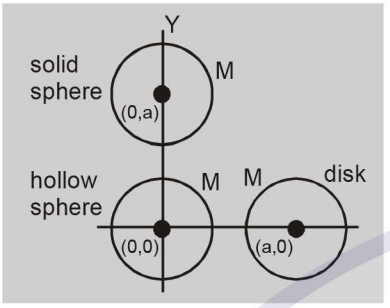
1. The coordinate of the centre of mass of a system as shown in figure :–



(1) $\left(\frac{a}{3}, 0\right)$ (2) $\left(\frac{a}{2}, \frac{a}{2}\right)$

(3) $\left(\frac{a}{3}, \frac{a}{3}\right)$ (4) $\left(0, \frac{a}{3}\right)$

2. The centre of mass of a system of three particles of masses 1g, 2g and 3g is taken as the origin of a coordinate system. The position vector of a fourth particle of mass 4g such that the centre of mass of the four particle system lies at the point (1, 2, 3,) is $\alpha(\hat{i} + 2\hat{j} + 3\hat{k})$, where α is a constant. The value of α is :-

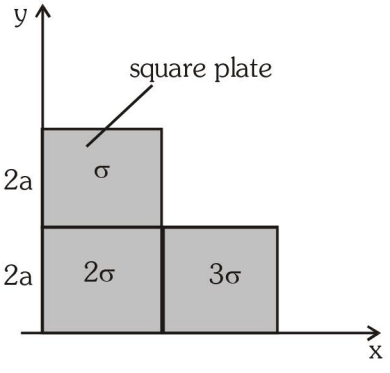
(1) $\frac{10}{3}$ (2) $\frac{5}{2}$ (3) $\frac{1}{2}$ (4) $\frac{2}{5}$

3. A rigid body consists of a 5 kg mass connected to a 10 kg mass by a massless rod. The 5 kg mass is located at $\vec{r}_1 = (5\hat{i} + 4\hat{j})$ m and the 10 kg mass at $\vec{r}_2 = (4\hat{i} + 3\hat{j})$ m. Find the coordinates of the centre of mass.

(1) (11, 10) (2) $\left(\frac{13}{3}, \frac{10}{3}\right)$

(3) $\left(\frac{11}{15}, \frac{10}{15}\right)$ (4) (3, 4)

4. Find the position of centre of mass of given figure :-



(1) $a\hat{i} + a\hat{j}$ (2) $\frac{3a}{2}\hat{i} + \frac{3a}{2}\hat{j}$

(3) $2a\hat{i} + \frac{4a}{3}\hat{j}$ (4) $2a\hat{i} + 2a\hat{j}$

5. Find the position of centre of mass from the base of a uniform solid cone of height 20 cm.

(1) 5 cm (2) $\frac{20}{3}$ cm

(3) 12 cm (4) lie outside the cone

6. If the linear density of a rod of length L varies as $\lambda = kx^2$, determine the position of its centre of mass (where x is the distance from one of its ends and k is constant) :-

(1) $\frac{L}{2}$ (2) $\frac{L}{3}$ (3) $\frac{2L}{3}$ (4) $\frac{3L}{4}$

7. The variation of density of a cylindrical thick and long rod, is $\rho = \rho_0 \frac{x^2}{L^2}$, then position of its centre of mass from x = 0 end is :-

(1) 2L/3 (2) L/2 (3) L/3 (4) 3L/4

8. Find the position of centre of mass from base for a solid hemisphere of radius 24 cm,

(1) 4 cm (2) 9 cm (3) 8 cm (4) 12 cm

9. Two particles which are initially at rest, move towards each other under the action of their internal attraction. If their speeds are v and 2v at any instant, then the speed of centre of mass of the system will be :-

(1) v (2) 2v (3) Zero (4) 1.5 v

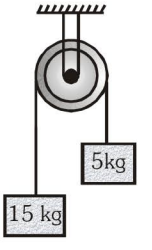
10. Two bodies of masses 15 kg and 5 kg are connected to the ends of a mass less cord and allowed to move as shown in figure. The pulley is massless and friction less. Calculate the acceleration of the centre of mass:-

