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UNIVERSITY EXAMINATIONS 2023/2024

FIRST YEAR, SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE (PHYSICS OPTION), BACHELOR OF SCIENCE IN MATHEMATICS AND PHYSICS, BACHELOR OF SCIENCE IN EDUCATION SCIENCE AND BACHELOR OF SCIENCE IN PHYSICS

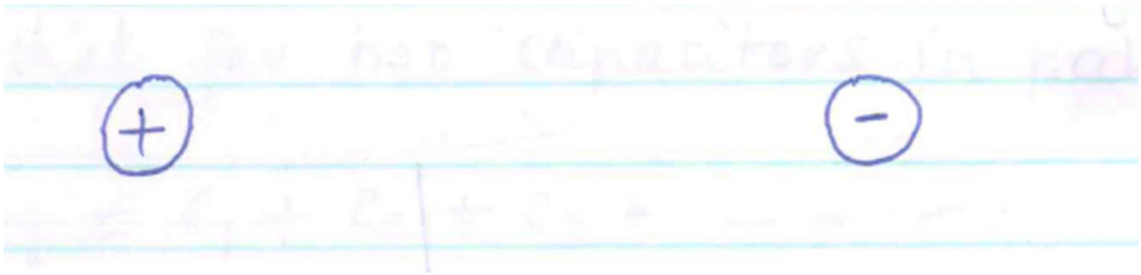
SPH 3152: ELECTRICITY AND MAGNETISM I

DATE: APRIL 2024 **TIME: 2 HOURS**

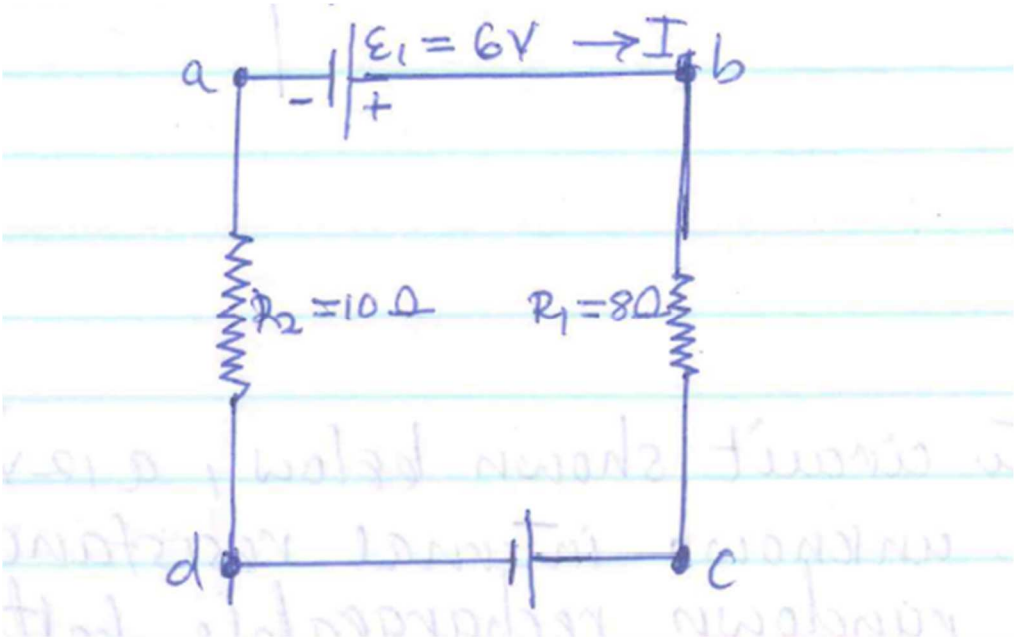
INSTRUCTIONS: Answer Question ONE and any other TWO questions.

QUESTION ONE (30 MARKS)

a) i. Define the term electric field. (2 Marks)
ii. Draw the electric field lines for the point charges shown below.



b) i. A single loop circuit contains two external resistor and two points of emf as shown below.



