3 **(a)** Define *gravitational potential energy*.

……

……

……[2]

(b) Fig. 3.1 shows part of the orbit of a satellite round the Earth.

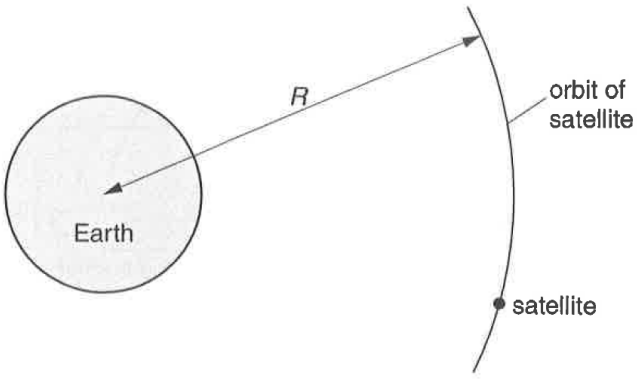

Fig. 3.1

The mass M of the Earth is 6.0×10^{24} kg. It may be assumed that the gravitational field of the Earth is the same as that of a point mass M situated at the centre of the Earth.

(i) On Fig. 3.1 show, by means of an arrow, the direction of the gravitational force on the satellite. [1]

(ii) Explain why the satellite does not move in the direction of the gravitational force.

……...……...

……...……..

……[1]

(iii) Show that v, the linear speed of the satellite in its orbit of radius R, is given by the expression

$$v = \sqrt{\frac{GM}{R}}$$

where G is the gravitational constant.

[1]

(c) The satellite is orbiting the Earth with a radius R of 6610 km at a speed v of 7780 m s^{-1}.

The satellite is boosted into a higher orbit of radius 6890 km. Determine the speed of the satellite in the new orbit.

speed of satellite = ... m s^{-1} [2]

(d) The satellite has a mass of 120 kg. Using the data in **(c)**, calculate the change in

(i) kinetic energy, and

change in kinetic energy = ... J [1]

(ii) gravitational potential energy.

change in potential energy = ... J [2]