Chapter 1-5 Recap Questions

1. Describe the similarities between electric fields and gravitational fields.

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2. Describe the differences between electric fields and gravitational fields.

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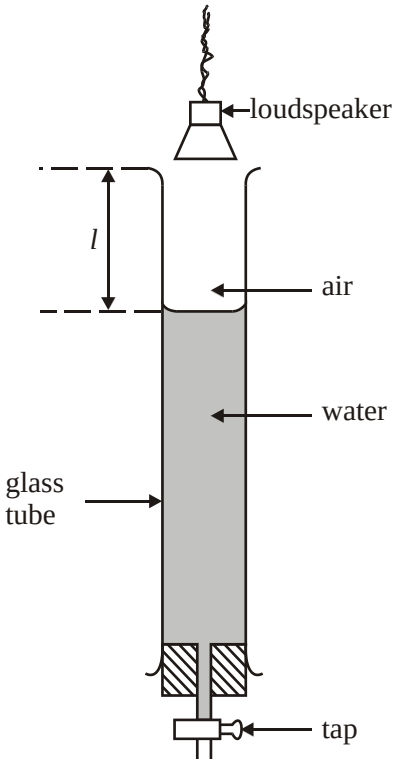
3.



A small loudspeaker emitting sound of constant frequency is positioned a short distance above a long glass tube containing water. When water is allowed to run slowly out of the tube, the intensity of the sound heard increases whenever the length *l* (shown above) takes certain values.

(a) Explain these observations by reference to the physical principles involved.

You may be awarded marks for the quality of written communication in your answer.

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(4)

(b) With the loudspeaker emitting sound of frequency 480 Hz, the effect described in part (a) is noticed first when l = 168 mm. It next occurs when l = 523 mm.

Use both values of l to calculate

(i) the wavelength of the sound waves in the air column,

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(ii) the speed of these sound waves.

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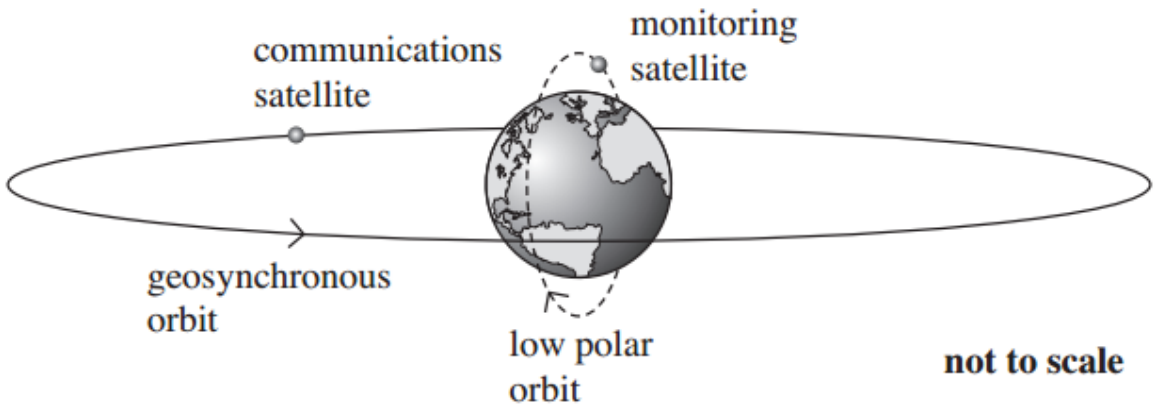
(4)
(Total 8 marks)

4. Two types of satellite orbit include "geo-synchronous" and "low polar". Geo-synchronous satellites orbit the earth in a circle above the equator, and maintain the same position above the earth's surface. Low polar satellites orbit in circular orbits of smaller radius, with their orbits passing over the north and south poles.



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

(a) What is the period of a satellite in a geo-synchronous orbit?

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(1)

b) The mass of the Earth 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 750 kg when it is raised from the Earth's surface into a geo-synchronous orbit.

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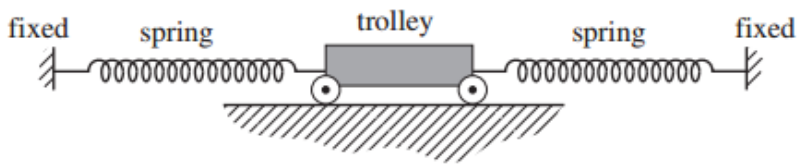
(6)
(Total 7 marks)

5.

A trolley of mass 0.80 kg rests on a horizontal surface attached to two identical stretched springs, as shown in **Figure 3**. Each spring has a spring constant of 30 N m^{-1}, can be assumed to obey Hooke's law, and to remain in tension as the trolley moves.

Figure 3



(a) (i) The trolley is displaced to the left by 60 mm and then released. Show that the magnitude of the resultant force on it at the moment of release is 3.6 N.

(2 marks)

(a) (ii) Calculate the acceleration of the trolley at the moment of release and state its direction.

answer = ...m s^{-2}

direction .....

(2 marks)