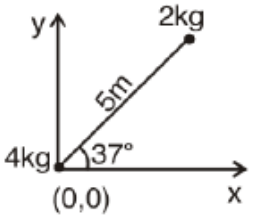
CONSERVATION OF MOMENTUM

1. Two particle of mass 4 kg and 2 kg are located as shown in figure then find out the position of centre of mass



(A) $\left(\frac{2}{3},1\right)$ (B) $\left(\frac{4}{3},1\right)$

(C) $\left(1,\frac{2}{3}\right)$ (D) $\left(1,\frac{4}{3}\right)$

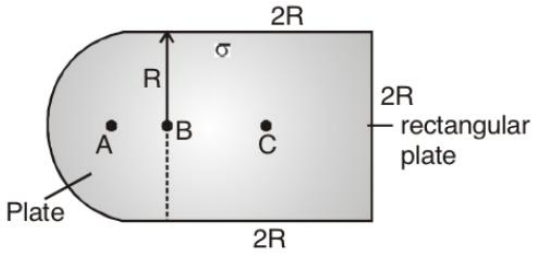
2. Two particles of mass 2 kg and 4 kg lie on the same line. If 4 kg is displaced rightwards by 5m then by what distance 2 kg should be move for which centre of mass will remain at the same position.

(A) 2m (B) 4m (C) 7m (D) 10m

3. Three particles of mass 1 kg, 2 kg and 3 kg are placed at the corners A, B and C respectively of an equilateral triangle ABC of edge 1m. Find the distance of their centre of mass from A.

(A) $\frac{\sqrt{19}}{6}$m (B) $\frac{\sqrt{17}}{3}$m (C) $\frac{15}{13}$m (D) $\frac{116}{71}$m

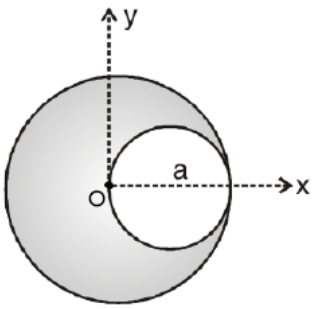
4. Find out the position of centre of mass of the figure shown below.



(A) $\frac{\pi R(\pi+4)}{3\pi+8}$ (B) $\frac{\pi R(3\pi+4)}{3(\pi+8)}$

(C) $\frac{3\pi R(3\pi+8)}{(\pi+4)}$ (D) $\frac{2\pi R(\pi+8)}{3(\pi+4)}$

5. Find the position of centre of mass of the uniform lamina shown in figure. If the mass density of the lamina is σ.



(A) left side of O at $\frac{a}{2}$ distance

(B) left side of O at $\sqrt{\frac{a}{2}}$ distance

(C) left side of O at $\frac{2a}{3}$ distance

(D) left side of O at $\frac{2a}{5}$ distance

6. Calculate impulse of force $\vec{F}=\left(3t^2\tilde{i}-(2t-1)\tilde{j}+2\tilde{k}\right)$N over the time interval from $t=1s$ to $t=3s$.

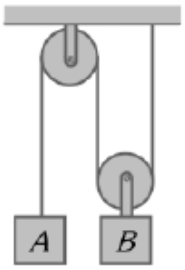
(A) $26\hat{i}-6\hat{j}+4k$ N$-$S (B) $26\hat{i}+6\hat{j}-4k$ N$-$S

(C) $21\hat{i}-3\hat{j}+4k$ N$-$S (D) $26\hat{i}-6\hat{j}-14k$ N$-$S

7. A particle of mass 2 kg is moving in free space with velocity $\vec{v}_0=\left(2\hat{i}-3\hat{j}+\hat{k}\right)$m/s is acted upon by force $\vec{F}_0=\left(2\hat{i}+\hat{j}-2\hat{k}\right)$N. Find velocity vector of the particle 3s after the force starts acting.

(A) $5\hat{i}-1.5\hat{j}+6k$ (B) $5\hat{i}-15\hat{j}-2k$ (C) $5\hat{i}-1.5\hat{j}-2k$ (D) $15\hat{i}-1.5\hat{j}+6k$

8. Two boxes A and B of masses m and M interconnected by an ideal rope and ideal pulleys are held at rest as shown. When it is released, box B accelerates downwards. Find velocities of box A and B as function of time t after system has been released.



