State	PARISHRAM ACADEMY NAME of Student : _____ Subject : Physics — Class : XII Topic: 1 - Rotational Dynamics — Total Marks :- 35	

SECTION – A

Q. 1. Select the write the correct answer: **(4 Marks)**

(i) The kinetic energy of a rotating body depends upon
(a) distribution of mass only (b) angular speed only
(c) distribution of mass and angular speed (d) angular acceleration only

(ii) Two particles with their masses in the ratio 2 : 3 perform uniform circular motion with orbital radii in the ratio 3 : 2. If the centripetal force acting on them is the same, the ratio of their speeds is
(a) 4 : 9 (b) 1 : 1 (c) 3 : 2 (d) 9 : 4

(iii) The maximum speed with which a car can be driven safely along a curved road of radius 17.32 m and banked at 30° with the horizontal is [g = 10 m/s^2]
(a) 5 m/s (b) 10 m/s (c) 15 m/s (d) 20 m/s

(iv) The radius of gyration of a thin ring about a transverse axis through its centre is
(a) 0.5 × diameter of the ring (b) diameter of the ring
(c) 2 × diameter of the ring (d) (diameter of the ring)^2.

Q. 2. Answer the following: **(3 Marks)**

(i) Define a rigid body.
(ii) Define angular acceleration
(iii) What is the rotational analogue of (i) mass (ii) force?

SECTION – B

Attempt any Four **(8 Marks)**

Q. 3. Define radius of gyration. Explain its physical significance.

Q. 4. Obtain an expression for the total kinetic energy of a rolling body in the form $\frac{1}{2}Mv^2\left[1+\frac{k^2}{R^2}\right]$

Q. 5. Assuming the expression for the moment of inertia of a thin uniform disc about a transverse axis through its centre, obtain an expression for its moment of inertia about any diameter.

Q. 6. A vehicle is moving on a circular track whose surface is inclined towards the horizon at an angle of 10°. The maximum velocity with which it can move safely is 36 km/hr. Calculate the length of the circular track. [Take π = 3.142]

Q. 7. In a conical pendulum, a string of length 120 cm is fixed at rigid support and carries a mass of 150 g at its free end. If the mass is revolved in a horizontal circle of radius 0.2 m around a vertical axis, calculate tension in the string. (g = 9.8 m/s^2)

SECTION – C

Attempt any Four **(12 Marks)**

Q. 8. Derive an expression for the kinetic energy of a body rotating with constant angular velocity.

Q. 9. Obtain an expression for torque acting on a rotating body with constant angular acceleration. Hence state the dimensions and SI unit of torque.

Q. 10. State and prove the theorem of perpendicular axes about moment of inertia.

Q. 11. Derive an expression for the difference in tensions at the highest and lowest points for a particle performing vertical circular motion.

Q. 12. In a circus, a motor-cyclist having mass of 50 kg moves in a spherical cage of radius 3 m. Calculate the least velocity with which he must pass the highest point without losing contact. Also calculate his angular speed at the highest point.

SECTION – D

Attempt Any Two: **(8 Marks)**

Q. 13. State and prove the theorem of parallel axis.

Q. 14. Obtain expressions for the energy of a particle at the lowest point, highest point and midway of a vertical circular motion. Assume that the body is just able to reach to the top of the path and complete the circular motion.

Q. 15. A racing track of radius of curvature 9.9 m is banked at $\tan^{-1}(0.5)$. Coefficient of static friction between the track and the tyres of a vehicle is 0.2. Determine the speed limits with 10% margin. (Take $g = 10\ m/s^2$)