Tutorial 2.1 Angular Motion

1. Convert the following from degrees to radians:
   30º, 45º, 60 º, 90 º, 180 º, 270 º, 360 º, 720 º.

2. Convert the following from radians to degrees:
   1 rad, 10 rad, 0.1 rad, π rad, 2π rad, ½ π rad, $\frac{\pi}{6}$ rad.

3. Convert the following from revolutions per minute to radians per second:
   33 rpm, 45 rpm, 78 rpm, 300 rpm.

4. Using calculus notation write down the expression for
   (a) the angular velocity in terms of the angular displacement
   (b) the angular acceleration in terms of the angular velocity
   (c) the angular acceleration in terms of the angular displacement.

5. State the three equations which can be used when an object moves with a constant angular acceleration, α.
   State the meaning of each symbol used.

6. A disc is slowed uniformly at 5.0 rad s^{-2} for 4.0 s. The initial angular velocity is 200 rad s^{-1}.
   (a) Determine the angular velocity at the end of the four seconds.
   (b) What is the angular displacement in this time?

7. The angular velocity of an engine is increased from 800 rpm to 3 000 rpm in 8.0 s.
   (a) Determine the angular acceleration. You may assume this is uniform.
   (b) Find the total angular displacement.
   (c) How many revolutions does the engine make during this 8.0 s?

8. A wheel accelerates uniformly from rest at 3.0 rad s^{-2} for 5.0 s.
   (a) Find
      (i) the final angular velocity after 5.0 s
      (ii) the angular displacement after 5.0 s.
   (b) The wheel has a radius of 1.50 m.
      Determine the linear velocity at a point on its rim at the end of the 5.0 s.

9. Radius of Earth = 6.4 x 10^3 km Geostationary orbit radius = 3.6 x 10^4 km
   Radius of Earth's orbit = 1.5 x 10^8 km Radius of Moon's orbit = 3.8 x 10^5 km
   Period of Earth about Sun = 365 days Period of Moon about Earth = 28 days

   (a) Calculate the angular velocity in rad s^{-1} of
      (i) the Earth about the sun
      (ii) the Moon about the Earth
      (iii) an object on the Earth's surface about its axis of rotation
      (iv) a geostationary satellite.
   (b) Find the tangential velocity in m s^{-1} of each of the above quantities in part (a).

10. Derive the expression $v = r\omega$ for a particle in circular motion.