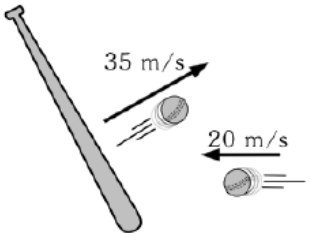
(A) $v_A = \left(\frac{M-2m}{M+4m}\right)gt$ and $v_B = \left(\frac{M-2m}{M+4m}\right)gt$

(B) $v_A = 2\left(\frac{M-2m}{M+4m}\right)gt$ and $v_B = \left(\frac{M-2m}{M+4m}\right)gt$

(C) $v_A = \left(\frac{M-2m}{M+4m}\right)gt$ and $v_B = 2\left(\frac{M-2m}{M+4m}\right)gt$

(D) $v_A = 2\left(\frac{M-2m}{M+4m}\right)gt$ and $v_B = 2\left(\frac{M-2m}{M+4m}\right)gt$

9. A 100 gm ball moving horizontally with 20 m/s is struck by a bat, as a result it starts moving with a speed of 35 m/s at an angle of 37 above the horizontal in the same vertical plane as shown in the figure. Find the average force exerted by the bat if duration of impact is 0.30 s.



(A) $160\hat{i} + 8\hat{j}$ (B) $16\hat{i} + 701\hat{j}$

(C) $160\hat{i} + 71\hat{j}$ (D) $16\hat{i} + 8\hat{j}$

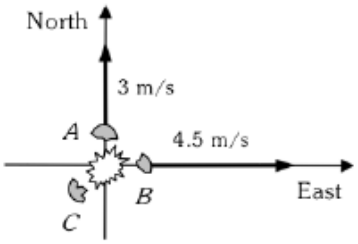
10. An object is moving so that its kinetic energy is 150 J and the magnitude of its momentum is 30.0 kg m/s. With what velocity is it travelling?

(A) 10 m/s (B) 8 m/s (C) 45 m/s (D) 15 m/s

11. Two blocks of masses m and M are held against a compressed spring on a frictionless horizontal floor with the help of a light thread. When the thread is cut, the smaller block leaves the spring with a velocity u relative to the larger block. Find the recoil velocity of the larger block.

(A) $\frac{Mu}{m+m}$ (B) $\frac{mu}{m+m}$ (C) $\left(\frac{m-M}{m+M}\right)u$ (D) $\frac{2mu}{m+m}$

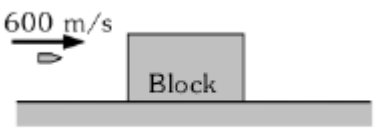
12. A shell fired vertically up, when reaches its highest point, explodes into three fragments A, B and C of masses $m_A = 4kg$, $m_B = 2kg$ and $m_C = 3kg$. Immediately after the explosion, A is observed moving with velocity $v_A = 3m/s$ towards north and B with a velocity $v_B = 4.5m/s$ towards east as shown in the figure. Find the velocity v_C of the piece C.



(A) 3 m/s, 37° south of west (B) 3 m/s, 53° south of west

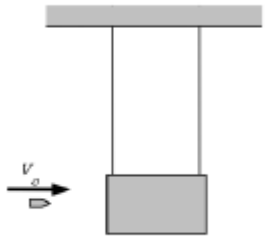
(C) 5 m/s, 37° south of west (D) 5 m/s, 53° south of west

13. A bullet of mass 50 g moving with velocity 600 m/s hits a block of mass 1.0 kg placed on a rough horizontal ground and comes out of the block with a velocity of 400 m/s. The coefficient of friction between the block and the ground is 0.25. Neglect loss of mass of the block as the bullet pierces through it. Find the distance the block will travel before it stops.



(A) 20 m/s (B) 25 m/s (C) 30 m/s (D) 35 m/s

14. A wooden block of mass M is suspended with the help of two threads to prevent rotation while swinging. A bullet of mass m moving horizontally with velocity v_0 hits the block and becomes embedded in the block. Receiving momentum from the bullet, the bullet-block system swings to a height h. Find expression for speed of the bullet in terms of given quantities.

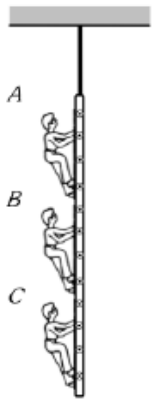


(A) $\frac{M+m}{M}\sqrt{gh}$ (B) $\frac{M+m}{M}\sqrt{2gh}$ (C) $\frac{M+m}{m}\sqrt{gh}$ (D) $\frac{M+m}{m}\sqrt{2gh}$

15. A ball of mass 2 kg moving with speed 5 m/s collides directly with another of mass 3 kg moving in the same direction with speed 4 m/s. The coefficient of restitution is 2/3. Find the velocities after collision.
(A) 4.67 m/s (B) 3.23 m/s (C) 5.67 m/s (D) 1.67 m/s

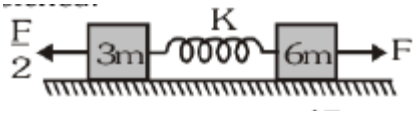
16. A block of mass 5 kg moves from left to right with a velocity of 2 m/s and collides with another block of mass 3 kg moving along the same line in the opposite direction with velocity 4 m/s. If the collision is perfectly elastic, determine velocities of both the blocks after their collision.
(A) 2.5 m/s, 2.5 m/s (B) 3.5 m/s, 3.5 m/s (C) 2.5 m/s, 3.5 m/s (D) 3.5 m/s, 2.5 m/s

17. A ladder of mass 20 kg is hanging from ceiling as shown in figure. Three men A, B and C of masses 40 kg, 60 kg, and 50 kg are climbing the ladder. Man A is climbing with upward retardation 2m/s^2, B is climbing up with a constant speed of 0.5 m/s and C is climbing with upward acceleration of 1m/s^2. Find the tension in the string supporting the ladder.



