2.6 - Rotation of Rigid Bodies

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- (1999) State the parallel axis theorem.
- (1999) Show that the Kinetic energy (K.E.) of rotation of a rigid body about an axis with a constant angular velocity w is given by $KE = 1/2Iw^2$ where i is the moment of inertia of the rigid body about the given axis.
- (1999) What do you understand by the term "moments of inertia" of a rigid body?
- (1999) State the perpendicular axes theorem of moments of inertia for a body in the form of a lamina
- (1999) Calculate the moments of inertia of a thin circular disc of radius 50 cm and mass 2 kg about an axis along a diameter of the disc.
- (1999) A wheel mounted on an axle that is not frictionless is initially at rest. A constant external torque of 50 Nm is applied to the wheel for 20 s. At the end of the 20 s, the wheel has an angular velocity of
  - 600 rev/min. The external torque is the removed, and the wheel comes to rest after 120 s more.
  - Determine the moments of inertia of the wheel.
  - Calculate the frictional torque which is assumed to be constant.
- (2007) The T is then suspended from the free end of rod Y and the pendulum swings in the plane of T about the axis Of rotation.
  - Calculate the moment of inertia i of the T about the axis of rotation.
  - Obtain the expression for the k.e. and p.e. in terms of the angle θ of inclination to the vertical oscillation of the pendulum.
  - Show that the period of oscillation is $2\pi\sqrt{17L/18g}$.
  - (Moment of inertia of a thin rod about its centre $I_C = mL^2/12$.)
- (2009) Define angular momentum and give its dimensions.
- (2009) A grinding wheel in a form of solid cylinder of 0.2 m diameter and 3 kg mass is rotated at 3600 rev/minute.
  - What is its kinetic energy?
  - Find how far it would have to fall to acquire the same kinetic energy as in the question above.

- (2014) A disc of moment of inertia 2.5×10^{-4} kg/m^2 is rotating freely about an axis through its centre at 20 rev/min. If some wax of mass 0.04 kg is dropped gently on to the disc 0.05 m from its axis, what will be the new revolution per minute of the disc?
- (2014) Explain briefly why a:
  - high diver can turn more somersaults before striking the water?
  - dancer on skates can spin faster by folding her arms?
- (2014) A heavy flywheel of moment of inertia 0.4 kg/m^2 is mounted on a horizontal axle of radius 0.01 m. If a force of 60 N is applied tangentially to the axle:
  - Calculate the angular velocity of the flywheel after 5 seconds from rest.
  - List down two assumptions taken to arrive at your answer in above.
- (2015) Define moment of inertia of a body.
  - Briefly explain why there is no unique value for the moment of inertia of a given body?
- (2015) State the principle of conservation of angular momentum.
  - A horizontal disc rotating freely about a vertical axis makes 45 revolutions per minute. A small piece of putty of mass 2.0×10^{-2} kg falls vertically onto the disc and sticks to it at a distance of 5.0×10^{-2} m from the axis. If the number of revolutions per minute is thereby reduced to 36 , calculate the moment of inertia of the disc.
- (2015) What would be the length of a day if the rate of rotation of the Earth were such that the acceleration due to gravity $g = 0$ at the equator?
- (2016) Why is Newtons first law of motion called the law of inertia?
- (2016) What is meant by moment of inertia of a body?
- (2016) List two factors on which the moment of inertia of a body depends.
- (2016) A thin sheet of aluminum of mass 0.032 kg has the length of 0.25 m and width of 0.1 m. Find its moment of inertia on the plane about an axis parallel to the:
  - Length and passing through its centre of mass, m .
  - Width and passing through the centre of mass, m , in its own plane.
- (2016) Define the term angular momentum.
- (2016) A thin circular ring of mass, M , and radius, r , is rotating about its axis with constant angular velocity, w_1 . If two objects each of mass, m , are attached gently at the ring, what will be the angular velocity of the rotating wheel?
- (2016) Why are space rockets usually launched from west to east?
- (2017) Justify the statement that If no external torque acts on a body, its angular velocity will not conserved.
- (2018) Why is flywheel designed such that most of its mass is concentrated at the rim? Briefly explain.

- (2018) Estimate the couple that will bring the wheel to rest in 10 seconds when a grinding wheel of radius 40 cm and mass 3 kg is rotating at 3600 revolutions per minute.
- (2018) Why an ice skater rotates at relatively low speed when stretches her arms and a leg outward?
- (2018) Calculate the moment of inertia of a sphere about an axis which is a tangent to its surface given that the mass and radius of the sphere are 10 kg and 0.2 m respectively.