The internal resistances of the leatteries have been neglected

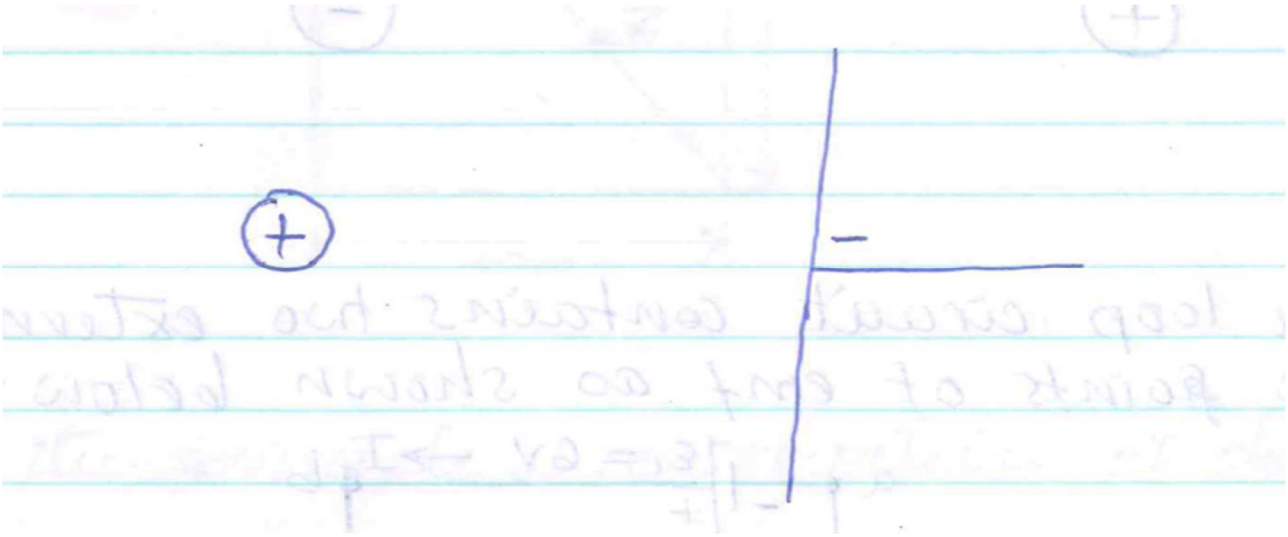
i. find the current in the circuit (2 Marks)

ii. power lost in each capacitor (3 Marks)

iii. give two postulates of the bohr model (4 Marks)

c) i. What is the energy carried by a quantum of light whose frequency equals $6x10^{14}$ yellow light H_3? (3 Marks)

ii. Draw the electric field due to the following arrangement. (2 Marks)