(A) 1670 N (B) 1620 N
(C) 1590 N (D) 1570 N

18. For shown situation find the maximum elongation in the spring. Neglect friction everywhere. Initially, the blocks are at rest and spring is unstretched.

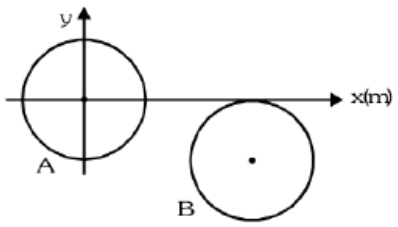


(A) $\frac{4F}{3K}$ (B) $\frac{3F}{4K}$ (C) $\frac{4F}{K}$ (D) $\frac{2F}{K}$

19. A small sphere of mass 1 kg is moving with a velocity $\left(6\hat{i}+\hat{j}\right)\text{m/s}$. It hits a fixed smooth wall and rebounds with velocity $\left(4\hat{i}+\hat{j}\right)\text{m/s}$. The coefficient of restitution between the sphere and the wall is

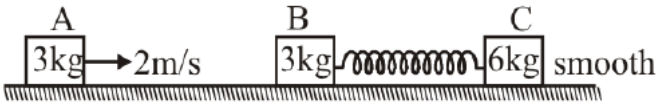
(A) $\frac{3}{2}$ (B) $\frac{2}{3}$ (C) $\frac{9}{16}$ (D) $\frac{4}{9}$

20. Two smooth balls A and B, each of mass m and radius R, have their centre at $(0,0,R)$ and $(5R,-R,R)$ respectively, in a coordinate system as shown. Ball A, moving along positive x-axis, collides with ball B. Just before the collision, speed of ball A is 4 m/s and ball B is stationary. The collision between the balls is elastic. Velocity of the ball A just after the collision is

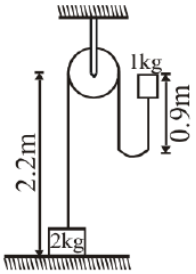


(A) $\left(\tilde{i}+3\tilde{j}\right)\text{m/s}$ (B) $\left(\tilde{i}-\sqrt{3}\tilde{j}\right)\text{m/s}$ (C) $\left(2\tilde{i}+\sqrt{3}\tilde{j}\right)\text{m/s}$ (D) $\left(2\tilde{i}+2\tilde{j}\right)\text{m/s}$

21. For shown situation, if collision between block A and B is perfectly elastic, then find the maximum energy stored in spring in joules.

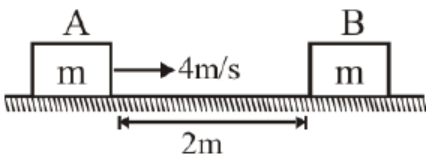


22. In the shown figure, the heavy block of mass 2 kg rests on the horizontal surface and the lighter block of mass 1 kg is dropped from a height of 0.9 m. At the instant the string gets taut, find the upward speed (in m/s) of the heavy block.

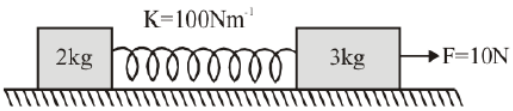


23. A thin rod of length 6 m is lying along the x-axis with its ends at $x=0$ and $x=6m$. Its linear density (mass/length) varies with x as kx^4. Find the position of centre of mass of rod in meters.

24. The friction coefficient between the horizontal surface and blocks A and B are $\frac{1}{15}$ and $\frac{2}{15}$ respectively. The collision between the blocks is perfectly elastic. Find the separation (in meters) between the two blocks when they come to rest.



25. At $t=0$, a constant force is applied on 3 kg block. Find out maximum elongation in spring in cm.



KEY

1.	B	**2.**	D	**3.**	A	**4.**	B	**5.**	C
6.	A	**7.**	C	**8.**	B	**9.**	D	**10.**	A
11.	B	**12.**	D	**13.**	A	**14.**	D	**15.**	A
16.	C	**17.**	A	**18.**	A	**19.**	D	**20.**	A
21.	4	**22.**	2	**23.**	5	**24.**	5	**25.**	8

Wish You all the Best