Surname		Other Names	
Centre Number			Candidate Number	
Candidate Signature				

Leave blank

General Certificate of Education
June 2002
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Tuesday 11 June 2002 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 blue or black ink or 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.

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 12½% of the total marks for Physics Advanced.
- A *Data Sheet* is provided on pages 3 and 4. You may wish to detach this perforated sheet at the start of the examination.
- 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			
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.
- You may wish to detach this sheet before you begin work.

DATA SHEET

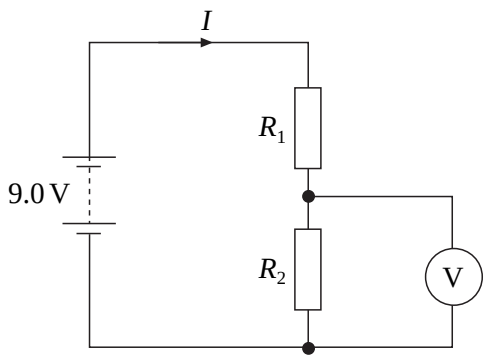
DATA SHEET

TURN OVER FOR THE FIRST QUESTION

LEAVE MARGIN BLANK

Answer **all** questions

1 In the circuit shown, the battery has negligible internal resistance.



(a) (i) If the emf of the battery = 9.0 V, R_1 = 120 Ω and R_2 = 60 Ω, calculate the current I flowing in the circuit.

.....

.....

.....

.....

(ii) Calculate the voltage reading on the voltmeter.

.....

.....

(4 marks)

(b) The circuit shown in the diagram acts as a potential divider. The circuit is now modified by replacing R_1 with a temperature sensor, whose resistance decreases as the temperature increases.

Explain whether the reading on the voltmeter increases or decreases as the temperature increases from a low value.

.....

.....

.....

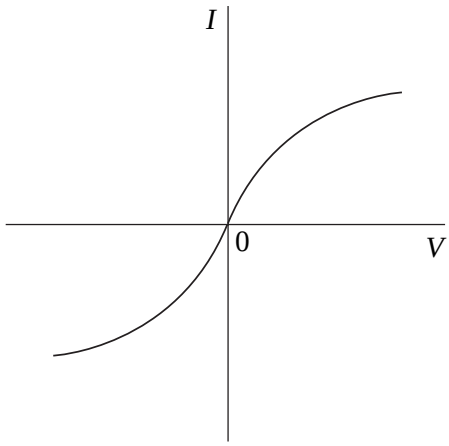
.....

.....

(3 marks)

7

2 (a) The characteristic shown below is that of a filament lamp.



Explain why, as the voltage is increased either positively or negatively from zero, the characteristic has the form shown in the figure.

.....

.....

.....

.....

.....

.....

.....

.....

(5 marks)

(b) At a certain point on the characteristic, the power developed in the lamp is 20 W and the current is 90 mA. Calculate the resistance of the filament at this point on the characteristic.

.....

.....

.....

.....

(2 marks)

7

3 (a) The resistivity of a material in the form of a uniform resistance wire is to be measured. The area of cross-section of the wire is known.

The apparatus available includes a battery, a switch, a variable resistor, an ammeter and a voltmeter.

(i) Draw a circuit diagram using some or all of this apparatus, which would enable you to determine the resistivity of the material.

(ii) Describe how you would make the necessary measurements, ensuring that you have a range of values.

.....

.....

.....

.....

.....

.....

.....

.....

.....

(iii) Show how a value of the resistivity is determined from your measurements.

.....

.....

.....

.....

.....

.....

.....

.....

(9 marks)

(b) A sheet of carbon-reinforced plastic measuring 80 mm × 80 mm × 1.5 mm has its two large surfaces coated with highly conducting metal film. When a potential difference of 240 V is applied between the metal films, there is a current of 2.0 mA in the plastic. Calculate the resistivity of the plastic.

.....

.....

.....

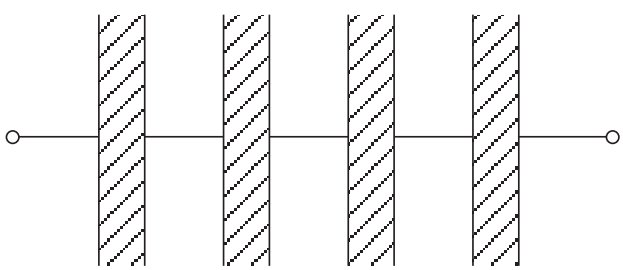
.....

