Section A

For Examiner's Use

Answer **all** the questions in the spaces provided.

1 **(a)** State Newton's law of gravitation.

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.....

.....[2]

(b) A satellite of mass m is in a circular orbit of radius r about a planet of mass M.
For this planet, the product GM is $4.00 \times 10^{14}\,\text{N m}^2\,\text{kg}^{-1}$, where G is the gravitational constant.
The planet may be assumed to be isolated in space.

(i) By considering the gravitational force on the satellite and the centripetal force, show that the kinetic energy E_K of the satellite is given by the expression

$$E_K = \frac{GMm}{2r}.$$

[2]

(ii) The satellite has mass 620 kg and is initially in a circular orbit of radius 7.34×10^6 m, as illustrated in Fig. 1.1.

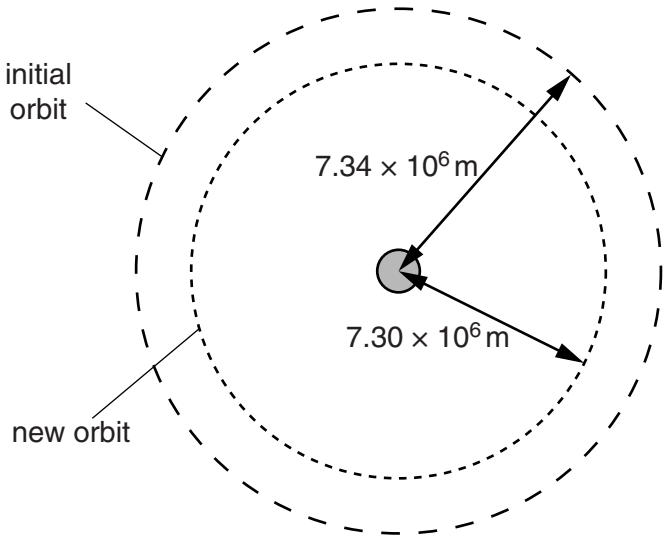

Fig. 1.1 (not to scale)

Resistive forces cause the satellite to move into a new orbit of radius 7.30×10^6 m.

For Examiner's Use

Determine, for the satellite, the change in

1. kinetic energy,

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

2. gravitational potential energy.

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

(iii) Use your answers in **(ii)** to explain whether the linear speed of the satellite increases, decreases or remains unchanged when the radius of the orbit decreases.

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.....[2]