TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR THE BACHELOR OF TECHNOLOGY IN APPLIED CHEMISTRY
(BTAC 12J)

SPH 2171/APH4102/SPH2174: PHYSICS II

END OF SEMESTER EXAMINATION
SERIES: APRIL 2013
TIME: 2 HOURS

Instructions to Candidates:
You should have the following for this examination
- *Answer Booklet*

This paper consist of **FIVE** questions in **TWO** sections **A** & **B**
Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **FOUR** printed pages

SECTION A (COMPULSORY)

Question One

a) (i) State Columb's Law **(2 marks)**

(ii) An electron and a proton are separated by a distance of 5.5 x 10-11m. Find the magnitude of electrostatic between the force. **(3 marks)**

b) Use the superposition principle for forces between multiple charges to show that given charges q_1 q_2…..q_n. The force experienced by q1 due to the other charges is given by:

$$\vec{F}_1 = \sum_{l=2}^{n} 1/4\pi\varepsilon_o \quad \frac{q1\ qi}{ri1}\hat{r}\,i1$$

(3 marks)

Where $\hat{r}\,i1$ is the displacement between charge q_1 and q_i

c) In the classical model of the hydrogen atom the electron revolves around the proton with a radius of r – 0.53 x 10^{-10}m. The magnitude of the charge of the electron and proton is e = 1.6 x 10^{-19}C.

(i) What is the magnitude of the electron force between the proton and the electron? **(2 marks)**

(ii) What is the magnitude of the electron field due to the proton at r. **(2 marks)**

(iii) What is ratio of magnitudes of the electrical and gravitational force between electron and proton? Does the result depend on the distance between the proton and electron? **(4 marks)**

d) (i) What is an electric dipole? **(1 mark)**

$$E = \frac{1}{4\pi\varepsilon_o} \quad \frac{2p^{\rightarrow}}{r^3}$$

(ii) Show that electric filed strength due to a dipole is given by: **(4 marks)**

e) Two capacitors C1 and C2 are connected in series with voltage V across the combination. Show that the voltages across the individual capacitor are:

$$V1 = \frac{C_2 V}{C_1 + C_2} \quad and \quad \frac{C1V}{C_1 + C_2}$$

(4 marks)

f) (i) Differentiate between self and mutual inductance. **(2 marks)**

(ii) Give three difference between electric and magnetic forces. **(3 marks)**

(iii) State Amphes law **(2 marks)**

SECTION B (Answer any TWO questions from this section)

Question Two

a) An election $q = -e$ placed near a charged body experiences a force in the +y direction of magnitude μ 3.6 x 10^{-8} :

(i) What is the electronic field at that location. **(3 marks)**

(ii) What would be the force exerted by the same charged body on an alpha particle $q = +2e$ placed at the location formerly occupied by the electron? Take $e = +1.602 \times 10^{-9} C$

(3 marks)

b) Two points charges q_1 and q_2 of 8 x 10^{-9}C and -8 x 10^{-9}C respectively are placed 0.1m apart as shown. Find the electronic fields at point a, b and c. **(8 marks)**

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$g_1 = 6mC \ \ and \ \ q_2 = 6mC$

c) Electric dipole consists of two charges separated by 0.04m. Find the electric field at a point 1.5m away from the centre of the dipole.

(i) On the side of the charge q_1 **(3 marks)**

(ii) On the line perpendicular to the axis. **(3 marks)**

Question Three

$8\Omega F$

a) A potential difference of 300V is applied to a 2mf capacitor and a connected in the series.

(i) Calculate the potential difference across each capacitor **(3 marks)**

(ii) The charged capacitors are reconnected with their positive plates together and then negative plates together with no external voltage being applied. Calculate the charge and the potential difference across capacitor **(4 marks)**

(iii) The charged capacitor in (a) are connected together with plates of opposite sign. Calculate the charge and the potential difference across each capacitor. **(2 marks)**

ΩF

b) A camera flash gets its energy from 150 capacitor and requires 170V to fire. If the capacitor is charged by a 200V source through an 18 $K\Omega$ resistor, how long must the photographer wait between flashes? **(4 marks)**

ϕ

c) Show that for a spherical capacitor consisting of conducting a sheet of radius b and charge concentric with a smaller conducting sphere of radius a and charge Q is given by:

$$C = \frac{ab}{1c\,(b-a)}$$

(5 marks)

Question Four

5Ω

a) (i) A certain meter has a resistance of and deflect full scale for a voltage of 20Mv across its

terminal. How can it be converted into a 3A ammeter? **(3 marks)**

(ii) Calculate the magnetic field of a long straight wire carrying a current of 10A at a distance 8cm f from the wire. **(3 marks)**

(iii) A wire loop of radius 10cm has a resistance of 2Ω. The plane of the loop is perpendicular to a uniform magnetic field that is increasing at 0.10T/s. Find the magnitude of the induced current in the loop. **(5 marks)**

b) (i) State factors that affect capacitance. **(2 marks)**

(ii) A parallel place capacitor with air between the plates has an area of $2cm^3$ and plate separation of 1mm. Find its capacitance. **(4 marks)**

Question Five

a) State Kirchhoff's Law. **(2 marks)**

b) A steady uniform current of 5m A flows axially along a metal cylinder of cross-section area $0.2mm^2$, length 5m and resistivity 3×10^{-5} Ωm. Find:

(i) The potential difference between the ends of the cylinder. **(3 marks)**
(ii) The rate of heat production. **(3 marks)**

c) Consider the circuit below:

E_3

If $E_1 = 2.1V$, $E_2 = R5 = 1.7\Omega$ and $R_3 = 3.5\Omega$. Find current i, i2, i3. **(7 marks)**

d) Consider the formation of the Helium nucleus whose atomic number is 2 and mass number is $4(H_3{}^42)$. Using 2 protons and 2 neutrons. Determine nuclear mass defect and the bending energy of helium nucleus. Take Mp = 1.007277 a.m.u Mn = 1.008666 a.m.u and mass of helium = 4.001509 a.m.u where 1.am.u = 1.66×10^{-27}kg