

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

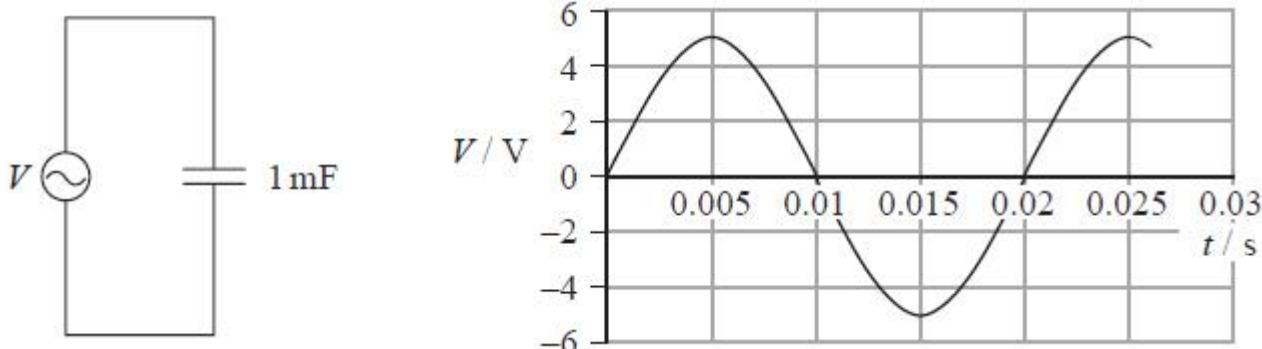
Name of the Student: _____

Max. Marks : 27 Marks

Time : 27 Minutes

Q1.

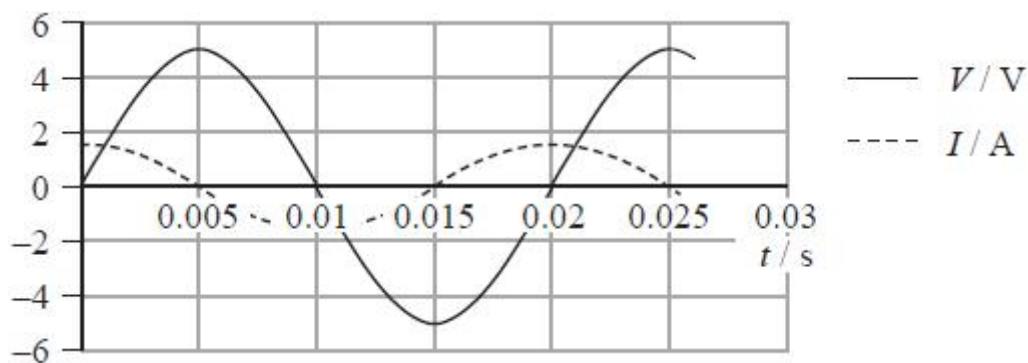
The circuit shows a 1 mF capacitor connected to an a.c. supply. The graph shows how the potential difference V varies with time t .



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	$\Delta t / \text{s}$	V / V	$Q_{\text{initial}} / \text{C}$	$Q_{\text{final}} / \text{C}$	$\Delta Q / \text{C}$	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

The spreadsheet data are used to plot a graph to show how I varies with t . This is shown as a dashed line below.



The corresponding graph of V against t is also shown as a continuous line.

Deduce whether the capacitor dissipates power over one cycle of the a.c. supply.

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(Total for question = 4 marks)

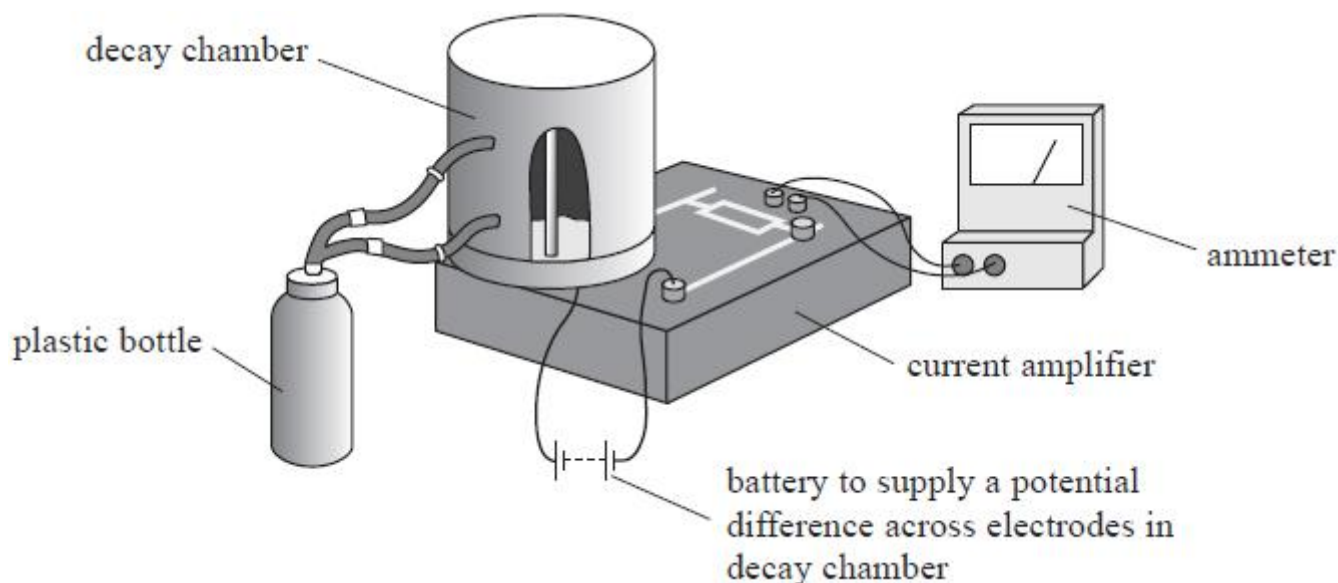
Q2.

