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 SCIENCE IN CIVIL ENGINEERING
BACHELOR OF SCIENCE IN BUILDING & CIVIL ENGINEERING
BACHELOR OF SCIENCE IN ELECTRICAL & ELECTRONIC ENGINEERING
BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

SPH 2171: PHYSICS II

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 **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

Question One (Compulsory)

a) State the properties of electrostatic forces. **(4 marks)**

b) Using the Gauss law, derive the coulomb law for an isolated point charge. **(5 marks)**

c) A piece of plastic pipe of radius r is uniformly charged on the surface. What is the electric field along it axis. Explain. **(2 marks)**

d) Three capacitors C_1, C_2, and C_3 are connected in series. Derive an expression for the net capacitance. **(4 marks)**

e) The potential at a certain region is given by $V = 4x^2 - 3xy^2 + 2z^2$ volts. Find the components of the electric field intensity, E at the point (4, 3, -2) metres. **(6 marks)**

f) (i) State the Lorentz Law **(2 marks)**
(ii) Charges are flowing into a wall within a region where the magnetic field is vertically upwards. On a sketch, illustrate the direction of the lines of force. **(3 marks)**

g) Two isolated conductors of radii a_1, and a_2 are electrically connected together. Find the ratio of their final charge densities λ_1 and λ_2 **(4 marks)**

Question Two

Three charges are placed at the vertices of an equilateral triangle of sides 10cm, such that the line joining q_1 to q_2 is parallel to the x-axis. Given that $q_1 = -1.0\mu C,\ q2 = +3\mu C$ and $q_3 = -2\mu C$, Find:-

a) The resultant force on q_1 and its direction due to this charge distribution. **(6 marks)**
b) The electric field at X, the centre of the configuration. **(9 marks)**
c) The electric potential at X. **(2 marks)**
d) The total electric potential energy due to the configuration. **(3 marks)**

Question Three

a) Show that the electric field strength E due to a dipole of magnitude q placed a distance 2a apart at a point X a distance r from the line joining them is inversely proportional to r^3, when r >>a. **(7 marks)**

b) Determine the potential at point P, r metres on the axis of a uniformly charged disk of radius a, whose surface density is δ hence show that it behaves as a point charge when r>>a. **(13 marks)**

Question Four

a) Describe the charging and discharging process of a capacitor. **(5 marks)**

b) A circuit is connected as shown below. Each of the capacitor has a capacitance of 5 μF.

(i) Find the total capacitance of the circuit. **(4 marks)**
(ii) Determine the charge on C_1 and C_A. **(5 marks)**

(iii) Determine the total energy stored in the network when fully charged. **(3 marks)**

c) Explain the effect of a dielectric on the capacitance of a capacitor. **(4 marks)**

Question Five

a) A singly charged carbon ion is moving at a speed of 300km/s at right angles to a magnetic field of 0.75T.

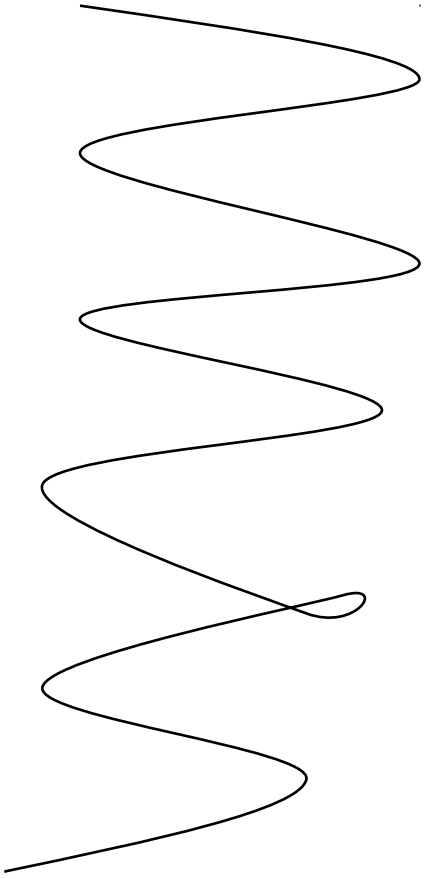
(i) What is the force on the ion? **(3 marks)**

(ii) What is the centripetal acceleration of the ion? **(4 marks)**

(iii) Find the radius of the circle in which the ion moves. **(3 marks)**

(1 amu = 1.66×10^{-27} kg, mass of carbon 12 amu)

b) The figure below shows a circuit is which E = 3V, R_1 = 0.4K Ω, $R_2 = 0.3K\Omega$, $R3 = 0.6K\Omega$ and $R_4 = 1K\Omega$



Find:

(i) The equivalent resistance between A and B. **(4 marks)**

(ii) The electric potential across R_1. **(3 marks)**

(iii) The current through R_3. **(3 marks)**