KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

MAIN CAMPUS

FIRST SEMESTER, 2017/2018 ACADEMIC YEAR

EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER SCIENCE AND BACHELOR OF EDUCATION SCIENCE

PHYS 110: ELECTRICITY & MAGNETISM I

STREAM: Y1S2 **TIME: 9.00-11.00 PM**

EXAMINATION SESSION: DECEMBER **DATE: 8/12/2017**

Instructions:

1. *Answer **Question One** and any other **Two***
2. *Electric charge $e = 1.6 \times 10^{-19}C$, $\varepsilon_o = 8.85 \times 10^{-12}F/m$, $\mu_o = 4\pi \times 10^{-7}Tm/A$, $h = 6.63 \times 10^{-34}J.s$, $1eV = 1.6 \times 10^{-19}J$, $M_e = 9.11 \times 10^{-31}kg$,*

QUESTION 1 (30 MARKS)

a.) Give the difference between magnetic permeability and magnetic flux. (2 marks)

b.) Using a diagram of a capacitor with a dielectric, show that the presence of a dielectric increases amount of charge stored by a capacitor. (3 marks)

c.) A charged electron moves through a distance of 0.03 m when a force of 3.8×10^{-11}N is exerted on it. Find

I.) The electric field created by this charge. (1 mark)

II.) The work done on the charge by the field. (1 mark)

III.) The potential difference between the initial and final points. (2 marks)

d.) A car battery is rated as 12 V and 70 Amperes hours. Explain what this rating implies. (2 marks)

e.) Show that the potential of a charge can be expressed as

$$U = \frac{kq_1q_2}{r}$$

(3 marks)

f.)

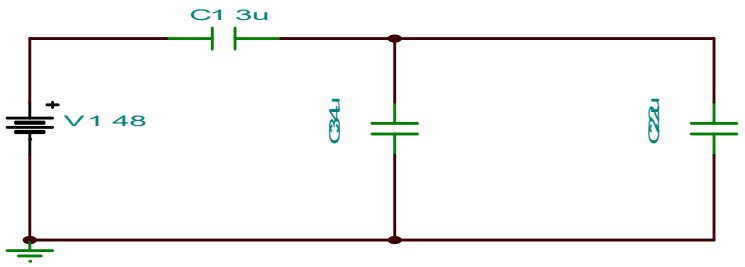

Fig 1

The network in Fig 1 has capacitors C1 = 3μF, C2 = 2 μF and C3 = 4 μF. If the potential across the terminals is V1 = 48 V, calculate the voltage across and the charge on each capacitor for this network. (4 marks)

g.) Give two properties of magnetism. (2 marks)

h.) An electron moves into a region of uniform magnetic field **B** of magnitude 4.55 X 10^{-4}T. The angle between the directions of **B** and the electron's velocity **V** is 65.5^0. If this electron creates a force of 1.32 X 10^{-20}N; determine

i) The velocity of motion of this charge. (3 marks)

ii) The radius it can execute in the field if the path is circular. (3 marks)

i.) Give the difference between paramagnetism and ferromagnetism. (2 marks)

j.) Give two applications of electromagnetism in day today life. (2 marks)

Question Two (20 marks)

a.) Define electric current density. Give its SI unit (2 marks)

b.) i.) State Ohm's law (2 marks)

ii.) Sketch the characteristic curves of ohmic and non-ohmic material (e.g. a diode) (4 marks)

c.) For the circuit of Fig 2, determine current through each resistor (7 marks)

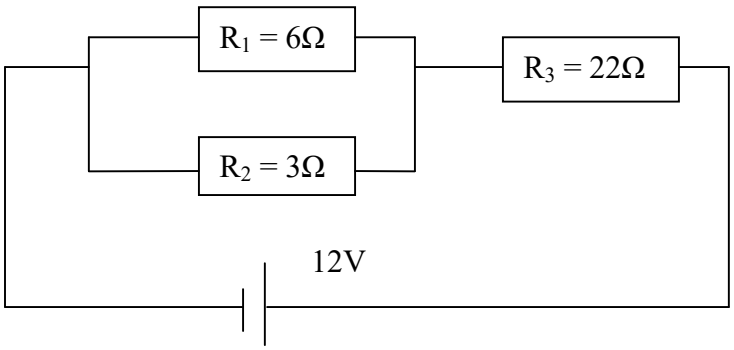

Fig 2

d.) Show quantitatively that electric flux through a surface enclosing a charge is independent of the size of surface (or distance from the charge). (5 marks)

Question Three (20 marks)

a.) State the principle of superposition of forces (1 mark)

b.) i.) State Faraday's law of electromagnetic induction (1 mark)

ii.) Show that the torque τ exerted on a rectangular coil of *N* turns carrying a current I oriented at an angle of φ in a magnetic field B can be expressed as $\tau = BIAN\sin\varphi$, where A is the cross sectional area of the coil. Hence calculate the maximum torque for a coil N = 100 turns, A = 50mm^2, $I = 2A$ subjected to a B field of 10 Tesla (7 marks)

c.) i.) State factors that influence the capacitance of a parallel plate capacitor (3 marks)

ii.) Suppose the plates of a parallel plate capacitor of dimensions 2.0cm by 3cm are separated by 1.0mm, determine its capacitance. (3 marks)

d.) Three charges $q_1 = q_2 = 3\ \mu$C and q_3 = -2μC are placed as shown in Fig 3 below. The distance between the charges q_1 and q_2 and q_1 and q_3 is 0.015m. Calculate force on q_1.

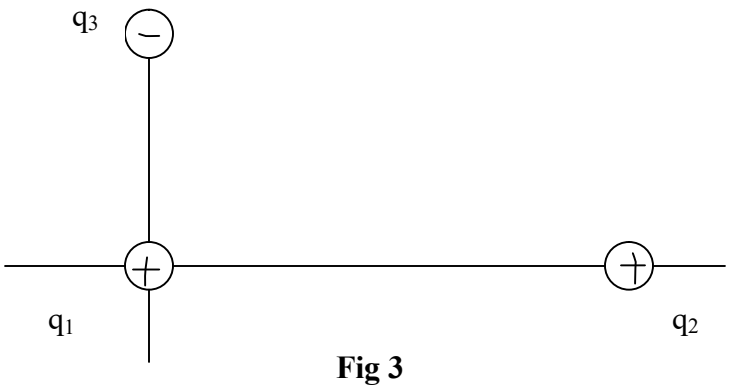

Fig 3

(5 marks)

Question Four (20 marks)

a.) State three transformer losses (3 marks)

b.) Fig 4 shows three capacitors connected to potential difference V.

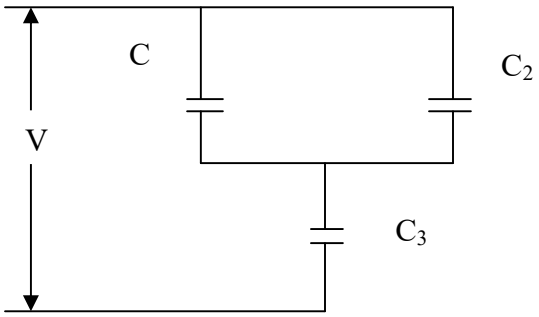

Fig 4

i) Find the equivalent capacitance for the combination of the capacitances shown if $C_1 = 12.00\mu F$, $C_2 = 5.30\mu F$ and $C_3 = 4.5\mu F$ (3 marks)

ii) The potential difference applied at V is 12.5V calculate the charge on C_1. (2 marks)

iii) Find the potential difference across C_1. (2 marks)

c.) Fig 5 below shows a full Gaussian surface enclosing two of the four positively charged particles $q_1 = q_4 = +3.1nC$, $q_2 = -5.9nC$, $q_3 = -3.1nC$.

