



MURANG'A UNIVERSITY COLLEGE

A constituent college of Jomo Kenyatta University of Agriculture and Technology
University Examination 2014/2015

BACHELOR OF SCIENCE IN MATHEMATICS AND COMPUTER SCIENCE

YEAR 1 SEMESTER 11,

SPH 2172: PHYSICS

SUPPLEMENTARY EXAMINATION

DATE: 4TH August 2015

TIME: 11.00-1.00 PM

INSTRUCTIONS TO CANDIDATES

1. Answer question 1 and any other two
2. All working must be clearly shown on the answer booklet
3. Do not answer more than three questions
4. Start each question on a fresh page
5. Use of Mobile phones is prohibited in examination rooms
6. Indicate on the table in the front page of the answer booklet the questions you attempted
7. Electronic calculators may be used

Useful constants

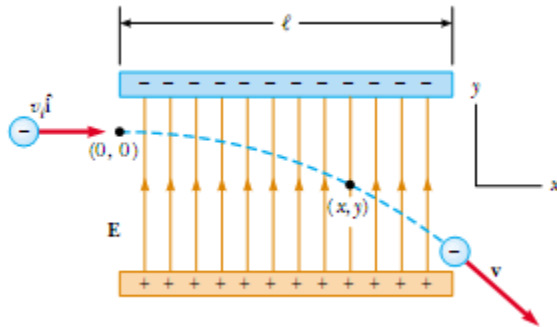
- Charge of an electron = $1.6 \times 10^{-19} \text{C}$
- Permeability of free space, $\mu_0 = 4\pi \times 10^{-7} \text{ Tm/A}$
- Permittivity of free space, $\epsilon_0 = 8.85 \times 10^{-12} \text{ F/m}$
- Mass of an electron, $m_e = 9.1 \times 10^{-31} \text{ kg}$
- Mass of a proton, $m_p = 1.7 \times 10^{-27} \text{ kg}$
- Resistivity of tungsten $\alpha = 4.5 \times 10^{-3} / ^\circ\text{C}$
- Planck's constant $h = 6.63 \times 10^{-34} \text{ Js}$

QUESTION 1 (30 MARKS).

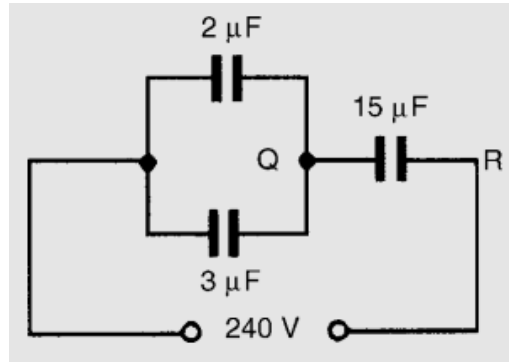
- a) Define the following terms;
- (i) Potential difference between two points in an electric field
 - (ii) Capacitor
 - (iii) The volt

3marks

- b) An electron is released from rest in a uniform electric field set up between two oppositely charged metal plates as shown in the figure below. Describe its motion. **5marks**



- c) State Kirchoff's loop rule. **1mark**
- d) Two point charges each of charge -12nC are placed 10cm apart. Calculate the electric field strength due to these charges at a point that is 10cm from both charges. **5marks**
- A proton moves in a straight line from point a to point b inside a linear accelerator, a total distance $d = 0.5\text{m}$. The electric field is uniform along this line with magnitude $E = 1.5 \times 10^7 \text{N/C}$ in the direction from a to b. Determine;
- The force on the proton **3marks**
 - The work done on the proton **3marks**
 - The potential difference **2marks**
- e) The figure below shows a capacitor network



- Calculate the p.d across the $15\mu\text{F}$ capacitor. **5marks**
- The energy stored in the $15\mu\text{F}$ capacitor. **3marks**

QUESTION 2 (20MKS)

