Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

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General Certificate of Education
June 2001
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

PHYSICS (SPECIFICATION A) PHA3/W
Unit 3 Current Electricity and Elastic Properties of Solids

Monday 18 June 2001 Morning Session

In addition to this paper you will require:
- a calculator;
- a pencil and a ruler.

Time allowed: 1 hour 15 minutes

Instructions
- Use a blue or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. All working must be shown.
- Do all rough work in this book. Cross through any work you do not want marked.
- A *Data Sheet* is provided on pages 3 and 4. Detach this perforated sheet at the start of the examination.

Information
- The maximum mark for this paper is 50.
- Mark allocations are shown in brackets.
- The paper carries 25% of the total marks for Physics Advanced Subsidiary and carries $12\frac{1}{2}$% of the total marks for Physics Advanced.
- You are expected to use a calculator where appropriate.
- In questions requiring description and explanation you will be assessed on your ability to use an appropriate form and style of writing, to organise relevant information clearly and coherently, and to use specialist vocabulary where appropriate. The degree of legibility of your handwriting and the level of accuracy of your spelling, punctuation and grammar will also be taken into account.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
3			
4			
5			
6			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

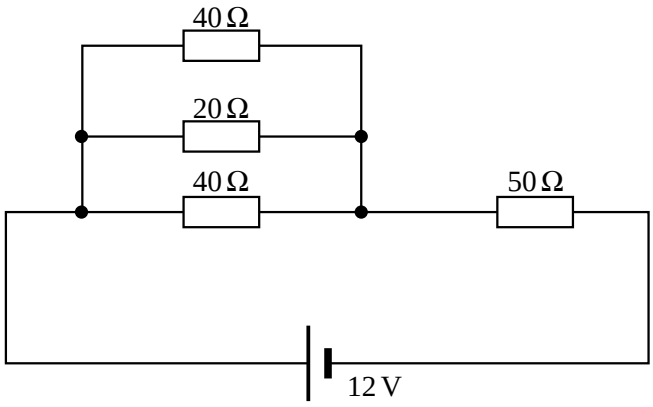
Data Sheet

- A perforated *Data Sheet* is provided as pages 3 and 4 of this question paper.
- This sheet may be useful for answering some of the questions in the examination.
- Detach this sheet before you begin work.

The data sheet will replace this page

The data sheet will replace this page

1 A battery of e.m.f. 12 V and negligible internal resistance is connected to a resistor network as shown in the circuit diagram.



(a) Calculate the total resistance of the circuit.

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(3 marks)

(b) Calculate the current through the 50 Ω resistor.

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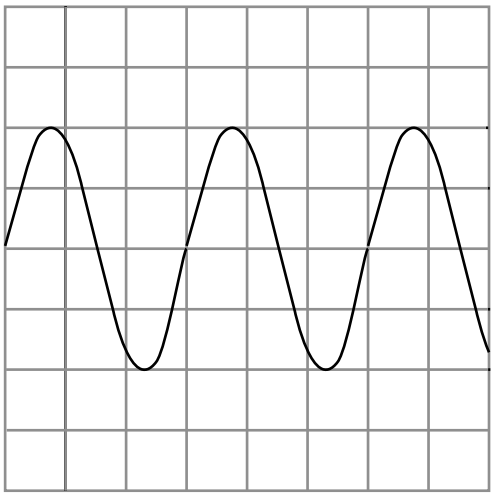
(1 mark)

4

TURN OVER FOR THE NEXT QUESTION

2 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 ms per division.

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

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(ii) Hence calculate the r.m.s. voltage.

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

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(iv) Hence calculate the frequency of the a.c. signal.

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(4 marks)

4

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

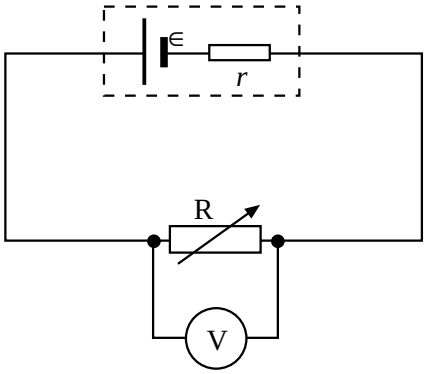

Figure 1

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

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(ii) The reading *V* on the voltmeter is the voltage across R.
Why is *V* less than $\in$?

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(3 marks)

QUESTION 3 CONTINUES ON THE NEXT PAGE

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

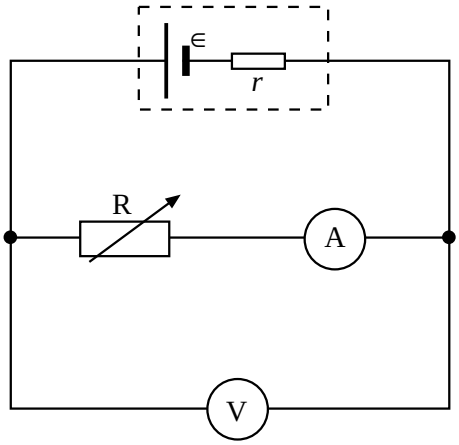

Figure 2

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

(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 $\in$ and r from the graph, explaining your method.