Radon is a radioactive gas. One isotope of radon, $^{220}_{86}\text{Rn}$, decays to polonium, Po, by emitting an alpha particle.

The diagram shows apparatus for monitoring the decay of radon in the laboratory.

Radon gas is produced in the plastic bottle from the decay of radium. A small amount of radon is then inserted into the decay chamber by squeezing the plastic bottle.

A current is produced between two electrodes inside the chamber. This current is amplified and recorded by the ammeter.



(i) Explain why a current is produced in the decay chamber.

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(ii) A teacher is demonstrating the operation of the decay chamber to her class. She squeezes the bottle to introduce radon into the chamber.

She claims that within 450 s the activity of the radon in the chamber will be less than 1% of its initial value.
Assess whether her claim is correct.
half-life of radon = 55.6 s

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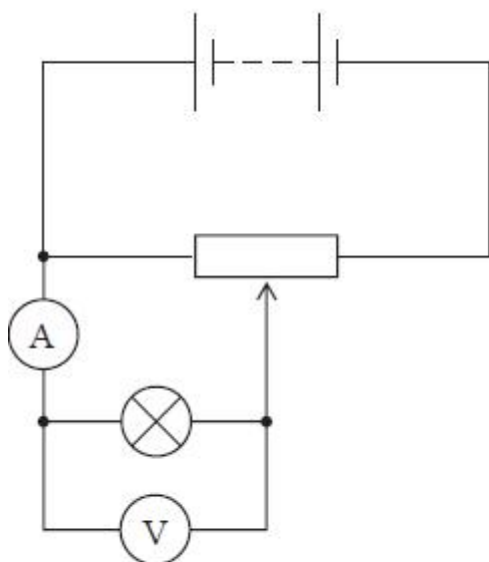
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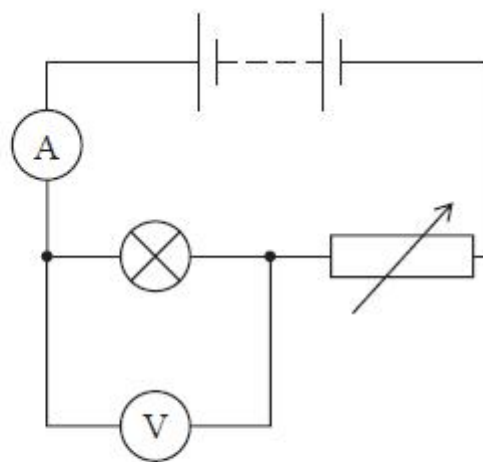
(Total for question = 5 marks)

Q3.

A student is planning to collect data to produce a current-potential difference graph for a filament lamp. Her teacher suggests two circuits that she could use.



Circuit 1



Circuit 2

Circuit 1 uses a potential divider and circuit 2 uses a variable resistor to vary the potential difference across the filament lamp.

*Discuss the suitability of each circuit to collect the data.

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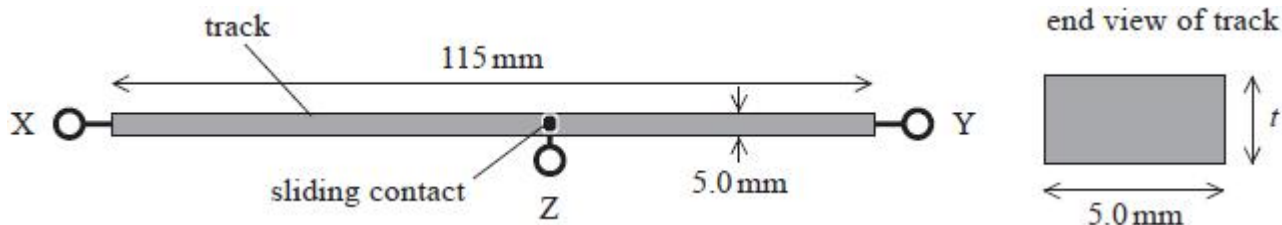
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(Total for question = 6 marks)