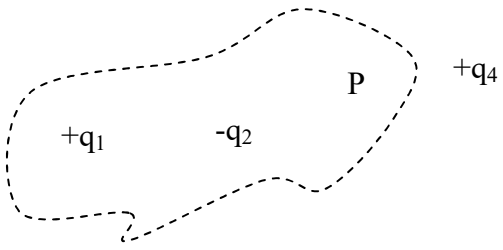

Fig 5

Find the particles that contribute to the electric field at point P and hence calculate the net electric flux through the surface? (4 marks)

d.) A flat sheet of paper of area $0.500m^2$ is oriented so that the normal to the sheet is at an angle of 70^0 to a uniform electric field of magnitude 12.0 N/C. Find;

I. The magnitude of the electric flux through the sheet. (3 marks)

II. The angle at which the magnitude of the flux is smallest. (3 marks)

Question 5 (20 marks)

a.) Why is necessary to step up voltage in long distance power transmission. (2 marks)

b.) An electron is in a field of 0.03 Weber/m^2 and experience a force that causes it to move in a circular path. If its velocity on this path was 2.54 x 10^8m/s, determine the radius of its path. (3 marks)

c.) Fig 6 below shows a circuit whose elements have the following values;

$E_1 = 3.0V$, $E_2 = 6.0V$, $R_1 = 2.0\Omega$ and $R_2 = 4.0\Omega$.

The three batteries are ideal. Find the magnitude and direction of the current in each of the three batteries.

(6 marks)

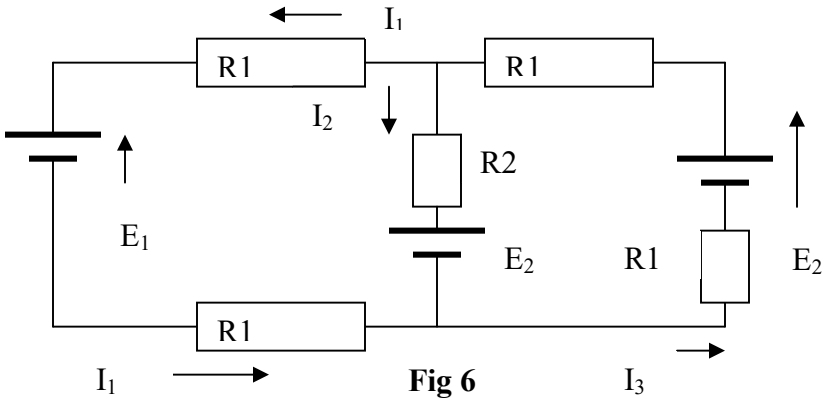

Fig 6

d.) Give two factors that affect the magnitude of induced emf in a loop (2 marks)

e.) Fig 7 below shows cross-section of a long conducting cylinder with inner radius a = 1 cm and outer radius b = 3 cm. The cylinder carries a current out of the page and the current density in the cross-section is given as $J = pr^2$ where p = 3.0 X 10^6 A/m^4 and r is in meters. Show that the current enclosed;

$$i_{encl.} = \frac{\pi p}{2}\left(r^4 - a^4\right)$$ (3 marks)

f.) Hence find the magnetic field B at a point that is 3cm from the central axis of the cylinder?
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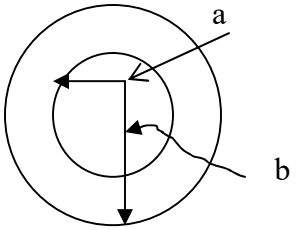

Fig 7

KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

MAIN CAMPUS

FIRST SEMESTER, 2017/2018 ACADEMIC YEAR

EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER SCIENCE AND BACHELOR OF EDUCATION SCIENCE

PHYS 110: ELECTRICITY & MAGNETISM I

STREAM: Y1S2 **TIME: 9.00-11.00 PM**

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Instructions:

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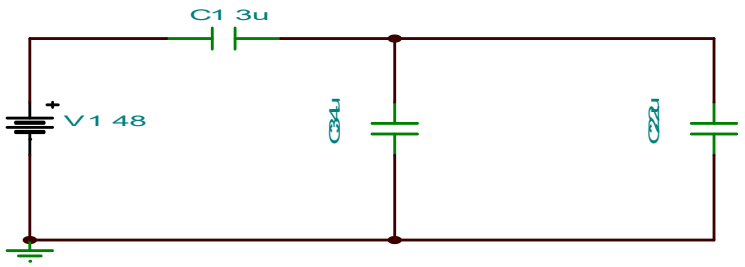

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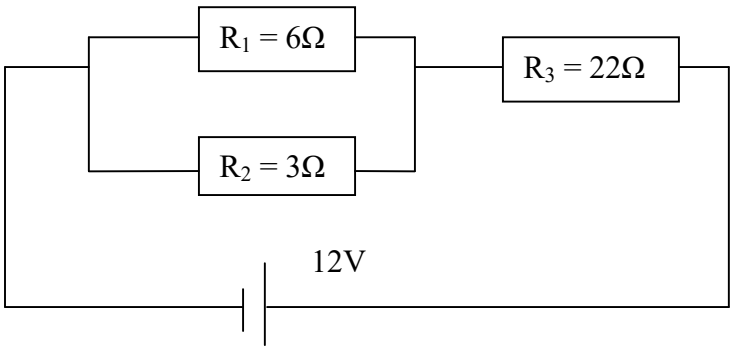

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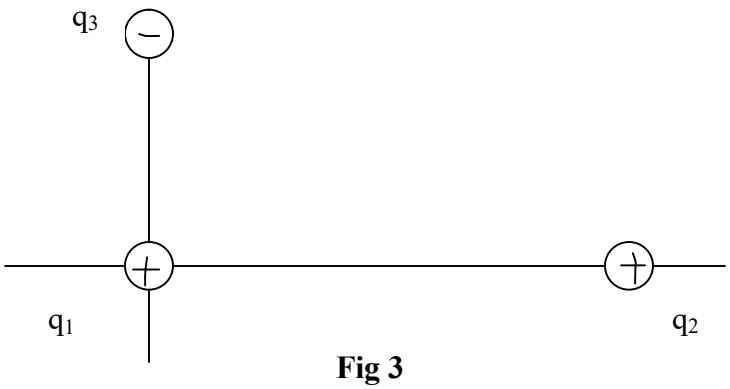

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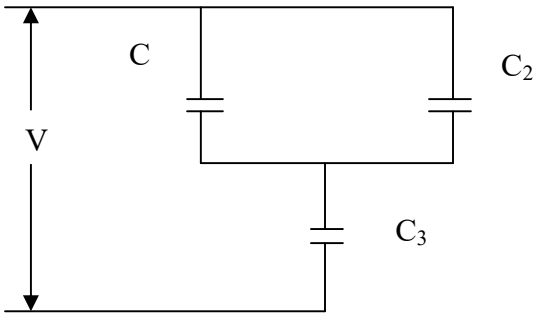

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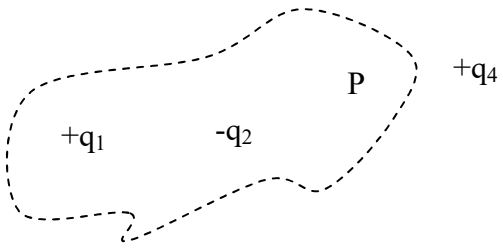

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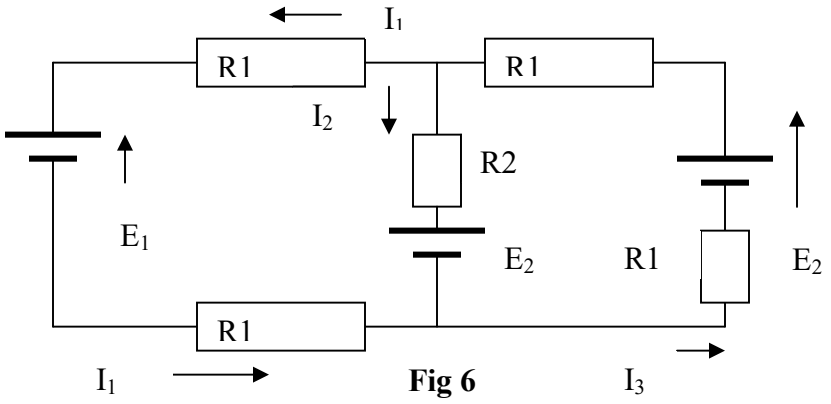

