BCM SCHOOL, BASANT AVENUE, DUGRI ROAD, LUDHIANA.

CLASS – XI

SUBJECT – PHYSICS

CHAPTER – SYSTEM OF PARTICLES AND ROTATIONAL MOTION

CASE STUDY BASED QUESTIONS

1. Motion of a rigid body and centre of mass :-

A Point object is only a hypothetical concept. In actual practice, we have bodies or objects which have definite size. An extended object or a real objects is made up of large number of particles. Whereas point object/mass can have only translation motion, extended object can have translational motion, rotational motion & combination of translational & rotational motion as well.

The motion of system of particles or an extended object is quite complicated. This is because every particle of the system moves in a different manner than the other particles of the system. Therefore to describe the overall motion of a body or a system of particles in a simple manner. We define a concept 'Centre of Mass'.

(i) The centre of mass of a system of particles does not depend on

(a) position of particles

(b) relative distance between the particles

(c) forces acting on the particles

(d) mass of the particles

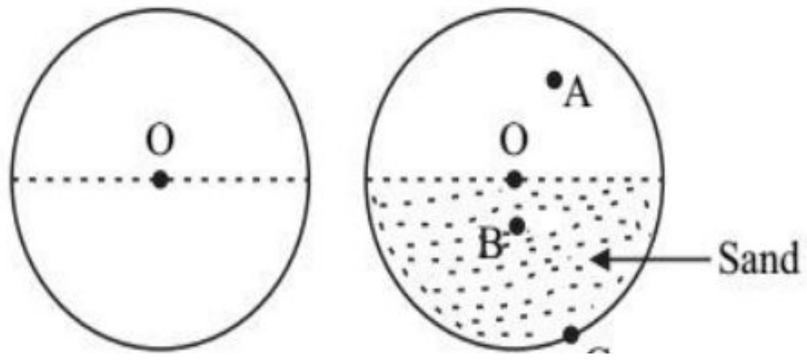
(ii) The centre of mass of a hallow sphere is at the its centre. Centre of mass of the hollow sphere when filled half with sand :

(a) shifts to A

(b) shifts to B

(c) shifts to C

(d) remains at O



2. Torque :-

We know that when an external force is applied on a body. It accelerates the body and the body has translation motion. Similarly, a body has rotational motion, upon a force is applied on a body at a certain distance from the axis of rotation of the body. The product of the applied force & distance of the point of application of the force from the axis of rotation its expressed by a physical quality known as a 'Torque'. Torque is rotational analogue of force. Torque is an axial vector as it points along the axis of rotation.

(i) The torque about the origin of the force $\vec{F} = mg\,\hat{j}$ and $\vec{r} = x\hat{i} + y\hat{i}$ is

(a) $\vec{\tau} = mgx\hat{i}$ (b) $\vec{\tau} = mgy\hat{j}$ (c) $\vec{\tau} = mgx\hat{k}$ (d) $\vec{\tau} = 0$

(ii) Which of the following statement is false for torque

(a) $\vec{\tau} = \frac{d\vec{l}}{dt}$ (b) $\vec{\tau} = \vec{r} \times \vec{f}$ (c) $\vec{\tau} = \vec{f} \times \vec{r}$ (d) $\vec{\tau} = I\vec{\alpha}$

(iii) Let $\vec{F}$ be the force acting on a particle having position vector $\vec{r}$ and $\vec{\tau}$ be the torque of this force about the origin, then

(a) $\vec{r}.\vec{F} = 0$ and $\vec{F}.\vec{\tau} \neq 0$ (b) $\vec{r}.\vec{\tau} \neq 0$ and $\vec{F}.\vec{\tau} = 0$

(c) $\vec{r}.\vec{\tau} \neq 0$ and $\vec{F}.\vec{\tau} \neq 0$ (d) $\vec{r}.\vec{\tau} = 0$ and $\vec{F}.\vec{\tau} = 0$

(iv) Angular momentum of the particle rotating with a central force is constant due to

(a) constant force (b) constant linear momentum

(c) constant torque (d) zero torque

(v) When a disc rotates with uniform angular velocity, which of the following is correct?

(a) The sense of rotation remains the same

(b) The orientation of the axis of the rotation remains the same

(c) The speed of rotation is non-zero & remains the same

(d) The angular acceleration is non-zero & remains the same.

(vi) The separation between the C and O atoms in CO is 1.2 A°. The distance of carbon atom from the centre of mass is

(a) 0.3 A° (b) 0.7 A° (c) 0.5 A° (d) 0.9 A°

3. Equilibrium of a rigid body :-

A rigid body is said to be in translational equilibrium, if the net external force acting on the body is zero and it is said to be in rotational equilibrium, if net external torque acting on the body is zero. A rigid body is said to be in partial equilibrium, if either it is in rotational equilibrium but not in translational equilibrium or it is in translational equilibrium but not in rotational equilibrium.

(i) A couple is acting on rigid body then which statement is true

(a) The body is in translational equilibrium but not in rotational equilibrium

(b) The body is in rotational equilibrium but not in translational equilibrium

(c) The body is in translational as well as in rotational equilibrium

(d) The body is neither in translational equilibrium nor in rotational equilibrium.

(ii) For a body in translational equilibrium, which of the following statement is false

(a) $\sum \vec{F}_{ext} = 0$ (b) $\vec{p} = 0$ (c) $\vec{v} = 0$ or constant (d) $\vec{a} \neq 0$

(iii) For a body in rotational equilibrium which of the following is true

(a) $\sum \vec{\tau}_{ext} = 0$ (b) $\vec{L} \neq 0$ (c) $\vec{r} \neq 0$ (d) $\vec{w} \neq 0$

(iv) A merry go round, made of a ring like platform of radius R and mass M, is revolving with angular speed ω. A person of mass M is standing on it. At one instant, the person jumps off the round, radially away from the centre of the round (as seen the ground). The speed of the marry go round afterwards is

(a) 2ω (b) ω (c) $\frac{\omega}{2}$ (d) 0

(iv) A thin horizontal circular disc is rotating about a vertical axis passing through its centre. An insect is at rest at a point near the rim of the disc. The insect now moves along a diameter of the disc to reach its other end. During the journey of the insect, the angular speed of the disc.

(a) Continuously decrease

(b) Continuously increase

(c) First increases and then decrease

(d) remaining unchanged