**JEE MAIN : CHAPTER WISE TEST PAPER-7**

SUBJECT :- PHYSICS
CLASS :- 11th
CHAPTER :- CENTRE OF MASS
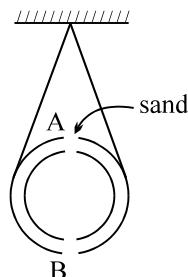
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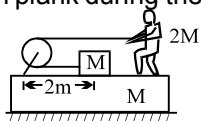SECTION..............................................#...

**(SECTION-A)**

**1.** A uniform metallic spherical shell is suspended from ceiling. It has two holes A and B at top and bottom respectively. Which of the following is/are true



(A) If B is closed and sand is poured from A, centre of mass first rises and then falls
(B) If shell is completely filled with sand and B is opened then centre of mass falls initially.
(C) If shell is slightly filled with sand and B is opened, then centre of mass falls.
(D) none of these

**2.** A ball is dropped from a height h. As it bounces off the floor, its speed is 80 percent of what it was just before it hit the floor. The ball will then rise to a height of most nearly
(A) 0.80 h        (B) 0.75 h
(C) 0.64 h        (D) 0.50 h

**3.** A block of mass M is tied to one end of a massless rope. The other end of the rope is in the hands of a man of mass 2M as shown in the figure. The block and the man are resting on a rough plank of mass M as shown in the figure. The whole system is resting on a smooth horizontal surface. The man pulls th e rope. Pulley is massless and frictionless. What is the displacement of the plank when the block meets the pulley.(Man does not leave his position on plank during the pull)



(A) 0.5 m    (B) 1m        (C) zero        (D) 2/3 m

**4.** Two identical cars start at the same point, but travel in opposite directions on a circular path of radius R, each at speed v. While each car travels a distance less than ($\pi$/2)R, (one quarter circle) the center of mass of the two cars

(A) remains at the initial point
(B) travels along a diameter of the circle at speed < v
(C) travels along a diameter of the circle at speed = v
(D) travels along a diameter of the circle at speed > v

**5.** **Statement-1 :** Two particles of mass 1 kg and 3 kg move towards each other under their mutual force of attraction. No other force acts on them. When the relative velocity of approach of the two particles is 2 m/s, their centre of mass has a velocity of 0.5 m/s. When the relative velocity of approach becomes 3 m/s, the velocity of the centre of mass is 0.75 m/s.
**Statement-2 :** The total kinetic energy as seen from ground is $\frac{1}{2}\mu v_{rel}^2 + \frac{1}{2}mv_c^2$ and in absence of external force, total energy remains conserved.
(A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.
(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.
(C) Statement-1 is true, statement-2 is false.
(D) Statement-1 is false, statement-2 is true.

**6.** Four particles of mass $m_1$ = 2m, $m_2$ = 4m, $m_3$ = m and $m_4$ are placed at four corners of a square. What should be the value of $m_4$ so that the centre of mass of all the four particles are exactly at the centre of the square ?
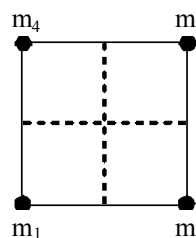


(A) 2 m                    (B) 8 m
(C) 6 m                    (D) not possible

**7.** Two masses of 1 gm and 4 gm are moving with equal kinetic energies. The ratio of the magnitudes of their linear momentum is
(A) 4 : 1                   (B) $\sqrt{2}$ : 1
(C) 1 : 2                   (D) 1 : 16

**PG #1**

**8.** A man of 80 kg attempts to jump from the small boat of mass 40 kg on to the shore. He can generate a relative velocity of 6 m/s between him and boat. His velocity towards shore is
(A) 2 m/s   (B) 3 m/s.   (C) 4 m/s   (D) 8 m/s

**9.** A bomb of mass 9 kg, initially at rest, explodes into two pieces of masses 3 kg and 6 kg. The kinetic energy of the 3 kg mass is 216 J . The kinetic energy of the 6 kg mass is
(A) 213 J    (B) 108 J     (C) 432 J    (D) 54 J

