



UNIVERSITY OF GHANA
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FIRST SEMESTER EXAMINATIONS: 2011/2012

LEVEL 100: BACHELOR OF SCIENCE IN ENGINEERING

FAEN 109: GENERAL PHYSICS (3 Credits)

TIME ALLOWED: TWO AND A HALF (2½) HOURS

INSTRUCTION: Answer ALL questions.

Assume the following constants

Velocity of light $c = 3 \times 10^8 \text{ ms}^{-1}$

Rydberg constant $R = 2.18 \times 10^{-18} \text{ J}$

Planck's constant $h = 6.63 \times 10^{-34} \text{ Js}$

Mass of electron $= 9.11 \times 10^{-31} \text{ kg}$

Charge of electron $= 1.6 \times 10^{-19} \text{ C}$

$1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$

Emissivity of free space $= 8.85 \times 10^{-12} \text{ C}^2/\text{N m}^2$

- a. The shock absorbers in an old car with mass 1000 kg are completely worn out. When a 980 N person climbs slowly into the car to its centre of gravity, the car sinks 2.8 cm. When the car, with the person aboard, hits a bump, the car starts oscillating up and down in SHM. Model the car and the person as a single body on a single spring, and find the period and frequency of the oscillation.
- b. By means of diagrams, distinguish among the following: under-damped, critically and over-damped vibrations.
- c. Show that in a very basic circuit just involving an inductor of L Henrys and a capacitor of C Farads, there can be a current $I(t)$ through the circuit that would oscillate with an angular frequency $\omega = \frac{1}{\sqrt{LC}}$

7.

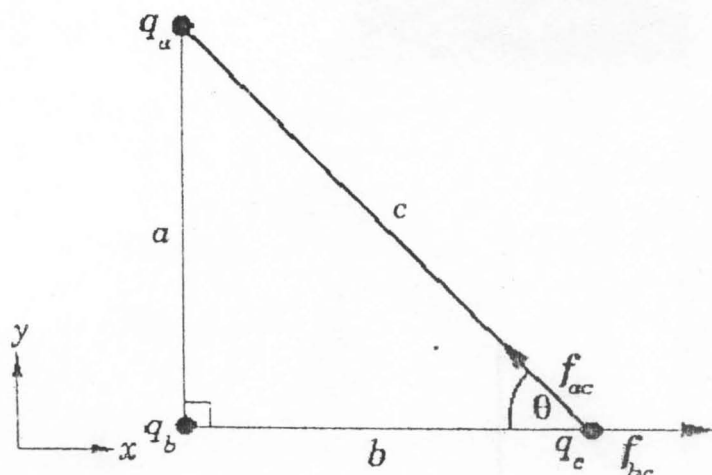
4. (a) Explain what is meant by **magnetic dipole**? Derive an equation for **magnetic dipole moment**. [6 marks]
- (b) A square loop of wire of dimension $L \times L$ carries a current I . What is the **magnetic field** at the **centre of the loop**? [8 marks]
- (c) What is a **cross field**? How is it important in **velocity selectors**? [6 marks]
5. (a) Outline **two successes** and **two shortcomings** of the Bohr's model of the Hydrogen atom. [4 marks]
- (b) What is Bohr radius? Show that the Bohr radius a_0 is given by 0.529 \AA .
(Take $m_e = 9.11 \times 10^{-31} \text{ kg}$ and $e = 1.6 \times 10^{-19} \text{ C}$) [6 marks]
- (c) Which of the spectral lines of the **Brackett series** is closest in wavelength to the first spectral line ($n=6$) of the **pfund series**? By how much do the wavelengths differ? (Assume that $R_\infty = 1.097 \times 10^7 \text{ m}^{-1}$) [10 marks]



Examiner: BO. Asimeng

4. A positive point charge $q = 5.0 \mu\text{C}$ is surrounded by a sphere with radius 0.30 m . Find the electric flux through the sphere due to this charge.

b.



Suppose that three point charges q_a , q_b and q_c are arranged at the vertices of a right-angled triangle, as shown in the diagram. What is the magnitude and direction of the electrostatic force acting on the third charge if $q_a = -6.0 \mu\text{C}$, $q_b = +4.0 \mu\text{C}$, $q_c = +2.0 \mu\text{C}$, $a = 4.0 \text{ m}$, and $b = 3.0 \text{ m}$?

5. a. When an ultraviolet light of wavelength $3.0 \times 10^{-7} \text{ m}$ falls on a metal surface, a retarding potential of 0.5 Volt is applied to keep the most energetic electrons from reaching the collector. Calculate the work function.
- b. Three cells of e.m.f 2 Volts , 1 volt and 4 Volts and the corresponding resistances 4 ohms , 3 ohms , and 2 ohms are in parallel with similar poles connected together. Determine the current flowing through each cell.

