Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

Leave blank

General Certificate of Education
January 2005
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

PHYSICS (SPECIFICATION B) PHB3
Unit 3 Practical

Thursday 20 January 2005 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. Attach your graph to this book before handing it to the invigilator at the end of the examination.
- 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 one 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 You are going to investigate how much energy is absorbed when a table tennis ball rebounds from a soft pad. The apparatus has been set up for you and is shown in **Figure 1**.

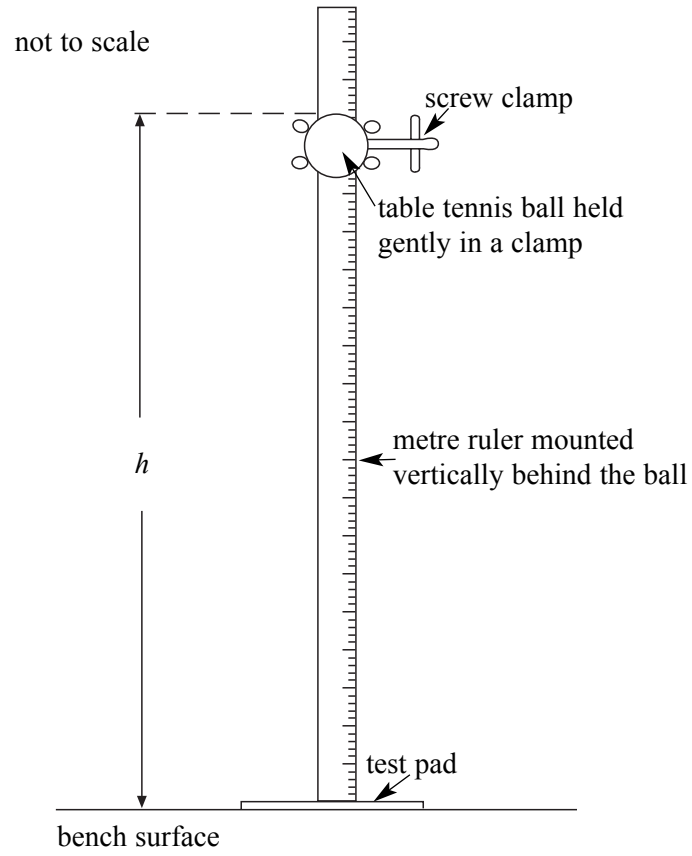

Figure 1

(a) Move the test pad aside and measure the height, *h*, of the top of the ball above the bench surface.

(1 mark)

(b) Open the clamp screw so that the ball is released and observe its motion. You are now going to measure the height to which the ball bounces, both with and without the test pad in position. Gently clamping the ball into its **original position each time**, take sufficient measurements to fill in the table in **Figure 2**.

y is the height of the bounce without the pad and *x* is the height of the bounce with the pad. These measurements are shown in **Figure 3**.

y/cm	*x*/cm

Figure 2

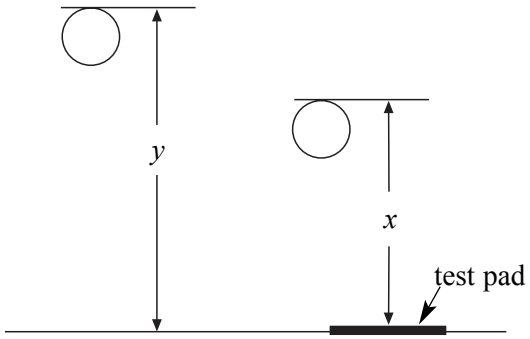

Figure 3

(2 marks)

(c) Use your values from the table in **Figure 2** to:

(i) calculate in metres: *X*, the mean value of *x*, and *Y*, the mean value of *y*;

(1 mark)

(ii) find the absolute uncertainty in *X* and the absolute uncertainty in *Y*.

(3 marks)

QUESTION 1 CONTINUES ON THE NEXT PAGE

(d) More energy is absorbed when the ball rebounds from the pad than when it rebounds from the bench alone. This extra energy, E, is given by

$$E = mg\Delta h$$

where m is the mass of the ball,
$\Delta h = (Y - X)$ and
$g = 9.8 \pm 0.1\ \text{m s}^{-2}$.

