

**SAINIK SCHOOL GOPALGANJ**  
**CLASS & SECTION – XI**  
**ASSIGNMENT ON SYSTEM OF PARTICLES AND ROTATIONAL MOTION**

**SECTION A : MULTIPLE CHOICE QUESTION (TOTAL 05 QUESTIONS)**

1. For which of the following does the centre of mass lie outside the body?
  - (a) A pencil
  - (b) Ashotput
  - (c) A dice
  - (d) A bangle
  
2. When a disc rotates with uniform, angular velocity, which of the following is not true?
  - (a) The sense of rotation remains same.
  - (b) The orientation of the axis of rotation remains same.
  - (c) The speed of rotation is non-zero and remains same.
  - (d) The angular acceleration is non-zero and remains same.
  
3. A uniform square plate has a small piece Q of an irregular shape removed and glued to the centre of the plate leaving a hole behind in figure. The moment of inertia about the z-axis is then
  - (a) increased
  - (b) decreased
  - (c) the same
  - (d) changed in unpredicted manner
  
4. A merry-go-round, made of a ring-like platform of radius R and mass M, is revolving with angular speed  $\omega$ . 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 from the round). The speed of the round afterwards is
  - (a)  $2\omega$
  - (b)  $\omega$
  - (c)  $\omega/2$
  - (d) 0
  
5. Choose the correct alternatives:
  - (a) For a general rotational motion, angular momentum L and angular velocity  $\omega$  need not be parallel.
  - (b) For a rotational motion about a fixed axis, angular momentum L and angular velocity  $\omega$  are always parallel.
  - (c) For a general translational motion, momentum p and velocity v are always parallel.
  - (d) For a general translational motion, acceleration a and velocity v are always parallel.

## **SECTION B : SHORT ANSWERS QUESTIONS (TOTAL 05 QUESTIONS)**

6. Explain the concept of Rigid Body.
7. The centre of gravity of a body on the earth coincides with its centre of mass for a small object whereas for an extended object it may not. What is the qualitative meaning of small and extended in this regard? For which of the following two coincides—A building, a pond, a lake, a mountain?
8. Why does a solid sphere have smaller moment of inertia than a hollow cylinder of same mass and radius, about an axis passing through their axes of symmetry?
9. The vector sum of a system of non-collinear forces acting on a rigid body is given to be non-zero. If the vector sum of all the torques due to the system of forces about a certain point is found to be zero, does this mean that it is necessarily zero about any arbitrary point?
10. A door is hinged at one end and is free to rotate about a vertical axis (figure). Does its weight cause any torque about this axis? Give **reason** for your answer.

## **SECTION C : LONG ANSWER QUESTIONS (TOTAL 05 QUESTIONS)**

11. Two cylindrical hollow drums of radii  $R$  and  $2R$ , and of a common height  $h$ , are rotating with angular velocities (anti-clockwise) and (clockwise), respectively. Their axes, fixed are parallel and in a horizontal plane separated by  $(3R + )$ . They are now brought in contact ( $\rightarrow 0$ ).
- (a) Show the frictional forces just after contact.
- (b) Identify forces and torques external to the system just after contact.
- (c) What would be the ratio of final angular velocities when friction ceases?
12. A uniform disc of radius  $R$ , is resting on a table on its rim. The coefficient of friction between disc and table is  $\mu$ , (Figure). Now, the disc is pulled with a force  $F$  as shown in the figure. What is the maximum value of  $F$  for which the disc rolls without slipping?
13. A disc of radius  $R$  is rotating with an angular  $\omega_0$  about a horizontal axis. It is placed on a horizontal table. The coefficient of kinetic friction is  $\mu_k$ .
- (a) What was the velocity of its centre of mass before being brought in contact with the table?
- (b) What happens to the linear velocity of a point on its rim when placed in contact with the table?
- (c) What happens to the linear speed of the centre of mass when disc is placed in contact with the table?
14. Two discs of moments of inertia  $I_1$ , and  $I_2$  about their respective axes (normal to the disc and passing through the centre), and rotating with angular speed  $\omega_1$  and  $\omega_2$  and are brought into contact face to face with their axes of rotation coincident.

- (a) Does the law of conservation of angular momentum apply to the situation? Why?
- (b) Find the angular speed of the two discs system.
- (c) Calculate the loss in kinetic energy of the system in the process.

15. Answer Type Questions

Find the centre of mass of a uniform (a) half-disc, (b) quarter-disc