Part I

1. Two uniform solid discs of equal mass roll down an inclined plane without slipping. Disc A has twice the radius of disc B. Which disc has the greater total kinetic energy when it reaches the bottom of the plane?

   (a) Disc A

   (b) Disc B

   (c) They both have the same kinetic energy.

   (d) More information is needed.

2. When an object is in equilibrium the net force and net torque acting on it must be zero. Which of the following statements is true?

   (a) If it is in equilibrium then both its linear and angular speed must be zero.

   (b) If its linear and angular speeds are zero then it must be in equilibrium.

   (c) If its linear and angular speeds are constant then it must be in equilibrium.

   (d) None of the above statements is true.

3. A person stands at the centre of a merry-go-round which spins clockwise as seen from above. In one hand she is holding a bicycle wheel with its axis vertical and with the other she starts spinning the wheel clockwise as seen from above. As a result of this action

   (a) the merry-go-round rotates faster and the kinetic energy of the system increases.

   (b) the merry-go-round rotates slower and the kinetic energy of the system increases.

   (c) the merry-go-round rotates faster and the kinetic energy of the system decreases.

   (d) the merry-go-round rotates slower and the kinetic energy of the system decreases.

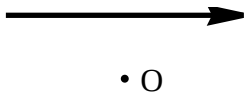
4. The diagram below shows the direction of motion of a particle as it passes by a point labeled O. Relative to O the angular momentum of the particle is

   (a) directed into the page.

   (b) directed out of the page.

   (c) directed in the direction of motion.

   (d) zero.



5. A satellite orbits the earth with a radius equal to one half the radius of the moon's orbit. If the period of the moon is T then then the period of the satellite will be

   (a) $2^{-1}\,T$ (b) $2^{-1/2}\,T$ (c) $2^{-3/2}\,T$ (d) $2^{-2/3}\,T$

Part II

1. A simple pendulum is designed so that it oscillates once a second.

   (a) What should the length of the pendulum be?

   (b) Unfortunately the clock loses 40 seconds every hour. What is the actual period of the clock?

   (c) By how much should the length of the pendulum be shortened or lengthened to fix this problem?

2. A tangential force of 8.0 N acts on uniform disc of radius 0.50 m which completes its first revolution from rest in 2.0 s. The force acts 0.30 m from the centre of the wheel. Calculate

   (a) the angular acceleration.

   (b) the torque.

   (c) the moment of inertia of the disc.

   (d) the mass of the disc.

3. A Neutron Star is an extremely dense star made from neutrons which is formed when a star with sufficient mass collapses under the force of its own gravity. Consider a star of mass 6.0×10^{30} kg and radius 7.0×10^{8} m which collapses to a neutron star of radius 24000 m.

   (a) Find the angular velocity of the neutron star if the original star rotated once every 20 days. (Assume the mass before and after the collapse is the same and that the bodies both have uniform density and are spherical).

   (b) Find the linear velocity at the equator of the neutron star.

   (c) Find the speed of an object which orbits just at the surface of the neutron star.