Practice Question Set For A-Level
Subject : Physics
Paper-1 Topic : 3_ElectricCircuits

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Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Q1.

A solar panel uses electromagnetic radiation from the Sun to generate electricity.
In one installation a sensor in the solar panel measures the intensity of radiation arriving from different directions. A motor rotates the solar panel so that it always faces the brightest part of the sky.

When light is incident on an LDR, electrons move to a higher energy level where they become conduction electrons. This causes the resistance of the LDR to decrease.

A student suggests that this is an example of the photoelectric effect. The student is not correct.

Compare and contrast the photoelectric effect with the effect of radiation incident on an LDR.

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(Total for question = 6 marks)

Q2.

At the end of the 19th century, J.J. Thompson used electric and magnetic fields to deflect beams of charged particles. A photograph of his apparatus is shown.

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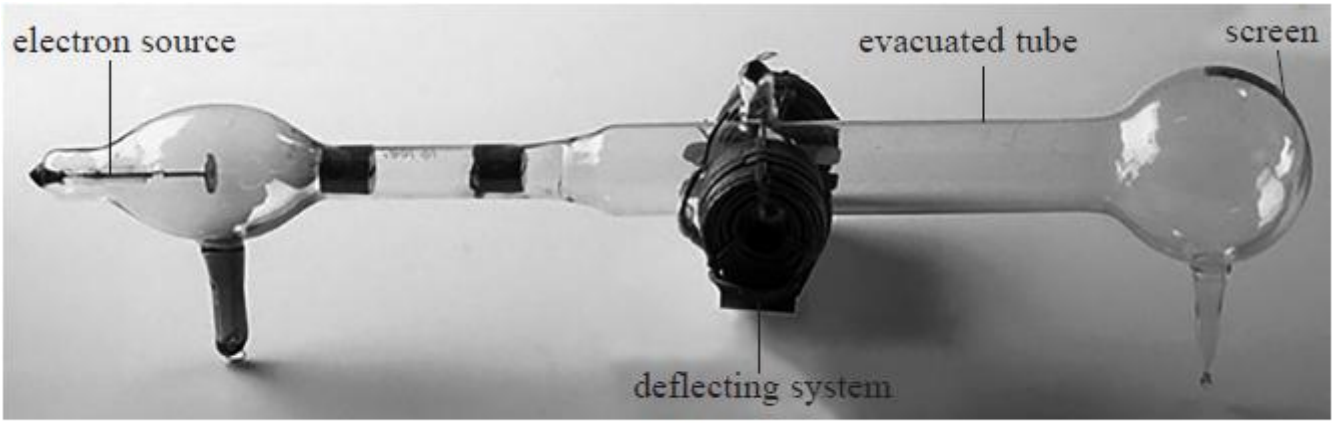

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Electrons were accelerated through a potential difference to produce a beam of high-energy electrons. The beam was then deflected in perpendicular directions by the magnetic and electric fields. The final position of the beam on the screen was determined by the charge and mass of the electrons.

In a modern version of Thompson's experiment, a uniform electric field of electric field strength *E* is applied so that the electric and magnetic forces on the electrons are equal and in opposite directions.

(i) Show that for electrons to be undeflected their velocity must be given by

$$v = \frac{E}{B}$$

where *B* is the magnetic flux density of the magnetic field.

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(ii) The beam is produced by accelerating electrons through a potential difference of 250 V.

The electric field strength is $1.4 \times 10^{4}\ \text{V m}^{-1}$. The magnetic flux density is $1.5 \times 10^{-3}\ \text{T}$.

Calculate the value of the specific charge *e*/*m* for the electron using this data.

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e/*m* = ...

(Total for question = 5 marks)

Q3.

The circuit shows a 1 mF capacitor connected to an a.c. supply. The graph shows how the potential difference *V* varies with time *t*.

