2 A rocket is launched from the surface of a planet and moves along a radial path, as shown in Fig. 2.1.

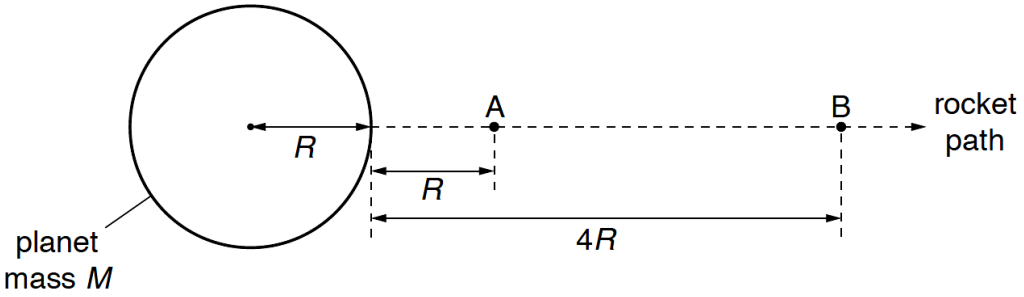

Fig. 2.1

The planet may be considered to be an isolated sphere of radius R with all of its mass M concentrated at its centre. Point A is a distance R from the surface of the planet. Point B is a distance $4R$ from the surface.

(a) Show, for moving a short distance h near the surface of the planet, that the change in gravitational potential energy ΔE_P of the rocket is given by the expression

$$\Delta E_P = mgh$$

where g is the acceleration of free fall.

……

……

……

……

……

……[3]

(b) The rocket motor is switched off at point A. During the journey from A to B, the rocket has a constant mass of 4.7×10^4 kg and its kinetic energy changes from 1.17 TJ to 0.35 TJ.

For the planet, the product GM is 4.0×10^{14} Nm^2 kg^{-1}. It may be assumed that resistive forces to the motion of the rocket are negligible.

Determine the distance from A to B.

distance = …….m [4]

(c) The rocket eventually reaches a distance far away from the planet.

Suggest one similarity and one difference between the gravitational fields at the surface of the planet and at the surface of the rocket.

similarity: ..……..……..

……..……..

difference: ……..……..

……..…….....[2]

[Total: 9]