1 **(a)** Explain why the gravitational potential near to a point mass is negative.

.....

.....

.....

..... [2]

(b) 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 $\frac{1}{r}$ of ϕ is shown in Fig. 1.1.

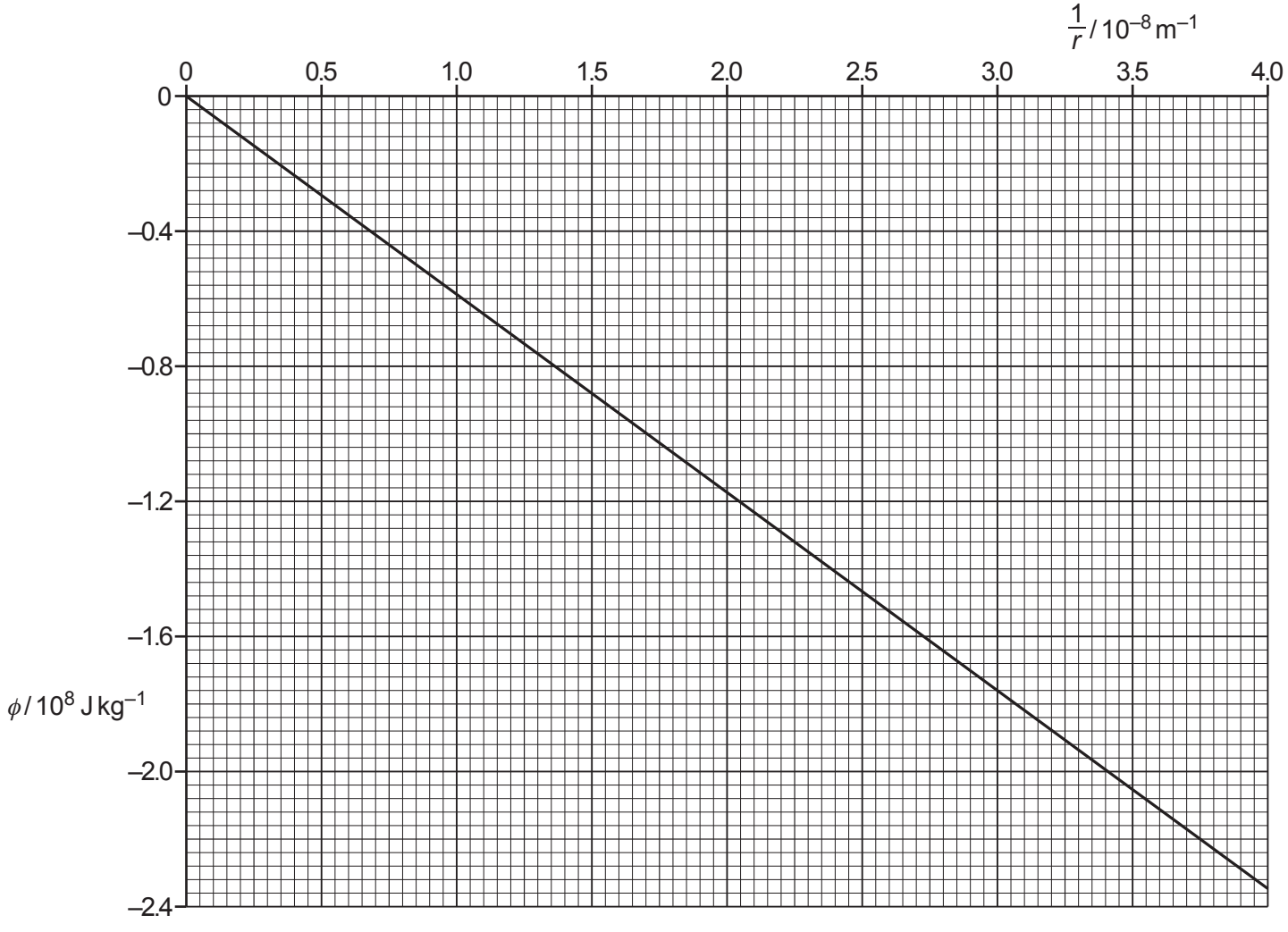

Fig. 1.1

(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.

Use the mass of the planet in **(b)(i)** to determine the radius R of the orbit of the satellite.

R = ... m [3]

(iii) The speed of the satellite in **(b)(ii)** 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]

[Total: 10]