

1 (a) Define gravitational field.

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..... [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.

$R =$ 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]