CHUKA  **UNIVERSITY**

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE , BACHELOR OF EDUCATION

PHYS 213: ELECTRICITY AND MAGNETISM I

STREAMS: BSC, BED **TIME: 2 HOURS**

DAY/DATE: WEDNESDAY 22/4/2015 **11.30 A.M – 1.30 P.M.**

INSTRUCTIONS:

(a) This paper consists of five questions

(b) Answer question ONE (Compulsory) and any other TWO questions

Take:

Permittivity in free space $\varepsilon_o = 8.85\ x\ 10^{-12}\ C/(Nm^2)$

Charge of electron $e^- = 1.6\ x\ 10^{-19} C$

Permeability $\mu_o = 4\pi\ x\ 10^{-7}\ Tm/A$

Speed of light $C = 3\ x\ 10^8\ m/s$

$K_e = 9.0\ x\ 10^9\ N\ m^2 C^{-2}$

QUESTION ONE (30 MARKS)

(a) (i) State Coulomb's law of the electrostatic forces between two point charges. [2 marks]

(ii) An electron and a proton are separated by a distance of $6.8\ x\ 10^{-11}\ m$. Find the electrostatic force between them. [3 marks]

(b) (i) State TWO factors affecting capacitance. [2 marks]

(ii) A parallel plate capacitor has an area of $1.25\ x\ 10^{-4}\ m^2$ and plates separated by a distance of $5\ x\ 10^{-3}$m. Find its capacitance [3 marks]

(c) A student makes circular coil of 300 loops of thin copper wire with a resistance of 0.25Ω. The coil diameter is 14.0 cm and the coil is connected to a 18.0 V battery. Determine:

(i) The magnetic moments of the coil [3 marks]

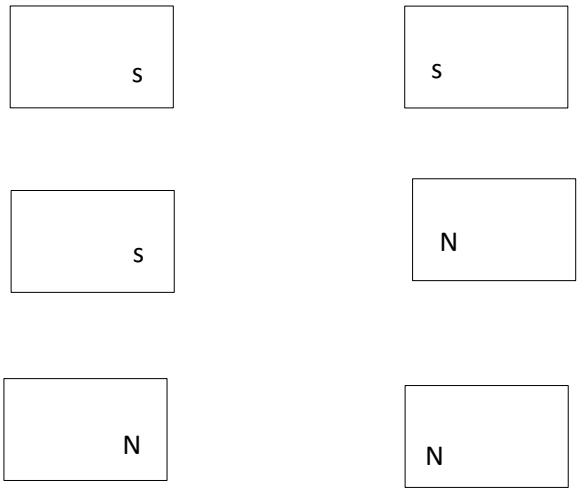
(ii) The maximum torque on the coil if it were placed between the poles of a magnet where the magnetic field strength was 0.4t. [2 marks]

(d) (i) Calculate the resistance per unit length of a 22-gauge nichrome wire of radius 0.28 mm. Resistivity of the wire is $1.5\ x\ 10^{-6}\Omega$.m [3 marks]

(ii) If a potential of 18.0 V is maintained across a 1.0m length of nichrome wire. What is the current in the wire? [2 marks]

(e) (i) State the basic law of magnetism [2 marks]

(ii) Draw magnetic field lines of the following: [3 marks]



(f) State:

(i) Ohms law [2 marks]

(ii) THREE properties of a conductor in electrostatic equilibrium. [3 marks]

QUESTION TWO (20 MARKS) – ELECTIVE

(a) Find the currents I_1 I_2 and I_3 in the circuit drawn below [6 marks]

(b) An electric heater is operated by applying a potential difference of 240 V to a nichrome wire of total resistance. 6Ω. Find the current carried by the wire and the power rating of the heater. [4 marks]

(c) What is the current through the battery and power provided in the circuit drawn below? (Neglect the internal resistance of the battery). [5 marks]

(d) (i) What are the magnitudes and the direction of the magnetic field a current produces a 4.0 cm directly below a straight wire if the current passing the wire is 12.0 A. [3 marks]

(ii) Find the amount of energy stored in a 7μF capacitor when it is connected across an 80-V battery. [2 marks]

QUESTION THREE (20 MARKS) – ELECTIVE

(a) A 9μC point charge is at the origin, and appoint charge of -5 μC is on the x axis at (6, 0) m as the figure below. If the electric potential is taken to be zero at infinity, find the total electric potential due to these charges at point p, with coordinates (0, 8) m. [3 marks]

(b) (i) Find the amount of energy stored in a 7μF capacitor when it is connected across an 80-V battery. [3 marks]

(ii) Find the electric force on a proton placed in an electric field of $8\ x\ 10^4\ N/C$ that is directed along the positive x axis. [3 marks]

(c) What are the magnitudes and the direction of the magnetic field a current produces 4.0 cm directly below a straight wire if the current passing the wire is 15.0A. [4 marks]

(d) (i) Determine the capacitance of a single capacitor that is equivalent to the parallel combination of capacitors shown below. [3 marks]

(ii) Find charge on the 16μF and 4μF capacitors. [4 marks]

QUESTION FOUR (20 MARKS) – ELECTIVE

(a) Define the following terms: [4 marks]

(i) Ferromagnetic

(ii) Geomagnetism

(iii) Para magnetism

(iv) Superconductors

(b) The magnetic field across the area of the coil is initially 0.06T. The coil radius is 4mm and there are 400 loops in the coil. Determine the magnitude of the average induced emf in the coil if the bar magnet is removed after 2.5 seconds. (Assume magnetic field is constant over the coil area. [3 marks]

(c) Consider three point charges at the corners of triangle
$q_1 = 8 \times 10^{-9}, q_3 = 5 \times 10^{-9}, q_2 = -3 \times 10^{-9}$ [4 marks]

(d) (i) Differentiate between self and mutual induction [2 marks]

(ii) A 24 volt battery is connected between two parallel plates separated by 6 mm. Find the strength of the electric field. [3 marks]

(e) FOUR capacitors are connected in series with a battery as shown below. Find

(i) The capacitance of the equivalent capacitor. [2 marks]

(ii) The charge on the 12μF capacitor. [2 marks]

QUESTION FIVE (5 MARKS) – ELECTIVE

(a) State:

(i) Lenz's law [2 marks]

(ii) Faraday's law of induction [2 marks]

(iii) Back emf [1 mark]

(b) An ideal 1200W transformer has 100 turns on its primary coil and 200 turns on its secondary coil:

(i) If the primary coil is connected to a 120.0V source. What is the output is voltage of the secondary coil? [2 marks]

(ii) If the transformer is operated in reverse and the 120.0V input is applied to the 200 turn coil. What is the output current? [3 marks]

(c) Find the equivalent capacitance between a and b for the combinations of capacitors shown below. All values are in μF. [5 marks]

(d) Three resistors are connected in parallel as shown below. A potential difference of 12.0 V is maintained between points a and b. Find:

(i) The current in across the 4Ω resistor. [1 mark]

(ii) The power dissipated by the 6.0Ω resistor [2 marks]

(e) Define the following terms [2 marks]

(i) Electron volt

(ii) Equipotential surface
