Gravitation – PPQs

Name ……

1. Which one of the following has different units to the other three?

A gravitational potential

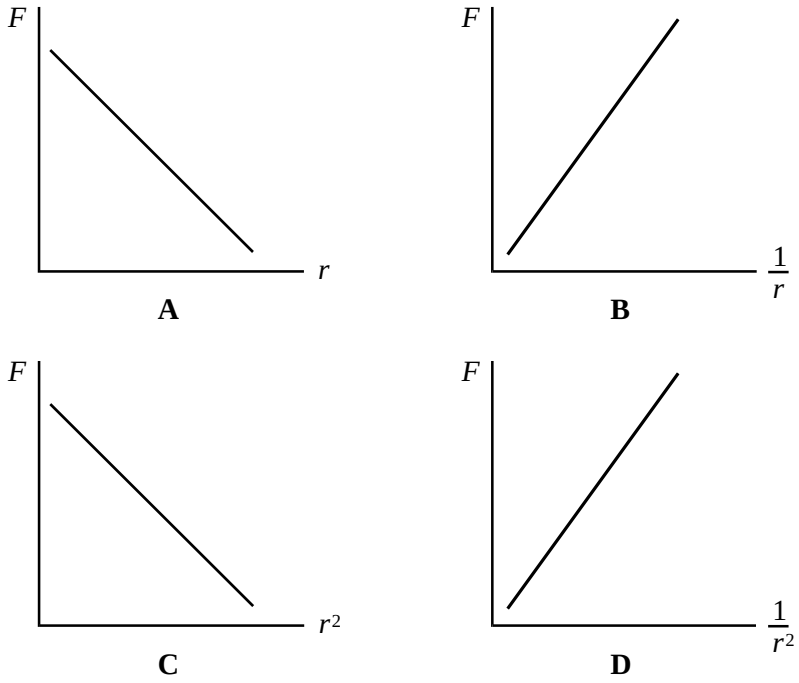
B gravitational field strength

C force per unit mass

D gravitational potential gradient

(Total 2 marks)

2. Which one of the following graphs correctly shows the relationship between the gravitational force, *F*, between two masses and the distance, *r*, between them?



(Total 2 marks)

3. A satellite is in orbit at a height *h* above the surface of a planet of mass *M* and radius *R*. What is the velocity of the satellite?

A $\sqrt{\frac{GM(R+h)}{R}}$

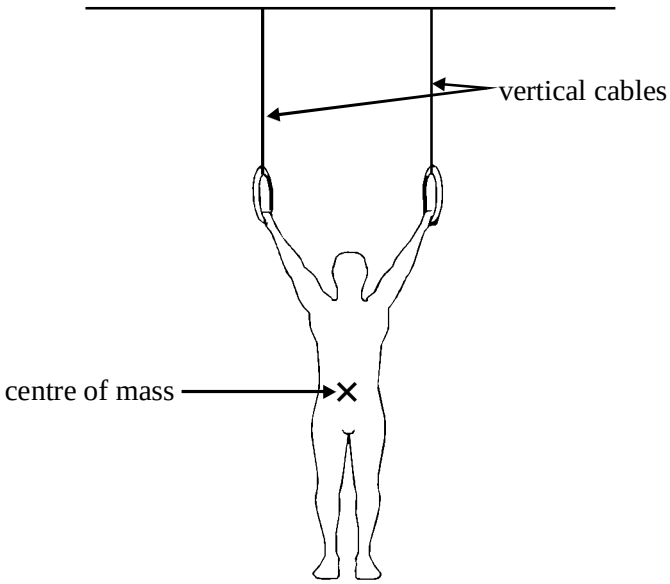
B $\frac{\sqrt{GM(R+h)}}{R}$

C $\sqrt{\frac{GM}{(R+h)}}$

D $\frac{\sqrt{GM}}{(R+h)}$

(Total 2 marks)

4. The diagram shows a gymnast of weight 720N hanging centrally from two rings, each attached to cables which hang vertically.



(a) State the tension in each cable.

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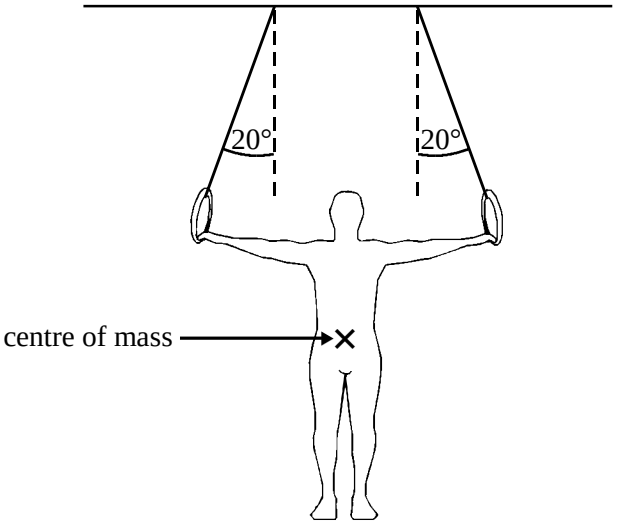
(1)

(b) The diagram shows the gymnast after he has raised his body so that his centre of mass moves through a vertical distance of 0.60 m.



Calculate

(i) the increase in gravitational potential energy of the gymnast,

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(ii) the tension in each cable.

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(3)

(c) The gymnast now raises his legs so that they become horizontal, without raising the rest of his body. State and explain whether his gravitational potential energy is changed by this manoeuvre.

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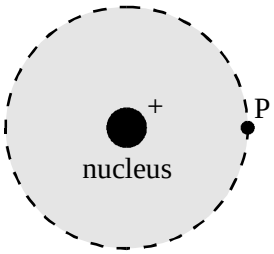
(2)
(Total 6 marks)

5. The mass of the nucleus of an isolated copper atom is 63 u and it carries a charge of +29 *e*. The diameter of the atom is 2.3×10^{-10} m.

P is a point at the outer edge of the atom.



(a) Calculate

(i) the electric field strength at P due to the nucleus,

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(ii) the gravitational potential at P due to the nucleus.

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(5)

(b) Draw an arrow on the above diagram to show the direction of the electric field at the point P.

(1)
(Total 6 marks)

6. Communications satellites are usually placed in a *geo-synchronous orbit*.

(a) State **two** features of a geo-synchronous orbit.

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(2)

(b) Given that the mass of the Earth is 6.00×10^{24} kg and its mean radius is 6.40×10^{6} m,

(i) show that the radius of a geo-synchronous orbit must be 4.23×10^{7} m,

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(ii) calculate the increase in potential energy of a satellite of mass 750 kg when it is raised from the Earth's surface into a geo-synchronous orbit.

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(6)
(Total 8 marks)