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$$i_{encl.} = \frac{\pi p}{2}\left(r^4 - a^4\right)$$ (3 marks)

f.) Hence find the magnetic field B at a point that is 3cm from the central axis of the cylinder?
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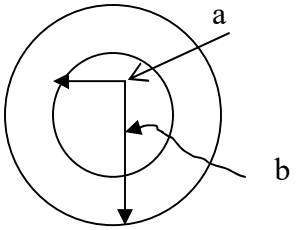


Fig 7

KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

MAIN CAMPUS

FIRST SEMESTER, 2018 ACADEMIC YEAR

EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER SCIENCE AND BACHELOR OF EDUCATION SCIENCE

PHYS 110: ELECTRICITY AND MAGNETISM I

STREAM: Y1S1 **TIME:**

EXAMINATION SESSION: APRIL 2018 **DATE:**

INSTRUCTIONS:

- *Answer Question **ONE** and any other **TWO** Questions. Question One carries 30marks while each of the other Two Questions carry 20marks.*

Useful constants

Permeability of free space $\mu_0 = 4\pi \times 10^{-7}\ {}^{C^2}\!/_{NM^2}$

Permittivity of free space $\varepsilon_0 = 8.85 \times 10^{-12}\ {}^{C^2}\!/_{NM^2}$

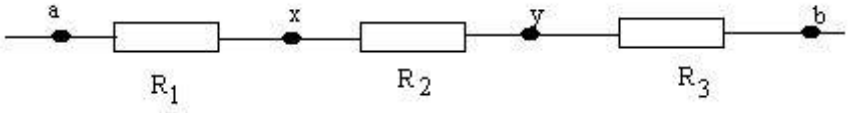
Acceleration due to gravity $g = 9.9mc^{-2}$

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

QUESTION ONE (30MKS)

a) State the Ohms law (1mk)

b) Show that for resistors in series as shown below its equivalent resistance is $R = R_1 + R_2 + R_3$ (4mks)



c) The power of a locomotive machine is 50 watts. Find the energy that is lost if it locomotes for 5 minutes (3mks)

d) State three effects of dielectrics on capacitors. (3mks)

e) State and explain two factors that affect the magnitude of force experienced by a current carrying wire in a magnetic field. (4mks)

f) A solenoid containing 10,000 turns has a length of 25cm and cross sectional area of $1cm^2$. If the current through it is decreasing at the rate of $10A/s$, calculate the e.m.f induced in the coil. (4mks)

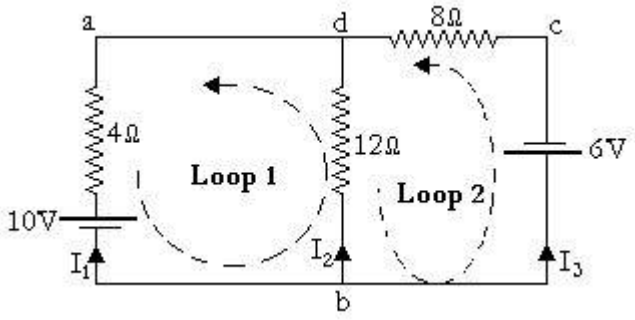
g) A galvanometer has full scale deflection current of 2.5mA and a coil resistance of 50Ω.

i). How should this device be adopted so as to measure a voltage of 5V? (1mk)

ii). Calculate the value of the resistor required to measure the required 5V (2mks)

h) State the Kirchoff's Laws (2mks)

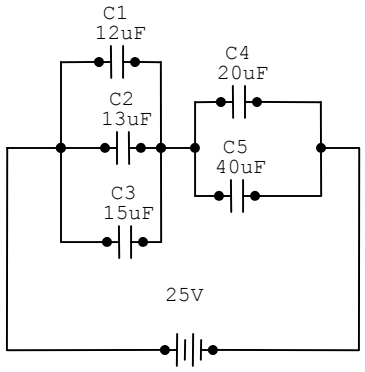
i) Consider the following circuit. Calculate the current I_1, I_2 and I_3 in the above circuit. (6mks)



QUESTION TWO (20MKS)

a) i) Define capacitance. (1mk)

ii) In the circuit below;



Calculate:

I.) Total capacitance (3mks)
II.) Total charge (3mks)
III.) Charge on capacitor C_3 (3mks)
IV.) Voltage across the two capacitors in parallel (2mks)

b) Consider a cell of *emf* (E) and internal resistance (r) connected in series to a resistor of resistance 5Ω.

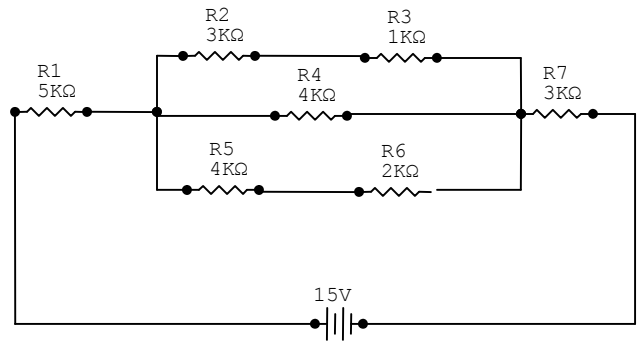
i) The energy supplied to one electron in transferring it around the circuit is $5.1\times10^{-19}J$ .Find the *emf* of the cell. (4mks)

ii) Each electron in the circuit transfers energy of $4.0\times10^{-19}J$ to the5Ω resistor. Determine the value of the internal resistance of the cell. (4mks)

QUESTION THREE (20 marks)

a) i) What is an EMF of a cell (1mks)

ii) Consider the given resistor network circuit.

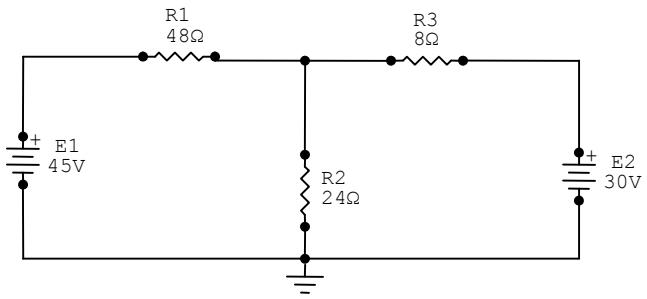


Calculate;

I.) Total resistance (3mks)
II.) the total current in the circuit (3mks)

b) When a battery of e.m.f. 12V is connected to a load resistor of resistance 15Ω, the terminal voltage measured is 10V. Find the internal resistance of the battery. (3mks

c) Consider the given resistor circuit network



Calculate;

I. Total resistance (2mks)
II. Current through the 24Ω resistor (4mks)

d) A galvanometer has full scale deflection current of 2mA and a coil resistance of 50Ω.

i) How should this device be adopted so as to measure a current of 2A? (1mk)

ii) Calculate the value of the resistor required to measure the required 2A (3mks)

QUESTION FOUR (20 marks)

a) i) Define inductance. (1mk)

ii) An RL circuit of R=4KΩ and L=2.5mH is connected to a d.c. source of 15V. Calculate its time constant. (2mks)

b) i) State Lenz's law of electromagnetic induction and give its mathematical expression.