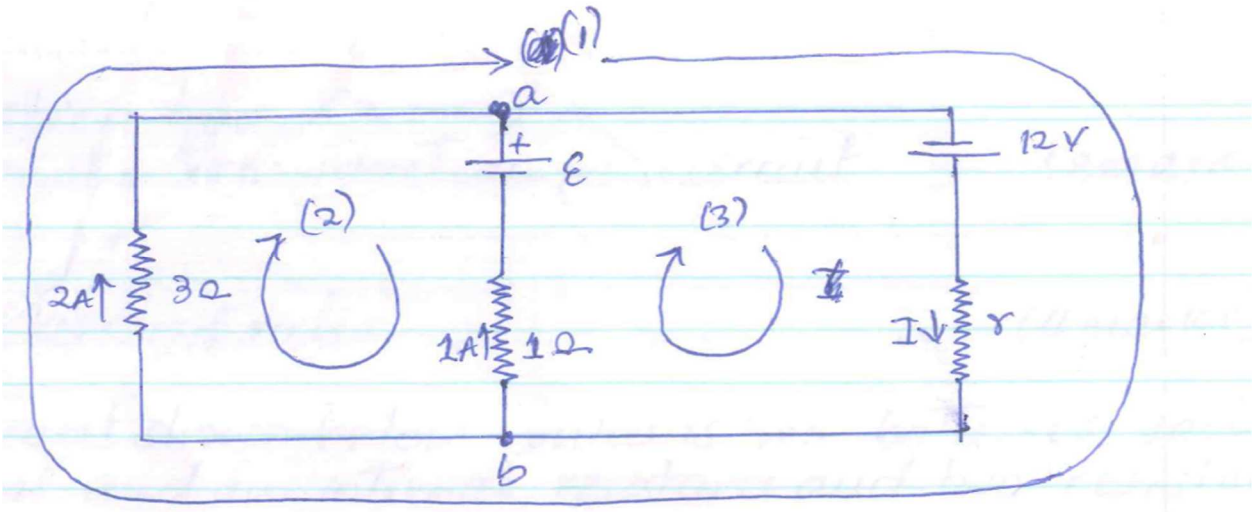


d) In the circuit shown below, a 12v power supply with unknown internal resistance r is connected to a random rechargeable battery with unknown $e.m.f\ \varepsilon$ and internal resistance 1Ω and to.an indicator light bulb of resistance 3 Ω carrying a current of 2 A. the current through the run down battery is 1 A in the direction shown. Find

i. find the resistance r (3 Marks)

ii. find the $\varepsilon mf\ \varepsilon$ (3 Marks)

iii. find the current I (3 Marks)



e) Show that for two capacitors in parallel.
$C_{eq} = C_1 + C_2 + C_3 + - - -$ (3 Marks)

QUESTION TWO (20 MARKS)

a) Define the term junction in a circuit. (2 Marks)

b) i. State larchoff rules (4 Marks)

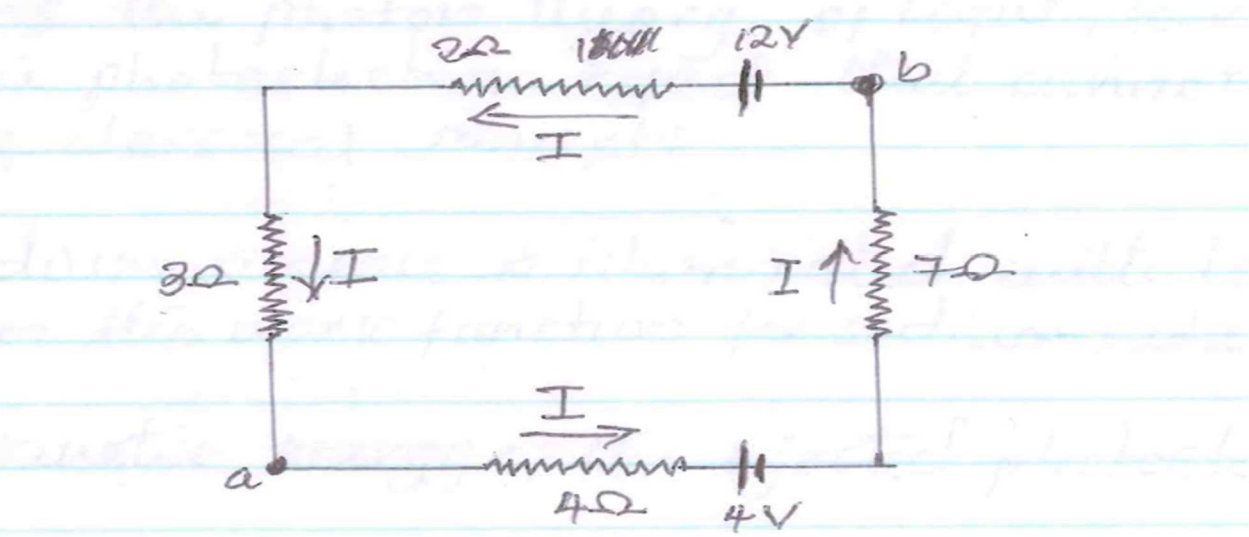
c) ii. The circuit shown below contains two batteries each with an emf and an internal resistance and two resistors.

