

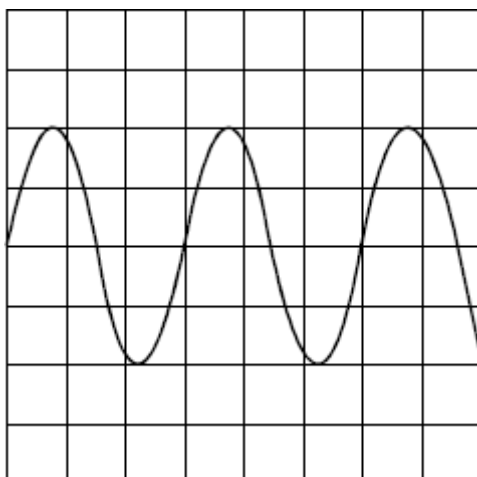
Name of the Student: _____

Max. Marks : 21 Marks

Time : 21 Minutes

Q1.

An alternating current (a.c.) source is connected to a resistor to form a complete circuit. The trace obtained on an oscilloscope connected across the resistor is shown.



The oscilloscope settings are: Y sensitivity 4.0 V per division,
time base 1.0 m s per division.

- (a) Determine the peak voltage of the a.c. source.

- (b) Hence calculate the r.m.s. voltage.

- (c) Determine the time period of the a.c. signal.

- (d) Hence calculate the frequency of the a.c. signal.

(Total 4 marks)

Q2.

A battery of e.m.f. ε and internal resistance r is connected in series with a variable resistor R as shown in **Figure 1**. A voltmeter is connected as shown.

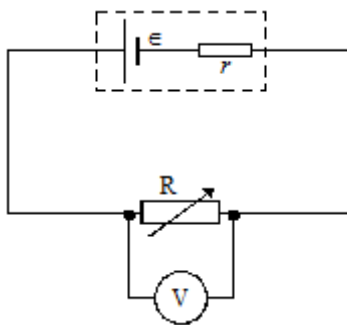


Figure 1

- (a) (i) State what is meant by the e.m.f of a battery.

- (ii) The reading V on the voltmeter is the voltage across R .
Why is V less than ε ?

(3)

- (b) In order to measure ε and r , an ammeter is used in the circuit, as shown in **Figure 2**.

