UNIT 4 ROTATIONAL MOTION (2)

1. A disc has a moment of inertia about its centre of 0.1 kgm^2 and rotates about an axis through the centre perpendicular to its plane at 5 rev s^{-1}
   Calculate :
   i. its kinetic energy ii . its angular momentum about the centre

Ans :
i. 49.3J ii 3.1 $kgm^2\ s^{-1}$

2. The electron in a hydrogen atom rotates at a frequency of 6.6×10^{15} rev s^{-1} in a circle of radius 5.3×10^{-11} m The mass of the electron is 9.1×10^{-31} kg . Calculate the orbital angular momentum of the electron about an axis through the centre of the circle perpendicular to its plane

3. The earth rotates with a period of one year about the sun in an orbit which is roughly circular and of average radius 1.5×10^{11}m. The mass of the earth is 6×10^{24}kg . Calculate the orbital angular momentum of the earth about an axis through the sun , perpendicular to the plane of the orbit . Ans 2.7×10^{40} kg ms^{-1}

4. A horizontal turn table has a moment of inertia of 0.05kg m^2 about its centre and rotates steadily at 2.0 revs s^{-1} about an axis through its centre :
   i. What is its angular momentum about the centre
   ii If a small mass of 200g is placed gently on the rim of the table of radius 50cm calculate the reduced frequency of the turn table in rev s^{-1}

5.

A uniform cylindrical disc of mass 30 kg and radius 0.20 m rotates uniformly on a frictionless vertical shaft, with angular speed $\omega = 2.6$ revolutions per second. Calculate its:

(i) moment of inertia (*hint*: a disc is a cylinder of negligible length) *(4 marks)*

(ii) magnitude of angular momentum *(6 marks)*

(iii) rotational kinetic energy *(4 marks)*

A second identical disc, initially stationary, is dropped vertically along the same central shaft onto the first disc. Friction ensures that both discs rotate together. Calculate the values of the following quantities for the combined system of the two discs, explaining the physical principles underlying your answers:

(iv) moment of inertia *(4 marks)*

(v) magnitude of angular momentum *(4 marks)*

(vi) angular speed *(4 marks)*

(vii) rotational kinetic energy *(3 marks)*

Comment on your answer to part (vii) in view of the law of conservation of energy. *(3 marks)*