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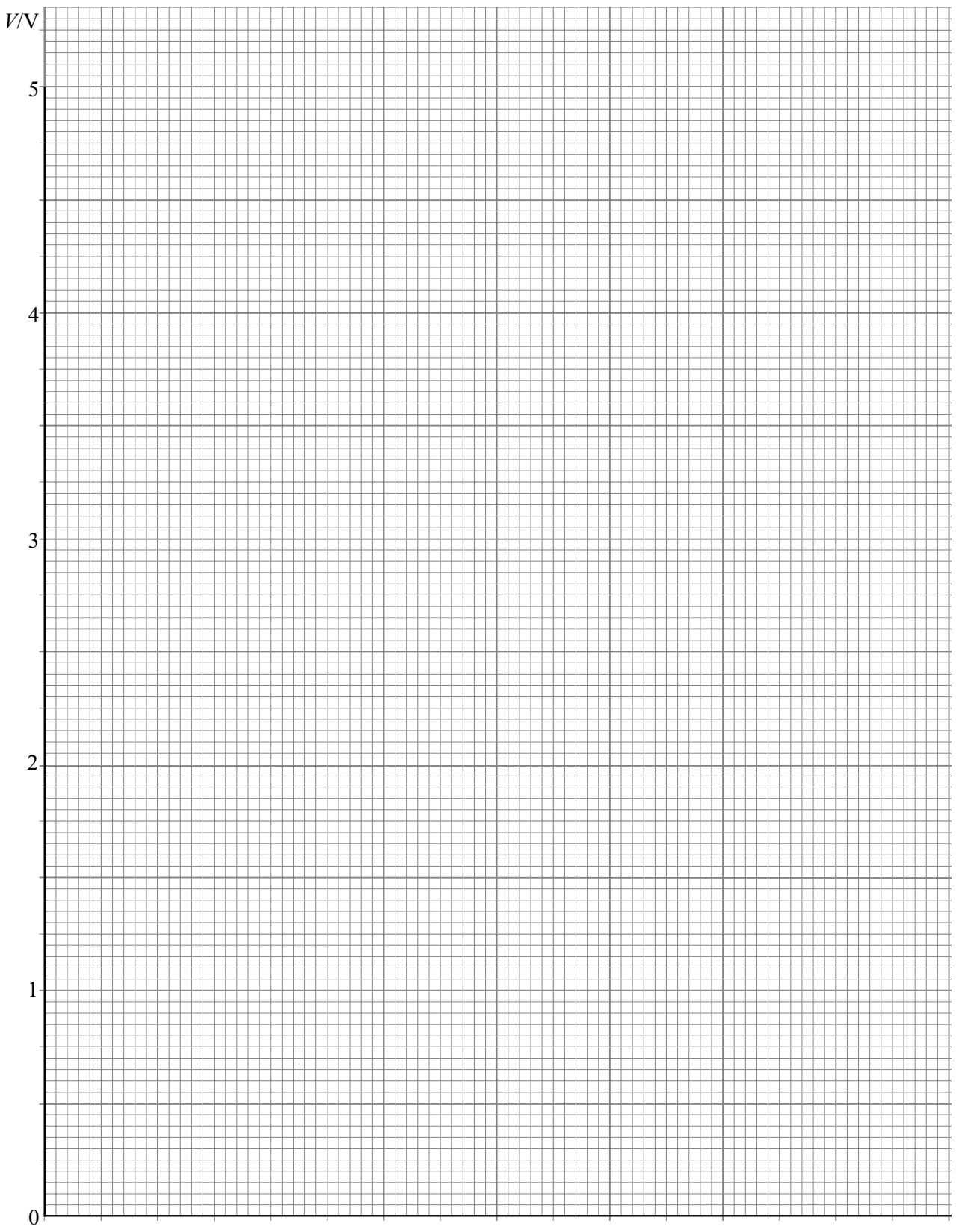
(8 marks)

11



4 (a) (i) Give the equation which relates the *electrical resistivity* of a conducting material to its *resistance*. Define the symbols in the equation.

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.....

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(ii) A potential difference of 1.5 V exists across the ends of a copper wire of length 2.0 m and uniform radius 0.40 mm. Calculate the current in the wire.

resistivity of copper = $1.7 \times 10^{-8}\ \Omega$ m

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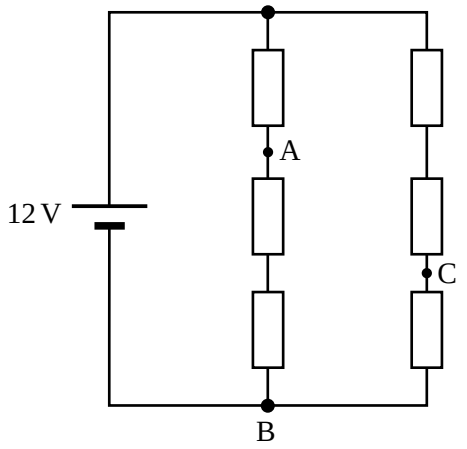
(5 marks)

(b) In the circuit shown, each resistor has the same resistance. The battery has an e.m.f. of 12 V and negligible internal resistance.



