

- 1 (a) Define gravitational field.

..... [1]

- (b) The gravitational field strength  $g$  at a distance  $x$  from the centre of a uniform spherical planet of mass  $M$  is given by the expression

$$g = \frac{GM}{x^2}$$

where  $G$  is the gravitational constant and distance  $x$  is greater than the radius of the planet.

- (i) Describe the pattern of the field lines outside the planet that represent the gravitational field due to the planet.

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..... [2]

- (ii) Explain why, for small changes in vertical height near the surface of the planet,  $g$  may be assumed to be constant.

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..... [2]

- (c) Assume that the Earth is a uniform sphere. For the Earth, the product  $GM$  is equal to  $3.99 \times 10^{14} \text{ m}^3 \text{s}^{-2}$ .

- (i) Determine a value, to three significant figures, for the radius  $R$  of the Earth.

$$R = ..... \text{ m} [2]$$





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- (ii) Calculate the gravitational potential at the Earth's surface. Give a unit with your answer.

gravitational potential = ..... unit ..... [2]

- (d) Explain why the gravitational potential energy of two point masses is always negative.

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..... [2]