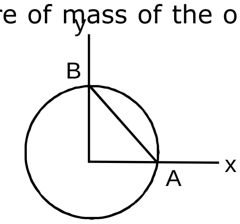
Exercise - II　Multiple Choice Problem

1. A body has its centre of mass at the origin. The x-coordinates of the particles
(A) may be all positive
(B) may be all negative
(C) may be all non-negative
(D) may be positive for some cases and negative in other cases

2. An object comprises of a uniform ring of radius R and its uniform chord AB (not necessarily made of the same material) as shown. Which of the following can not be the centre of mass of the object.



(A) (R/3, R/3)　(B) (R3, R/2)
(C) (R/4, R/4)　(D) $(R/\sqrt{2}, R/\sqrt{2})$

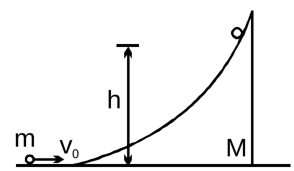
3. In which of the following cases the centre of mass of a an rod is certainly not at its centre ?
(A) the density continuously increases from left to right
(B) the density continuously decreases from left to right
(C) the density decreases from left to right upto the centre and then increase
(D) the density increases from left to right upto the centre and then decreases

4. Consider following statements
[1] CM of a uniform semicircular disc of radius R = 2R/π from the centre
[2] CM of a uniform semicircular ring of radius R = 4R/3π from the centre
[3] CM of a solid hemisphere of radius R = 4R/3π from the centre
[4] CM of a hemisphere shell of radius R = R/2 from the centre
Which statements are correct?
(A) 1, 2, 4　(B) 1, 3, 4
(C) 4 only　(D) 1, 2 only

5. If the external forces acting on a system have zero resultant, the centre of mass
(A) must not move　(B) must not accelerate
(C) may move　(D) may accelerate

Question No. 6 to 12 (7 Questions)

A particle of mass m moving horizontal with v_0 strikes a smooth wedge of mass M, as shown in figure. After collision, the ball starts moving up the inclined face of the wedge and rises to a
height h.



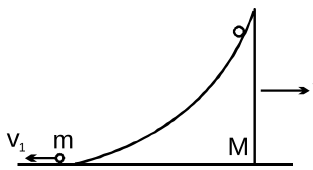
6. The final velocity of the wedge v_2 is
(A) $\frac{mv_0}{M}$　(B) $\frac{mv_0}{M+m}$
(C) v_0　(D) insufficient data

7. When the particle has risen to a height h on the wedge, then choose the correct alternative(s)
(A) The particle is stationary with respect to ground
(B) Both are stationary with respect to the centre of mass
(C) The kinetic energy of the centre of mass remains constant
(D) The kinetic energy with respect to centre of mass is converted into potential energy

8. The maximum height h attained by the particle is
(A) $\left(\frac{m}{m+M}\right)\frac{v_0^2}{2g}$　(B) $\left(\frac{m}{M}\right)\frac{v_0^2}{2g}$
(C) $\left(\frac{M}{m+M}\right)\frac{v_0^2}{2g}$　(D) none of these.

9. Identify the correct statement(s) related to the situation when the particle starts moving downward.
(A) The centre of mass of the system remains stationary
(B) Both the particle and the wedge remain stationary with respect to centre of mass
(C) When the particle reaches the horizontal surface its velocity relative to the wedge is v_0
(D) None of these

10. Suppose the particle when reaches the horizontal surfaces, its velocity with respect to ground is v_1 and that of wedge is v_2. Choose the correct statement (s)



(A) $mv_1 = Mv_2$ (B) $Mv_2 - mv_1 = mv_0$
(C) $v_1 + v_2 = v_0$ (D) $v_1 + v_2 < v_0$

11. Choose the correct statement(s) related to particle m

(A) Its kinetic energy is $K_f = \left(\frac{mM}{m+M}\right)gh$

(B) $v_1 = v_0\left(\frac{M-m}{M+m}\right)$

(C) The ratio of its final kinetic energy to its initial kinetic energy is $\frac{K_f}{K_i} = \left(\frac{M}{m+M}\right)^2$

(D) It moves opposite to its initial direction of motion

12. Choose the correct statement related to the wedge M

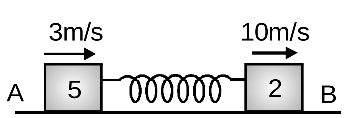
(A) Its kinetic energy is $K_f = \left(\frac{4m^2}{m+M}\right)gh$

(B) $v_2 = \left(\frac{2m}{m+M}\right)v_0$

(C) Its gain in kinetic energy is $\Delta K = \left(\frac{4mM}{(m+M)^2}\right)\left(\frac{1}{2}mv_0^2\right)$

(D) Its velocity is more that the velocity of centre of mass

13. Two blocks A (5kg) and B(2kg) attached to the ends of a spring constant 1120 N/m are placed on a smooth horizontal plane with the spring undeformed. Simultaneously velocities of 3m/s and 10m/s along the line of the spring in the same direction are imparted to A and B then



(A) when the extension of the spring is maximum the velocities of A and B are zero.

