Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

For Examiner's Use

General Certificate of Education
January 2007
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Wednesday 17 January 2007 1.30 pm to 3.30 pm

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

Time allowed: 2 hours

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

Instructions
- Use a blue or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided. 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.
- Four of these marks will be awarded for using good English, organising information clearly and using specialist vocabulary where appropriate.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- Questions 1(e) and 2(f) should be answered in continuous prose. In these questions you may be marked on your ability to use good English, to organise information clearly and to use specialist vocabulary where appropriate.

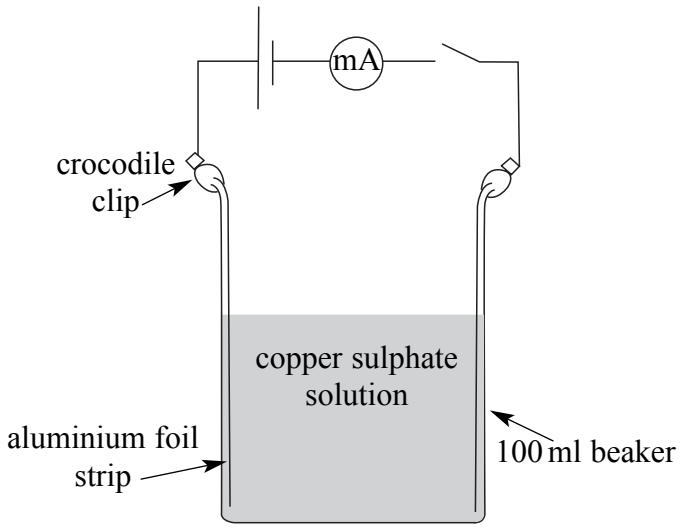
Advice
- You are allowed 30 minutes for each of Questions 1 and 2, and one hour for Question 3.
- Before commencing the first part of any question, read the question through completely.

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

You are allowed 30 minutes for this question.

1 You are going to investigate electrical conduction in a liquid and consider the physical factors that affect the magnitude of the current.

Figure 1



(a) (i) The apparatus is shown in **Figure 1**. Connect the circuit and, using the measuring cylinder, pour 25 cm^3 of the copper sulphate solution into the beaker. Switch on the circuit, measure and record the maximum current *I* and then switch off the circuit.

(ii) Add a further 25 cm^3 of the solution, switch on the circuit, measure and record *I* and then switch off the circuit.

(iii) Add a further 25 cm^3 of the solution, switch on the circuit, measure and record *I* and then switch off the circuit.

(4 marks)

(b) It is suggested that I is directly proportional to the volume of liquid in the beaker. Without plotting a graph, use your data from part (a) to test this suggestion. Show your working and clearly state your conclusion.

(4 marks)

(c) The value of I is affected by the volume of liquid in the beaker, the separation of the foil strips and the properties of the power supply circuit. State **two** other physical factors that you would expect to affect I.

(2 marks)

(d) With the aid of a sketch graph, explain how you would expect I to vary with the separation of the foil strips.

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(3 marks)

Question 1 continues on the next page

(e) Carefully describe how you would perform an experiment to test the prediction implied by your answer to part (d).

Two of the 7 marks in this question are for the quality of your written communication.

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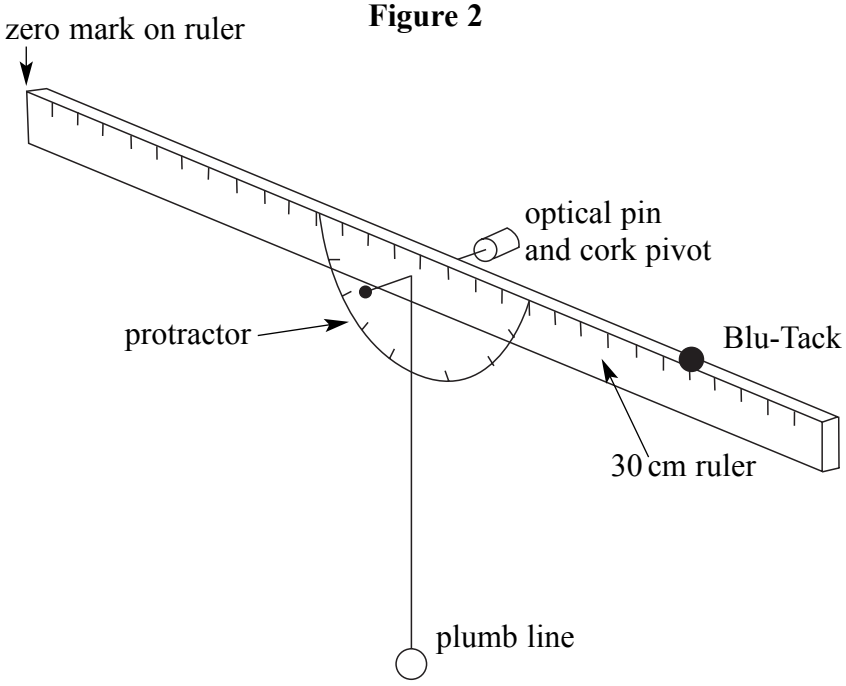
(7 marks)

20

You are allowed 30 minutes for this question.

