TOPIC :-ROTATIONAL MOTION

Q.1 Moment of inertia of a body about a given axis is the rotational inertia of the body about that axis. It is represented by I= MK^2 , where M is mass of the body and K is the radius of gyration of the body about that axis . It is a scalar quantity , which is measured in kgm^2 . When a body rotates about a given axis , and the axis of rotation also moves , then total K.E.of body =K.E. of translation + K.E. of rotation E = 1/ 2 mv^2 + 1/2 Iω^2 .

With the help of above comprehension, choose the most appropriate alternative for each of the following questions:

(i) Moment of inertia of a body depends on

(a) mass of body (b) size and shape of body

(C) axis of rotation of body (d) all the above

(a) (i) and (ii) (b) (i) and (iii) (c) (ii) and (iii) (d) (iv)

ANS:- (d) (iv)

(ii) A bomb travelling in a parabolic path under the effect of gravity, explodes in mid air. The centre of mass of the fragments will

(a) move in irregular path

(b) move vertically downward

(c) move in parabolic path, the unexploded bomb will have travelled

(d) move vertically upward and then vertically downward.

ANS:- (c) move in parabolic path, the unexploded bomb will have travelled

(iii). A 40 kg flywheel in the form of a uniform circular disc of diameter 1 m is making 120 rpm . Its moment of inertia about a transverse axis through its centre is

(a) 40 kgm^2 (b) 5 kgm^2 (c) 10 kgm^2 (d) 20 kgm^2

ANS:- (b) 5 kgm^2

(iv) Kinetic energy of rotation of flywheel in the above case is

(a) 20 J (b) 2 J (c) 400 J (d) 80 J

ANS:-(c) 400 J

Q.2 The time rate of the total angular momentum of a system of particles about a point (taken as the origin of our frame of reference) is equal to the sum of the external torques (i.e. the torques due to external forces) acting on the system taken about the same point.

$\tau ext = dL/\ dt$

If τext =0 $dL/\ dt$ =0

or L = constant. Or $I\omega$ = $constan$t

Thus, if the total external torque on a system of particles is zero, then the total angular momentum of the system is conserved, i.e.remains constant. With the help of above comprehension, choose the most appropriate alternative for each of the following questions:

(i) The angular momentum of a rotating body changes from A to 4 A in 4 seconds. The torque acting on the body is

(a) 3A/4 (b) 3A/2 (C) 3A (D) 4 A

ANS:- (a) 3A/4

(ii) If the earth shrinks to half of its radius without change in mass, the duration of the day will be:

(a) 48 hr (b) 24 hr (c) 13 hr (d) 6 hr

ANS:- (d) 6 hr

(iii) A person sits on a freely spinning lab stool that has no friction in its axle. When this person extends her arms,

(a) her moment of inertia increases and her angular speed decreases.

(b) her moment of inertia decreases and her angular speed increases.

© her moment of inertia increases and her angular speed increases.

(d) her moment of inertia increases and her angular speed remains the same.

ANS:- (a) her moment of inertia increases and her angular speed decreases.

(iv) Two children, Ahmed and Saleh, ride on a merry-go-round. Ahmed is at a greater distance from the axis of rotation than Saleh. Which of the following are true statements?

(a) Saleh and Ahmed have the same tangential speed.

(b) Ahmed has a greater tangential speed than Saleh.

© Saleh has a greater angular speed than Ahmed.

(d) Saleh has a smaller angular speed than Ahmed

ANS:- (b) Ahmed has a greater tangential speed than Saleh.

These questions are Assertion (A) and Reason (R) type questions. Two statements are given - one labelled Assertion (A) and the other labelled Reason (R).
Select the correct answer from the codes (A), (B), (C) and (D) as given below.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A)
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false and Reason (R) is also false

Q.3 Assertion: Two cylinders, one hollow (metal) and the other solid(wood) with the same mass and identical dimensions are simultaneously allowed to roll without slipping down an inclined plane form the same height. The hollow cylinder will reach the bottom of the inclined plane first.
Reason: By the principle of conservation of energy, the total kinetic energies of both the cylinders are identical when they reach the bottom of the incline.

ANS:-(D) Assertion (A) is false and Reason (R) is also false

Q.4 Assertion: To unscrew a rusted nut, we need a pipe wrench of longer arms.
Reason: Wrench with a longer arm reduces the force applied on the arm.

ANS:-(C) Assertion (A) is true, but Reason (R) is false.