(B) the maximum extension of the spring is 25 cm

(C) maximum extension and maximum compression occur alternately.

(D) the maximum compression occur for the first time after $\frac{\pi}{56}$ sec.

14. Two identical balls are interconnected with a massless and inextensible thread. The system is in gravity free space with the thread just taut. Each ball is imparted a velocity v, one towards the other ball and the other perpendicular to the first, at t = 0. Then,

(A) the thread will become taut at t = (L/v)

(B) the thread will become taut at some time t < (L/v).

(C) the thread will always remain taut for t > (L/v)

(D) the kinetic energy of the system will always remain mv^2.

15. A ball moving with a velocity v hits a massive wall moving towards the ball with a velocity u. An elastic impact lasts for a time Δt.

(A) The average elastic force acting on the ball is $\frac{m(u+v)}{\Delta t}$

(B) The average elastic force acting on the ball is $\frac{2m(u+v)}{\Delta t}$

(C) The kinetic energy of the ball increases by 2mu (u + v)

(D) The kinetic energy of the ball remains the same after the collision.

16. A particle moving with kinetic energy = 3 joule makes an elastic head on collision with a stationary particle when has twice its mass during the impact.

(A) The minimum kinetic energy of the system is 1 joule

(B) The maximum elastic potential energy of the system is 2 joule.

(C) Momentum and total kinetic energy of the system are conserved at every instant.

(D) The ratio of kinetic energy to potential energy of the system first decreases and then increases.

17. Two balls A and B having masses 1 kg and 2 kg, moving with speeds 21 m/s and 4 m/s respectively in opposite direction, collide head on. After collision A moves with a speed of 1 m/s in the same direction, then correct statements is :

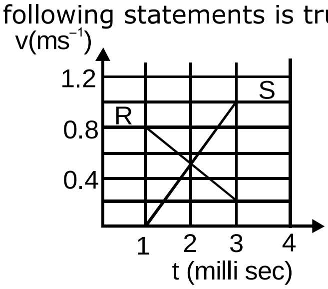
(A) The velocity of B after collision is 6 m/s opposite to its direction of motion before collision.

(B) The coefficient of restitution is 0.2.

(C) The loss of kinetic energy due to collision is 200 J.

(D) The impulse of the force between the two balls is 40 Ns.

18. The diagram to the right shown the velocity-time graph for two masses R and S that collided elastically. Which of the following statements is true?



(I) R and S moved in the same direction after the collision.

(II) Kinetic energy of the system (R & S) is minimum at t = 2 milli sec.

(III) The mass of R was greater than mass of S.

(A) I only (B) II only

(C) I and II only (D) I, II and III

19. In an inelastic collision,

(A) the velocity of both the particles may be same after collision.

(B) kinetic energy is not conserved

(C) linear momentum of the system is conserved.

(D) velocity of separation will be less than velocity of approach.

20. In a one-dimensional collision between two particles, their relative velocity is $\vec{v}_1$ before the collision and $\vec{v}_2$ after the collision

(A) $\vec{v}_1 = \vec{v}_2$ if the collision is elastic

(B) $\vec{v}_1 = -\vec{v}_2$ if the collision is elastic

(C) $|\vec{v}_2| = |\vec{v}_1|$ in all cases

(D) $\vec{v}_1 = -k\vec{v}_2$ in all cases, where $k \geq 1$

21. A set of n-identical cubical blocks lie at rest parallel to each other along a line on a smooth horizontal surface. The separation between the near surfaces of any two adjacent blocks is L. The block at one end is given a speed V towards the next one at time t = 0. All collision are completely inelastic, then

(A) The last block starts moving at $t = n(n-1)\dfrac{L}{2V}$

(B) The last block starts moving at $t = (n-1)\dfrac{L}{V}$

(C) The centre of mass of the system will have a final speed v/n

(D) The centre of mass of the system will have a final speed v

22. An isolated rail car original moving with speed v_0 on a straight, frictionless, level track contains a large amount of sand. A release value on the bottom of the car malfunctions, and sand begins to pour out straight down relative to the rail car.

(a) Is momentum conserved in this process?

(A) The momentum of the rail car along is conserved

(B) The momentum of the rail car + sand remaining within the car is conserved

(C) The momentum of the rail car + all of the sand, both inside and outside the rail car, is conserved

(D) None of the three previous systems have momentum conservation

(b) What happens to the speed of the rail car as the sand pours out?

(A) The car begins to roll faster

(B) The car maintains the same speed

(C) The car begins to slow down

(D) The problem cannot be solved since momentum is not conserved