(1) 5 m/s^2

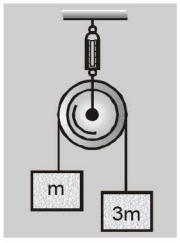
(2) –5 m/s^2

(3) $\frac{5}{2}$ m/s^2

(4) $-\frac{5}{2}$ m/s^2



11. If the system is released, then the acceleration of the centre of mass of the system :-



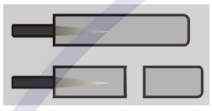
(1) $\frac{g}{4}$

(2) $\frac{g}{2}$

(3) g

(4) 2g

12. A cricket bat is cut at the location of its centre of mass as shown. Then :-



(1) The two pieces will have the same mass

(2) The bottom piece will have larger mass

(3) The handle piece will have larger mass

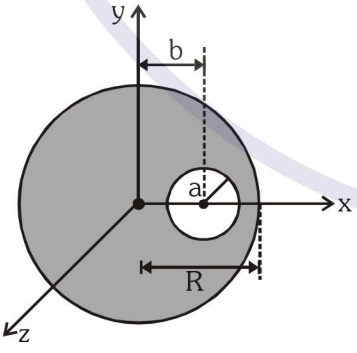
(4) Mass of handle piece is double the mass of bottom piece

13. Two spherical bodies of mass M and 5M and radii R and 2R are released in free space with initial separation between their centres equal to 12R. If they attract each other due to gravitational force only, then the distance covered by the smaller body before collision is :-

(1) 9.5R (2) 7.5R

(3) 4.5R (4) 3.5R

14. A uniform solid sphere as shown below has a spherical hole in it. Find the position of its centre of mass.



(1) $\frac{-a^3b^2}{R^3-a^3}$ (2) $\frac{-a^3b}{R^3-a^3}$

(3) $\frac{-a^3b^3}{R^3-a^3}$ (4) $\frac{-b^3a}{R^3-a^3}$

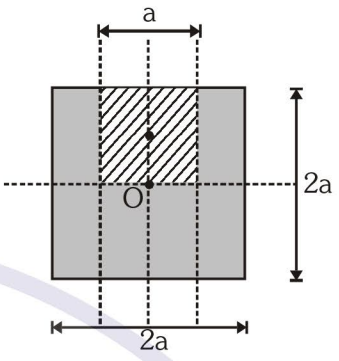
15. A uniforme sheet is shown below if the shaded area is removed find new position of centre of mass.

(1) $+\frac{a}{6}$

(2) $-\frac{a}{6}$

(3) $+\frac{a}{3}$

(4) $-\frac{a}{3}$



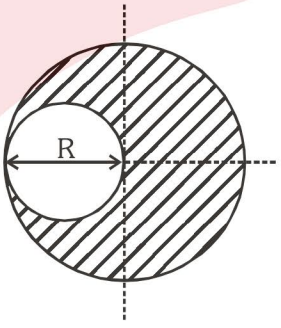
16. A circular disc of radius R has a uniform thickness. A circular hole of diameter equal to radius of disc has been cut out as shown. Distance of centre of mass of remaining disc from O is :-

(1) $\frac{R}{14}$

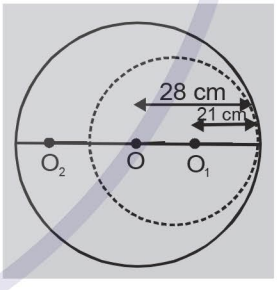
(2) $\frac{R}{12}$

(3) $\frac{R}{8}$

(4) $\frac{R}{6}$



17. A circular plate of uniform thickness has a diameter 56 cm. A circular portion of diameter 42 cm is removed from one edge as shown in the figure. The centre of mass of the remaining portion from the centre of plate will be :



(1) 5 cm (2) 7 cm (3) 9 cm (4) 11 cm

18. A 1 kg stationary bomb is exploded in three parts having mass ratio 1 : 1 : 2. Parts having same mass move in perpendicular directions with velocity 30 m/s, then the velocity of bigger part will be :-

(1) $3\sqrt{2}$ m/s (2) $\frac{10}{\sqrt{2}}$ m/s

(3) $15\sqrt{2}$ m/s (4) $\frac{15}{\sqrt{2}}$ m/s

19. A big ball of mass M, moving with velocity u strikes a small ball of mass m, which is at rest. Finally small ball attains velocity u and big ball v. What is the value of v :-

