THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of JKUAT)

(A Centre of Excellence)

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN ANALYTICAL & INDUSTRIAL CHEMISTRY

APS 4103: PHYSICS FOR CHEMISTS

END OF SEMESTER EXAMINATION

SERIES: DECEMBER 2012

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 **THREE** questions

Maximum marks for each part of a question are as shown

This paper consists of **FOUR** printed pages

Take:

$\varepsilon_o = 8.85\times10^{-12} Fm^{-1}$

$K = 1/(4\pi\varepsilon_O) = 9\times10^{9} Nm^2/C^2$

g

$q_e = 1.6\times10^{-19} C$

Electron Charge,

Mass of electron, Me = 9.11 x 10-31 kg

$\mu_o = 4\pi\times10^{-7} Tm/A$

Permeability constant, =

Proton Mass, mp = 17×10^{-27} kg

$1\mu C$ = 10^{-6}C

1nC = 10^{-9}C

1eV = 1.6×10^{-19}

Acceleration Due to gravity, g = $9.8 ms^{-2}$

Boltzmann Constant K = 1.38×10^{-23} $Jmol^{-1} k^{-1}$

Universal constant G = $6.673 \times 10^{-11} Nm^2 kg^{-2}$

Question One (Compulsory)

a) (i) Differentiate between velocity and speed. **(1 marks)**

(ii) An object is dropped into a well and hits the water 2 seconds after being released. How deep is the well? **(3 marks)**

(iii) If the velocity of a particle changes by the same amount for each similar time interval, what can you say about the acceleration? **(1 mark)**

b) Find the equivalent resistance of the following combinations of resistors:

Ω, 2Ω 5Ω

(i) Parallel arrangement of 3 and resistor. **(2 marks)**

3Ω 4Ω 5Ω

(ii) Series combination of and resistors in parallel with a resistor. **(2 marks)**

c) Explain the term half life as used in discharging of a capacitor. **(1 marks)**

d) (i) Show that for a linear conductor of electric current, resistivity ρ is given by:

$$\rho = \frac{RA}{L}$$

where R is the resistance and L is the length of the conductor. **(3 marks)**

(ii) State Kirchhoff's Laws **(2 marks)**

(iii) Distinguish between Ohmic and Non Ohmic conductors. **(2 marks)**

μF μF

e) A 2.00 and a 4.00 capacitors are connected to a 60.0V battery. How much charge is supplied by the battery in charging the capacitors when the wiring is in series. **(3 marks)**

f) (i) State Ohm's Law **(1 mark)**

(iii) Show that the effective resistance RT of three resistors connected in parallel is given as:

$$RT = \frac{R_1 R_2 R_3}{R_1 R_2 + R_2 R_3 + R_1 R_3}$$

(4 marks)

Question Two

a) What do you understand by the term capacitance? **(2 marks)**

b) In the circuit below, $C1 = 2\mu F,\ C2 = C3 = 0.5\mu F$ and $V = 6V$

Figure 1

(i) Compute the charge in each capacitor. **(3 marks)**

(ii) Calculate the potential difference across each capacitor. **(4 marks)**

c) A 10 μF capacitor is charged for a 30V supply and then connected across an uncharged 50 μF capacitor; calculate the:

(i) Final potential difference across the combination. **(2 marks)**

(ii) Initial and final energies. **(4 marks)**

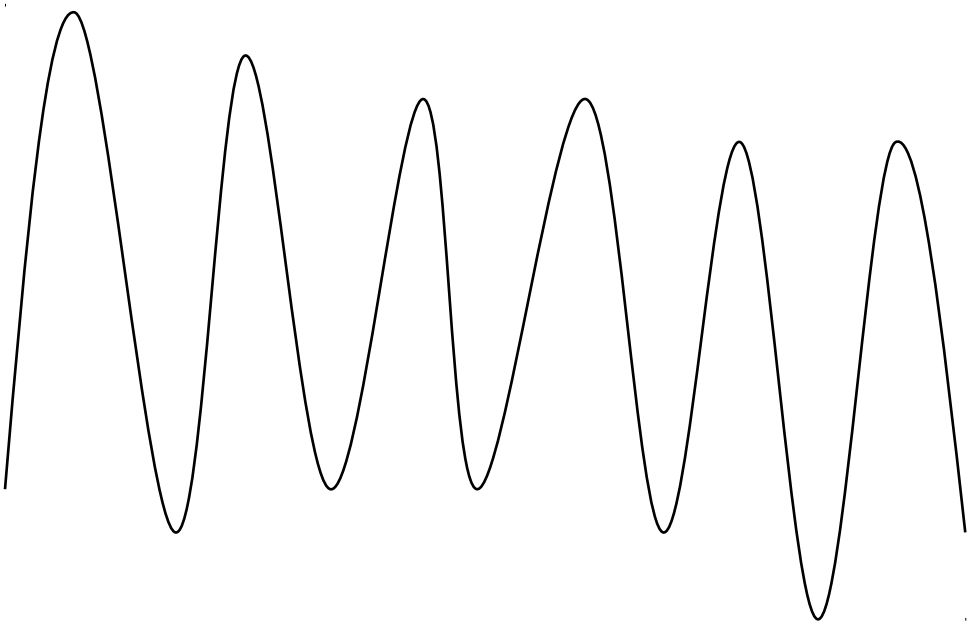
Question Three

a) Explain what is meant by electromotive force. **(1 mark)**

b) The heating element of a heater is rated at 1KW when operating at 240V.

(i) Determine the current through it under normal conditions. **(3 marks)**

(ii) What would be its power consumption if the potential difference drops to 120V? **(4 marks)**



Find the equivalent resistance of the combination of resistors in the circuit. Compute current I if the applied voltage is 6V. **(7 marks)**

Question Four

a) Define the following terms:

(i) Distance **(1 mark)**

(ii) Displacement **(1 mark)**

(iii) Acceleration **(1 mark)**

(iv) Friction **(1 mark)**

b) Derive Newton's second law **(3 marks)**

c) A 600N object is to be given an acceleration of $0.7ms^{-2}$. How large an unbalanced force must act upon it? **(3 marks)**

d) Two masses of 0.5kg and 0.25kg are connected by a light inextensible string, which passes over a smooth light pulley. If the system is released form rest with the string taut, find the acceleration of each mass and the distance travelled in 1 second from rest. **(5 marks)**

Question Five

a) State Coulomb's law for the electrostatic force between two point charges. **(1 mark)**

b) Three positive charges lie along the same line as shown. Derive an expression for the force acting on Q2.

(4 marks)

Figure 3

c) The charges below are placed at the corners of an equilateral triangle of side a

Figure 4

Show that the force experienced by charge Q1 is given by the expression:

$$F = \frac{\sqrt{3}\ KQ^2}{a^2}$$

(5 marks)

d) Consider two charges Q_1 and Q_2 separated initially by a distance r^1. If charge Q_2 is moved towards Q_1 such that the new separation distance r, show that the work done in moving the charge Q_2 is given by:

$$W = \frac{Q1\ Q2}{4\pi\varepsilon_o}\left[\frac{1}{r} - \frac{1}{r'}\right]$$

(5 marks)