1 **(a)** Fig. 2.1 shows an aeroplane flying in a horizontal circle at constant speed. The weight of the aeroplane is *W* and *L* is the lift force acting at right angles to the wings.

Fig. 2.1

(i) Explain how the lift force *L* maintains the aeroplane flying in a **horizontal** circle.

.....

.....

.....

..... **[2]**

(ii) The aeroplane of mass 1.2×10^5 kg is flying in a horizontal circle of radius 2.0 km.

The centripetal force acting on the aeroplane is 1.8×10^6 N. Calculate the speed of the aeroplane.

speed = ... $m\,s^{-1}$ **[2]**

(b) Fig. 2.2 shows a satellite orbiting the Earth at a constant speed *v*. The radius of the orbit is *r*.

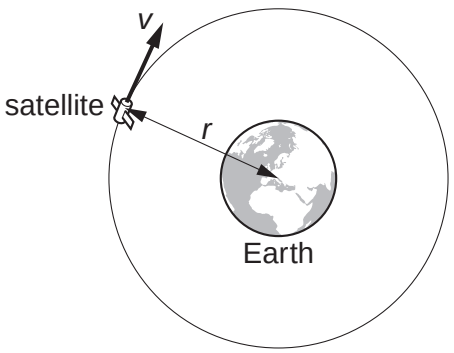

Fig. 2.2

Show that the orbital period T of the satellite is given by the equation

$$T^2 = \frac{4\pi^2 r^3}{GM}$$

where M is the mass of the Earth and G is the gravitational constant.

[3]

(c) The satellites used in television communication systems are usually placed in geostationary orbits.

In your answer, you should use appropriate technical words spelled correctly.

(i) State two features of geostationary orbits.

1. .....

.....

2. .....

..... **[2]**

(ii) Calculate the radius of orbit of a geostationary satellite.

The mass of the Earth is 6.0×10^{24} kg.

radius = ... m **[3]**

[Total: 12]

2 **(a)** **(i)** State, in terms of force, the conditions necessary for an object to move in a circular path at constant speed.

.....

..... **[1]**

(ii) Explain why this object is accelerating. State the direction of the acceleration.

.....

..... **[2]**

(b) A satellite moves in a circular orbit around the Earth at a constant speed of $3700\,m\,s^{-1}$.

The mass M of the Earth is $6.0 \times 10^{24}\,kg$.

Calculate the radius of this orbit.

radius = ... m **[4]**

(c) In order to move the satellite in **(b)** into a new smaller orbit, a decelerating force is applied for a brief period of time.

(i) Suggest how the decelerating force could be applied.

.....

..... **[1]**

(ii) The radius of this new orbit is $2.0 \times 10^{7}\,m$. Calculate the speed of the satellite in this orbit.

speed = ... $m\,s^{-1}$ **[2]**

[Total: 10]