MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS

2018/2019 ACADEMIC YEAR

FOURTH YEAR FIRST SEMESTER EXAMINATION

SCHOOL OF SCIENCE AND INFORMATION SCIENCES

UNIVERSITY EXAMINATIONS FOR THE DEGREE OF BACHELOR OF SCIENCE (COMPUTER SCIENCE)

COURSE CODE: PHY 210
COURSE TITLE: ELECTRICITY AND MAGNETISM

DATE: 11TH DECEMBER, 2018 **TIME: 1100 - 1300HRS**

INSTRUCTIONS

- Answer Question ONE and any other TWO

- *You may need the following constants where necessary:*
- $\pi = 3.14$ *;* , 8.8541878176 10^{-12} F/m $\varepsilon_0 = \times$, g *=9.81 ms-2,*
- $\mu_0 = 4\pi \times 10^{-7}$ $N^{-1}A^{-2}$.

QUESTION ONE (30 MARKS) COMPULSORY

a. State Coulomb's law and express it mathematically **(2marks)**

b. When defining the electric field,why is it necessary to specify that the magnitude of the test charge be very small **(2marks)**

c.i). Briefly explain Xerography **(2mark)**

ii). State Biot-Savart's law. **(1mark)**

d. i). State Ampere's law for a magnetic field. (**1mark)**

ii). What is the electric flux through a sphere of radius 1.0 m containing a charge of +1 μC at its centre **(2marks)**

e. What is the force between two current carrying conductors . **(1mark)**

f. Give the relation between magnetic flux density and magnetic field intensity. **(2mark)**

g.State the Gauss's law for magnetic fields. **(1mark)**

h. Explain what happens to the torque on a current carrying loop. **(2marks)**

i. Define magnetic moment. **(1mark**

j. What are the basic properties of conductors. **(2marks)**

k. Give the Maxwell's equation in both integral form and point form**. (3marks)**

l. i) What is an electromagnetic induction **(2 marks)**

ii) Explain the negative sign in the Faraday's law of electromagnetic induction. **(2 marks)**

m) Define the following terms:

i) Solenoid **(2marks)**

ii) Toroid **(2 marks)**

SECTION B: Answer ONLY TWO questions from this section. Each question carries 20 marks.

QUESTION TWO (20 MARKS)

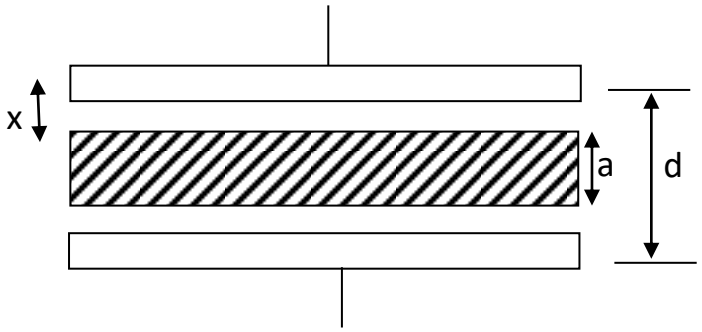
a) i) Define *electric charge* and give its units. **(3 marks)**

ii) What is the source of *electromotive force* **(2 marks)**

b) When does the surface of a conductor remain an *equipotential* surface? **(1 mark)**

c. Figure 4 shows a parallel plate capacitor with *a* conductor of thickness a inserted in between. Show for this arrangement, the capacitance can be expressed as

$C = \frac{4\prod \varepsilon_0 A}{d-a}$, where *A* is the area of the capacitor plates. **(5marks)**



d). A parallel plate capacitor has plates with dimensions 3 cm by 4 cm, separated by 2 mm. The plates are connected across a 60 V battery. Find **(4 marks)**

(i) the capacitance;

(ii) the magnitude of charge on each plate;

(iii) the energy stored in the capacitor

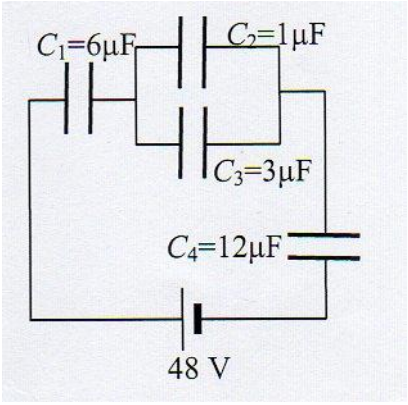
b). For the circuit shown below, find:

(i) the effective total capacitance;

(2marks)

(ii) the charge and potential difference for each individual capacitor.