(2mks)

ii) An a.c generator consists of 50 turns of wire each of area $0.8cm^2$ and a total resistance of the wire is 12Ω. The loop rotates in a uniform magnetic field of 2.5T at a constant frequency of 50Hz. Find;

I. maximum induced emf (3mks)
II. maximum induced current (2mks)

c) Consider a series RL circuit connected to a d.c. source. Derive the expression of finding current (I) at any time (t) during current growth in the circuit. (4mks)

d) An RL circuit with an inductor of inductance 16H and resistor of 10Ω is connected to the terminals of a battery of e.m.f. 12V and negligible internal resistance. Find

i). The rate of increase of current at the instant when the current is 0.25A (2mks)
ii). The current 0.25s after the circuit is closed (2mks)
iii). The final steady state current (2mks)

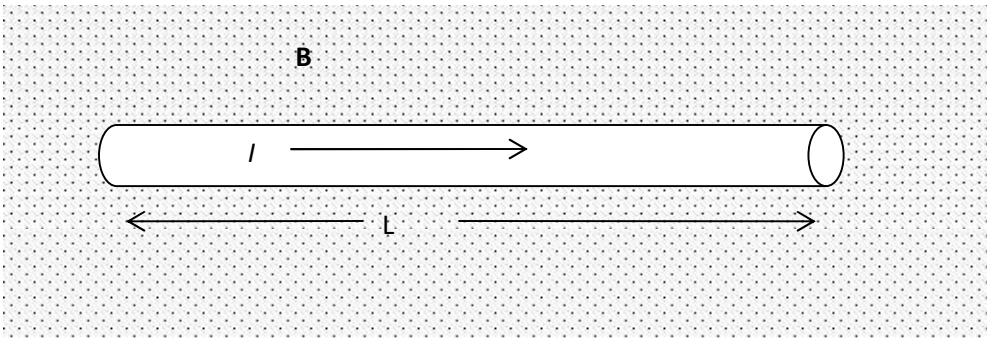
QUESTION FIVE (20 marks)

a) i) What is magnetic flux? (1mk)

ii) State two characteristics of magnetic flux (2mks)

b) i) State and explain two factors that affect the magnitude of force experienced by a charged particle in a magnetic field. (2mks)

ii) The diagram below shows a wire segment placed in a uniform magnetic field $(\vec{B})$ that point out of the plane of the diagram.



If the wire carries a current (I), from left to right as shown, derive the expression of the resultant magnetic force $(\overrightarrow{F_B})$ experienced by the wire. (5mks)

iii) Consider a straight horizontal segment of copper wire whose linear mass density is $50g/m$ carrying current $I = 25mA$. Find the magnitude and direction of magnetic field needed to balance its weight (4mks)

c) Consider a proton of charge $1.6\times10^{-19}C$ being moved at a velocity of $3.2\times10^{7}m/s$ in a uniform magnetic field of $1.5\times10^{-3}T$ at an angle of 50°.

i). Find the magnitude of magnetic force experienced by the proton (3mks)

ii). What will be the acceleration of the proton given that its mass is $1.67\times10^{-27}Kg$ (3mks)

KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

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SECOND SEMESTER 2018/2019 ACADEMIC YEAR

EXAMINATION FOR THE DEGREE OF BACHELOR OF EDUCATION ARTS

PHYS 110 ELECTRICITY AND MAGNETISM

STREAM: Y2 S1 PART TIME **TIME: 1:00-3:00PM**

EXAMINATION SESSION: APRIL **DATE: 9/04/2019**

VENUE: SKILLS LAB **COPIES: 15**

INSTRUCTIONS:

- *Answer Question **ONE** and any other **TWO** Questions. Question One carries **30marks** while each of the other Two Questions carry 2**0marks**.*
- ***EXTRA** Questions Answered **WILL NOT** be marked*
- ***The following constants may be useful***
  - Permeability of free space $\mu_0 = 4\pi \times 10^{-7} Wb/A$
  - Permittivity of free space $\varepsilon_0 = 8.85 \times 10^{-12} C^2/NM^2$
  - Resistivity of Iron $\rho = 9.68 \times 10^{-8} \Omega m$
  - Acceleration due to gravity $g = 9.8 m/s^2$
  - Charge of electron $e = 1.6 \times 10^{-19} C$

QUESTION ONE

a) State ohm's law in words and give its mathematica1 expression. (2mks)
b) State Kirchoff's voltage and current laws (2mks)
c) A toroid core has N = 1200 turns, length L = 80cm, cross-sectional area A = 60cm^2, current I = 1.5A. Compute B and H. Assume an empty core. (5mks)

d) Show that for two resistors arranged in parallel the effective resistance (R) is given by (5mks)

$$R = \frac{R_1 R_2}{R_1 + R_2}$$

e) A charge of 240C is moved when energy of 45J is applied between two points. Find the voltage between the two points. (4mks)

f) An RL circuit with an inductor of inductance 16H and resistor of 10Ω is connected to the terminals of a battery of e.m.f. 12V and negligible internal resistance. Find

i. The initial rate of increase of current in the circuit (3mks)
ii. The current 0.75s after the circuit was switched on (4mks)

g) State two similarities and two differences between electric force and magnetic force. (4mks)
h) State two characteristics of magnetic flux (2mks)

QUESTION TWO

(a) i) What is meant by magnetic hysteresis? (2mks)
ii) Sketch a typical hysteresis curve and explain. (12mks)
(b) What are the desirable magnetic properties for the material of (6mks)

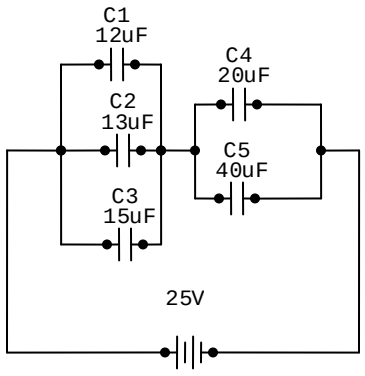
(i) the core of an electromagnet

(ii) a permanent magnet?

QUESTION THREE

a) i) Define capacitance. (2mks)

ii) In the circuit below;



Calculate:

i. Total capacitance (5mks)
ii. Total charge (3mks)
iii. Charge on capacitor C_3 (7mks)
iv. Voltage across the two capacitors in parallel (3mks)

QUESTION FOUR

a) What is magnetic flux? (1mk)

b) i)Consider a segment of conductor of length (L), cross sectional area (A), carrying current (I) placed in a uniform magnetic field (**B**), derive the expression of magnetic force F_B experienced by the wire segment. (8mks)

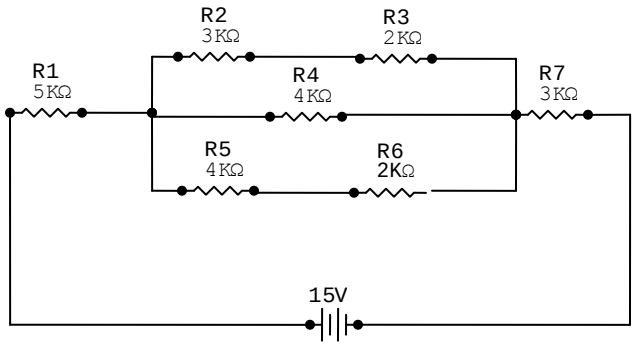
ii) A straight horizontal segment of copper wire carries a current $I = 25A$. What are the magnitude and direction of magnetic field needed to balance its weight? Given that it's linear mass density is $0.05kg/m$. (4mks)

c) Consider an electron of charge $1.6\times10^{-19}C$ being moved at a velocity of $2.5\times10^{7}m/s$ in a uniform magnetic field of $4.2\times10^{-3}T$ at an angle of 30°.

i). Find the magnitude of magnetic force experienced by the proton (4mks)
ii). What will be the acceleration of the electron given that its mass is $9.11\times10^{-31}Kg$ (3mks)

QUESTION FIVE

i) Consider the given resistor network circuit.

