

**FINAL  
ALTERNATIVE ASSESSMENT**

(COVER PAGE)

Session : January 2022

Programme : Diploma in Electrical & Electronic Engineering (DEEI)  
Diploma in Mechanical Engineering (DMEN)

Course : PHY1121/PHY1131: Physics

Date of Examination : 8 March 2022 (Tuesday)

Time : 8.00am – 10.30am Reading Time : Nil

Duration : 2 Hours 30 Minutes

**Special Instructions :**

This paper consists of **FOUR (4)** questions. Answer **ALL** questions. All questions carry equal marks.

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Material permitted : Non-Programmable Scientific Calculator

Materials provided : Physics Formulae Booklet

Examiner(s) : Chong Mee Teng

Chief Moderator : Manickampraslad M Sambasivam

*This paper consists of 6 printed pages, including the cover page*

DIPLOMA IN ELECTRICAL & ELECTRONIC ENGINEERING PROGRAMME (DEEI)  
 DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)  
 PHY1131 / PHY1121: PHYSICS  
 FINAL ALTERNATIVE ASSESSMENT: JANUARY 2022 SESSION

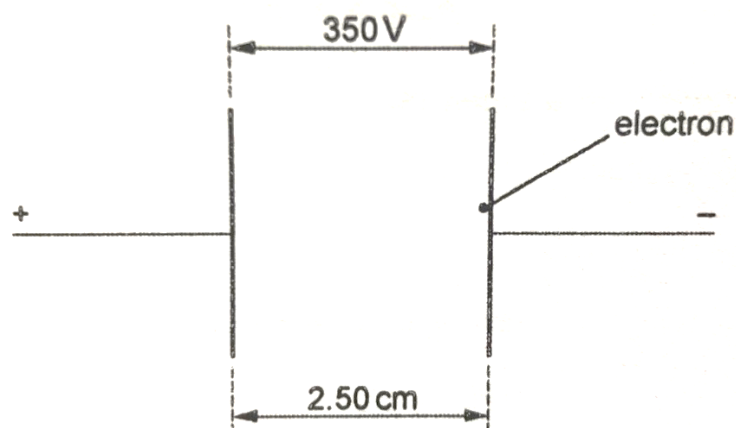
**Instructions:** This paper consists of **FOUR (4)** questions. Answer **ALL** questions. All questions carry equal marks.

**Question 1**

- (a) Two vertical parallel metal plates are situated 2.50 cm apart in a vacuum. The potential difference between the plates is 350 V, as shown in **Figure Q1(a)**.
- (i) Compute the magnitude of the electric field between the plates. (2 marks)
  - (ii) Show that the force on the electron due to the electric field is  $2.24 \times 10^{-15}$  N. (2 marks)

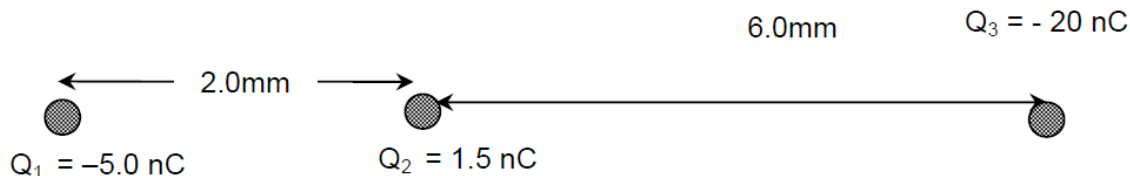
The electron accelerates horizontally across the space between the plates.

