Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

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General Certificate of Education
January 2003
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

PHYSICS (SPECIFICATION B) PHB3
Unit 3 Practical

Tuesday 21 January 2003 Morning session

In addition to this paper you will require:
- a calculator;
- A4 graph paper;
- a ruler.

Time allowed: 2 hours

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. A separate sheet of graph paper is required for Question 3.
- 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 78.
- Mark allocations are shown in brackets.
- You are expected to use a calculator where appropriate.
- 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.

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

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

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

30 minutes are allowed for this question.

Total for this question: *20 marks*

1 **Figure 1** shows a spring of unextended length *l*. You are first going to measure the extension of the spring for **two** different weights. You are then going to design an experiment that would allow you to measure an unknown weight using your spring and a lever.

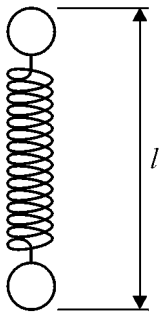

Figure 1

(a) (i) Measure and record *l* in m. *(1 mark)*

(ii) Suspend the spring from the clamp. Add a 1.00 N weight to the lower loop of the spring and measure and record the new length of the spring l_1 in m.

(1 mark)

(iii) Remove the 1.00 N weight and replace it with a 2.00 N weight. Measure and record the new length of the spring l_2 in m.

(1 mark)

(iv) Calculate the **two** extensions of the spring.

Extension for 1.00 N weight = ...
Extension for 2.00 N weight = ...

(2 marks)

(b) (i) Use your values of weight and extension to help you to decide whether or not the extension of the spring is proportional to the weight suspended from it.

(3 marks)

(ii) Explain how reliable you believe your conclusion to be.

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(1 mark)

QUESTION 1 CONTINUES ON PAGE 4

(c) **Figure 2** shows an arrangement for measuring the value of an unknown weight (W) using the principle of moments.

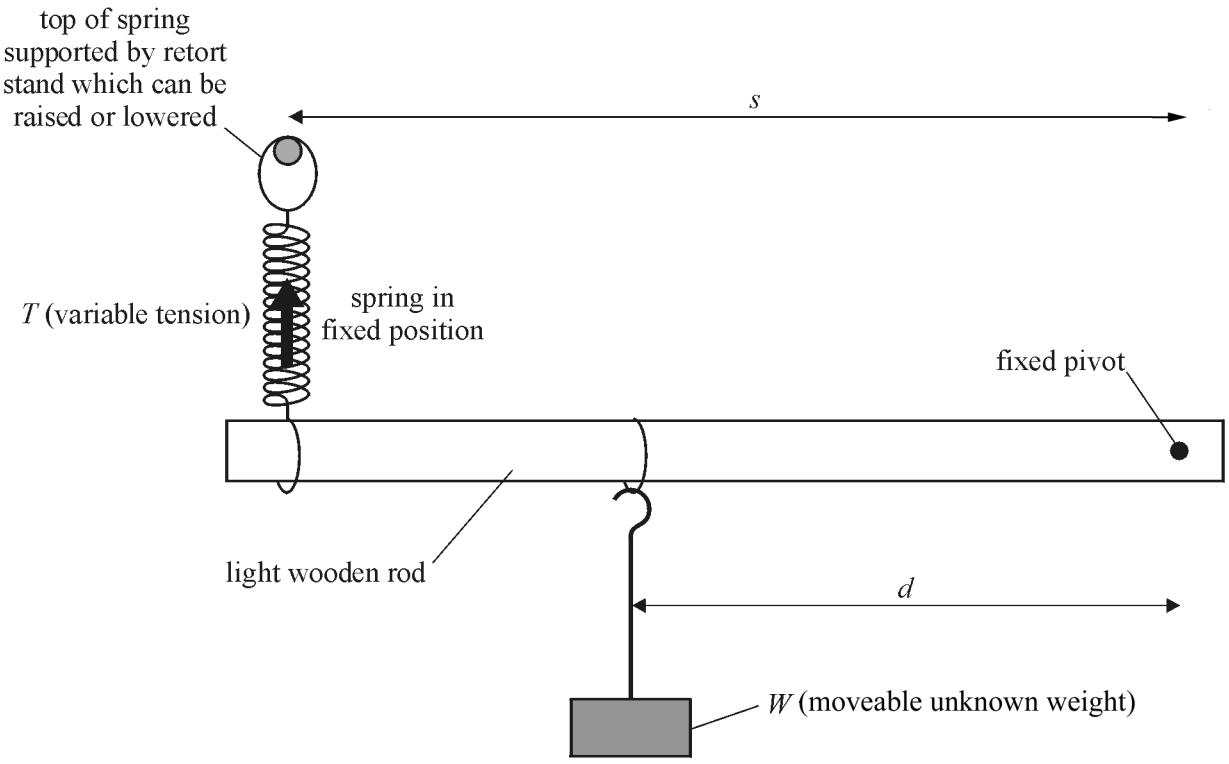

Figure 2

(i) State the principle of moments.

