3 **(a)** Define *angular velocity* for an object travelling in a circle.

……..……...……

……..... [1]

(b) A smooth hollow sphere of radius 20.0 cm rotates steadily about its vertical axis with a period of 0.75 s as shown in Fig. 3.1. A bead is encased in the sphere and is able to slide while in contact with the inner surface of the sphere.

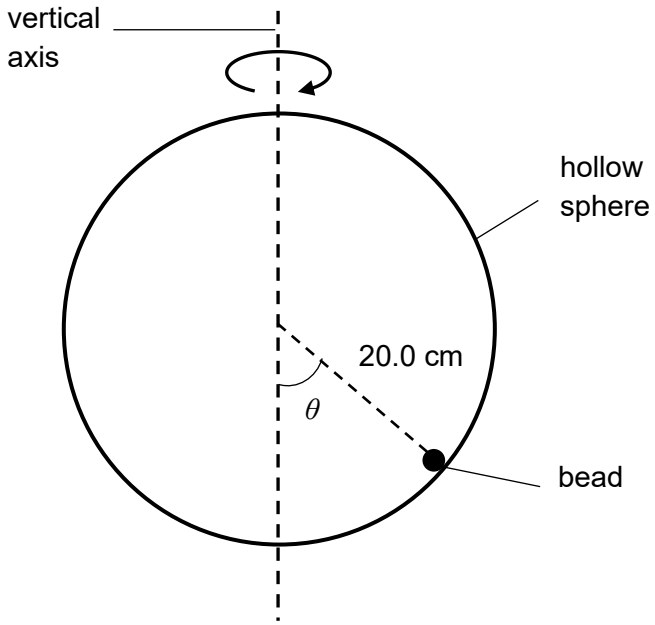


Fig. 3.1

There are two possible positions that the bead can remain in position when the sphere is rotating. One position is when the bead is at the bottom of the sphere and the other is when the bead is at an angle θ relative to the vertical axis as shown in Fig. 3.1.

(i) Draw and label the forces acting on the bead when it is in the position shown in Fig. 3.1. [1]

(ii) By considering the forces on the bead, calculate the value of θ.

θ = …….° [3]

(iii) Hence or otherwise, explain what will happen to θ when the sphere is rotating at a faster rate.

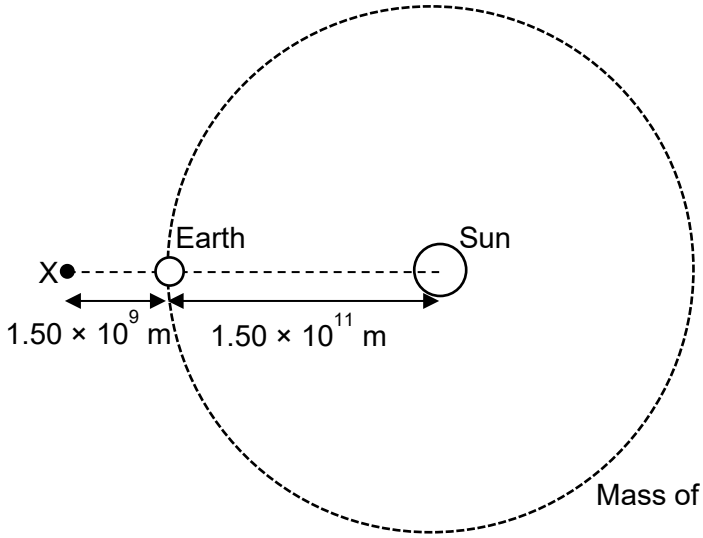
……..……..

……..……..

……...……

..... [2]

(c) A satellite of mass 6200 kg at point X is orbiting about the Sun together with the Earth as shown in Fig. 3.2. The satellite, the Earth and the Sun are in line with each other at all times.



Mass of the Sun = 1.99×10^{30} kg

Mass of the Earth = 5.98×10^{24} kg

Fig. 3.2 (not to scale)

(i) Calculate the resultant force acting on the satellite due to the Sun and the Earth.

resultant force = …….. N [3]

(ii) Calculate the angular velocity of the satellite, assuming that the satellite is in a circular orbit around the Sun.

angular velocity = …….. rad s^{-1} [2]