



MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF PURE AND APPLIED SCIENCE

DEPARTMENT OF APPLIED SCIENCE

UNIVERSITY ORDINARY EXAMINATION

2017/2018 ACADEMIC YEAR

**RE-SIT/SPECIAL EXAMINATION FOR BACHELOR OF SCIENCE IN
MATHEMATICS AND COMPUTER SCIENCE**

SPH2172 – PHYSICS

DURATION: 2 HOURS

DATE: 20TH APRIL 2018

TIME: 2.00PM – 4.00PM

Instructions to Candidates:

1. Answer **Section A** and **Any Other Two** questions in **Section B**.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

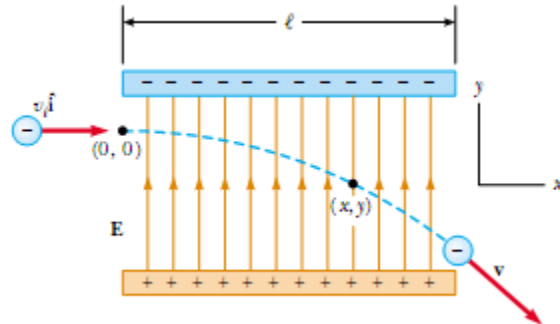
Useful constants

- ✓ Charge of an electron = $1.6 \times 10^{-19} C$
- ✓ Permeability of free space $\mu_0 = 4\pi \times 10^{-7} T_m/A$
- ✓ Permittivity of free space, $\epsilon_0 = 8.85 \times 10^{-12} F/M$
- ✓ Mass of an electron, $M_e = 9.1 \times 10^{-31} Kg$
- ✓ Mass of proton, $M_p = 1.7 \times 10^{-27} Kg$
- ✓ Resistivity of tungsten $\alpha = 4.5 \times 10^{-3} /^{\circ}C$
- ✓ Planck's constant $h = 6.63 \times 10^{-34} Js$

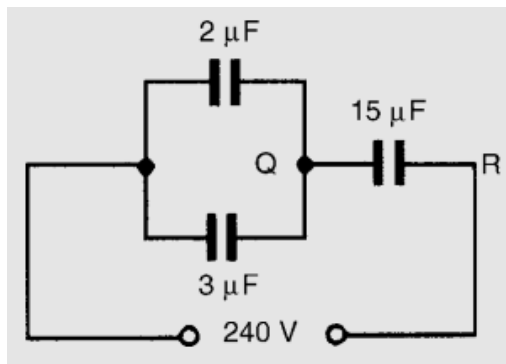
SECTION A – ANSWER ALL QUESTIONS IN THIS SECTION (30 Marks)

QUESTION ONE

- a) Define the following terms (3 Marks)
- Potential difference between two points of electric field.
 - Capacitor
 - The volt
- 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 the motion. (5 Marks)



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



- Calculate the *pd* across the $15\mu\text{F}$ capacitor. (5 Marks)

- ii. The energy stored in the $15\mu F$ capacitor. (3 Marks)

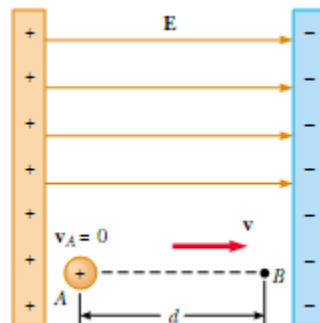
SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO (20 MARKS)

- a) Capacitors of capacitance $1\mu F$, $3\mu F$, $5\mu F$ and $6\mu F$ are connected in parallel to a 100V dc. Determine the effective capacitance and the charge of the capacitor. (6 Marks)
- b) Explain how dielectric in a parallel plate capacitor increases its capacitance. (4 Marks)
- c) Determine the distance between $q_1 = 30\mu C$ and $q_2 = 50\mu C$ for the electrostatic force between them to have a magnitude of 6N. (4 Marks)
- d) i) A point charge $q_1 = -5\mu C$ is placed at a point (0,6)M, while the charge $q_2 = 6\mu C$ is placed at (8,0)M, Calculate the electric potential at the origin (0,0) (4 Marks)
- ii) Find the change in pd energy of the $6\mu C$ charge as it moves from infinity to the origin. (2 Marks)

QUESTION THREE (20 MARKS)

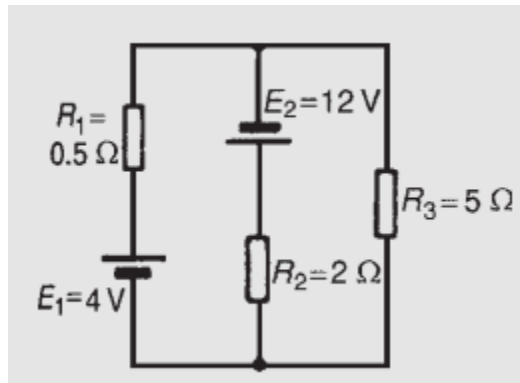
- a) Two parallel plates have a pd of 400V between them. If the distance between them is 2mm, determine the electric field strength. (4 Marks)
- b) The electron and proton of a hydrogen atom are separated by a distance of $5.3 \times 10^{-11}M$. Find the magnitude of the electric force between the two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



- i. Find a change in an electric potential between points A and B. (2 Marks)
- ii. Find the change in potential energy of the proton field system for this displacement. (4 Marks)
- iii. Find the speed of the proton after completing the 0.8M displacement in the electric field. (4 Marks)

QUESTION FOUR (20 MARKS)

- a) For the bridge network shown below, determine the currents in each branch (10 Marks)



- b) Define the following terms;
- i. Magnetic flux (1 Mark)
 - ii. Magnetic flux density (1 Mark)
- c) The maximum working flux 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 3453mWb, determine the radius of the pole face. (4 Marks)
- d) A coil of copper wire has resistance of 10Ω at 20°C . If the temperature coefficient of resistance of copper at 20°C is $0.004/^\circ\text{C}$, determine the resistance of the coil when the temperature rises to 100°C . (4 Marks)