Find

d) i. The current in the circuit (2 Marks)

ii. The potential difference Vab (2 Marks)

iii. Power output of the emf of each battery. (2 Marks)



e) i. A capacitor is valued 470μF and is charged to a p.d of 10 v

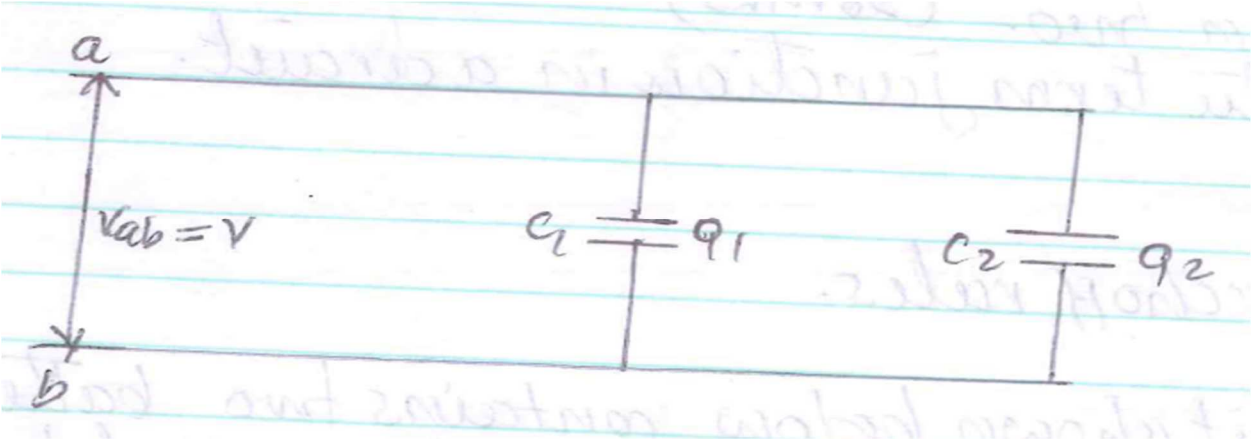
i. calculate the charge stored on the capacitor according to its labelled value. (2 Marks)

ii. if experimentally it is found to store 5.2 mC of charge calculate its actual capacitance. (2 Marks)

iii. in the figure below $l_1 = 6.0\mu F, C_2 = 3.0\mu F$ and $Vab = 18V$. Find the

a) equivalent capacitance (2 Marks)

b) charge on each capacitor (2 Marks)



QUESTION THREE (20 MARKS)

a) Define the term black body (2 Marks)

b) i. The temperature of the skin is approximately 35^0. What is the wave length at which the peak occurs in the radiation emitted from the skin? (2 Marks)

ii. Give two bold and controversial assumptions concerning the nature of the escalating molecules of the cavity walls. (4 Marks)

c) i. Using the photon theory of light, Give two explanations of the photoelectric effect that cannot be understood using classical concepts. (4 Marks)

ii. A sodium surface is illuminated with light of wavelength 300nm. The work function for sodium metal is $2.4eV$.

Find.

a. The Kinetic energy of the ejected photoelectrons (3 Marks)
b. The cut off wavelength for sodium (3 Marks)
c. Describe the lyman series for hydrogen (2 Marks)

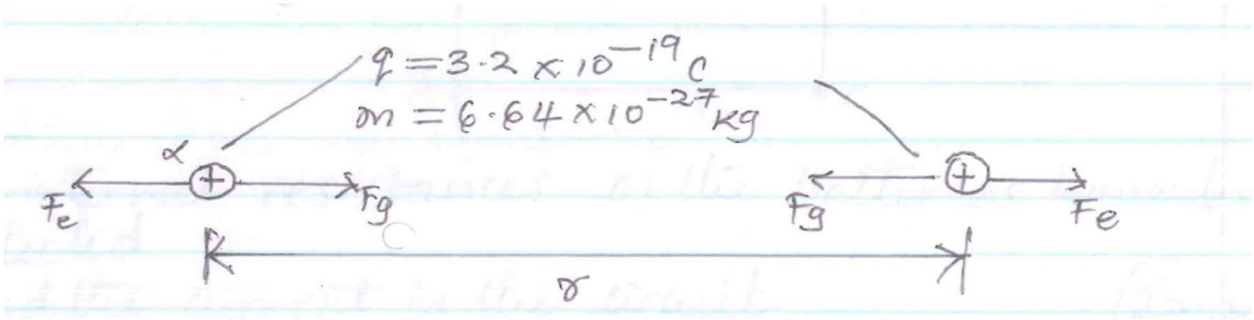
QUESTION FOUR (20 MARKS)

a) i. Draw the electric field lines in the indicated point charges. (2 Marks)

ii. Give two properties of magnetic field lines. (2 Marks)

b) i. Define coulombs law (2 Marks)