- (iii) Compute the horizontal acceleration of the electron. (2 marks)
- (iv) Compute the time to travel the horizontal distance of 2.50 cm between the plates. (2 marks)
- (v) Explain the reason the gravitational effects on the electron need not be taken into consideration in the calculation of part (iii) and (iv). (2 marks)



**Figure Q1(a)**

- (b) Three charges  $Q_1$ ,  $Q_2$  and  $Q_3$  with positions shown in the **Figure Q1(b)** exerts electrostatic forces on each other. Given the Coulomb constant,  $k = 9.0 \times 10^9 \text{ Nm}^2/\text{C}^2$ . Compute:

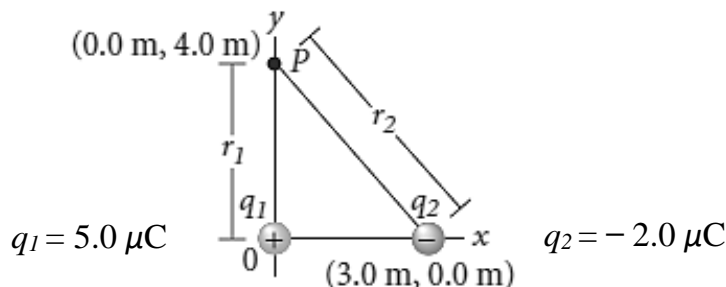


**Figure Q1(b)**

- (i) the magnitude and direction of the resultant electrostatic force on  $Q_2$ , and (6 marks)
- (ii) the magnitude and direction of the electric field at the point where  $Q_2$  is situated. (4 marks)
- (c) An electric heater is to be made from Nichrome wire. Nichrome has a resistivity of  $1.0 \times 10^{-6} \Omega\text{m}$  at the operating temperature of the heater. The heater is to have a power dissipation of 60 W when the potential difference across its terminals is 12 V.
- (i) Show that the resistance of the Nichrome wire is  $2.4 \Omega$ . (2 marks)
- (ii) Compute the length of nichrome wire of diameter 0.80 mm required for the heater. (3 marks)

### Question 2

- (a) A  $5.0 \mu\text{C}$  point charge is located at the origin, and a point charge of  $-2.0 \mu\text{C}$  is along the  $x$ -axis at (3.0 m, 0.0 m) as shown in **Figure Q2(a)**. Compute the total potential difference resulting from these charges between point  $P$ , with coordinates (0.0 m, 4.0 m) and a point infinitely far away. (8 marks)

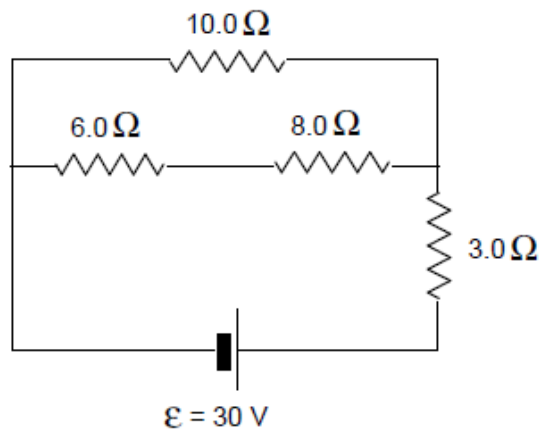


**Figure Q2(a)**

- (b) A parallel-plate capacitor has circular plates of 8.2 cm radius and 1.3 mm separation. Given the permittivity of vacuum,  $\epsilon_0 = 8.85 \times 10^{-12}$  F/m. Compute:
- the capacitance of the capacitor, and (4 marks)
  - the amount of charge accumulated on the plates if a potential difference of 120 V is applied. (2 marks)
- (c) A point charge of magnitude  $+ 4.0 \times 10^{-9}$  C is moved at constant velocity against a uniform electric field from point *A* to point *B*. If the distance between points *A* and *B* is 0.01 m and the work done by the external force is  $4.8 \times 10^{-7}$  J. Compute:
- the potential difference between *A* and *B*, and (2 marks)
  - the magnitude of the uniform electric field. (3 marks)
- (d) If the electrical energy costs 25 cents per kilowatt-hour, compute for the cost to operate an electric oven for 5.0 hour if it carries a current of 20.0 A at 220 V? (6 marks)

