Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

For Examiner's Use

General Certificate of Education
June 2008
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

PHYSICS (SPECIFICATION B) **PHB3**
Unit 3 Practical

Wednesday 14 May 2008 1.30 pm to 3.30 pm

For this paper you must have:
- a calculator
- A4 graph paper
- a ruler.

Time allowed: 2 hours

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. A separate sheet of graph paper is required for Question 3. Attach your graph to this book before handing it to the invigilator at the end of the examination.
- 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 78.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- Questions 1(c) and 2(d)(iv) should be answered in continuous prose. In these questions you will be marked on your ability to use good English, organise information clearly and to use specialist vocabulary where appropriate.

Advice
- You are allowed 30 minutes for each of Questions 1 and 2, and one hour for Question 3.
- Before commencing the first part of any question, read the question through completely.

For Examiner's Use			
Question	Mark	Question	Mark
1			
2			
3			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

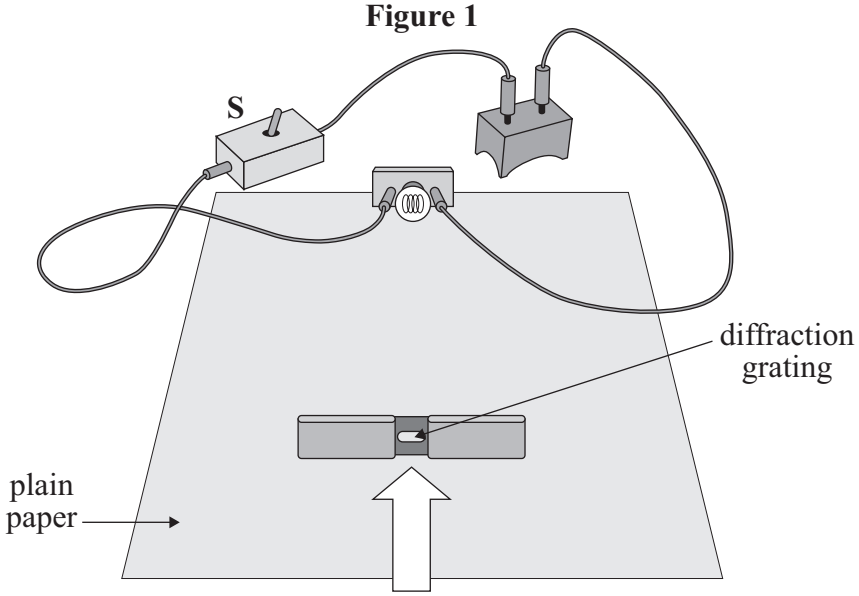
Answer **all** questions in the spaces provided.

You are allowed 30 minutes for this question.

1 You are going to use a diffraction grating to measure the wavelength of the red light emitted by a filament lamp.

The arrangement shown in **Figure 1** is set up for you.

Figure 1



1 (a) (i) Close the switch **S** and look at the filament lamp through the diffraction grating.

Describe what you see.