(1) $\frac{M-m}{M}u$ (2) $\frac{m}{M+m}u$

(3) $\frac{2m}{M+m}$ (4) $\frac{M}{M+m}v$

20. A heavy nucleus at rest breaks into two fragments which fly off with velocities 8 : 1. The ratio of radii of the fragments is :-

(1) 1 : 2 (2) 1 : 4

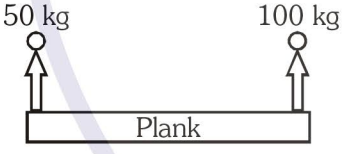
(3) 4 : 1 (4) 2 : 1

21. A person of mass m is standing on one end of a plank of mass M and length L and floating in water. The person moves from one end to another and stops. The displacement of the plank is –

(1) $\frac{Lm}{(m+M)}$ (2) Lm(M + m)

(3) $\frac{(M+m)}{Lm}$ (4) $\frac{LM}{(m+M)}$

22. Two man of mass 50 kg and 100 kg are standing on a 150 kg plank. Find the displacement of plank if both interchange their positions on 10 m long plank.



(1) 5m, Right (2) $\frac{5}{3}$m , Right

(3) 3m, Left (4) 0

23. A bullet of mass m is fired from a gun of mass M. The recoiling gun compresses a spring of force constant k by a distance d. Then the velocity of the bullet is :-

(1) kd $\sqrt{M/m}$ (2) $\frac{d}{M}\sqrt{km}$

(3) $\frac{d}{m}\sqrt{kM}$ (4) $\frac{kM}{m}\sqrt{d}$

24. A bullet of mass m is fired into a large block of wood of mass M with velocity v. The final velocity of the system is :-

(1) $\left(\frac{m}{M-m}\right)v$ (2) $\left(\frac{m+M}{M}\right)v$

(3) $\left(\frac{M-m}{M}\right)v$ (4) $\left(\frac{m}{m+M}\right)v$

25. A bullet of mass 10g moving horizontally with a velocity of 500 m/s strikes a wooden block of mass 2 kg which is suspended by a light inextensible string of length 5 m. As a result, the centre of gravity of the block is found to rise a vertical distance of 10 cm. The speed of the bullet after it emerges out horizontally from the block will be :-

(1) 220 m/s (2) 200 m/s

(3) 160 m/s (4) 120 m/s

26. A 10 gm lump of clay, moving with a velocity of 10 cm/s towards east, collides head–on with another 20 gm lump of clay moving with 15cm/s towards west. After collision, the two lumps stick together. The velocity of the compound lump will be –

(1) 5 cm/s towards east

(2) 5 cm/s towards west

(3) 6.6 cm/s towards east

(4) 6.6 cm/s towards west

27. Two identical balls, one moves with 6 m/s and second is at rest, collides elastically. After collision velocity of second and first ball will be :

(1) 6m/s, 6m/s (2) 12m/s, 12m/s

(3) 6m/s, 0m/s (4) 0m/s, 6m/s

28. Two identical balls A and B having velocities of 5 m/s and –3 m/s respectively collide elastically in one dimension. The velocities of B and A after the collision respectively will be :-

(1) –3 m/s and 5 m/s

(2) 3 m/s and 5 m/s

(3) –5 m/s and 3 m/s

(4) 5 m/s and –3 m/s

29. A 1 Kg ball falls from a height of 25 cm and rebounds upto a height of 16 cm. The co–efficient of restitution is –

(1) 0·8 (2) 0·32 (3) 0·40 (4) 0·56

30. A ball is dropped from a height of 10 m. If 60% of its energy is lost on collision with the earth then after collision the ball will rebound to a height of–

(1) 10 m (2) 8 m

(3) 4 m (4) 6 m

31. Two balls of equal masses undergo a head-on collision with speeds 6 m/s moving in opposite direction. If the coefficient of restitution is 0.5, find the speed of each ball after impact in m/s.

(1) 3 (2) 6

(3) 2 (4) 4

32. Identify the wrong statement.

(1) A body can have momentum without energy

(2) A body can have energy without momentum

(3) The momentum is conserved in an elastic collision only.

