Surname		Other Names	
Centre Number			Candidate Number	
Candidate Signature			

For Examiner's Use

General Certificate of Education
June 2009
Advanced Subsidiary Examination

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

Thursday 21 May 2009 1.30 pm to 2.30 pm

For this paper you must have:
- a pencil and a ruler
- a calculator
- a data sheet insert.

Time allowed: 1 hour

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Answers written in margins or on blank pages will not be marked.
- Show all your working.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The maximum mark for this paper is 50.
- The marks for questions are shown in brackets.
- A *Data Sheet i*s provided as a loose insert to this question paper.
- You are expected to use a calculator where appropriate.
- Questions 2(a) and 5(a) should be answered in continuous prose. In these questions you will be marked on your ability to use good English, to organise information clearly and to use specialist vocabulary where appropriate.

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Question	Mark	Question	Mark
1			
2			
3			
4			
5			
Total (Column 1) →			
Total (Column 2) →			
Quality of Written Communication			
TOTAL			
Examiner's Initials			

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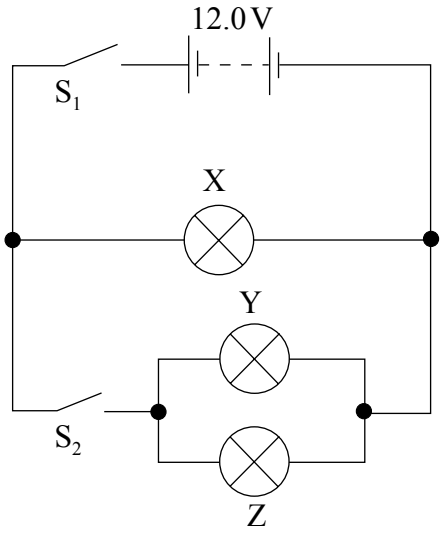
Answer **all** questions in the spaces provided.

1 **Figure 1** shows a low-voltage lighting circuit that includes three identical 12 V, 36 W lamps, X, Y and Z, and a 12.0 V battery of negligible internal resistance.

Figure 1



1 (a) Calculate

1 (a) (i) the resistance of each lamp when it is at normal brightness,

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1 (a) (ii) the total resistance of the circuit when both switches are closed.

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(3 marks)

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1 (b) When switch S_1 is closed and S_2 is open, the battery can light lamp X at full brightness for 21 hours before it becomes discharged.

Calculate

1 (b) (i) the charge, in coulombs, passing through the battery in this time,

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1 (b) (ii) the energy supplied by the battery in this time.

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(3 marks)

1 (c) Explain why the battery would light the lamps for about 7 hours if both switches had been closed.

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(3 marks)

9

Turn over for the next question

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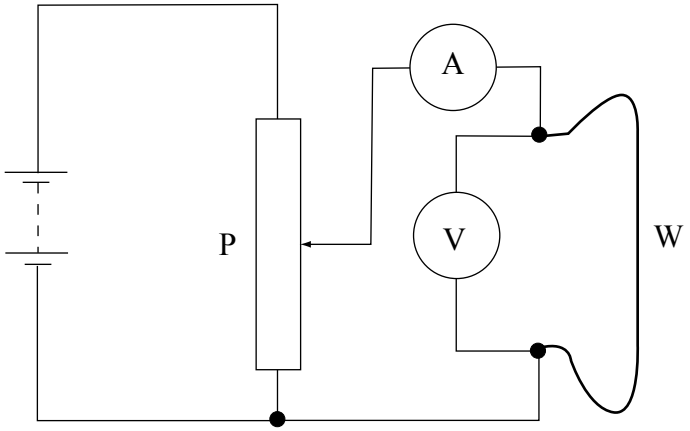
2 (a) **Figure 2** shows a wire, W, of known length and known cross-sectional area connected in a circuit which includes a potential divider P.

You may be awarded additional marks to those shown in brackets for the quality of written communication in your answer.

Figure 2



2 (a) (i) Describe how you would use the circuit in **Figure 2** to determine the resistance of wire W by a graphical method.

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2 (a) (ii) Explain how you would find the resistivity of the material of the wire.

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(5 marks)

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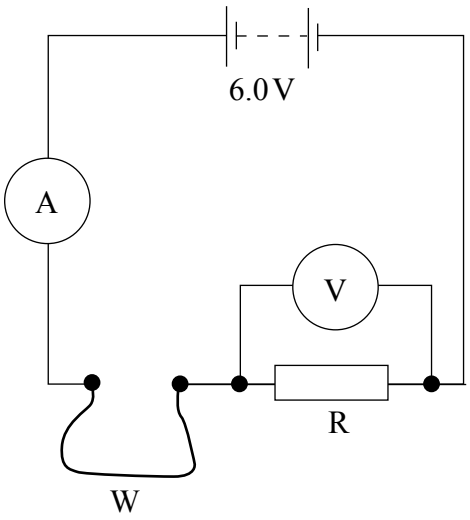
2 (b) **Figure 3** shows a resistor, R, connected in series with wire W and a battery of emf 6.0 V and negligible internal resistance. When the ammeter reading is 0.82 A, the voltmeter reading is 1.1 V.