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(2 marks)

(ii) When the rod is horizontal, write down the relationship between the tension T in the stretched spring, the unknown weight W and the distances s and d. You should ignore the weight of the light wooden rod.

(2 marks)

(d) Describe how you would use the apparatus shown in **Figure 2** to take a series of readings of d and the extension of the spring, which would allow you to draw a graph to help you to calculate an accurate value for the unknown weight W.

Include in your description:

- the range and number of readings that you would expect to take;
- sensible dimensions for your apparatus;
- the graph that you would plot and the way that you would use your graph to calculate the value of the unknown weight W.

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

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(7 marks)

20

30 minutes are allowed for this question

Total for this question: *20 marks*

2 You are going to investigate the sensitivity of a light dependent resistor (LDR) to light of different wavelengths. You have been provided with a voltage divider circuit set up as in **Figure 3**.

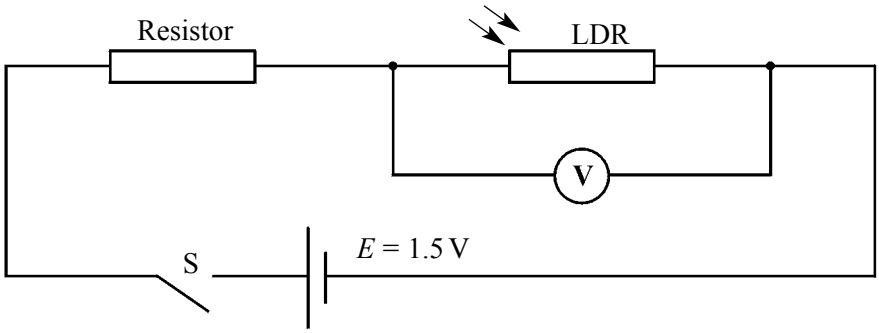


Figure 3

(a) Switch on the lamp; do not attempt to alter its position. Close the switch **S** and measure and record the potential difference, V, across the LDR with the lamp held directly above it.

V = ...

(1 mark)

(b) (i) Calculate the resistance, R_L, of the LDR using the following equation:

$$R_L = \frac{RV}{E-V}$$

where R = resistance of the resistor, $(5.0 \pm 0.3)\,\text{k}\Omega$
and E = emf of the cell, $(1.5 \pm 0.1)\,\text{V}$ *(3 marks)*

(ii) Estimate the absolute uncertainty in your value V.

(1 mark)

(iii) Calculate the absolute uncertainty in $E - V$

(1 mark)

(iv) Calculate a value for the percentage uncertainty in R_L.

(2 marks)

(c) Calculate the current through the LDR.

(2 marks)

(d) (i) You are provided with three colour filters marked **red**, **green** and **blue**. You are to slide each filter, in turn, between the lamp and the window of the LDR. In each case record the voltmeter reading.

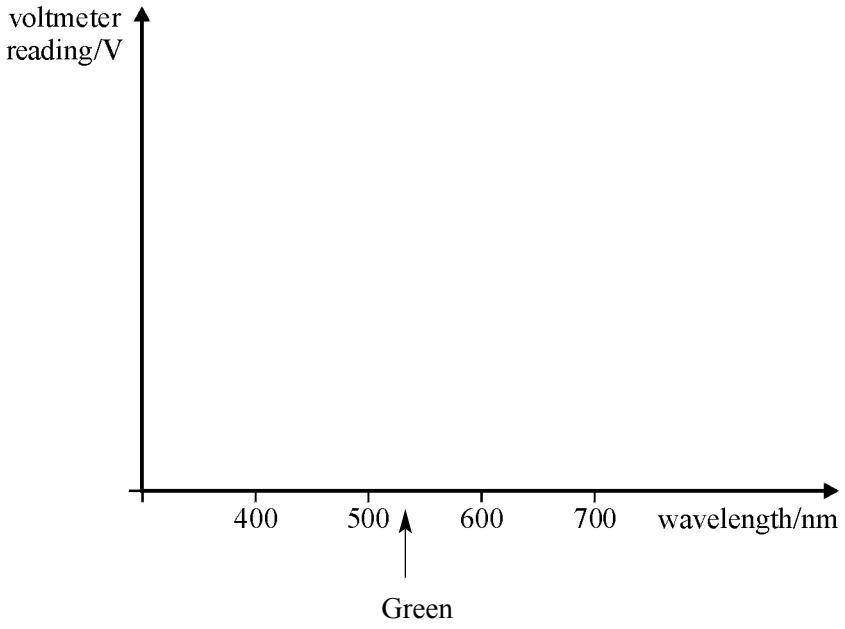
voltmeter reading with **red** filter = ...

voltmeter reading with **green** filter = ...

voltmeter reading with **blue** filter = ...

(3 marks)

(ii) Sketch on the axes below a graph to show how the voltmeter reading varies with the wavelength of the transmitted light. You should label your values for **red** and **blue**. The **green** wavelength is already labelled.



(3 marks)

(e) Name **two** variables, other than light intensity, that must be controlled in order to ensure that the comparison between coloured filters is fair.