(4) Kinetic energy is not conserved in an inelastic collision

33. A sphere of mass m moving with a constant velocity collides with another stationary sphere of same mass. The ratio of velocities of two spheres after collision will be, if the co-efficient of restitution is e-

(1) $\frac{1-e}{1+e}$ (2) $\frac{e-1}{e+1}$

(3) $\frac{1+e}{1-e}$ (4) $\frac{e+1}{e-1}$

34. A ball is dropped from height h on the ground level. If the coefficient of restitution is e then the height upto which the ball will go after n^{th} jump will be –

(1) $\frac{h}{e^{2n}}$ (2) $\frac{e^{2n}}{h}$

(3) he^{n} (4) he^{2n}

35. A particle falls from a height 'h' upon a fixed horizontal plane and rebounds. If 'e' is the coefficient of restitution the total distance travelled before rebounding has stopped is :-

(1) $h\left(\frac{1+e^2}{1-e^2}\right)$ (2) $h\left(\frac{1-e^2}{1+e^2}\right)$

(3) $\frac{h}{2}\left(\frac{1-e^2}{1+e^2}\right)$ (4) $\frac{h}{2}\left(\frac{1+e^2}{1-e^2}\right)$

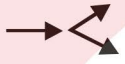
36. If two masses m_1 and m_2 collide, the ratio of the changes in their respective velocities is proportional to :-

(1) $\frac{m_1}{m_2}$ (2) $\sqrt{\frac{m_1}{m_2}}$

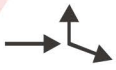
(3) $\frac{m_2}{m_1}$ (4) $\sqrt{\frac{m_2}{m_1}}$

37. In the diagrams given below the horizontal line represents the path of a ball coming from left and hitting another ball which is initially at rest. The other two lines represents the paths of the two balls after the collision. Which of the diagram shows a physically impossible situation ?

(1) 

(2) 

(3) 

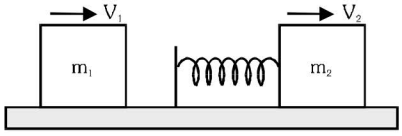
(4) 

38. A rubber ball is dropped from a height of 5m on a plane, where the acceleration due to gravity is not shown. On bouncing it rises to 1.8 m. The ball loses its velocity on bouncing by a factor of :-

(1) $\frac{16}{25}$ (2) $\frac{2}{5}$

(3) $\frac{3}{5}$ (4) $\frac{9}{25}$

39. Two masses m_1 = 2kg and m_2 = 5kg are moving on a frictionless surface with velocities 10m/s and 3 m/s respectively. m_2 is ahead of m_1. An ideal spring of spring constant k = 1120 N/m is attached on the back side of m_2. The maximum compression of the spring will be :-



(1) 0·51 m (2) 0·062 m

(3) 0·25 m (4) 0·72 m

40. Two spheres A and B of masses m_1 and m_2 respectively collide. A is at rest initially and B is moving with velocity 2v along x-axis. After collision B has a velocity v in a direction perpendicular to the original direction. The mass A moves after collision in the direction.

(1) $\theta = \tan^{-1}(1/2)$ to the x-axis

(2) $\theta = \tan^{-1}(-1/2)$ to the x-axis

(3) same as that of B

(4) opposite to that of B

41. A ball moving with velocity of 9m/s collides with another similar stationary ball. After the collision both the balls move in directions making an angle of 30° with the initial direction. After the collision their speed will be –

(1) $\frac{5}{\sqrt{3}}$ m/s

(2) $3\sqrt{3}$ m/s

(3) $\frac{10}{\sqrt{3}}$ m/s

(4) 52 m/s

ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	**3**	**2**	**2**	**3**	**1**	**4**	**4**	**2**	**3**	**4**	**1**	**2**	**2**	**2**	**2**
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	**4**	**3**	**3**	**1**	**1**	**1**	**2**	**3**	**4**	**1**	**4**	**3**	**4**	**1**	**3**
Que.	31	32	33	34	35	36	37	38	39	40	41				
Ans.	**1**	**3**	**1**	**4**	**1**	**3**	**3**	**2**	**3**	**1,2**	**2**				