.....

.....

(3 marks)

(c) If four of the units described in part (b) are connected as shown in the diagram, calculate the total resistance of the combination.



.....

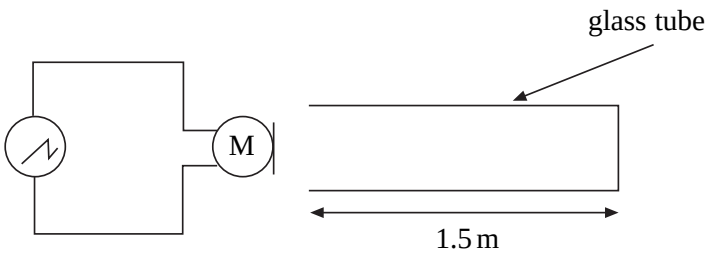
.....

.....

.....

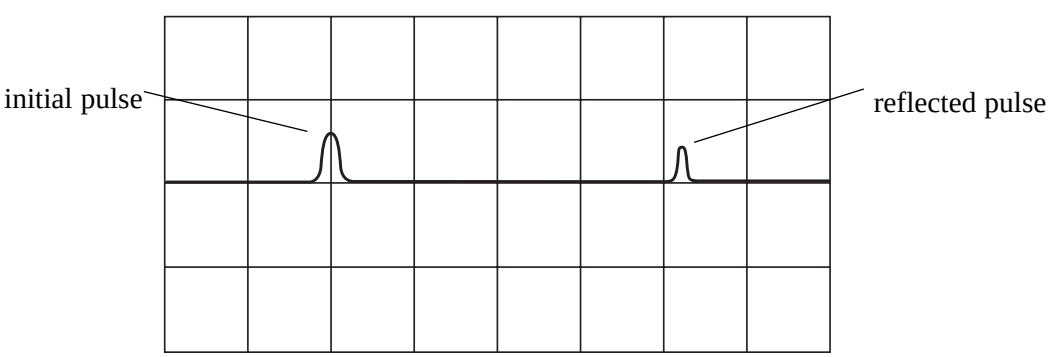
(2 marks)

4 (a) The diagram shows the apparatus required for a simple experiment to measure the speed of sound.



A pulse of sound is sent down a hollow glass tube and is reflected at the sealed end of the tube. A microphone, M, placed at the open end detects the initial pulse and, at a later time, the reflected pulse. The microphone is connected to an oscilloscope which gives a signal when the microphone detects a pulse of sound.

The signal displayed on the oscilloscope screen is shown below.



If the time base of the oscilloscope is set to 2.0 ms per division, estimate the speed of sound in air.

.....

.....

.....

.....

(3 marks)

(b) Describe how the frequency of a sinusoidal alternating (ac) voltage source is measured using an oscilloscope.

Your answer should include a sketch of the trace seen on the oscilloscope screen and explain how the frequency is obtained from this trace.

.....

.....

.....

.....

.....

.....

.....

.....

.....

(5 marks)

8

5 (a) (i) Define the Young modulus for a material.

.....

.....

(ii) Explain what is meant by the *elastic limit* for a wire.

.....

.....

(2 marks)

(b) A wire supported at its upper end, hangs vertically. The table shows readings obtained when stretching the wire by suspending masses from its lower end.

load/N	0	2.0	4.0	6.0	7.0	8.0	9.0	10.0	10.5
extension/mm	0	1.2	2.4	3.6	4.2	4.9	5.7	7.0	8.0

(i) Plot a graph of load against extension on the grid provided.

(ii) Indicate on your graph the region where Hooke's law is obeyed.

(iii) The unstretched length of the wire is 1.6 m and the area of cross-section $8.0 \times 10^{-8}\,m^2$. Calculate the value of the Young modulus of the material.

.....

.....

.....