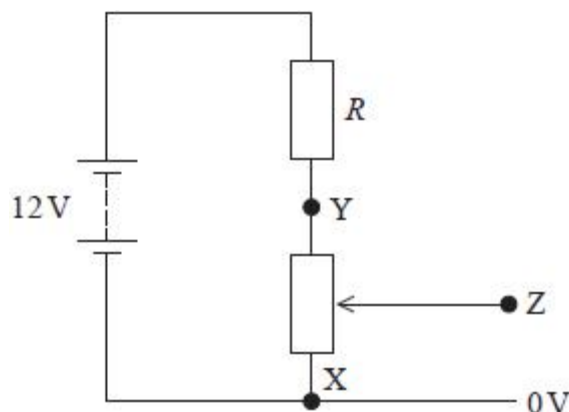
Q4.

A potential divider circuit may contain a component known as a potentiometer. One type of potentiometer consists of a track with terminals X and Y at either end. There is a sliding contact that can move along the track connected to a terminal Z as shown.



The length of the track is 115 mm and the width is 5.0 mm.

The potentiometer is used to monitor the displacement of a moving tool on a machine in a production line. The tool is attached to the sliding contact. The potentiometer is connected to a resistor of resistance R and a potential difference is applied as shown. The tool moves through a maximum displacement of 60 mm from end X, producing a maximum potential difference of 5.0 V between Z and X.



(i) Show that the potential difference between X and Y is about 10 V.

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(ii) Calculate the value of R .

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$R =$

(iii) When the circuit is assembled, using the correctly calculated resistance value and a battery of e.m.f. 12 V, it is found that the maximum output from the potentiometer is slightly less than 5.0 V.

Explain why the maximum output is slightly less than predicted.

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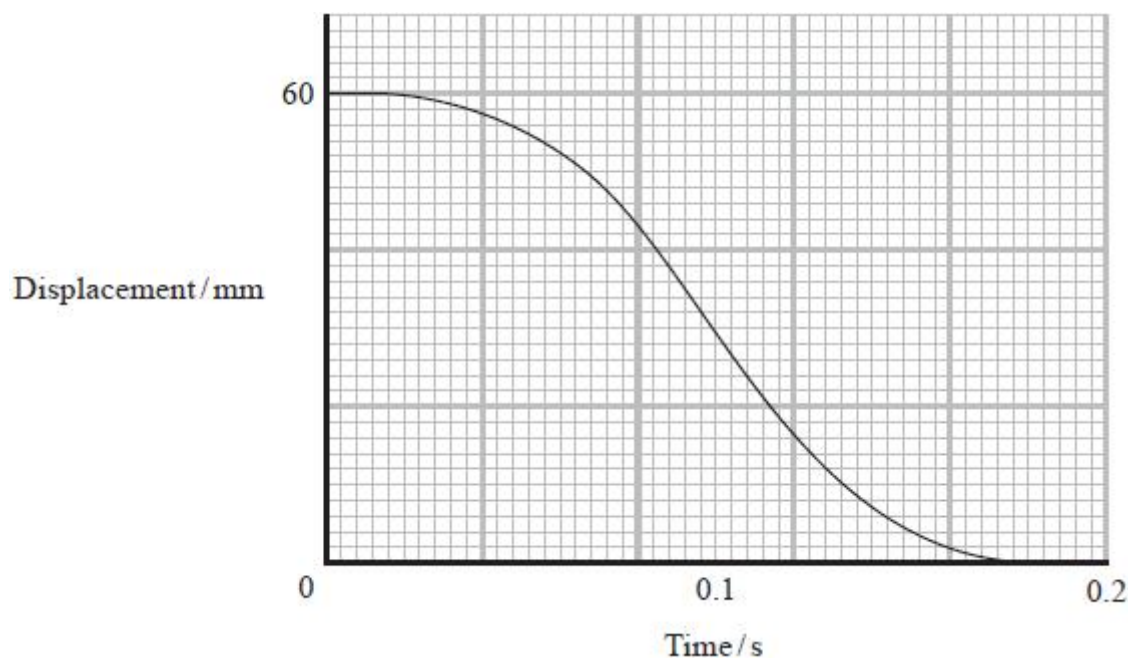
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(iv) The tool on the machine should not travel with a speed any larger than 0.8 m s^{-1} .

The graph shows how the displacement varies with time for the downward stroke of the moving tool.



Deduce whether this speed is exceeded by the moving tool.

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(Total for question = 12 marks)