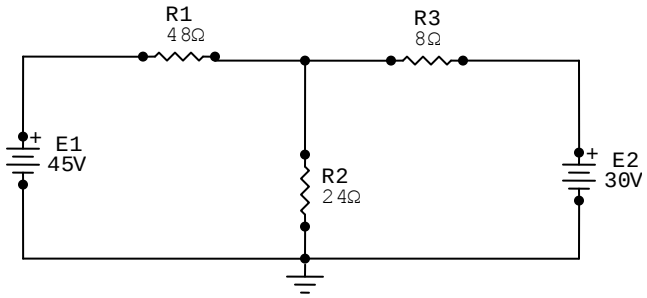


Calculate;

i. Total resistance (6mks)
ii. the total current in the circuit (3mks)

b) When a battery of e.m.f. 12V is connected to a load resistor of resistance 15Ω, the terminal voltage measured is 10V. Find the internal resistance of the battery. (6mks

c) Consider the given resistor circuit network



Calculate; Total resistance (5mks)

KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

MAIN CAMPUS

SECOND SEMESTER 2018/2019 ACADEMIC YEAR

EXAMINATION FOR THE DEGREE OF BACHELOR OF EDUCATION ARTS

PHYS 110 ELECTRICITY AND MAGNETISM

STREAM: Y2 S1 PART TIME **TIME: 1:00-3:00PM**

EXAMINATION SESSION: APRIL **DATE: 9/04/2019**

VENUE: SKILLS LAB **COPIES: 15**

INSTRUCTIONS:

- *Answer Question **ONE** and any other **TWO** Questions. Question One carries **30marks** while each of the other Two Questions carry 2**0marks**.*
- ***EXTRA** Questions Answered **WILL NOT** be marked*
- ***The following constants may be useful***
  - Permeability of free space $\mu_0 = 4\pi \times 10^{-7} Wb/A$
  - Permittivity of free space $\varepsilon_0 = 8.85 \times 10^{-12} C^2/NM^2$
  - Resistivity of Iron $\rho = 9.68 \times 10^{-8} \Omega m$
  - Acceleration due to gravity $g = 9.8 m/s^2$
  - Charge of electron $e = 1.6 \times 10^{-19} C$

QUESTION ONE

a) State ohm's law in words and give its mathematica1 expression. (2mks)
b) State Kirchoff's voltage and current laws (2mks)
c) A toroid core has N = 1200 turns, length L = 80cm, cross-sectional area A = 60cm^2, current I = 1.5A. Compute B and H. Assume an empty core. (5mks)

d) Show that for two resistors arranged in parallel the effective resistance (R) is given by (5mks)

$$R = \frac{R_1 R_2}{R_1 + R_2}$$

e) A charge of 240C is moved when energy of 45J is applied between two points. Find the voltage between the two points. (4mks)

f) An RL circuit with an inductor of inductance 16H and resistor of 10Ω is connected to the terminals of a battery of e.m.f. 12V and negligible internal resistance. Find

i. The initial rate of increase of current in the circuit (3mks)
ii. The current 0.75s after the circuit was switched on (4mks)

g) State two similarities and two differences between electric force and magnetic force. (4mks)
h) State two characteristics of magnetic flux (2mks)

QUESTION TWO

(a) i) What is meant by magnetic hysteresis? (2mks)
ii) Sketch a typical hysteresis curve and explain. (12mks)
(b) What are the desirable magnetic properties for the material of (6mks)

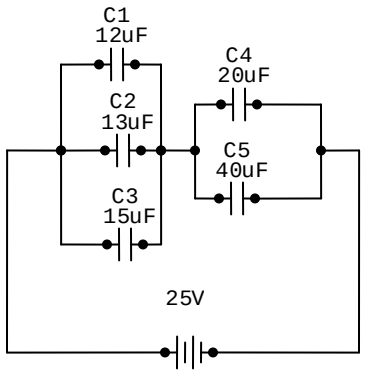
(i) the core of an electromagnet

(ii) a permanent magnet?

QUESTION THREE

a) i) Define capacitance. (2mks)

ii) In the circuit below;



Calculate:

i. Total capacitance (5mks)
ii. Total charge (3mks)
iii. Charge on capacitor C_3 (7mks)
iv. Voltage across the two capacitors in parallel (3mks)

QUESTION FOUR

a) What is magnetic flux? (1mk)

b) i)Consider a segment of conductor of length (L), cross sectional area (A), carrying current (I) placed in a uniform magnetic field (**B**), derive the expression of magnetic force F_B experienced by the wire segment. (8mks)

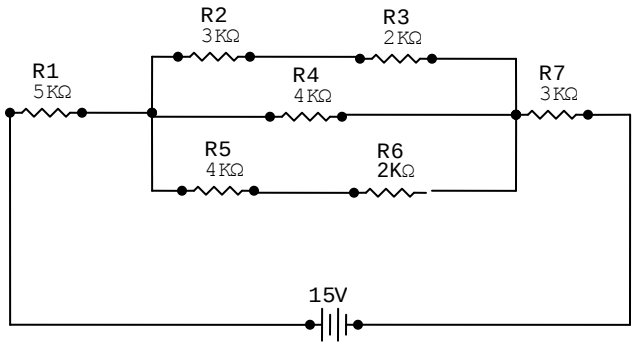
ii) A straight horizontal segment of copper wire carries a current $I = 25A$. What are the magnitude and direction of magnetic field needed to balance its weight? Given that it's linear mass density is $0.05kg/m$. (4mks)

c) Consider an electron of charge $1.6\times10^{-19}C$ being moved at a velocity of $2.5\times10^{7}m/s$ in a uniform magnetic field of $4.2\times10^{-3}T$ at an angle of 30°.

i). Find the magnitude of magnetic force experienced by the proton (4mks)
ii). What will be the acceleration of the electron given that its mass is $9.11\times10^{-31}Kg$ (3mks)

QUESTION FIVE

i) Consider the given resistor network circuit.

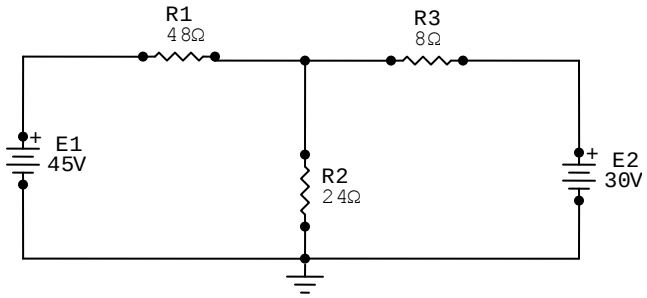


Calculate;

i. Total resistance (6mks)
ii. the total current in the circuit (3mks)

b) When a battery of e.m.f. 12V is connected to a load resistor of resistance 15Ω, the terminal voltage measured is 10V. Find the internal resistance of the battery. (6mks

c) Consider the given resistor circuit network



Calculate; Total resistance (5mks)

KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

MAIN CAMPUS

FIRST SEMESTER, 2018 ACADEMIC YEAR

EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER SCIENCE AND BACHELOR OF EDUCATION SCIENCE

PHYS 110: ELECTRICITY AND MAGNETISM I

STREAM: Y1S1 **TIME:**

EXAMINATION SESSION: APRIL 2018 **DATE:**

INSTRUCTIONS:

- *Answer Question **ONE** and any other **TWO** Questions. Question One carries 30marks while each of the other Two Questions carry 20marks.*

Useful constants

Permeability of free space $\mu_0 = 4\pi \times 10^{-7}\ {}^{C^2}\!/_{NM^2}$

Permittivity of free space $\varepsilon_0 = 8.85 \times 10^{-12}\ {}^{C^2}\!/_{NM^2}$

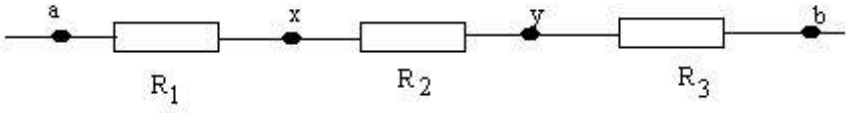
Acceleration due to gravity $g = 9.9mc^{-2}$

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

QUESTION ONE (30MKS)

a) State the Ohms law (1mk)

b) Show that for resistors in series as shown below its equivalent resistance is $R = R_1 + R_2 + R_3$ (4mks)



c) The power of a locomotive machine is 50 watts. Find the energy that is lost if it locomotes for 5 minutes (3mks)

d) State three effects of dielectrics on capacitors. (3mks)

e) State and explain two factors that affect the magnitude of force experienced by a current carrying wire in a magnetic field. (4mks)

f) A solenoid containing 10,000 turns has a length of 25cm and cross sectional area of $1cm^2$. If the current through it is decreasing at the rate of $10A/s$, calculate the e.m.f induced in the coil. (4mks)