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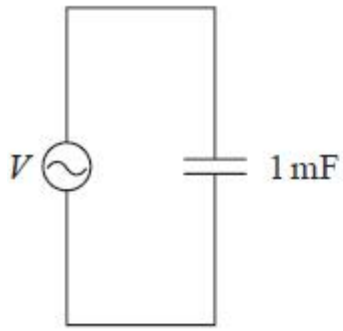

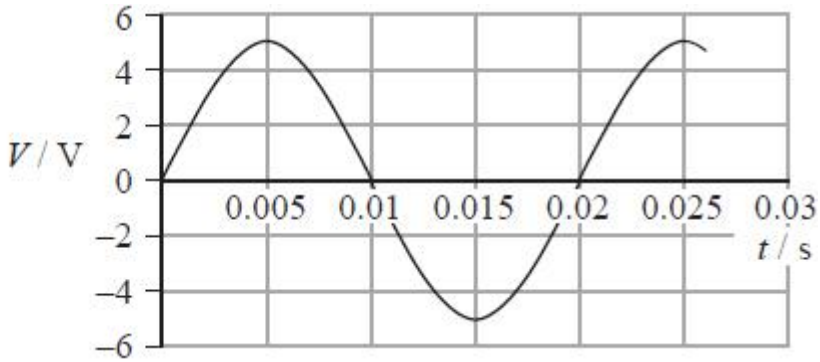

A spreadsheet is used to model how the current *I* in the 1 mF capacitor varies with *t*. Six rows of the spreadsheet are shown below.

	A	B	C	D	E	F	G
	t / s	Δt / s	V / V	$Q_{initial}$ / C	Q_{final} / C	ΔQ / C	I / A
7	0.0050	0.0010	5.00	0.00476	0.00500	0.00024	0.24
8	0.0060	0.0010	4.76	0.00500	0.00476	–0.00024	–0.24
9	0.0070	0.0010	4.05	0.00476	0.00405	–0.00071	–0.71
10	0.0080	0.0010	2.94	0.00405	0.00294	–0.00111	–1.11
11	0.0090	0.0010	1.55	0.00294	0.00155	–0.00139	–1.39
12	0.0100	0.0010	0	0.00155	0.00000	–0.00155	–1.55

(i) Explain how cell E10 has been calculated.

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(ii) State the formula used to calculate cell G11.

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(iii) Calculate the maximum energy stored on the capacitor.

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Maximum energy stored on the capacitor = ...

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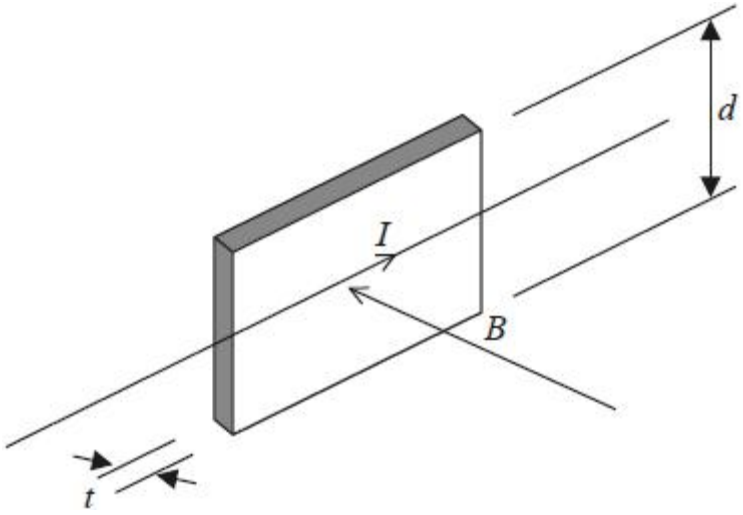
(Total for question = 5 marks)

Q4.

Tiny sensors in smartphones could be used to determine the position of the phone on the Earth's surface by measuring the Earth's magnetic flux density.

A current *I* and a magnetic field of flux density *B* are applied to a slice of semiconductor as shown. The slice has thickness *t* and depth *d*.



Electrons collect at the top edge of the slice and the bottom edge becomes positively charged. As a result a potential difference known as a Hall voltage V_{HALL} develops.

Electrons continue to collect at the top edge of the slice, until the force on a moving electron due to the magnetic field is equal to the force on the electron due to the electric field.

Derive the following equation for V_{HALL}:

$$V_{HALL} = \frac{BI}{nte}$$

where *n* is the number of charge carriers per unit volume of the semiconductor.

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(Total for question = 4 marks)

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