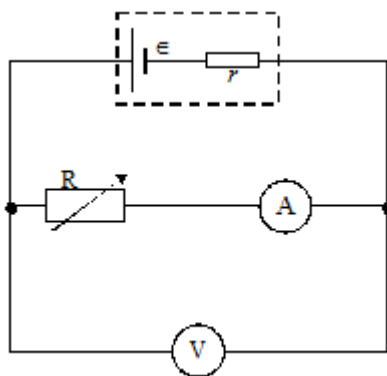


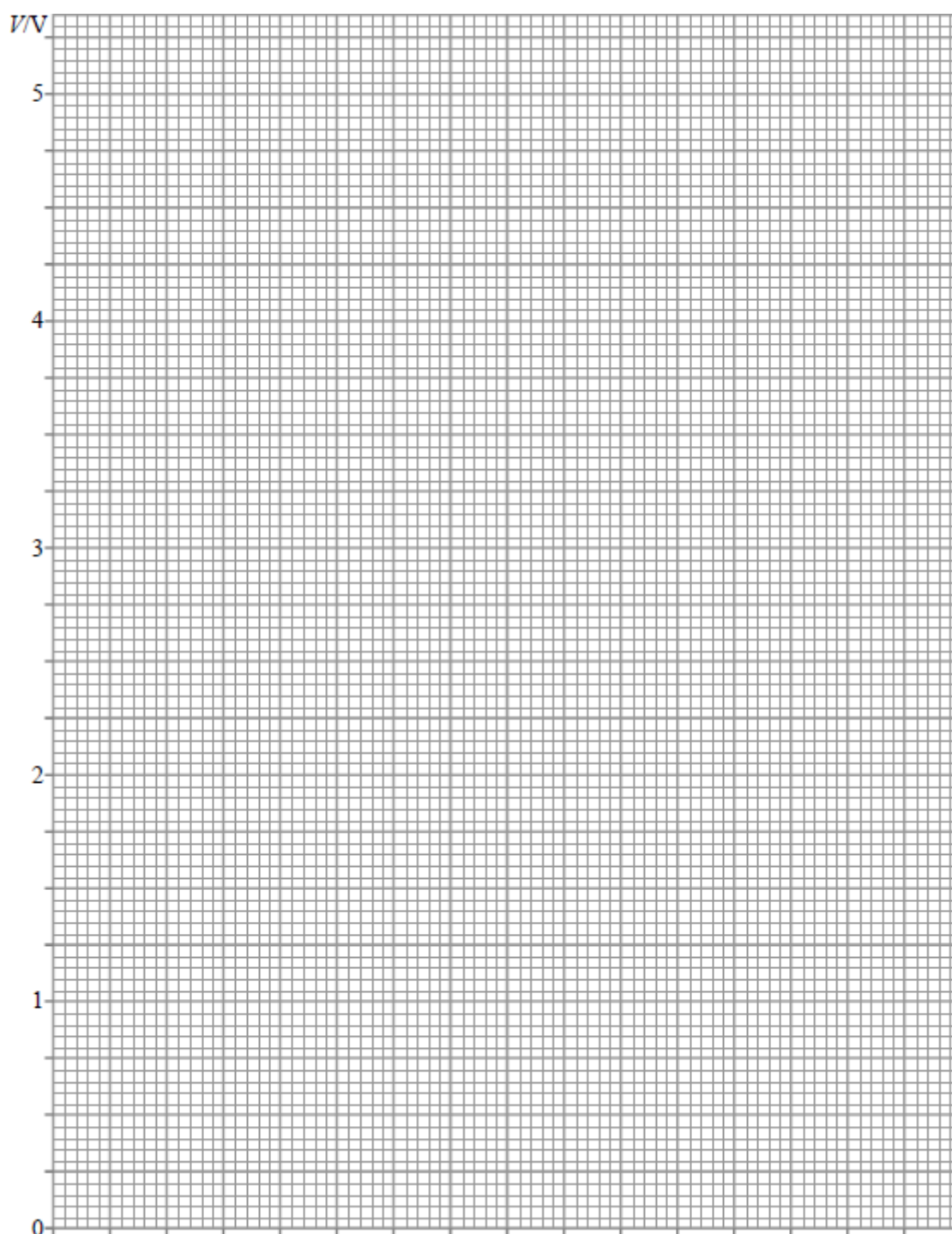
Figure 2

The value of R is decreased in steps and at each step the readings V and I on the voltmeter and ammeter, respectively, are recorded. These are shown in the table.

reading on voltmeter/ V	reading on ammeter/ A
4.0	0.07
3.0	0.14
2.0	0.21

1.0	0.28
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- (i) Plot a graph of V (on y axis) against I (on x axis) and draw the best straight line through the points.



- (ii) Determine the values of ε and r from the graph, explaining your method.

(8)
(Total 11 marks)

Q3.

Photographs of lines in the spectrum of the Sun show changes in wavelength due to the Doppler effect. Due to the rotation of the Sun about its axis, one edge of the Sun is approaching the Earth, and the other edge is receding.

- (a) Give expressions for the observed change in the wavelength of a line of original wavelength, λ ,

- (i) for light coming from the edge which is moving away from the observer at speed v ,

- (ii) for light coming from the edge which is moving towards the observer at speed v .

(2)

- (b) The apparent wavelength of a line of original wavelength 589 nm is measured from photographs showing opposite ends of the diameter of the Sun. The difference between the readings is 78×10^{-3} nm.

Calculate

- (i) the speed, v , of a point on the edge of the Sun,

- (ii) the angular speed of rotation of the Sun.
radius of Sun = 7.0×10^8 m

(4)
(Total 6 marks)