2 The apparatus has been set up for you as shown in **Figure 2**.

Figure 2



(a) Remove the Blu-Tack and measure the angle between the plumb line and the 90° line on the protractor. This is the zero error for your apparatus.

(1 mark)

(b) (i) Attach the piece of Blu-Tack at the 20 cm mark on the ruler and record the angle between the plumb line and the 90° line on the protractor.

(ii) Calculate the angle θ given by your value from part (b)(i) corrected by the zero error recorded in part (a).

(2 marks)

Question 2 continues on the next page

(c) Take appropriate readings and complete the table in **Figure 3**. d is the distance between the Blu-Tack and the pivot and ϕ is the mean value of θ.

Figure 3

d/cm	θ/degrees			ϕ/degrees	tanϕ
5.0					
10.0					
15.0					

(4 marks)

(d) Estimate the absolute uncertainty in your readings for θ and show clearly how you arrived at this estimate.

(3 marks)

(e) Theory suggests that for this experiment the ratio $\frac{d}{\tan\phi}$ is a constant. Using your data, estimate the percentage uncertainty in the value of $\frac{d}{\tan\phi}$ for $d = 5.0\,\text{cm}$. Show your working clearly.

In this case, you may assume that the percentage uncertainty in $\tan\phi$ is the same as the percentage uncertainty in ϕ.

(3 marks)

(f) Describe an experiment, based on the apparatus used in this question, to verify as accurately as possible that $\frac{d}{\tan\phi}$ = constant.

You should clearly identify sources of uncertainty and then suggest ways to minimise them.

Two of the 7 marks in this question are for the quality of your written communication.

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(7 marks)

You are allowed one hour for this question.

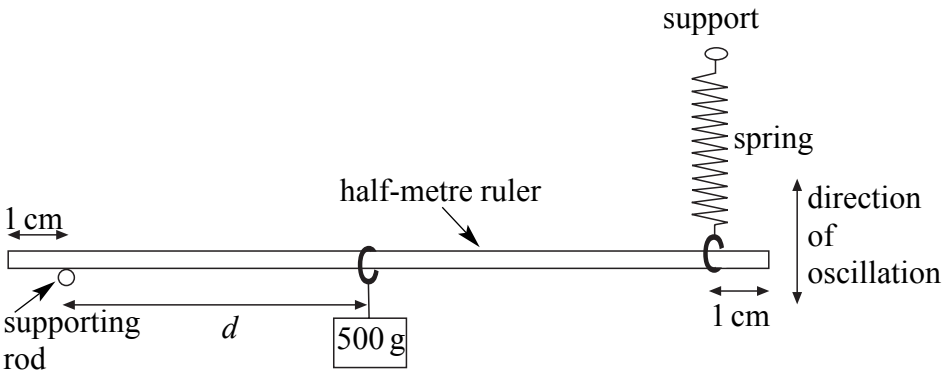
3 You are going to investigate how vertical oscillations of a supported beam are affected by the loading of that beam. Assemble the apparatus as shown in **Figure 4**.

The supporting rod at one end, and the loop at the bottom of the spring at the other end, should each be positioned **1 cm from the end of the ruler**.

Initially, the 500 g load should be suspended so that $d = 0.450$ m.

The spring should be vertical.

Figure 4



It is important that, each time the apparatus is adjusted, the half-metre ruler is resting horizontally with its supports 1 cm from its ends, before it is set in motion.

(a) Carefully displace the right-hand end of the ruler a short distance downwards and then release it so that it oscillates in a vertical plane. Take sufficient measurements to determine accurately the period T of these oscillations.

(4 marks)

(b) You are going to investigate how the period of oscillation T varies with the distance d shown in **Figure 4**, where d is measured in metres.

(i) In the space below, draw a table in which to record **all** of your measurements. Include in your table columns for recording d^2 and T^2.

(ii) Complete your table making measurements of T for values of d = 0.250, 0.300, 0.350 and 0.400 m.

(18 marks)

Question 3 continues on the next page

(c) (i) On a separate sheet of graph paper, plot a graph of T^2 (y-axis) against d^2. Start both origins at zero.

Draw the best straight line through your points. *(7 marks)*

(ii) Determine the gradient of your graph.

(3 marks)

(d) Theory suggests that the equation for your line is

$$T^2 = \frac{A}{k}d^2 + B$$

where $A = 86\,\text{kg}\,\text{m}^{-2}$
k is the spring constant
and B is a constant for the apparatus.

The equation for a straight line graph is $y = mx + c$.

Use your gradient to calculate k.

(3 marks)

(e) (i) Determine the period when d is zero.

(ii) Suggest a reason why the graph does not pass through the origin.

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(3 marks)

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END OF QUESTIONS

There are no questions printed on this page