2 An isolated spherical planet has radius R. From any point above the planet, its mass M appears to be concentrated at its centre.

A satellite is in a circular orbit at a height h above the surface of the planet. Resistive forces due to the planet's atmosphere are negligible.

(a) Derive an expression, in terms of M, R, h and the gravitational constant G, for the speed v_s of the satellite. Explain your working.

[3]

(b) A rock, initially at rest at an infinite distance away, approaches the planet, as shown in Fig. 2.1.

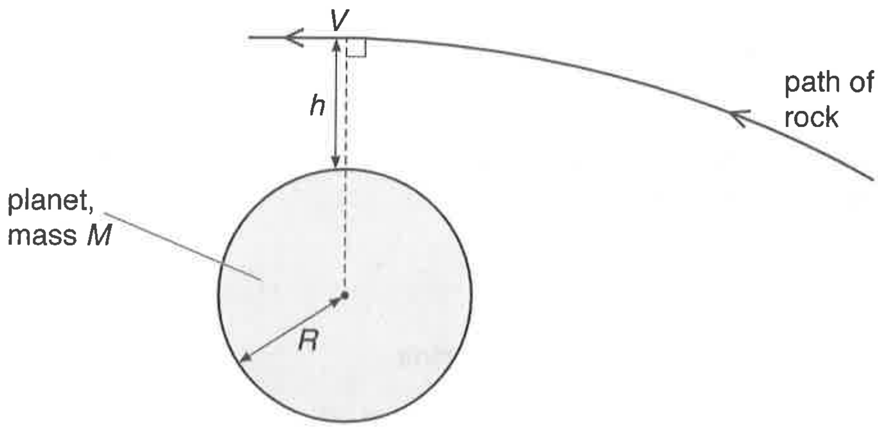

Fig. 2.1

At the height h above the surface of the planet, the rock is travelling at speed V in a direction parallel to a tangent to the planet's surface.

Derive an expression, in terms of M, R, h and the gravitational constant G, for the speed V of the rock. Explain your working.

[3]

(c) By reference to your answers in **(a)** and **(b)**, state and explain whether the rock will fall to the planet's surface **or** go into orbit around the planet **or** travel off into space.

....

....

.... [2]

[Total: 8]