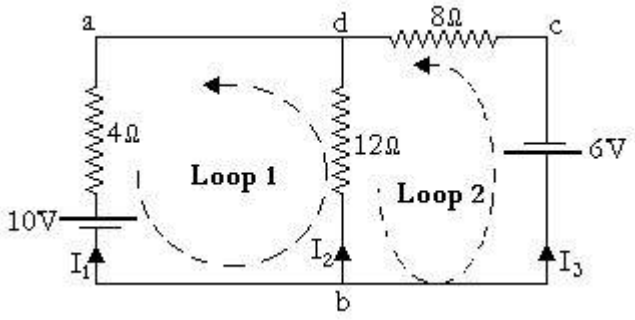
g) A galvanometer has full scale deflection current of 2.5mA and a coil resistance of 50Ω.

i). How should this device be adopted so as to measure a voltage of 5V? (1mk)

ii). Calculate the value of the resistor required to measure the required 5V (2mks)

h) State the Kirchoff's Laws (2mks)

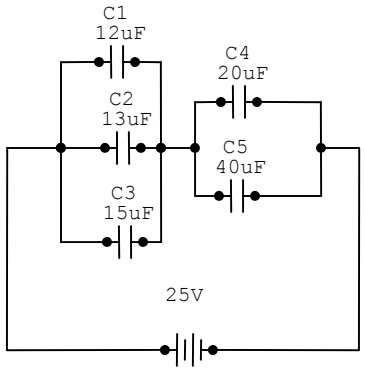
i) Consider the following circuit. Calculate the current I_1, I_2 and I_3 in the above circuit. (6mks)



QUESTION TWO (20MKS)

a) i) Define capacitance. (1mk)

ii) In the circuit below;



Calculate:

I.) Total capacitance (3mks)
II.) Total charge (3mks)
III.) Charge on capacitor C_3 (3mks)
IV.) Voltage across the two capacitors in parallel (2mks)

b) Consider a cell of *emf* (E) and internal resistance (r) connected in series to a resistor of resistance 5Ω.

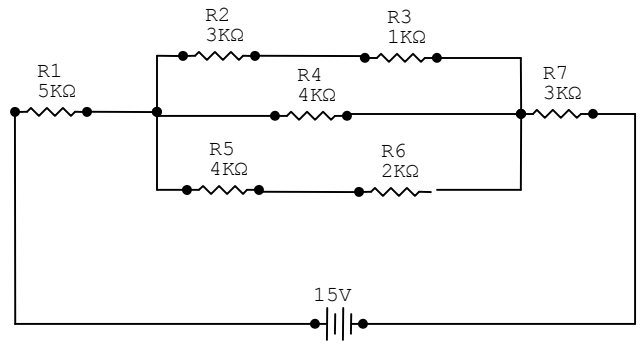
i) The energy supplied to one electron in transferring it around the circuit is $5.1\times10^{-19}J$ .Find the *emf* of the cell. (4mks)

ii) Each electron in the circuit transfers energy of $4.0\times10^{-19}J$ to the5Ω resistor. Determine the value of the internal resistance of the cell. (4mks)

QUESTION THREE (20 marks)

a) i) What is an EMF of a cell (1mks)

ii) Consider the given resistor network circuit.

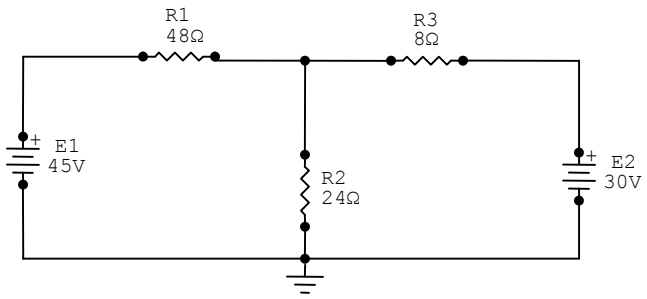


Calculate;

I.) Total resistance (3mks)
II.) the total current in the circuit (3mks)

b) When a battery of e.m.f. 12V is connected to a load resistor of resistance 15Ω, the terminal voltage measured is 10V. Find the internal resistance of the battery. (3mks

c) Consider the given resistor circuit network



Calculate;

I. Total resistance (2mks)
II. Current through the 24Ω resistor (4mks)

d) A galvanometer has full scale deflection current of 2mA and a coil resistance of 50Ω.

i) How should this device be adopted so as to measure a current of 2A? (1mk)

ii) Calculate the value of the resistor required to measure the required 2A (3mks)

QUESTION FOUR (20 marks)

a) i) Define inductance. (1mk)

ii) An RL circuit of R=4KΩ and L=2.5mH is connected to a d.c. source of 15V. Calculate its time constant. (2mks)

b) i) State Lenz's law of electromagnetic induction and give its mathematical expression.

(2mks)

ii) An a.c generator consists of 50 turns of wire each of area $0.8cm^2$ and a total resistance of the wire is 12Ω. The loop rotates in a uniform magnetic field of 2.5T at a constant frequency of 50Hz. Find;

I. maximum induced emf (3mks)
II. maximum induced current (2mks)

c) Consider a series RL circuit connected to a d.c. source. Derive the expression of finding current (I) at any time (t) during current growth in the circuit. (4mks)

d) An RL circuit with an inductor of inductance 16H and resistor of 10Ω is connected to the terminals of a battery of e.m.f. 12V and negligible internal resistance. Find

i). The rate of increase of current at the instant when the current is 0.25A (2mks)
ii). The current 0.25s after the circuit is closed (2mks)
iii). The final steady state current (2mks)

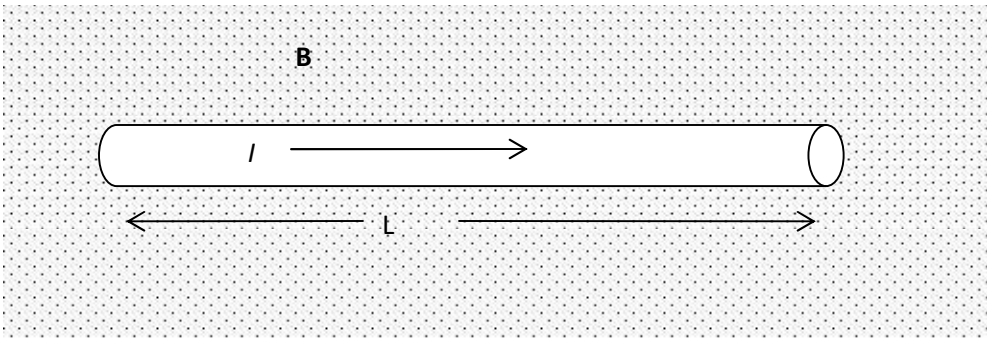
QUESTION FIVE (20 marks)

a) i) What is magnetic flux? (1mk)

ii) State two characteristics of magnetic flux (2mks)

b) i) State and explain two factors that affect the magnitude of force experienced by a charged particle in a magnetic field. (2mks)

ii) The diagram below shows a wire segment placed in a uniform magnetic field $(\vec{B})$ that point out of the plane of the diagram.



