Q.1 In the HCl molecule, the separation between the nuclei of the two atom is about 1.27 A° (1A° = 10^{-10} m). The approximate location of the centre of mass from the hydrogen atom, assuming the chlorine atom to be about 35.5 times massive as hydrogen is

(a) 1 Å (b) 2.5 Å (c) 1.24 Å (d) 1.5 Å

Q.2 A 2 kg body and a 3 kg body are moving along the x-axis. At a particular instant the 2 kg body has a velocity of 3 ms^{-1} and the 3 kg body has the velocity of 2 ms^{-1}. The velocity of the centre of mass at that instant is

(a) 5 ms^{-1} (b) 1 ms^{-1} (c) 0 (d) None of these

Q.3 The distance between the carbon atom and the oxygen atom in a carbon monoxide molecule is 1.1 Å. Given, mass of carbon atom is 12 a.m.u. and mass of oxygen atom is 16 a.m.u., calculate the position of the centre of mass of the carbon monoxide molecule

(a) 6.3 Å from the carbon atom
(b) 1 Å from the oxygen atom
(c) 0.63 Å from the carbon atom
(d) 0.12 Å from the oxygen atom

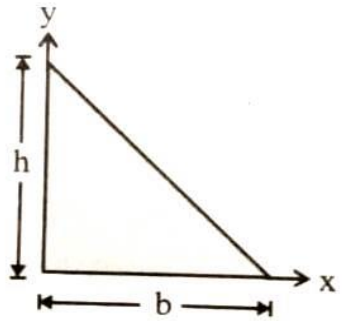
Q.4 The velocities of three particles of masses 20g, 30g and 50g are $10\hat{\imath}$,$10\hat{\jmath}$and $10\hat{k}$ respectively. The velocity of the centre of mass of the three particles is

(a) $2\hat{\imath}+3\hat{\jmath}+5\hat{k}$ (b) $10(\hat{\imath}+\hat{\jmath}+\hat{k})$ (c) $20\hat{\imath}+30\hat{\jmath}+5\hat{k}$ (d) $2\hat{\imath}+30\hat{\jmath}+50\hat{k}$

Q.5 The centre of mass of a triangle shown in figure has coordinates

(a) $x=\frac{h}{2}, y=\frac{b}{2}$ (b) $x=\frac{b}{3}, y=\frac{h}{2}$

(c) $x=\frac{b}{3}, y=\frac{b}{3}$ (d) $x=\frac{h}{3}, y=\frac{b}{3}$



Q.6 Two bodies of masses 2 kg and 4 kg are moving with velocities 2 m/s and 10 m/s respectively along same direction. That the velocity of their centre of mass will be (a) 8.1 m/s (b) 7.3 m/s (c) 6.4 m/s (d) 5.3 m/s

Q.7 Four particles of masses m, 2m, 3m and 4m are arranged at the corners of a parallelogram with each side equal to a and one of the angle between two adjacent sides is 6W. The parallelogram lies in the x-y plane with mass m at the origin and 4m on the x-axis. The centre of mass of the arrangement will be located at

(a) $\frac{\sqrt{3}}{2}a, 0.95a$ (b) $0.95a, \frac{\sqrt{3}}{2}a$ (c) $\frac{\sqrt{3}}{4}, \frac{a}{2}$ (d) $\frac{a}{2}, \frac{\sqrt{3}}{4}$

Q.8 Three identical metal balls each of radius rare placed touching each other on a horizontal surface such that an equilateral triangle is formed, when centres of three balls are joined. The centre of the mass of system is located at

(a) Horizontal surface
(b) Centre of one of the balls
(c) Line joining centres of any two balls
(d) Point of intersection of the medians

Q.9 2 bodies of different masses of 2 kg and 4 kg are moving with velocities 20 m/s and 10 m/s towards each other due to mutual gravitational attraction. What is the velocity of their centre of mass?

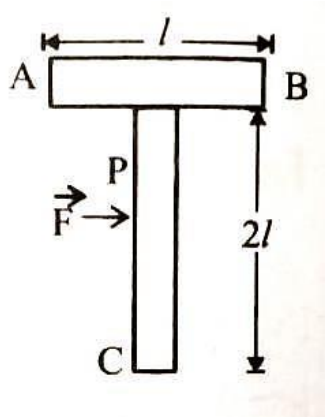
(a) 5 m/s (b) 6 m/s (c) 8 m/s (d) Zero

Q.10 Two particles of masses m, and m, initially at rest start moving towards each other under their mutual force of attraction. The speed of the centre of mass at any time t, when they are at a distance r apart, is

(a) zero (b) $\left(G\frac{m_1m_2}{r^2}, \frac{1}{m_1}\right)t$ (c) $\left(G\frac{m_1m_2}{r^2}, \frac{1}{m_2}\right)t$ (d) $\left(G\frac{m_1m_2}{r^2}, \frac{1}{m_1+m_2}\right)t$