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(2 marks)

(f) Draw a second line on your graph to indicate how you would expect the voltmeter readings to change when light of higher intensity is shone onto the filters. Label this line "higher intensity".

(2 marks)

20

THERE ARE NO QUESTIONS PRINTED IN THIS SPACE

One hour is allowed for this question.

Total for this question: *38 marks*

3 You are going to investigate how the period of a simple pendulum varies with the height of the bob above the work surface.

You will use your data to determine the height of the point of suspension of the pendulum above your work surface.

You are provided with the apparatus set up as in **Figure 4**.

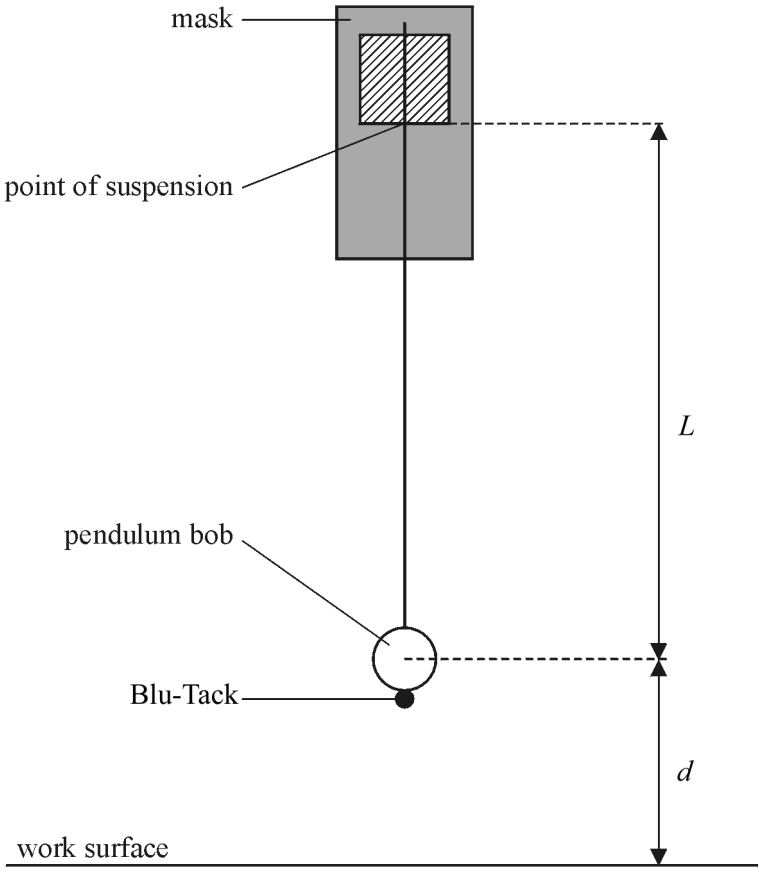

Figure 4

Throughout this experiment it is vital that you make no adjustment to the clamp or point of suspension of the bob. Should you accidentally adjust either of these factors you should tell your supervisor immediately and you will not be penalised.

(a) (i) Measure and record the diameter of the pendulum bob. Hence calculate a value for the radius of the bob in m.

(2 marks)

(ii) State and explain the aspects of your procedure which mean that your value is accurate.

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(2 marks)

(b) (i) Measure the height, y, of the lowest metal part of the pendulum bob from the top surface of the work surface. Record this value in m.

(1 mark)

(ii) Calculate the height, d, of the centre of the pendulum bob above the work surface by adding the radius of the bob to your value for y.

(1 mark)

(iii) Take readings to allow you to determine accurately the period, T, of the pendulum corresponding to this value of d.

(3 marks)

(c) (i) You are going to take a series of readings of T for different values of y. Draw a table in the space below in which to record all your measurements for y, d and T. Include a column in which to record the corresponding values of T^2.
Transfer your readings from part (b) to the table.

(2 marks)

(ii) Determine and record **four** further measurements of y and the corresponding values of d and T. Adjust y by sliding the bob up and down the string and securing the bob with the piece of Blu-Tack provided. The values of y should be in the range 0.05 m to 0.30 m.
In each case tabulate the values of d and T^2 where d is in m and T^2 in s^2.

Produce your table of measurements and calculated values on this page.

(9 marks)

(d) On the separate sheet of graph paper, plot a graph of T^2 (y-axis) against d (x-axis).
Include the origin on the d axis.
Use an appropriate false origin on the T^2 *axis.*
Draw the best straight line through your plotted points.

(7 marks)

(e) Find k , the magnitude of the slope of your graph.

(3 marks)

(f) The equation for the line you have drawn is:

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

where h is the height of the point of suspension of the pendulum above the work surface.

Choose a convenient point on your line and read off values of T^2 and d. Substitute these values and your value for k into the equation to calculate a value for h.

(3 marks)

(g) Describe how you determined the period of the pendulum. You should include:

- how you performed your timing;
- how you ensured that your data was as accurate as possible;
- how you would modify the procedure to obtain more reliable data.

Two of the 5 marks in this question are available for the quality of your written communication.

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(5 marks)

38

END OF QUESTIONS

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