Figure 3



2 (b) (i) Calculate the resistance of W.

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2 (b) (ii) Calculate the ammeter and voltmeter readings if the length of W in the circuit is reduced by half.

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(6 marks)

11

Turn over ▶

Areas outside the box will not be scanned for marking

3 A motorcycle battery has an *emf* of 6.0 V and an unknown internal resistance.

3 (a) (i) Explain what is meant by emf.

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3 (a) (ii) With the aid of a circuit diagram, describe how you would measure the pd across the terminals of the battery and the current through it for a range of currents.

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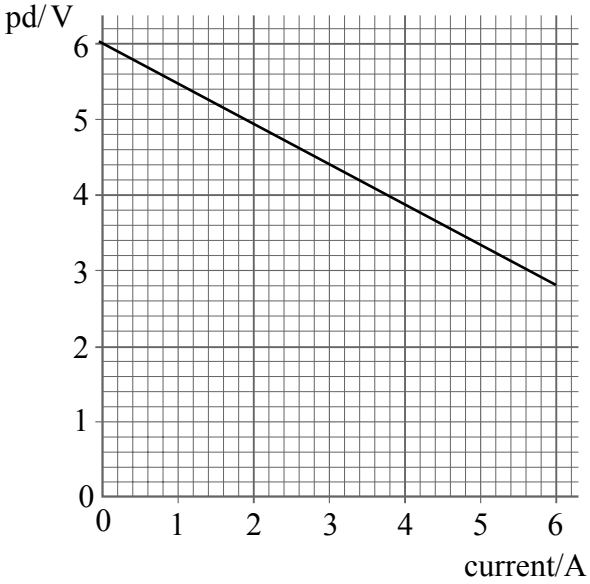
(5 marks)

Areas outside the box will not be scanned for marking

3 (b) **Figure 4** shows how the pd across the battery terminals varies with the current.

Figure 4



3 (b) (i) Use the graph to determine the internal resistance of the battery.

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3 (b) (ii) Calculate the percentage of the battery power that is wasted due to its internal resistance when the current is 5.0 A.

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(6 marks)

11

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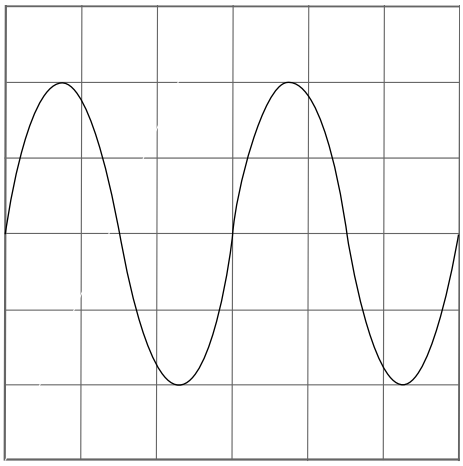
4 In an experiment to measure the frequency and peak value of an ac supply, the voltage waveform was displayed on an oscilloscope, as shown in **Figure 5**.

Figure 5



4 (a) (i) The time base control of the oscilloscope was set at $2.0\,\text{ms}\,\text{cm}^{-1}$. Determine the frequency of the ac supply.

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4 (a) (ii) The voltage supply of the Y-input of the oscilloscope was $5.0\,\text{V}\,\text{cm}^{-1}$. Determine the peak voltage of the alternating supply.

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(4 marks)

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4 (b) An ac supply of peak voltage 6.2 V was applied to a 1.5 Ω resistor.

Calculate

4 (b) (i) the rms current through the resistor,

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4 (b) (ii) the mean power supplied to the resistor.

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(3 marks)

7

Turn over for the next question

Areas outside the box will not be scanned for marking

5 (a) A copper wire has a *breaking stress* of 1.5×10^8 Pa. When it is stretched until it breaks, it undergoes *plastic deformation* before it breaks.

You may be awarded additional marks to those shown in brackets for the quality of written communication in your answer.

Explain what is meant by

5 (a) (i) breaking stress,

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5 (a) (ii) plastic deformation.

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(3 marks)

5 (b) A steel wire on a guitar is fixed at one end and attached to a key at the other end that may be turned to alter the tension in the wire. The wire has a length of 810 mm and a cross-sectional area of 2.3×10^{-7} m^2.

With the wire in a state of tension, the key is turned to stretch the wire by winding 0.50 mm of the wire around the key.

Calculate

5 (b) (i) the increase in strain in the wire,

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5 (b) (ii) the increase in tension in the wire, stating **one** assumption you make in your calculation.

Young modulus of steel = 2.1×10^{11} Pa

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(7 marks)

10

Quality of Written Communication *(2 marks)*

2

END OF QUESTIONS

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