(i) Calculate E, given that $m = 2.5 \pm 0.1$ g.

(2 marks)

(ii) Calculate the percentage uncertainty in E.

(3 marks)

(e) (i) Predict how you would expect the value of X to vary with h. Explain your reasoning.

.....

.....

.....

.....

.....

.....

.....

(2 marks)

(ii) A quantity Q is defined by the equation

$$Q = \frac{E}{mgl}$$

where $l = (h - 0.019)$ in metres.

Describe in detail how you would modify the method used in part (a), part (b) and part (c) to obtain a reliable value for E and to investigate how Q varies with h.

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6 marks)

20

30 minutes are allowed for this question

Total for this question: *20 marks*

2 You are going to investigate how the size of the card and how the position of the pivot affect the period of oscillation of a triangular card. You are provided with an equilateral triangle **PQR**, as shown in **Figure 4**. It has been cut from stiff card and has three pivot holes (A, B and C) positioned along the axis of symmetry PS.

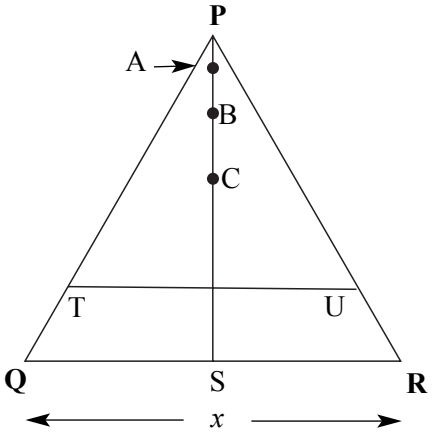

Figure 4

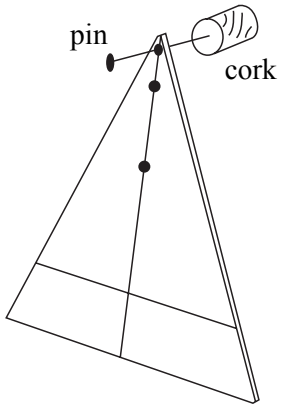

Figure 5

(a) Using the pin and cork, as shown in **Figure 5**, suspend the triangle from the pivot hole A, clamping the cork to the stand so that the pin is horizontal. The triangle should swing freely in a vertical plane perpendicular to the pin when it is displaced sideways and released.

(i) Set the card swinging and accurately measure its period of oscillation.

(3 marks)

(ii) Measure and record x, the length of the base of the triangle.

(1 mark)

(b) Using the scissors provided, reduce the size of the triangle by cutting carefully along the marked line TU. Measure and record the new period of oscillation about A.
You should not take repeat readings.

(2 marks)

(c) Theory suggests that for a flat rigid triangle oscillating in this way, the length of its base is directly proportional to the square of the period of oscillation. **Without plotting a graph** use your answers to part (a) and part (b) to test this suggestion. Show clearly your working and state your conclusion.

(4 marks)

(d) **Do not take repeat readings for this part of the question**.

(i) Measure the period of oscillation of the triangle when it is pivoted at B.

(1 mark)

(ii) Measure the period of oscillation of the triangle when it is pivoted at C.

(1 mark)

(e) Use your answers to part (b) and part (d) to sketch, on the axes in **Figure 6**, a graph to show how the period of oscillation, T, varies with d, the distance of the pivot from A. Indicate clearly the scale on the T axis.

