Gravitation – Past Paper Questions

1. The following data refer to two planets.

	radius/km	density/kg m^{-3}
planet P	8000	6000
planet Q	16000	3000

The gravitational field strength at the surface of P is 13.4 N kg^{-1}. What is the gravitational field strength at the surface of Q?

A 3.4 N kg^{-1}

B 13.4 N kg^{-1}

C 53.6 N kg^{-1}

D 80.4 N kg^{-1} **(1)**

2. The gravitational field strength at the surface of a planet, X, is 19 N kg^{-1}.

(a) (i) Calculate the gravitational potential difference between the surface of X and a point 10 m above the surface, if the gravitational field can be considered to be uniform over such a small distance.

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(ii) Calculate the minimum amount of energy required to lift a 9.0 kg rock a vertical distance of 10m from the surface of X.

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(iii) State whether the minimum amount of energy you have found in part (a)(ii) would be different if the 9.0 kg mass were lifted a vertical distance of 10 m from a point near the top of the highest mountain of planet X. Explain your answer.

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(3)

(b) Calculate the gravitational field strength at the surface of another planet, Y, that has the same mass as planet X, but twice the diameter of X.

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(2)
(Total 5 marks)

3. (a) State, in words, Newton's law of gravitation.

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(2)

(b) Some of the earliest attempts to determine the gravitational constant, *G*, were regarded as experiments to "weigh" the Earth. By considering the gravitational force acting on a mass at the surface of the Earth, regarded as a sphere of radius *R*, show that the mass of the Earth is given by

$$M = \frac{gR^2}{G},$$

where *g* is the value of the gravitational field strength at the Earth's surface.

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(2)

(c) In the following calculation use these data.

radius of the Moon	$= 1.74 \times 10^6$ m
gravitational field strength at Moon's surface	$= 1.62$ N kg^{-1}
mass of the Earth *M*	$= 6.00 \times 10^{24}$ kg
gravitational constant *G*	$= 6.67 \times 10^{-11}$ Nm^2 kg^{-2}

Calculate the mass of the Moon and express its mass as a percentage of the mass of the Earth.

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(3)
(Total 7 marks)