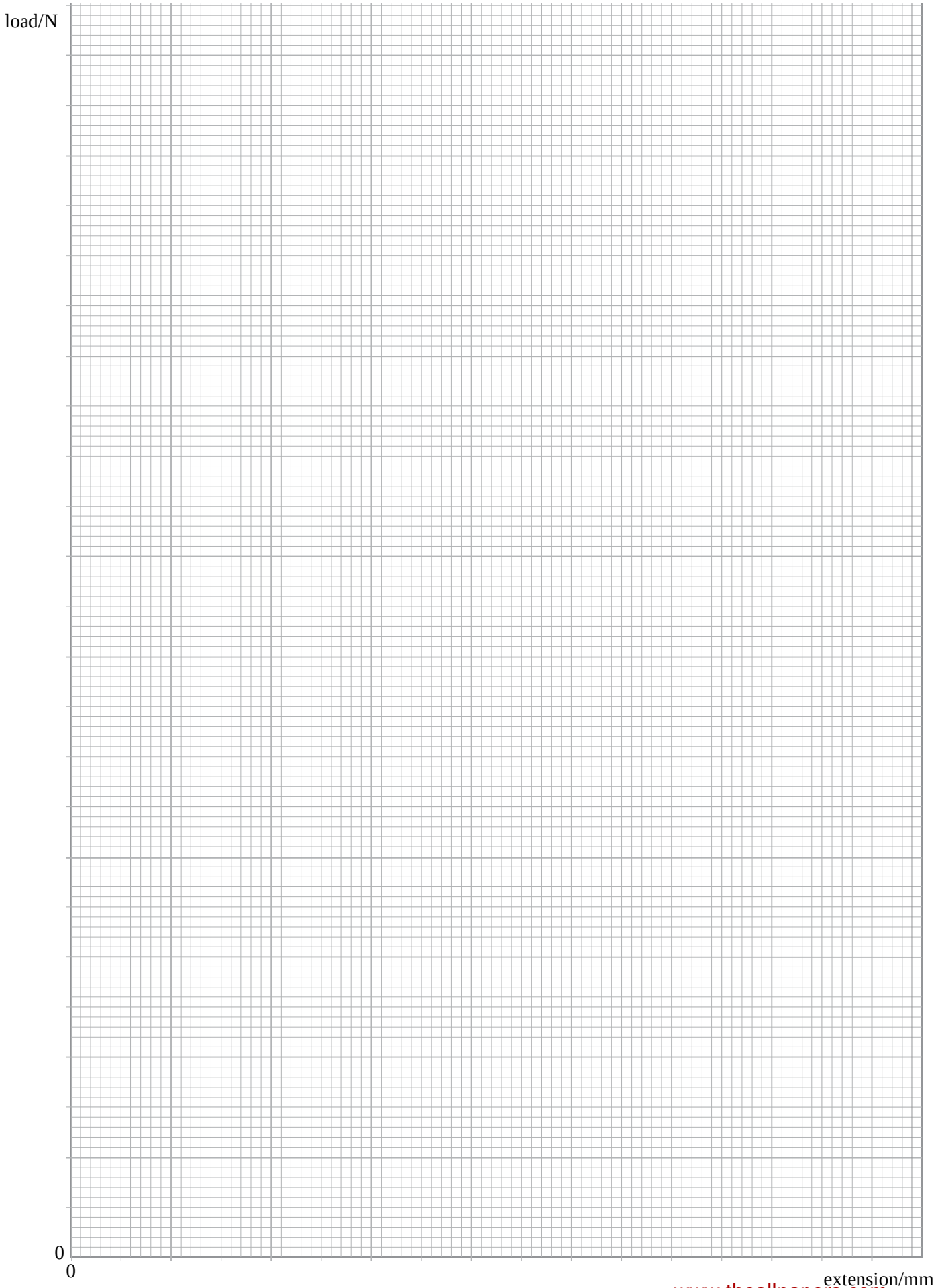
.....

.....

.....

(8 marks)

QUESTION 5 CONTINUES ON PAGE 14



(c) (i) By considering the work done in stretching a wire, show that the energy stored is given by ½ *Fe*, where *F* is the force producing an extension *e*.

.....

.....

.....

.....

.....

(ii) Calculate the energy stored in the wire in part (b) when the extension is 4.0 mm.

.....

.....

.....

(4 marks)

14

END OF QUESTIONS

THERE ARE NO QUESTIONS PRINTED ON THIS PAGE

THERE ARE NO QUESTIONS PRINTED ON THIS PAGE