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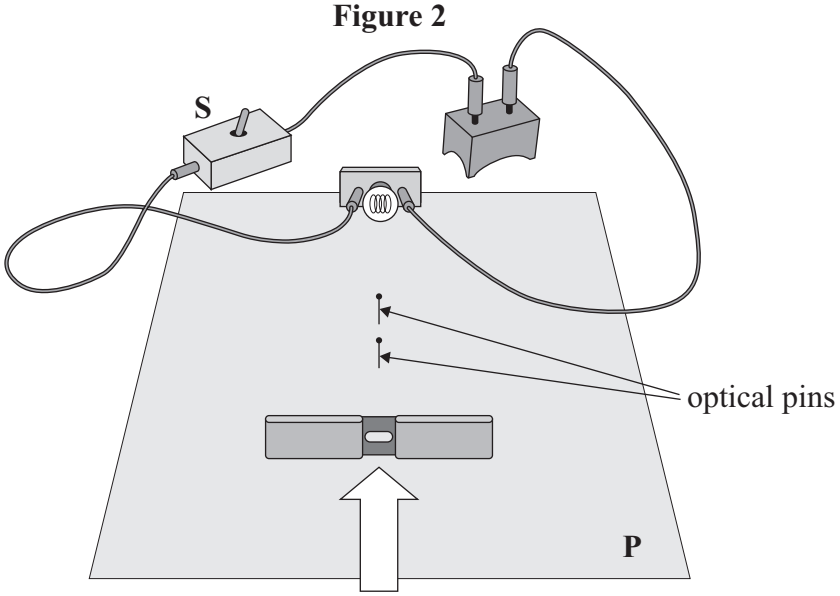
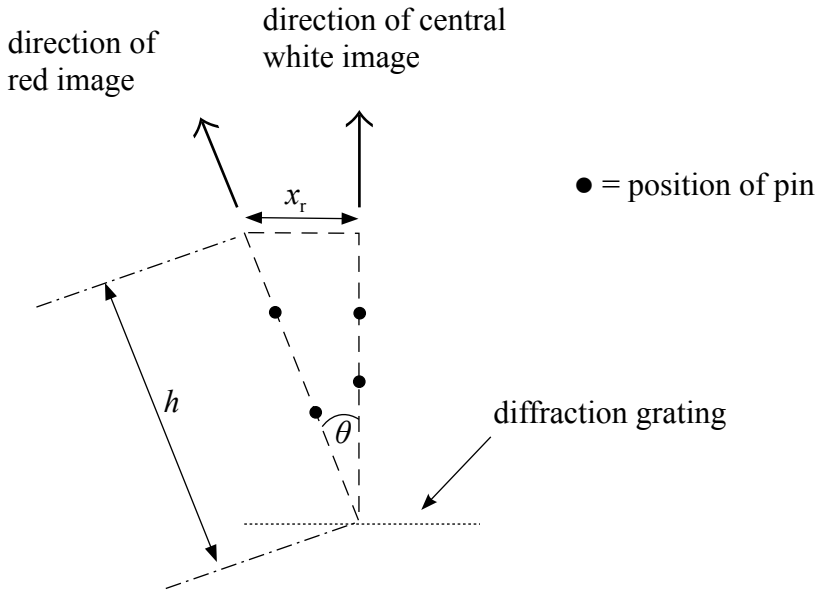
Figure 2



1 (a) (ii) Stick a pair of optical pins into the paper so that they are lined up with the central white image of the filament of the lamp when viewed through the grating as shown in **Figure 2**. Remove the pins, making sure that their positions are clearly marked.

1 (a) (iii) Using the pins again, line them up with the centre of the first order red image on one side of the filament image viewed in part (a)(ii). Again make sure that the pin positions are clearly marked.

Figure 3



Question 1 continues on the next page

1 (a) (iv) Remove the lamp, grating and pins. Using the position of the pins marked in parts (a)(ii) and (a)(iii) draw a right angled triangle on the paper **P** as shown in **Figure 3**.

1 (a) (v) Showing your working clearly calculate a value for sin θ where θ is the angle shown in **Figure 3**.

1 (a) (vi) Using the diffraction grating equation, calculate the wavelength of the red light emitted by the filament lamp.

The number of lines per mm for your grating is given on the card next to your apparatus.

(9 marks)

1 (b) (i) Estimate the absolute uncertainties in x_r and h shown in **Figure 3**.

1 (b) (ii) Calculate the percentage uncertainties in these quantities.

1 (b) (iii) Calculate the percentage uncertainty in your calculated wavelength for red light. Neglect any uncertainty in the grating spacing.

(5 marks)

1 (c) Suggest and explain **two** changes to the experiment you have performed in part (a) that would improve the reliability of your measurement of the wavelength.

Two of the 6 marks in this question are available for the quality of your written communication.

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(6 marks)

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Turn over for the next question

You are allowed 30 minutes for this question.

2 You are going to make measurements to allow you to estimate the resistivity of a metal and observe how it changes when the temperature is increased.

2 (a) Use the multimeter to measure the resistance R of the wire. Record R.

(1 mark)

2 (b) (i) The wire has been wound on a wooden rod. Use a ruler to measure the diameter d of the rod. Record your value.

2 (b) (ii) There are 50 turns of wire on the rod.
Use your measurement of d to estimate the length l of the sample of wire.
Show your working.

2 (b) (iii) State whether your estimate is likely to be too large or too small.
Give **two** reasons to support your statement.

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(5 marks)

2 (c) Resistivity is given by the equation $\rho = \frac{RA}{l}$.

2 (c) (i) State the meaning of the symbols in this equation.

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2 (c) (ii) The diameter of your wire is given on a card near your apparatus. Use this value and the measurements you made earlier to estimate the resistivity of the metal.

(3 marks)

2 (d) (i) Measure and record the room temperature.

2 (d) (ii) Reconnect the multimeter to the ends of the sample of wire. Fully immerse your sample of wire in the hot water provided by the Supervisor, making sure that the crocodile clip connections are above the water surface.
Record the new resistance of the wire and the temperature of the water.
Do not repeat these readings.

2 (d) (iii) From your data in parts (a), d(i) and d(ii), sketch a graph to suggest how the **resistivity** of the metal changes with temperature.

