

Name _____

Set _____

SRD Work

Gravitational and Electric Fields

1. The Sun has a mass of approximately 2.0×10^{30} kg, and the Earth has a mass of 5.972×10^{24} kg, and can be assumed to orbit in a circle of radius of 150×10^6 km.

a. Give a definition in words of gravitational field strength.

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[2]

b. Calculate the gravitational field strength due to the Sun at the radius of the Earth's orbit.

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[3]

c. What is the size of the gravitational force that Earth exerts on the Sun?

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[2]

d. Give a definition in words of gravitational potential.

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[2]

e. Calculate the gravitational potential energy of the Earth as it orbits the Sun?

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[2]

[Total 11]

2. Hyperion and Iapetus and Phoebe are three of the moons of Saturn. They orbit the planet at different distances. In the following question you can assume that these moons orbit Saturn in circular orbits.

a. Explain why these moons remain in their orbits around Saturn.

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[2]

b. Show that the time period, T, of a moon is related to the radius of orbit of the moon by the following equation:

$$T^2 = \frac{4\pi^2}{GM} R^3,$$

where M is the mass of Saturn.

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[3]

c. The time period of Phoebe is 550 days and orbits at a radius of 12.95×10^6 km. Use this information to calculate the Mass of Saturn.

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[2]

d. The ratio of the time period of Iapetus to Hyperion is 3.73. What is the ratio of the radius of orbit of Iapetus to that of Hyperion? [Ring the correct solution]

- A** 7.20 **B** 0.42 **C** 2.41 **D** 13.9

[1]

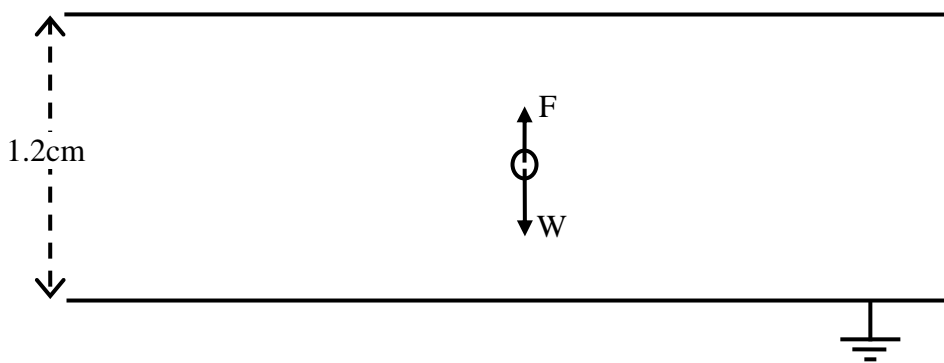
[Total 8]

3. An electrical charge oil drop is held stationary between two metal plates in a vacuum as shown in the diagram below. The plates are placed a distance of 1.2cm apart.

When the oil drop is held stationary the electrostatic force, F , balances the weight of the oil drop, W . These forces have been shown on the diagram.

The electric charge on the oil drop is $+1.6 \times 10^{-19}\text{C}$.

The electric field between the plates has a magnitude of $1.8 \times 10^5 \text{ NC}^{-1}$.



- a. Is the plate above the oil drop positively or negatively charged?

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[1]

- b. Sketch the electric field in between the plates, clearly showing the direction of the electric field.

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[2]

- c. Calculate the size of the potential difference between the plates.

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[2]

- d. What is the weight of the oil drop?

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[2]

[Total 7]

4. The dome of a Van de Graaff generator is nearly a perfect sphere of radius 0.15m. Sparks can jump from the dome when the electric field strength at its surface reaches $3 \times 10^5 \text{ NC}^{-1}$.

a. Calculate the minimum charge on the dome at which sparks will be produced.

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b. Find the potential at the surface of the dome when it holds this charge.

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[2]

[Total 4]