If the wire carries a current (I), from left to right as shown, derive the expression of the resultant magnetic force $(\overrightarrow{F_B})$ experienced by the wire. (5mks)

iii) Consider a straight horizontal segment of copper wire whose linear mass density is $50g/m$ carrying current $I = 25mA$. Find the magnitude and direction of magnetic field needed to balance its weight (4mks)

c) Consider a proton of charge $1.6\times10^{-19}C$ being moved at a velocity of $3.2\times10^{7}m/s$ in a uniform magnetic field of $1.5\times10^{-3}T$ at an angle of 50°.

i). Find the magnitude of magnetic force experienced by the proton (3mks)

ii). What will be the acceleration of the proton given that its mass is $1.67\times10^{-27}Kg$ (3mks)

KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

MAIN CAMPUS

SECOND SEMESTER 2018/2019 ACADEMIC YEAR

EXAMINATION FOR THE DEGREE OF BACHELOR OF EDUCATION ARTS

PHYS 110 ELECTRICITY AND MAGNETISM

STREAM: Y2 S1 PART TIME **TIME: 1:00-3:00PM**

EXAMINATION SESSION: APRIL **DATE: 9/04/2019**

VENUE: SKILLS LAB **COPIES: 15**

INSTRUCTIONS:

- *Answer Question **ONE** and any other **TWO** Questions. Question One carries **30marks** while each of the other Two Questions carry 2**0marks**.*
- ***EXTRA** Questions Answered **WILL NOT** be marked*
- ***The following constants may be useful***
  - Permeability of free space $\mu_0 = 4\pi \times 10^{-7} Wb/A$
  - Permittivity of free space $\varepsilon_0 = 8.85 \times 10^{-12} C^2/NM^2$
  - Resistivity of Iron $\rho = 9.68 \times 10^{-8} \Omega m$
  - Acceleration due to gravity $g = 9.8 m/s^2$
  - Charge of electron $e = 1.6 \times 10^{-19} C$

QUESTION ONE

a) State ohm's law in words and give its mathematica1 expression. (2mks)
b) State Kirchoff's voltage and current laws (2mks)
c) A toroid core has N = 1200 turns, length L = 80cm, cross-sectional area A = 60cm^2, current I = 1.5A. Compute B and H. Assume an empty core. (5mks)

d) Show that for two resistors arranged in parallel the effective resistance (R) is given by (5mks)

$$R = \frac{R_1 R_2}{R_1 + R_2}$$

e) A charge of 240C is moved when energy of 45J is applied between two points. Find the voltage between the two points. (4mks)

f) An RL circuit with an inductor of inductance 16H and resistor of 10Ω is connected to the terminals of a battery of e.m.f. 12V and negligible internal resistance. Find

i. The initial rate of increase of current in the circuit (3mks)
ii. The current 0.75s after the circuit was switched on (4mks)

g) State two similarities and two differences between electric force and magnetic force. (4mks)
h) State two characteristics of magnetic flux (2mks)

QUESTION TWO

(a) i) What is meant by magnetic hysteresis? (2mks)
ii) Sketch a typical hysteresis curve and explain. (12mks)
(b) What are the desirable magnetic properties for the material of (6mks)

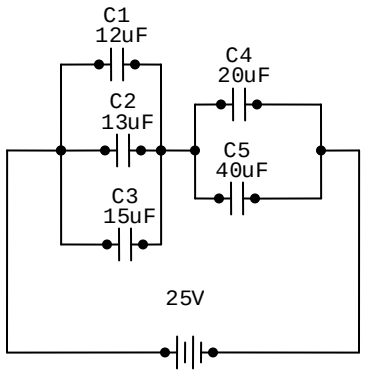
(i) the core of an electromagnet

(ii) a permanent magnet?

QUESTION THREE

a) i) Define capacitance. (2mks)

ii) In the circuit below;



Calculate:

i. Total capacitance (5mks)
ii. Total charge (3mks)
iii. Charge on capacitor C_3 (7mks)
iv. Voltage across the two capacitors in parallel (3mks)

QUESTION FOUR

a) What is magnetic flux? (1mk)

b) i)Consider a segment of conductor of length (L), cross sectional area (A), carrying current (I) placed in a uniform magnetic field (**B**), derive the expression of magnetic force F_B experienced by the wire segment. (8mks)

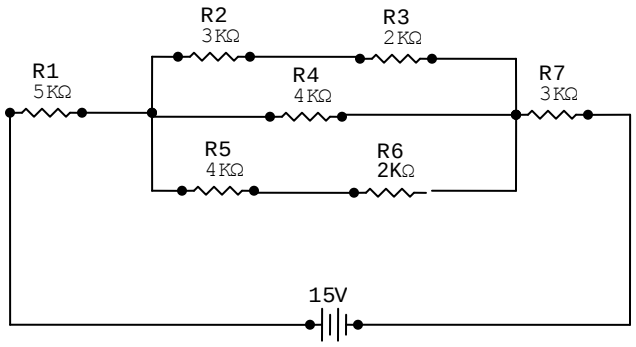
ii) A straight horizontal segment of copper wire carries a current $I = 25A$. What are the magnitude and direction of magnetic field needed to balance its weight? Given that it's linear mass density is $0.05kg/m$. (4mks)

c) Consider an electron of charge $1.6\times10^{-19}C$ being moved at a velocity of $2.5\times10^{7}m/s$ in a uniform magnetic field of $4.2\times10^{-3}T$ at an angle of 30°.

i). Find the magnitude of magnetic force experienced by the proton (4mks)
ii). What will be the acceleration of the electron given that its mass is $9.11\times10^{-31}Kg$ (3mks)

QUESTION FIVE

i) Consider the given resistor network circuit.

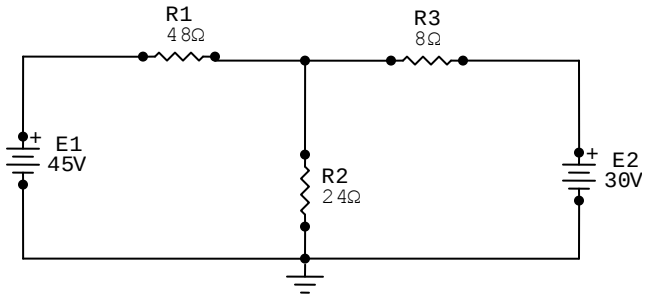


Calculate;

i. Total resistance (6mks)
ii. the total current in the circuit (3mks)

b) When a battery of e.m.f. 12V is connected to a load resistor of resistance 15Ω, the terminal voltage measured is 10V. Find the internal resistance of the battery. (6mks

c) Consider the given resistor circuit network



Calculate; Total resistance (5mks)

KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS
MAIN CAMPUS

SECOND SEMESTER, 2016/2017 ACADEMIC YEAR

EXAMINATION FOR BACHELOR OF SCIENCE IN COMPUTER SCIENCE AND BACHELOR OF EDUCATION SCIENCE

PHYS 110: ELECTRICITY AND MAGNETISM I

STREAM: DEGREE **TIME: 9.00-11.00 AM**

EXAMINATION SESSION: APRIL **DATE: 12/04/2017**

INSTRUCTIONS

- *Answer Question **ONE** and any other **TWO** Questions. Question One carries **30marks** while each of the other Two Questions carry 2**0marks**.*
- ***The following constants may be useful***
  - Permeability of free space $\mu_0 = 4\pi \times 10^{-7} Wb/A$
  - Permittivity of free space $\varepsilon_0 = 8.85 \times 10^{-12} C^2/NM^2$
  - Resistivity of Tungsten $\rho = 5.25 \times 10^{-8} \Omega m$
  - Acceleration due to gravity $g = 9.8 m/s^2$
  - **EXRTA QUESTIONS ANSWERED WILL NOT BE MARKED**

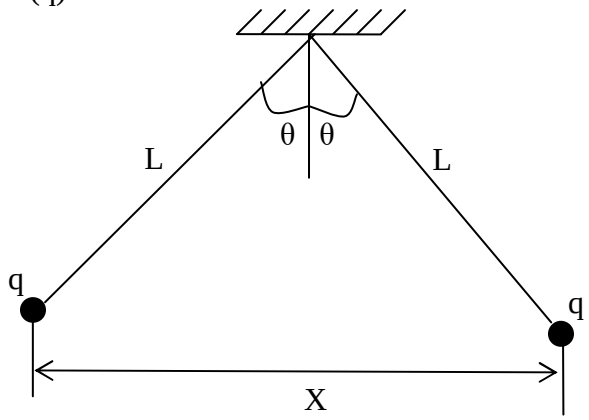
QUESTION 1 (30 marks)

a) i) Name two types of electric charges (1mk)

ii) Explain why conductors cannot be charged by friction. (1mk)

b) i) State Coulomb's law (1mk)

ii) Two similar tiny balls of mass (m) are hung from silk threads of length (L) and carry equal charges (q) as shown.