Q.11 A 'T' shaped object, dimensions shown in the figure, is lying on a smooth floor. A force '$\bar{F}$' is applied at the point P parallel to AB, such that the object has only the translational motion without rotation. Find the location of P with respect to C

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



Q.12 Two spheres of mass. 2M and Mare initially at rest at a distance R apart. Due to mutual force of attraction, they approach each other. When they are at separation R/2, the acceleration of the centre of mass of spheres would be

(a) 0 m/s^2 (b) g m/s^2 (c) 3 g m/s^2 (d) 12 g m/s^2

Q.13 Masses 8 kg, 2 kg, 4 kg and 2 kg are placed at the corners A, B, C, D respectively of a square ABCD of diagonal 80 cm. The distance of centre of mass from A will be

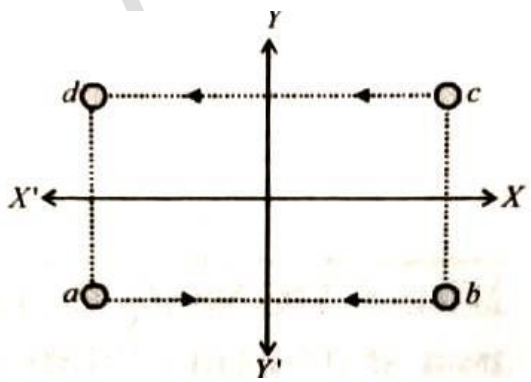
(a) 20 cm (b) 30 cm (c) 40 cm (d) 60 cm

Q.14 If linear density of a rod of length 3m varies as $\lambda = 2 + x$, them the position of the centre of gravity of the rod is

(a) $\frac{7}{3}m$ (b) $\frac{12}{7}m$ (c) $\frac{10}{7}m$ (d) $\frac{9}{7}m$

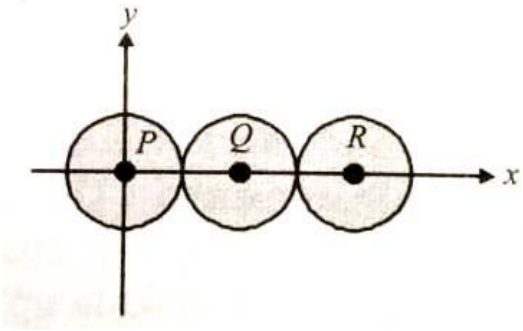
Q.15 Four bodies of equal mass start moving with same speed as shown in the figure. In which of the following combination the centre of mass will remain at origin?

(a) c and d (b) a and b (c) a and c (d) b and d



Q.16 Three identical spheres, each of mass 1 kg are kept as shown in figure, touching each other, with their centres on a straight line. If teir centres are marked P, Q, R respectively, the distance of centre of mass of the system from P is

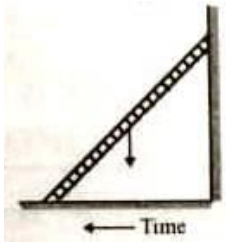
(a) $\frac{PQ+PR+QR}{3}$ (b) $\frac{PQ+PR}{3}$ (c) $\frac{PQ+QR}{3}$ (d) $\frac{PR+QR}{3}$

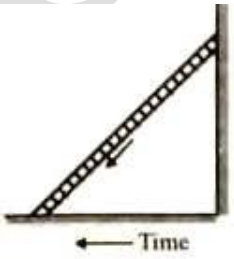


Q.17 A ladder is leaned against a smooth wall and it is allowed to slip on a friction less floor. Which figure represents trace of motion of its centre of mass

(a) 

(b) 

(c) 

(d) 

Q.18 The two particles X and Y, initially at rest, start moving towards each other under mutual attraction. If at any instant the velocity of X is V and that of Y is 2V, the velocity of their centre of mass will be

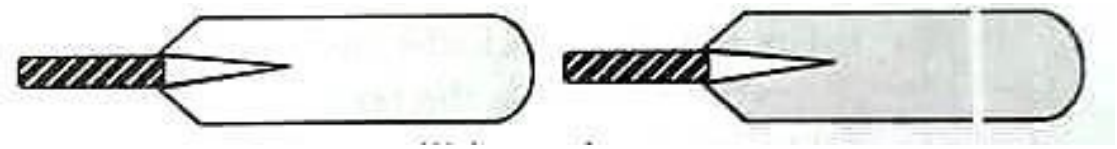
(a) 0 (b) V (c) 2V (d) V/2

Q.19 A cricket bat is cut at the location of its centre of mass as shown in the fig. Then

(a) The two pieces will have the same mass

(b) The bottom piece will have larger mass

(c) The handle piece will have larger mass



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

Q.20 Consider a system of two particles having mass m_1 and m_2. If the particle of mass m_1 is pushed towards the centre of mass of particles through a distance d, by what distance would be particle of mass m_2 move so as to keep the centre of mass of particles at the original position?

(a) $\frac{m_1}{m_1+m_2}d$ (b) $\frac{m_1}{m_2}d$ (c) d (d) $\frac{m_2}{m_1}d$