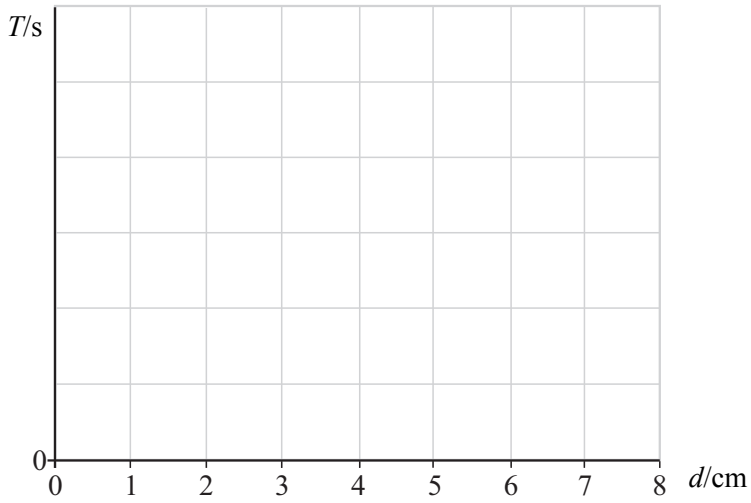

Figure 6

(3 marks)

QUESTION 2 CONTINUES ON THE NEXT PAGE

(f) Describe and explain **two** ways in which the apparatus could be modified to gather data to produce a more reliable graph than the one you have drawn in **Figure 6**.

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(5 marks)

20

TURN OVER FOR THE NEXT QUESTION

One hour is allowed for this question.

Total for this question: *38 marks*

3 You are going to investigate electrical conduction in a resistance ring. The ring has been constructed from twelve identical resistors and is shown in **Figure 7**.

(a) Connect the circuit as shown in **Figure 7** so that crocodile clips **P** and **Q** make good electrical contact with the ring on either side of one of the resistors.

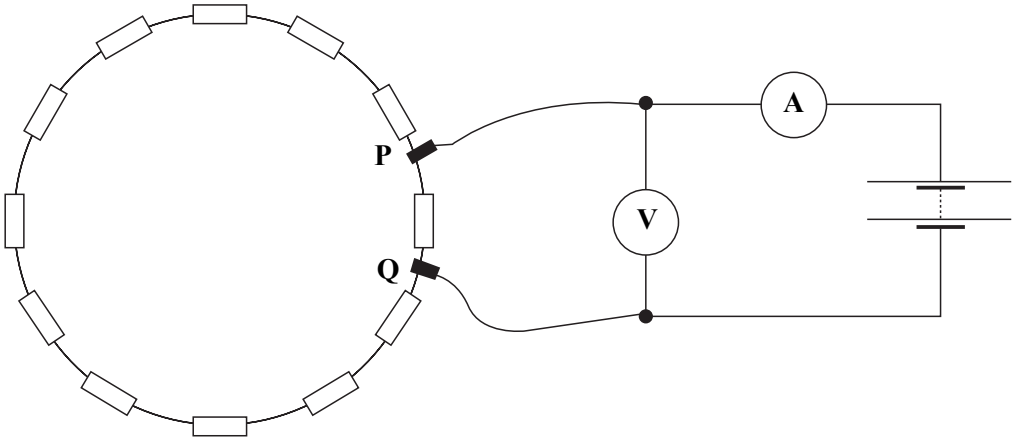

Figure 7

Measure I, the current in mA, and V, the potential difference across **PQ**.

(3 marks)

(b) You are now going to measure V and I with up to five resistors between **P** and **Q**.

On the blank page opposite, draw a table for your results.

In this table record I in mA and include columns for n, the number of resistors between **P** and **Q**, $N = n - \frac{n^2}{12}$ and $X = \frac{V}{N}$.

(3 marks)

(c) Take a series of measurements of I and V for n = 1, 2, 3, 4 and 5. Record all of your readings and derived values in the table.

(14 marks)

QUESTION 3 CONTINUES ON THE NEXT PAGE

(d) Plot a graph of I (*y-axis*) against X (*x-axis*). The scales on both axes should start at zero. Draw the best straight line through your plotted points.

(7 marks)

(e) The equation for the straight line you have drawn is

$$I = \frac{X}{r} + c$$

where r is the resistance of each of the resistors in the ring.

This equation may be compared to the general equation of a straight line

$$y = mx + c.$$

(i) Determine the gradient of the graph.

(4 marks)

(ii) Calculate a value for r.

(3 marks)

(f) In an ideal experiment the value for c would be exactly zero. Suggest and explain **two** reasons why in practice c may be non-zero.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

END OF QUESTIONS