EGERTON UNIVERSITY

UNIVERSITY EXAMINATIONS

SECOND SEMESTER EXAMINATIONS, 2018/2019 ACADEMIC YEAR

SECOND YEAR RESIT EXAMINATION FOR DEGREE OF BACHELOR OF SCIENCE & BACHELOR OF EDUCATION SCIENCE

PHYS 212: ELECTRICITY AND MAGNETISM

STREAM: BSc. & BED (Science) **TIME:** 2 HOURS

EXAMINATION SESSION: AUGUST **YEAR:** 2019

INSTRUCTIONS

i) **Answer question ONE and any other THREE questions**

ii) **Show all the workings clearly**

iii) **Use constants provided below whenever necessary**

Particle	Charge (C)	Mass (kg)
Electron (e)	$-1.6021917 \times 10^{-19}$	9.1095×10^{-31}
Proton (P)	$+1.6021917 \times 10^{-19}$	1.67261×10^{-27}
Neutron (n)	0	1.67492×10^{-27}

QUESTION ONE (40 Marks) Compulsory

(a) Define the following terms

i. Electromotive force
ii. Potential difference
iii. Internal Resistance

(3 Marks).

(b) A battery has an electromotive force of **12.0 V** and an internal resistance of **0.05 Ω**. Its terminals are connected to a load resistance of **3.00 Ω**. Find

i. Current in the circuit
ii. Terminal voltage of the battery **(4 Marks)**

(c) i. State the properties of Electric charge **(3 Marks)**

ii. Calculate the number of electrons whose total charge is approximately equal to 1C of charge. **(2 marks)**

(d) Show that the acceleration of a charged particle in a uniform electric field is given By; $a = \frac{qE}{m}$ **(4 Marks)**

(e) The electron and proton of a hydrogen atom are separated on average by a distance of approximately 5.3 x 10-11 m. Find the magnitude of the electric force between the two particles. **(3 Marks)**

(f) State the properties of Electric field lines **(3 Marks)**

(g)

i. Define Electric flux and give its SI units **(1 Mark)**

ii. What is the electric flux through a sphere that has a radius of **1.00** m and carries charge of $+1.00\ \mu C$ at its centre? **(3 marks)**

(h)i. State Faradays law. **(1 Mark)**

ii. Express Faraday's law of induction in equation form and define the relevant terms in the equation **(2 Marks)**

(i)

i. Stating its units, define inductance L of a coil. **(2 Marks)**
ii. Show that the total energy stored in a magnetic field of an inductor is given by; $U = \frac{1}{2}LI^2$ where I is current and L is the inductance **(4 Marks)**.

(j)

i. Differentiate between electric potential and electric potential energy **(2 Marks)**

ii. A proton is released from rest in a uniform electric field that has a magnitude of $8.0 \times 10^4\ v/m$. The proton undergoes a displacement of $0.50\ m$ in the direction of electric field E. Find the change in electric potential between any 2 points A and B. **(3 Marks)**

Question Two (10 Marks)

(a)

i. State the Principle of superposition of electric forces **(1 Mark)**

ii. Express Coulombs law of electrostatics in equation form and define the relevant terms in the equation **(2 Marks)**

iii. From Coulombs law, state 2 properties of electric force between 2 stationary charged particles **(2 Marks)**

(b) 2 point charges are located on the positive x-axis of a co-ordinate system. Charge $q_1 = \ln C$ is 2 cm from the origin and charge $q_2 = -3l\,n\,C$ is 4 cm from the origin. What is the total force exerted by these 2 charges on a charge $q_3 = 5 \ln C$ located at the origin? (Note: Gravitational forces are negligible) **(5 Marks)**

Question Three (10 Marks)

(a). A spherical gaussian surface surrounds a point charge q. Describe what happen to the total flux through the surface if:

i. the charge is tripled. **(1 Mark).**

ii. the radius of the sphere is doubled **(1 Mark).**

(b). i. State Gauss's law **(1 Mark)**

ii. Starting with Gauss's law, calculate the electric field due to an isolated point charge q **(3 Marks)**

(c) Show that the net flux through any closed surface surrounding a point charge q is given by q/ϵ_0 and is independent of the shape of that surface. **(4 Marks)**

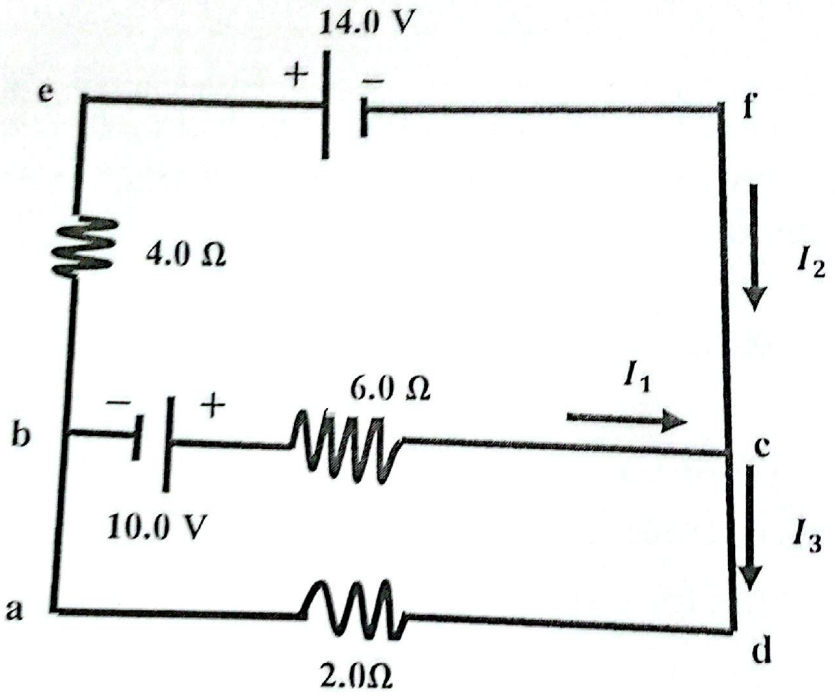
Question Four (10 Marks)

(a)

i. . State Kirchhoff's Junction and loop Rules (2 Marks)

ii. Write down any 2-sign conventions applicable when using Kirchhoff's second law (2 Marks)

(b) Find the currents I_1, I_2, and I_3 in the circuit shown below. (6 Marks).



Question Five (10 Marks)

(a)

i. Stating its *SI* units, define the capacitance of a capacitor. (2 Marks)

ii. List any 2 common uses of capacitors (2 Marks)

(b)

i. Show that the capacitance of a parallel plate capacitor is proportional to the area

of its plates and inversely proportional to the to the plate separation.

That is $C = \frac{\epsilon_0 A}{d}$

(4 Marks)

ii. A parallel plate capacitor with air between the plates has an area $A = 2.00 \times 10^{-4}\, m^2$ and a plate separation $d = 1.00\ mm$. Find its capacitance.

(2 Marks).