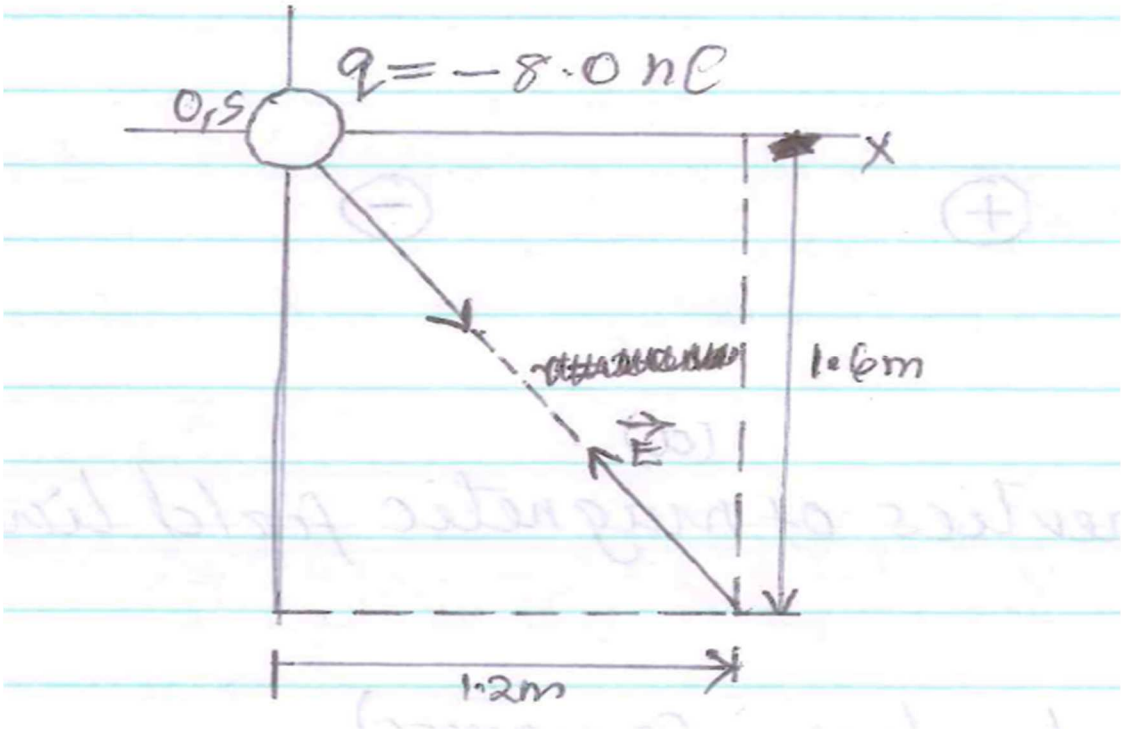
ii. An α particle (nucleus of a helium atom) has mass $m = 6.64 \times 10^{-27}$kg and charge $q = +2e = 3.2 \times 10^{-19}c$. Compare the magnitude of the electric repulsion between two α particles with that of the gravitational attraction between them. ($G = 6.67 \times 10^{-17} N.m^2/kg^2$). (3 Marks)



c) i. Define the term electric field $\vec{E}$ at a point. (2 Marks)

ii. What is the magnitude of the electric field $\vec{E}$ at a field point 2.0 m form a point charge $q = 0nC$. (2 Marks)

iii. A point charge $q = -8.0nC$ is located at the origin find the electric field vector at the point $x = 1.2m$, and $y = -1.6m$. (4 Marks)



d) State the principle of conservation of charge. (3 Marks)