5 **(a)** Define gravitational potential at a point.

.....

.....

..... [2]

(b) A planet of radius R is isolated in space. It has no atmosphere, and its mass M can be assumed to be concentrated at its centre.

A projectile is launched from the surface of the planet with a speed v, where v is the minimum speed required for the projectile to not return to the planet.

By considering energy, derive an expression for v in terms of G, M and R, where G is the gravitational constant.

Explain your working.

[3]

(c) The projectile in **(b)** has a mass of 1.0 kg and is launched with a kinetic energy of 8.0×10^6 J.

On Fig. 5.1, draw:

(i) a line, labelled **P**, to show how the gravitational potential energy of the projectile varies with distance from the centre of the planet as it moves from R to $4R$ [2]

(ii) a line, labelled **K**, to show how the kinetic energy of the projectile varies with distance from the centre of the planet as it moves from R to $4R$. [2]

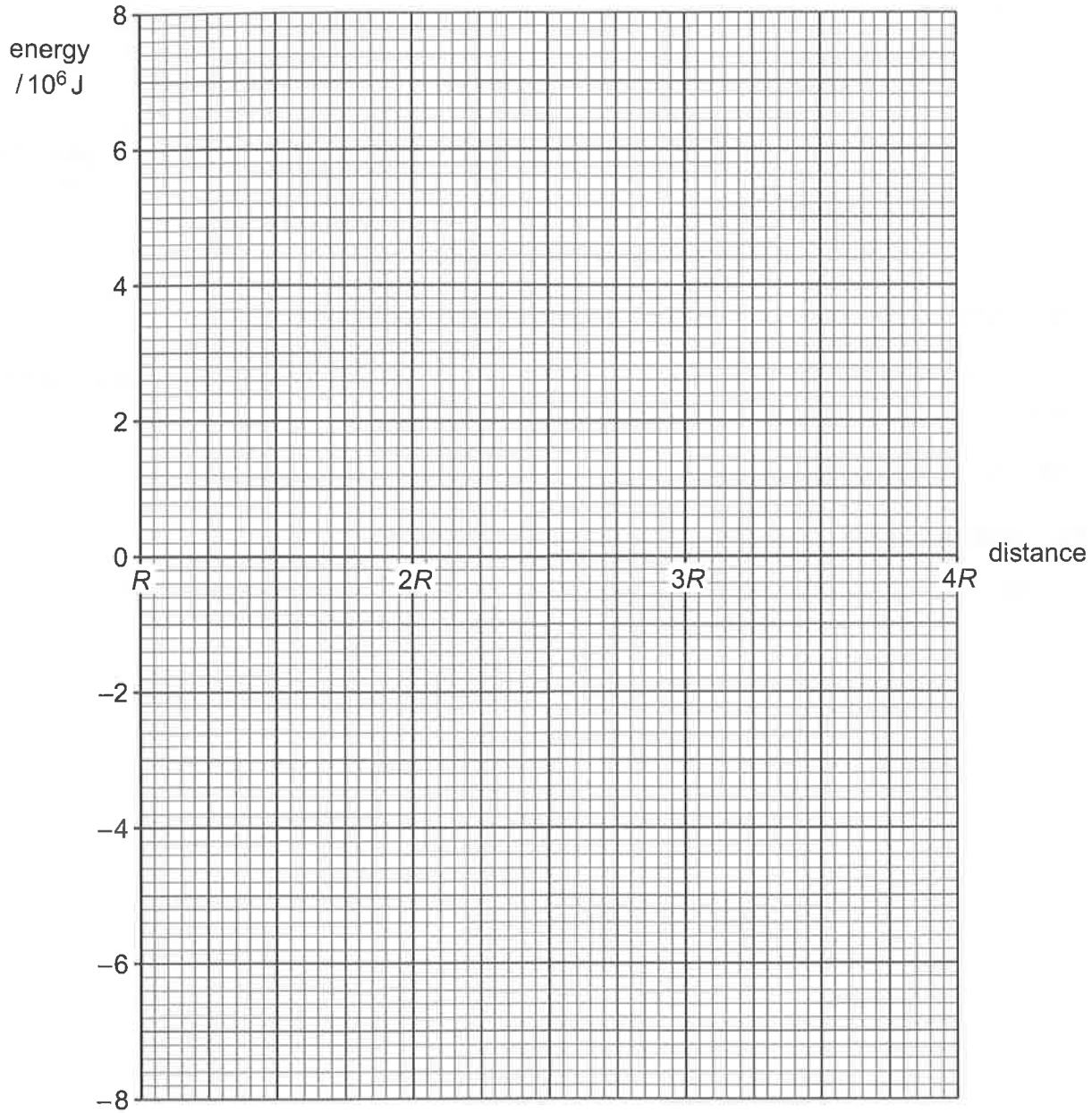

Fig. 5.1

[Total: 9]