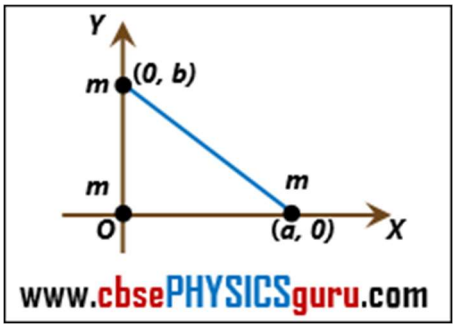
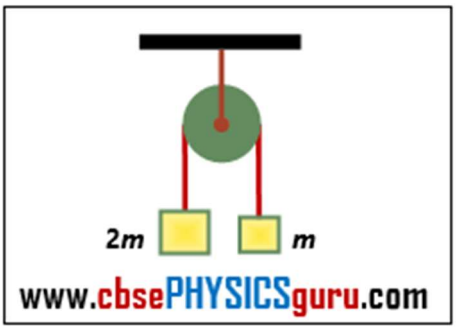
CENTRE OF MASS AND EQUILIBRIUM

1. Three particles, each of mass m, are placed at the corners of a right angled triangle as shown in figure. If the co-ordinates of point A and B are $(a, 0)$ and $(0, b)$ respectively, then the position vector of the centre of mass is:



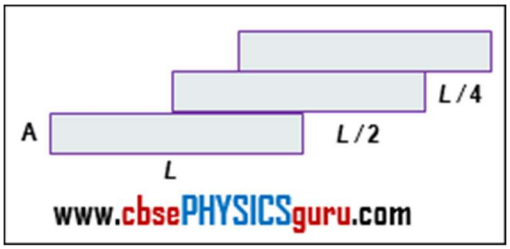
(a) $\frac{1}{2}(a\hat{\imath}+b\hat{\jmath})$ **(b)** $\frac{1}{3}(a\hat{\imath}+b\hat{\jmath})$ (c) $\frac{1}{2}(a\hat{\imath}-b\hat{\jmath})$ (d) $\frac{2}{3}(a\hat{\imath}+b\hat{\jmath})$

2. The position of centre of mass of a system of particles does not depend upon:
(a) masses of particles **(b)** forces on particles (c) position of the particles (d) relative distance between the particles
3. Three particles of masses 1 kg, 2 kg and 3 kg are situated at the corners of an equilateral triangle of side L in the x-y plane with mass 1 kg at the origin and 2 kg on the x-axis. The y- coordinate of the centre of mass is:
(a) $\frac{7L}{12}$ (b) $\frac{\sqrt{3}L}{2}$ **(c)** $\frac{\sqrt{3}L}{4}$ (d) $\frac{2\sqrt{3}L}{7}$
4. If the system is released, then the acceleration of the centre of mass of the system shown in the figure is:
(a) g/9 (b) g/3 (c) g/2 (d) g/6



5. Two particles of masses 3 kg and 1 kg have position vectors $\hat{\imath}+\hat{\jmath}+\hat{k}$ and $3\hat{\imath}+\hat{\jmath}-3\hat{k}$ respectively. The centre of mass has a position vector:
(a) $\hat{\imath}+4\hat{\jmath}+2\hat{k}$ (b) $4\hat{\imath}-\hat{\jmath}+0\hat{k}$ **(c)** $1.5\,\hat{\imath}+\hat{\jmath}+0\hat{k}$ (d) $\hat{\imath}+0\hat{\jmath}+2\hat{k}$.
6. A circular disc of radius R/2 is removed from a bigger circular disc of radius R, such that the circumferences of the discs touch at a point. The centre of mass of the new disc from the centre of the bigger disc is:
(a) R/4 (b) R/3 **(c)** R/6 (d) R/8
7. Figure shows position and velocities of two particles moving under mutual gravitational attraction in space at time t = 0. The position of centre of mass after 1 second is:

(a) x = 4.25 m (b) x = 6.75 m (c) x = 7.75 m **(d)** x = 9.25 m
8. Three bricks each of length L and mass m are arranged as shown figure. The distance of the centre of mass of the system from the point A is:
(a) $\frac{L}{3}$ (b) $\frac{4L}{3}$ **(c)** $\frac{11}{12}$ (d) $\frac{12}{11}$



9. A T shaped object with dimensions shown in figure, is lying on a smooth floor. A force F is applied at the point P parallel to AB, such that the object has only translational motion. The distance of point P with from point C is:

(a) $\frac{4L}{3}$ (b) $\frac{2L}{3}$ (c) $\frac{L}{3}$ (d) $\frac{L}{6}$

10. Two masses connected by a massless rod lies along the x-axis. A 0.3 kg mass is at a distance x = 1 m while a 0.7 kg mass is at a distance x = 5 m. The x-coordinate of the centre of mass is:
    (a) 2.5 m **(b)** 3.8 m (c) 4.5 m (d) 4.9 m
11. Centre of mass of 3 particles 1 kg, 2 kg and 3 kg is at (0, 0, 0). Where should a particle of mass 4 kg be placed so that the combined centre of mass will be at (3, 3, 3)?:
    (a) (0, 0, 0) (b) (1, 2, 3) (c) (7.5, 3, 3) **(d)** (7.5, 7.5, 7.5)
12. If the density of material of a square plate and a circular plate shown in figure is same, the centre of mass of the composite system will be:
    (a) inside the square plate (b) inside the circular plate (c) at the point of contact (d) outside the system
13. Two persons of masses 55 kg and 65 kg respectively are at the opposite ends of a boat of length 3 m and weight 100 kg. The 55 kg person walks upto the 65 kg mass and sits with him. If the boat is in still water the centre of mass of the system shifts by:
    (a) 3.0 m (b) 2.3 m **(c)** Zero (d) $0.75\ m$
14. A uniform horizontal metre scale of mass m is suspended by two vertical strings attached to its two ends. A body of mass 2m is placed on the 25 cm mark. The tensions in the two strings are in the ratio:
    (a) 2:3 (b) 1:3 **(c)** 2:1 (d) 3:4
15. A metre stick is balanced on a knife edge at its centre. When two coins, each of mass 5 g are put one on top of the other at the 12.0 cm mark, the stick is found to be balanced at 45.0 cm. What is the mass of the metre stick?
    (a) 56 g **(b)** 66 g (c) 76 g (d) 86 g
16. A rod of weight W is supported by two parallel knife edges A and B and is in equilibrium in a horizontal position. The knives are at distance *d* from each other. The centre of mass of the rod is at distance *x* from A. The normal reaction at A is:
    (a) $\frac{W(d-x)}{d}$ (b) $\frac{W(d-x)}{x}$ (c) $\frac{Wx}{d}$ (d) $\frac{Wd}{x}$