**10.** A projectile is launched from the origin with speed v at an angle θ from the horizontal. At the highest point in the trajectory, the projectile breaks into two pieces, A and B, of masses m and 2m, respectively. Immediately after the breakup piece A is at rest relative to the ground. Neglect air resistance. Which of the following sentences most accurately describes what happens next?
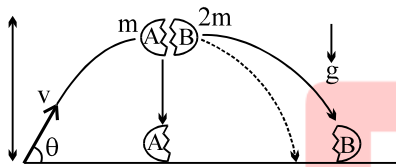


(A) Piece B will hit the ground first, since it is more massive.
(B) Both pieces have zero vertical velocity immediately after the breakup, and therefore they hit the ground at the same time.
(C) Piece A will hit the ground first, because it will have a downward velocity immediately after the breakup.
(D) There is no way of knowing which piece will hit the ground first, because not enough information is given about the breakup.

**11.** **Statement-1 :** Suppose no external force acts on system of two spheres which undergo a perfectly elastic head on collision. The minimum kinetic energy of this system is zero if the net momentum of this system is zero.
**Statement-2 :** In any two body system undergoing perfectly elastic head on collision at the instant of maximum deformation the complete kinetic energy of the system is converted to deformation potential energy of the system.
(A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.
(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.
(C) Statement-1 is true, statement-2 is false.
(D) Statement-1 is false, statement-2 is true.

**12.** Two blocks each of mass m tied by a massless inextensible string are kept on a smooth horizontal surface. A particle of mass m collides one of the blocks as shown and get stuck to it. Just after collision the velocity component of the particle perpendicular to the string is
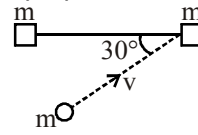


(A) $\dfrac{v}{2}$    (B) $\dfrac{v}{4}$    (C) $\dfrac{v}{8}$    (D) $\dfrac{3v}{8}$

**13.** A body of mass 2 kg moving with a velocity of 4 ms$^{-1}$ collides head-on with another body of mass 3 kg moving with a velocity of 4 ms$^{-1}$ in the opposite direction. If the heavier body is brought to rest after the collision, What is the velocity of 2kg mass after the collision.
(A) 6 ms$^{-1}$                (B) 2 ms$^{-1}$
(C) 12 ms$^{-1}$               (D) 4 ms$^{-1}$

**14.** A bomb is projected upwards. At topmost point it explodes in three identical fragments. First fragment comes to ground in 10 sec. and others in 20 sec each. Then the height reached by the original bomb is
(A) 800 m                 (B) 1600 m
(C) 1250 m                (D) 1500 m

**15.** A force is applied to an 8.0 kg object initially at rest. The magnitude of the net force varies with time as shown. What is the speed of the object t = 15 s.
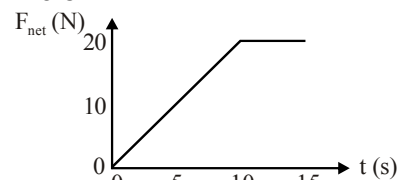


(A) 10.0 m/s                (B) 12.5 m/s
(C) 25.0 m/s                (D) 50.0 m/s

**16.** Two identical balls A and B lie on a smooth horizontal surface, which gradually merges into a curve to a height 3.2 m. Ball A is given a velocity of 10 m/s, it collides headon with ball B, which then takes up the curved path. The minimum cofficient of restitution e for the collision between A and B, in order that ball B reaches the highest point C of the curve is (g = 10 m/s$^2$) :
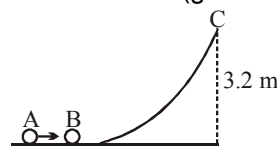


(A) $\dfrac{1}{4}$    (B) $\dfrac{3}{5}$    (C) $\dfrac{1}{2}$    (D) $\dfrac{3}{4}$

**17.** Two boys in a boat toss a baseball back and forth. What effect will this have on the boat? Neglect frictional forces with water or air.

(A) None, because the ball remains in the boat.

(B) The boat will drift in the direction of the boy who throws the ball harder each time.

(C) The boat will drift in the direction of the boy who throws the ball with less force each time.

(D) The boat will oscillate back and forth always moving opposite to the ball.