**Question 3**

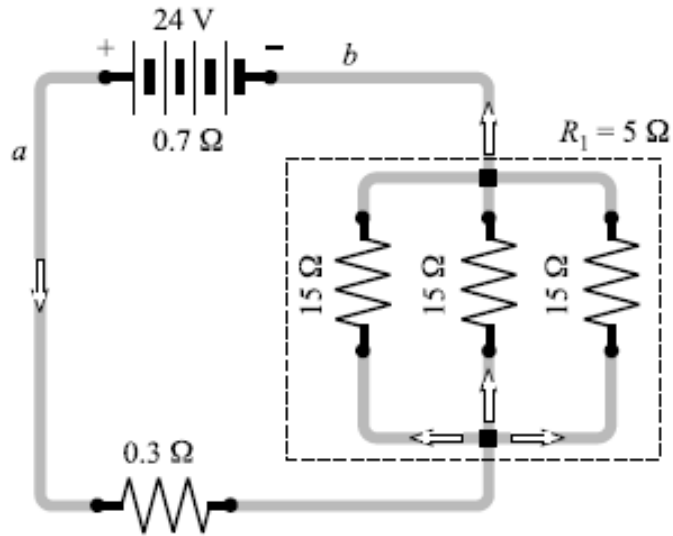
- (a) Neglect internal resistance of the battery. In the circuit shown in **Figure Q3(a)**, compute:



**Figure Q3(a)**

- the total external resistance of the circuit, and (5 marks)
- the current through the battery. (2 marks)

(b) In **Figure Q3(b)** below, the battery has an internal resistance of  $0.7 \Omega$ . Compute:



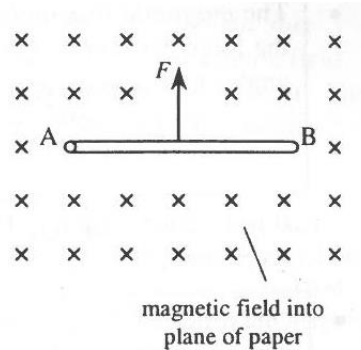
**Figure Q3(b)**

- (i) the current drawn from the battery, and (5 marks)
- (ii) the current in each  $15 \Omega$  resistor. (3 marks)
- (c) (i) Explain how to obtain n-type semiconductor. (2 marks)
- (ii) Explain how to obtain p-type semiconductor. (2 marks)
- (iii) Justify the majority and minority charge carriers in n-type and p-type semiconductor respectively. (4 marks)
- (iv) Explain the covalent bonding. (2 marks)

**Question 4**

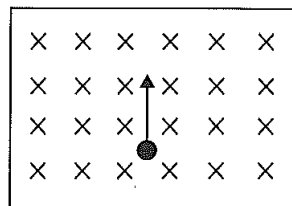
- (a) (i) Explain the difference between semiconductors, conductors and insulators on the basis of band gap. (3 marks)
- (ii) Explain the hole in a semiconductor and the hole current. (2 marks)

- (b) **Figure Q4(b)** shows a wire of length 0.57 m and cross section area  $1.0 \times 10^{-6} \text{ m}^2$  is placed at right angles to a uniform magnetic field of flux density  $1.8 \times 10^{-3} \text{ T}$ . The material of the wire has density  $7.9 \times 10^3 \text{ kg/m}^3$  and resistivity  $8.8 \times 10^{-8} \Omega\text{m}$ . A potential difference is applied between the ends of the wire so that there is a magnetic force,  $F$  acting on the wire.



**Figure Q4(b)**

- (i) Sketch the direction of the current on the wire. (1 mark)
  - (ii) Compute the weight and the resistance of the wire. (6 marks)
  - (iii) Compute the current required between the ends of the wire for the magnetic force on the wire to equal its weight. (3 marks)
- (c) **Figure Q4(c)** shows an electron is fired perpendicular into a 3.5 mT uniform magnetic field with a speed of  $2.0 \times 10^7 \text{ m/s}$ . The magnetic field is directed into the plane of the page.



**Figure Q4(c)**

- (i) Make a copy of the diagram and sketch the direction of the magnetic force on the electron. (2 marks)
- (ii) Compute the magnetic force acting on the electron. (2 marks)
- (iii) Explain the reason electron will move in a circle with constant speed. (2 marks)
- (iv) Compute the radius of the electron's circular path. (4 marks)