (b) $\sqrt{\frac{2GM}{R}}$
- (c) $\sqrt{\frac{2gM}{R^2}}$
- (d) $\sqrt{2gR^2}$

Sol. (b)

By conservation of mechanical energy

$$\frac{1}{2} mu^2 + \left(-\frac{GMm}{R}\right) = 0 + 0 \Rightarrow u = \sqrt{\frac{2GM}{R}}$$

Q26. The Fig. 11.34 shows the motion of a planet around the sun in all elliptical orbit with sun at the focus. The shaded areas A and B are also shown in the figure which can be assumed to be equal. If t_1 and t_2 represent the time taken for the planet to move from a to b and c to d respectively, then:

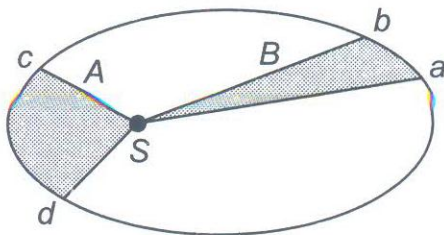


Fig. 11.34

- (a) $t_1 > t_2$
- (b) $t_1 < t_2$
- (c) $t_1 = t_2$
- (d) From the given information the relation between t_1 and t_2 cannot be determined

Sol. (c)

Q27. Which of the following are true for a satellite in a circular orbit?

- (i) It is a freely falling body
 - (ii) Its speed is constant
 - (iii) It suffer no acceleration
 - (iv) It does not require energy for its motion in the orbit
- (a) (ii, iii)
(b) (i, iii)
(c) (ii, iv)
(d) (i, ii, iv)

Sol. (d)

Q28. The density of a material is CGS system of units of 4 g/cm^3 , in a system of units in which unit of length is 10 cm and unit of mass is 100 g, the value of density of material will be:

- (a) 0.04
(b) 0.4
(c) 40
(d) 400

Sol. (c)

$$\text{Density of material} = 4 \frac{\text{g}}{\text{cm}^3} = \frac{4 \times 1000}{100} \frac{(100 \text{ g})}{(10 \text{ cm})^3} = 40 \frac{(100 \text{ g})}{(10 \text{ cm})^3}$$

Q29. According to Bernoulli's theorem, $\frac{p}{d} + \frac{v^2}{2} + gh = \text{constant}$, The dimensional formula of the constant is: (p – pressure, d-density, v = velocity, h-height, g-acceleration due to gravity)

- (a) $[M^0 L^0 T^0]$
(b) $[M^0 L T^0]$
(c) $[M^1 L^0 T^{-2} A^{-1}]$
(d) $[M^1 L^2 T^{-2}]$

Sol. (d)

$$[\text{Constant}] = \left[\frac{v^2}{2} \right] = [v^2] = [M^2 L^2 T^{-2}]$$

Q30. The time dependence of a physical quantity p is given by $P = P_0 \exp(-\alpha t^2)$ [where α is a constant and t is time]. The constant α :

- (a) Is dimensionless
- (b) Has dimensions $[T^{-2}]$
- (c) Has dimensions $[T^2]$
- (d) Has dimensions of p

Sol. (b)

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