**18.** A body of mass 2.9 kg is suspended from a string of length 2.5 m and is at rest. A bullet of mass 100 g, moving horizontally with a speed of 150 m/s, strikes and sticks to it. What is the maximum angle made by the string with the vertical after the impact ? (g = 10 m/s²)

(A) 30°     (B) 45°

(C) 60°     (D) 90°

**19.** A massive wooden plate of unknown mass M remains in equilibrium when n bullets are fired per second on it vertically. The mass of each bullet is m (M >> m) and it strikes the plate at the centre with speed v. If the coefficient of restitution is e, then M is equal to



(A) $\dfrac{mvn}{g}$     (B) $\dfrac{mevn}{g}$

(C) $\dfrac{mv(1+e)n}{g}$     (D) nm

**20.** In the figure shown a particle P strikes the inclined smooth plane horizontally and rebounds vertically. If the angle θ is 60°, then the coefficient of restitution is:
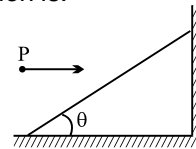


(A) 1/3     (B) $1/\sqrt{3}$     (C) 1/2     (D) 1

## (SECTION-B)

**21.** A particle of mass 1 kg is thrown vertically upwards with speed 100 m/s. After 5s it explodes into two parts. One part of mass 400g comes back with speed 25 m/s, what is the speed of other part just after explosion?

**22.** In the figure shown a hole of radius 2 cm is made in a semicircular disc of radius $6\pi$ cm at a distance 8 cm from the centre C of the disc. The distance of the centre of mass of this system from point C is:
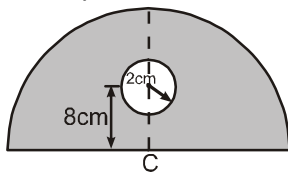


**23.** A uniform solid cone of height 40 cm is shown in figure. The distance of centre of mass of the cone from point B (centre of the base) is :
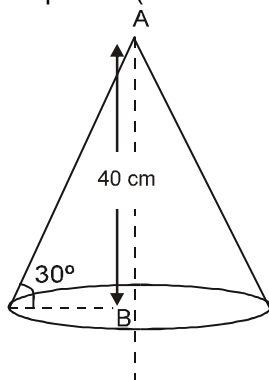


**24.** Two masses are connected by a spring as shown in the figure. One of the masses was given velocity v = 2 k as shown in figure where 'k' is the spring constant. Then maximum extension in the spring will be $\sqrt{nmk}$. What is the vlue of n?



Smooth
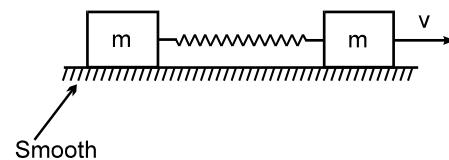
**25.** A ball of mass 50 gm is dropped from a height h = 10 m. It rebounds losing 75 percent of its kinetic energy. If it remains in contact with the ground for $\Delta t$ = 0.01 sec., the impulse of the impact force is :

**26.** During the head on collision of two masses 1 kg and 2 kg the maximum energy of deformation is $\dfrac{100}{3}$ J. If before collision the masses are moving in the opposite direction, then their velocity of approach before the collision is :

**27.** Two blocks A and B are connected by a massless string (shown in figure) A force of 30 N is applied on block B. The distance travelled by centre of mass in 2s starting from rest is :
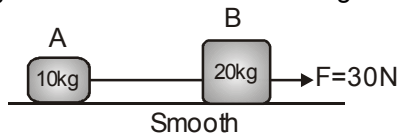


**28.** If the momentum of a body increases by 20%, the percentage increase in its kinetic energy is equal to :

**29.** A rocket with a lift-off mass $3.5 \times 10^4$ kg is blasted upwards with an intial acceleration of 10 m/s$^2$. Then the initial thrust of the blast is n × 10$^5$ N. Find the value of n.

**30.** A bomb of mass 16 kg at rest explodes into two pieces of masses of 4 kg and 12 kg. The velocity of the 12 kg mass is 4 ms$^{-1}$. The kinetic energy of the other mass is :