3 **(a)** A planet may be assumed to be a uniform sphere. It has gravitational potential Φ at distance r from the centre of the planet. The variation with $1/r$ of Φ is shown in Fig. 3.1.
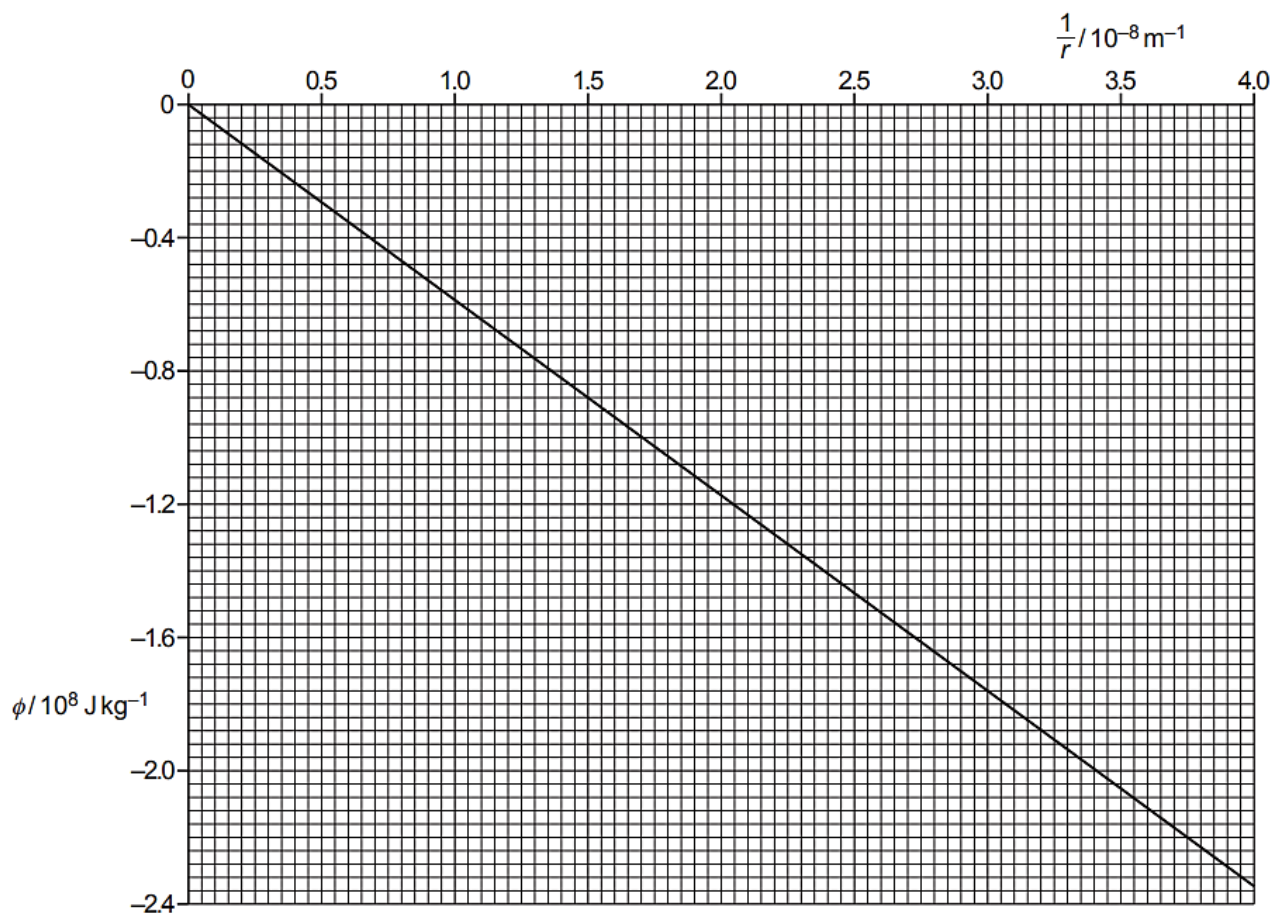

Fig. 3.1

(i) Show that the mass of the planet is 8.8×10^{25} kg.

[2]

(ii) The period of rotation of the planet is 0.72 Earth days.

A satellite in orbit around the planet remains above the same point on the surface of the planet. The speed of the satellite is 8400 m s^{-1}. The mass of the satellite is 1200 kg.

Determine the additional energy required to move the satellite from its orbit to infinity.

energy required = ... J [3]

(b) To move the satellite to a new, stable circular orbit closer to the planet, a short rocket thrust is required to begin the manoeuvre.

Explain the direction of this initial thrust.

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