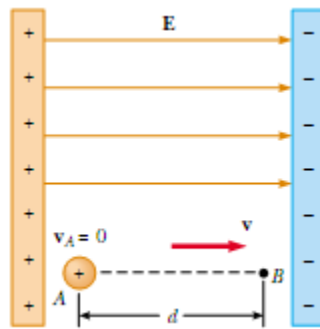
- Capacitors of capacitance $1\mu\text{F}$, $3\mu\text{F}$, $5\mu\text{F}$ and $6\mu\text{F}$ are connected in parallel to a 100V d.c. Determine the effective capacitance and the charge on each capacitor. **6marks**
- Explain how a dielectric in a parallel plate capacitor increases its capacitance. **4marks**
- Determine the distance between $q_1 = 30\mu\text{C}$ and $q_2 = 50\mu\text{C}$ for the electrostatic force between them to have a magnitude of 6N . **4marks**

d)

- i) A point charge $q_1 = -5\mu\text{C}$ is placed at a point (0,6) m, while the charge $q_2 = 6\mu\text{C}$ is placed at (8,0) m. calculate the electric potential at the origin (0,0). **4marks**
- ii) Find the change in potential energy of the $6\mu\text{C}$ charge as it moves from infinity to the origin **2marks**

QUESTION 3 (20 MARKS)

- a. Two parallel plates have a p.d of 400V between them. If the distance between them is 2mm, determine the electric field strength. **4marks**
- b. The electron and proton of a hydrogen atom are separated (on the average) by a distance of approximately 5.3×10^{-11} m. Find the magnitudes of the electric force between the two particles. **4marks**
- c. Find the force acting on a test charge $6\mu\text{C}$ placed in the electric field $E = 5\text{ V}$ created by another charged object. **2marks**
- d. A proton is released from rest in a uniform electric field that has a magnitude of $12 \times 10^4\text{ V/m}$ as shown in the figure below. The proton undergoes a displacement of 0.8 m in the direction of E .



- i) Find the change in electric potential between points A and B. **2marks**
- ii) Find the change in potential energy of the proton–field system for this displacement. **4mks**
- iii) Find the speed of the proton after completing the 0.8 m displacement in the electric field. **4marks**

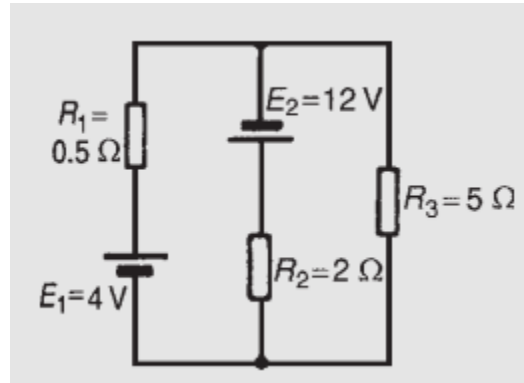
QUESTION 4 (20 MARKS)

- a. State four properties of x-rays. **4marks**
- b. An electron in an x-ray tube is accelerated through a p.d of 40 kV. Find the velocity it attains. **3mks**
- c. Calculate the p.d through which an electron must be accelerated in a vacuum in order that the short wave limit of the continuous X-ray spectrum will be three picometers. **4marks**
- d. The applied p.d across an x-ray tube is 8kV and the current through it is 4mA. Find the number of electrons striking the target per second. **3marks**
- e. Explain why the target in the x-ray tube is made of a material of high melting point. **2marks**
- f. A radioactive element ${}^A_Z X$ decays by emission of three α -particles, two β -particles and γ -rays. Find the mass number and atomic number of the resulting element. **4marks**

QUESTION 5 (20 MARKS)

- a. For the bridge network shown in the figure below, determine the currents in each branch.

10marks



- b. Define the following terms

2marks

- i) Magnetic flux
- ii) Magnetic flux density

- c. The maximum working flux density of a lifting electromagnet is 1.8T and the effective area of a pole face is circular in cross-section. If the total magnetic flux produced is 353mWb, determine the radius of the pole face.

4marks

- d. A coil of copper wire has a resistance of 10Ω at 20° C. If the temperature coefficient of resistance of copper at 20° C is 0.004/ °C, determine the resistance of the coil when the temperature rises to 100°C.

4marks