Assume that θ is so small that tanθ can be replaced by its approximate value equal to sinθ

I) To this approximation, show that for equilibrium

$$X = \left(\frac{q^2 L}{2\pi\varepsilon_0 mg} \right)^{\frac{1}{3}}$$ (5mks)

Where X is the distance between the two balls

II) If L= 15cm, m=5g and X=7.5cm, calculate the value of q (2mks)

c) A rectangular block of Tungsten has dimensions 15cm by 15cm by 80cm. Find the resistance of the block between the two square ends. (3mks)

d) State three effects of dielectrics on capacitors. (3mks)

e) A galvanometer has full scale deflection current of 2.5mA and a coil resistance of 50Ω.

i). How should this device be adopted so as to measure a voltage of 5V? (1mk)

ii). Calculate the value of the resistor required to measure the required 5V (3mks)

f) Define Lorentz force and give its mathematical expression? (2mks)

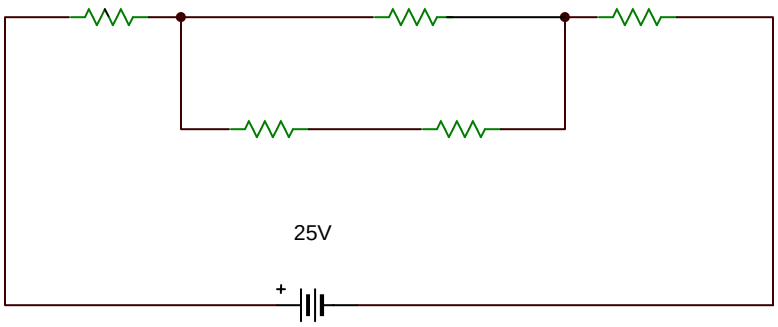
g) i) State and explain two factors that affect the magnitude of force experienced by a current carrying wire in a magnetic field. (3mks)

ii) Two charges of magnitude $-2.0\mu C$ and $-2.5\mu C$ are 15cm apart. Find a point (p) where the electric field strength is zero (5mks)

QUESTION 2 (20 marks)

a) i) State Ohm's law in words and give its mathematical expression. (2mks)

ii) Consider the given resistor network circuit.



Assuming that each resistor is 5KΩ, Calculate;

I.) Total resistance (3mks)

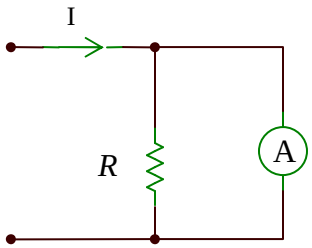
II.) the total current in the circuit (2mks)

b) Consider a series RC circuit connected to a d.c. source.

i) State the form in which the capacitor store energy. (1mk)

ii) Derive the expression of finding energy in the circuit. (4mks)

c) Consider the given circuit

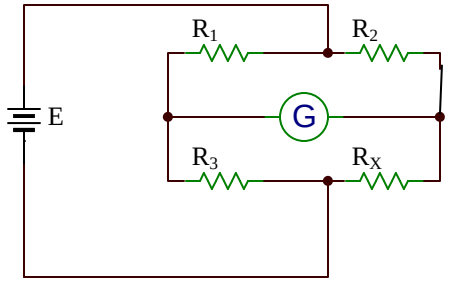


If the ammeter has coil resistance (R_m);

i). Derive the relation between the terminal current (I) and the meter current (I_m) (2mks)

ii). When resistor (R) is disconnected from the circuit, the meter has a full scale deflection current of $100\mu A$ and a resistance of 900Ω. When resistor (R) is connected into the circuit, the meter has a full scale deflection current of $1mA$. Determine the value of R. (4mks)

d) Consider the bridge circuit shown

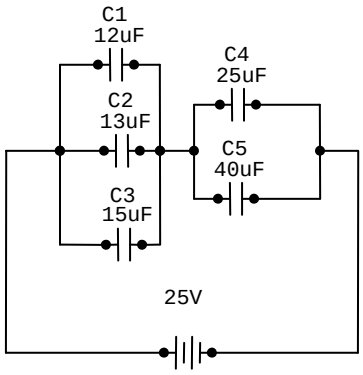


Show that at null condition, $R_X = \left(\frac{R_2}{R_1}\right)R_3$ (2mks)

QUESTION 3 (20 marks)

a) i) Define capacitance. (1mk)

ii) In the circuit below;



Calculate:

I.) Total capacitance (3mks)

II.) Total charge (3mks)

III.) Charge on capacitor C_4 (3mks)

IV.) Voltage across the three capacitors in parallel (2mks)

b) Consider a cell of *emf* (E) and internal resistance (r) connected in series to a resistor of resistance 5Ω.

i) Define *emf* of a cell (1mk)

ii) The energy supplied to one electron in transferring it around the circuit is $5.1\times10^{-19}\,J$ .Find the *emf* of the cell. (3mks)

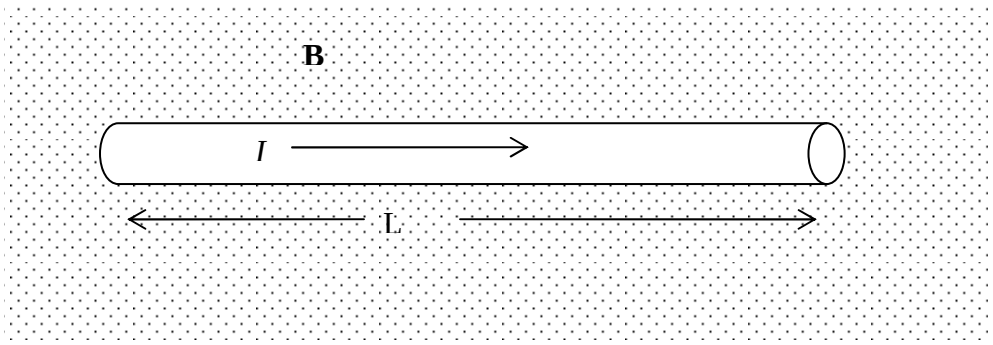
iii) Each electron in the circuit transfers energy of $4.0\times10^{-19}\,J$ to the5Ω resistor. Determine the value of the internal resistance of the cell. (4mks)

QUESTION 4 (20 marks)

a) i) What is magnetic flux? (1mk)
ii) State two characteristics of magnetic flux (2mks)

b) i) State and explain two factors that affect the magnitude of force experienced by a charged particle in a magnetic field. (2mks)

ii) The diagram below shows a wire segment placed in a uniform magnetic field $(\vec{B})$ that point out of the plane of the diagram.



If the wire carries a current (I), from left to right as shown, derive the expression of the resultant magnetic force $(\overrightarrow{F_B})$ experienced by the wire. (5mks)

iii) Consider a straight horizontal segment of copper wire whose linear mass density is $50g/m$ carrying current $I = 25mA$. Find the magnitude and direction of magnetic field needed to balance its weight (4mks)

c) Consider a proton of charge $1.6\times10^{-19}C$ being moved at a velocity of $3.2\times10^{7}m/s$ in a uniform magnetic field of $1.5\times10^{-3}T$ at an angle of 50°.

i). Find the magnitude of magnetic force experienced by the proton (3mks)

ii). What will be the acceleration of the proton given that its mass is $1.67\times10^{-27}Kg$ (3mks)

QUESTION 5 (20 marks)

a) State two ways through which e.m.f. can be induced in a coil. (2mks)

b) State Faraday's first and second laws of electromagnetic induction. (2mks)

c) i) Define inductance (1mk)

ii) A solenoid containing 20,000 turns has a length of 50cm and cross sectional area of $2cm^2$. If the current through it is decreasing at the rate of $20A/s$, calculate the e.m.f induced in the coil. (4mks)

d) Consider a series RL circuit connected to a d.c. source. Derive the expression for finding energy stored in the circuit. (4mks)

e) An RL circuit with an inductor of inductance 16H and resistor of 10Ω is connected to the terminals of a battery of e.m.f. 12V and negligible internal resistance. Find

i). The initial rate of increase of current in the circuit (3mks)

ii). The rate of increase at the instant when the current is 0.2A (4mks)