(i) Calculate the potential difference between A and B.

.....

.....

(ii) Calculate the potential difference between B and C.

.....

.....

(iii) A high resistance voltmeter is connected between A and C. What is the reading on the voltmeter?

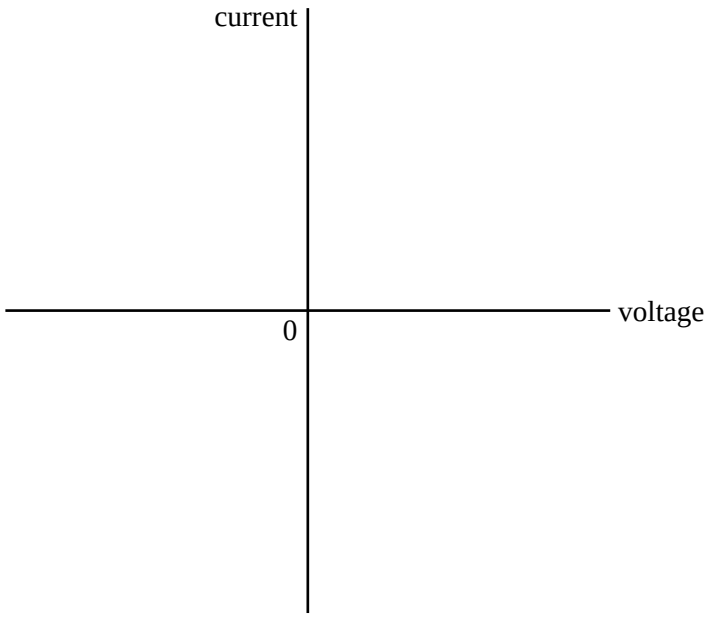
.....

(5 marks)

10

TURN OVER FOR THE NEXT QUESTION

5 (a) Draw, on the axes below, the current/voltage characteristic for a filament lamp.
Do **not** insert any values for current or voltage.



(3 marks)

(b) Explain why the characteristic has the shape you have drawn.

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(3 marks)

(c) The current/voltage characteristic of a filament lamp is to be determined using a datalogger, the data then being fed into a computer to give a visual display of the characteristic.
Draw the circuit diagram required for such an experiment and state what is varied so as to produce a range of values.

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(5 marks)

11

TURN OVER FOR THE NEXT QUESTION

6 (a) When determining the Young modulus for the material of a wire, a *tensile stress* is applied to the wire and the *tensile strain* produced is measured.

(i) State the meaning of

tensile stress, ...

.....

tensile strain. .....

.....

(ii) Define the Young modulus.

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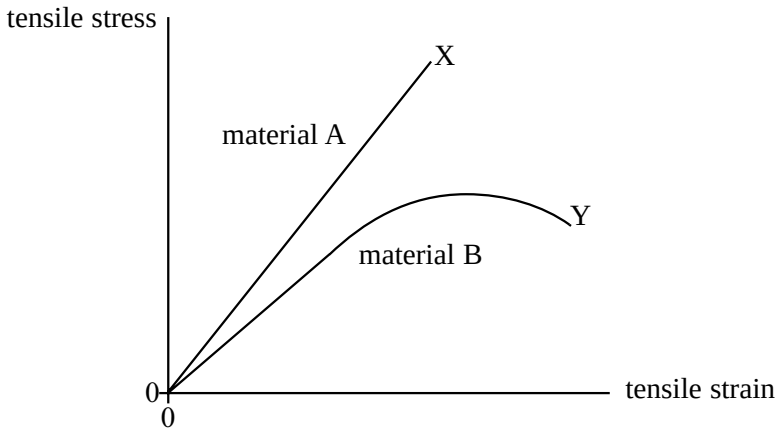
(3 marks)

(b) The graph represents tensile stress - tensile strain curves for two different materials A and B. X and Y are the respective points at which each material fractures.



(i) One of the materials is brittle, the other ductile. State which material is brittle.

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(ii) Making use of the curves in the graph, describe the behaviour of each material as it is stretched from its original state to breaking point.

material A .....

.....

material B .....

.....

(iii) State, giving a reason, which material has the greater value of the Young modulus.

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(5 marks)

(c) A vertical steel piano wire of length 1.5 m and cross-sectional area $1.3 \times 10^{-6} m^2$ supports a load of 80 N.

Given that the Young modulus for steel = 2.10×10^{11} Pa, calculate the extension in the wire produced by this load.

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(2 marks)

10

END OF QUESTIONS

THERE ARE NO QUESTIONS PRINTED ON THIS PAGE