(3marks)



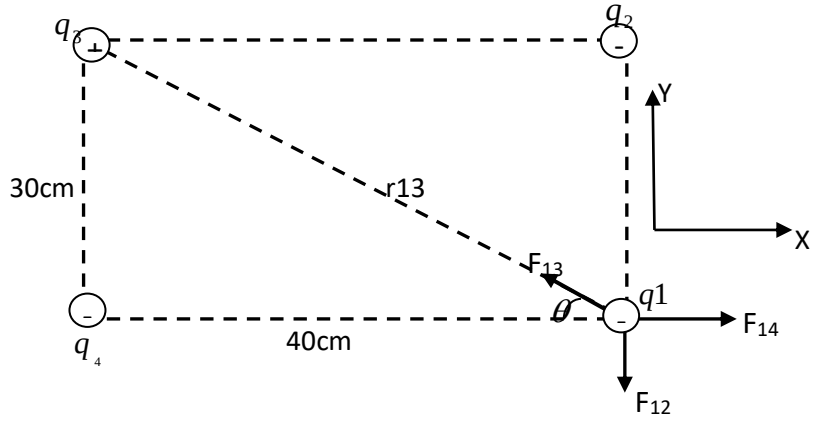
QUESTION THREE (20 MARKS)

a. i) (i) State and explain two factors that affect the magnitude of torque experienced by a current carrying wire in a magnetic field. **(2marks)**

(ii) State Gauss's Law in words and give its mathematical expressions **(2marks)**

i*ii.* Compare the properties of gravitational forces with those of electrostatic forces. **(6 marks)**

b. . Four point charges are arranged at the corners of a rectangle as shown below. *If* $q_1 = -3\,\mu C$, $q_2 = -5\,\mu C$, $q_3 = 13\,\mu C$ and $q_4 = 15\,\mu C$, find the net force on q_1 due to the other three charges. **(5 marks)**



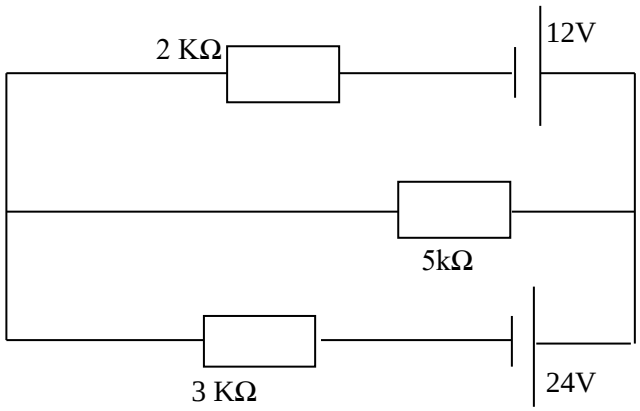
c.i Define point charge **(1mark)**

ii.Define electric field intensity and state any two of its properties **(3marks)**

d.Show that the electric field line is given by $E = \frac{q}{4\pi\varepsilon_0 r^2}$ **(3marks)**

QUESTION FOUR (20 MARKS)

(a) Derive a general expression for the total resistance of a circuit for n resistors connected in parallel, hence determine the total power dissipated by a network of three parallel resistors of 4Ω, 6Ω and 10Ω connected to a 12V power supply. **(6marks).**



(b) (i) State Kirchoff's circuit laws **(2marks)**

(i) (ii)Find currents in all the resistors in figure above. **(6marks)**

c. Copper has a resistivity of 1.7×10^{-8} Ωm. A wire of diameter 1.5 mm and length 25 m is connected across a potential difference of 50 V. Calculate:

(a) the resistance of the wire,

(b) the current,

(c) the power dissipated in the wire. **(6 marks)**

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