Section A

Answer **all** the questions in the spaces provided.

1 The mass M of a spherical planet may be assumed to be a point mass at the centre of the planet.

(a) A stone, travelling at speed v, is in a circular orbit of radius r about the planet, as illustrated in Fig. 1.1.

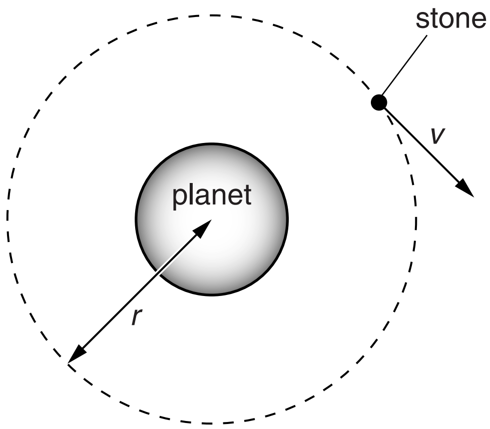

Fig. 1.1

Show that the speed v is given by the expression

$$v = \sqrt{\left(\frac{GM}{r}\right)}$$

where G is the gravitational constant.
Explain your working.

[2]

(b) A second stone, initially at rest at infinity, travels towards the planet, as illustrated in Fig. 1.2.

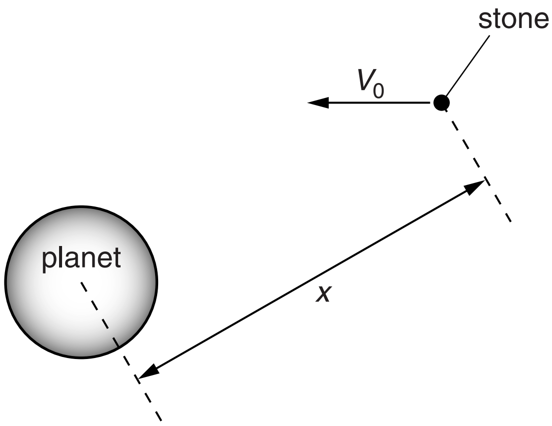

Fig. 1.2 (not to scale)

The stone does not hit the surface of the planet.

(i) Determine, in terms of the gravitational constant G and the mass M of the planet, the speed V_0 of the stone at a distance x from the centre of the planet. Explain your working. You may assume that the gravitational attraction on the stone is due only to the planet.

[3]

(ii) Use your answer in **(i)** and the expression in **(a)** to explain whether this stone could enter a circular orbit about the planet.

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.... [2]