Question 2 continues on the next page

2 (d) (iv) State the limitations of your sketch graph and go on to explain, in terms of charge carriers, why you expected the resistivity to change with temperature.

Two of the 6 marks in this part of this question are available for the quality of your written communication.

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(10 marks)

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You are allowed one hour for this question.

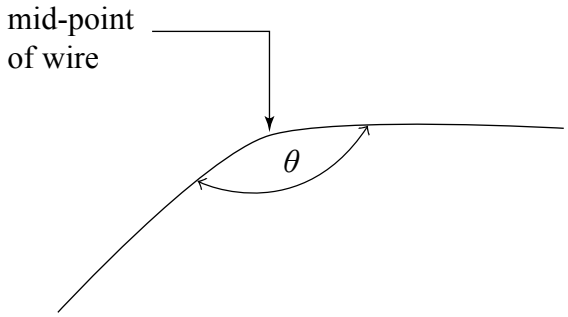
3 You are to investigate oscillations of a bent wire.

3 (a) Measure and record the length, L, in metres of the wire when it is straight.

(3 marks)

3 (b) Carefully bend the wire at its mid-point to form an angle θ of approximately 140° as shown in **Figure 4**.

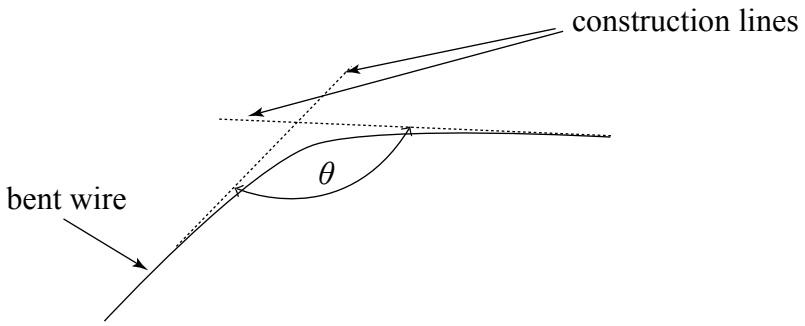
Figure 4



Question 3 continues on the next page

3 (b) Trace the shape of your wire onto a separate sheet of paper. Remove the wire and use a ruler to construct lines which will help you to measure θ as shown in **Figure 5**. Measure and record your value for θ.

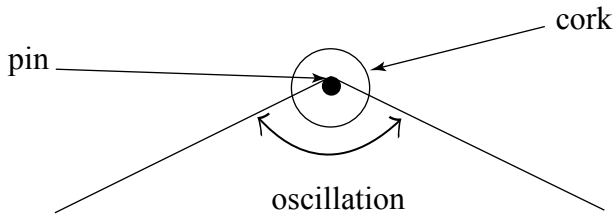
Figure 5



(1 mark)

3 (c) Suspend the wire so that it balances on the horizontally clamped pin as shown in **Figure 6.** Displace and release it so that it oscillates in the way shown in **Figure 6**.

Figure 6



3 (c) (i) Take and record appropriate readings and find the period of oscillation, T, of the wire at the angle measured in part (b).

3 (c) (ii) Explain how you made sure that your value for T was accurate.

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(4 marks)

3 (d) In the space below construct a table in which to record all the readings you need to obtain 6 sets of values of θ (as shown in **Figure 5**) and T.
Include further columns in your table or draw a second table to include T^2, $\cos\frac{\theta}{2}$ and $\frac{1}{\cos\frac{\theta}{2}}$ where $\frac{\theta}{2}$ is half the angle of the bend in the wire.

(4 marks)

3 (e) Take the readings to complete the table. You should include your original values for θ and T. Your range of values of θ should vary between 140° and 60°. You are advised to use additional values of θ of approximately 130°, 115°, 100°, 80° and 60°. **The exact values are not critical.**

(13 marks)

Question 3 continues on the next page

3 (f) Plot a graph of T^2 (along the y-axis) against $\dfrac{1}{\cos\frac{\theta}{2}}$

You should use a false origin for each axis.
Draw the best straight line through your plotted points. *(7 marks)*

3 (g) (i) Calculate the gradient of your line.

3 (g) (ii) The relationship between T and θ can be written in the form

$$T^2 = 4\pi^2 k\left(\frac{1}{\cos\frac{\theta}{2}}\right)$$

By comparing this equation with the equation of a straight line $y = mx + c$, use your value for the gradient to calculate a value for k.

3 (g) (iii) State the unit for k.

(6 marks)

3 (h) Consider the points on your plotted graph and explain why values of θ suggested in part (e) were not equally spaced.

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(1 mark)

END OF QUESTIONS

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