

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
TOTAL	



General Certificate of Education
Advanced Level Examination
June 2011

Physics PHA6/B6/XPM1

(Specifications A and B)

Unit 6 Investigative and Practical Skills in A2 Physics
Route X Externally Marked Practical Assignment (EMPA)

Section A Part 1

For this paper you must have:

- a calculator
- a pencil
- a ruler.

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. Do not write outside the box around each page or on blank pages.
- Show all your working.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for Section A Part 1 is 15.



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WMP/Jun11/PHA6/B6/XPM1

PHA6/B6/XPM1

Section A Part 1

Follow the instructions given below.

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

No descriptions of the experiments are required.

- 1** You are to investigate how the amplitude of a simple pendulum diminishes as its energy becomes absorbed by the surrounding air.

A golf ball is suspended from a string to form a simple pendulum.

Do not adjust the length of the pendulum or the height above the floor of the clamped end of the thread.

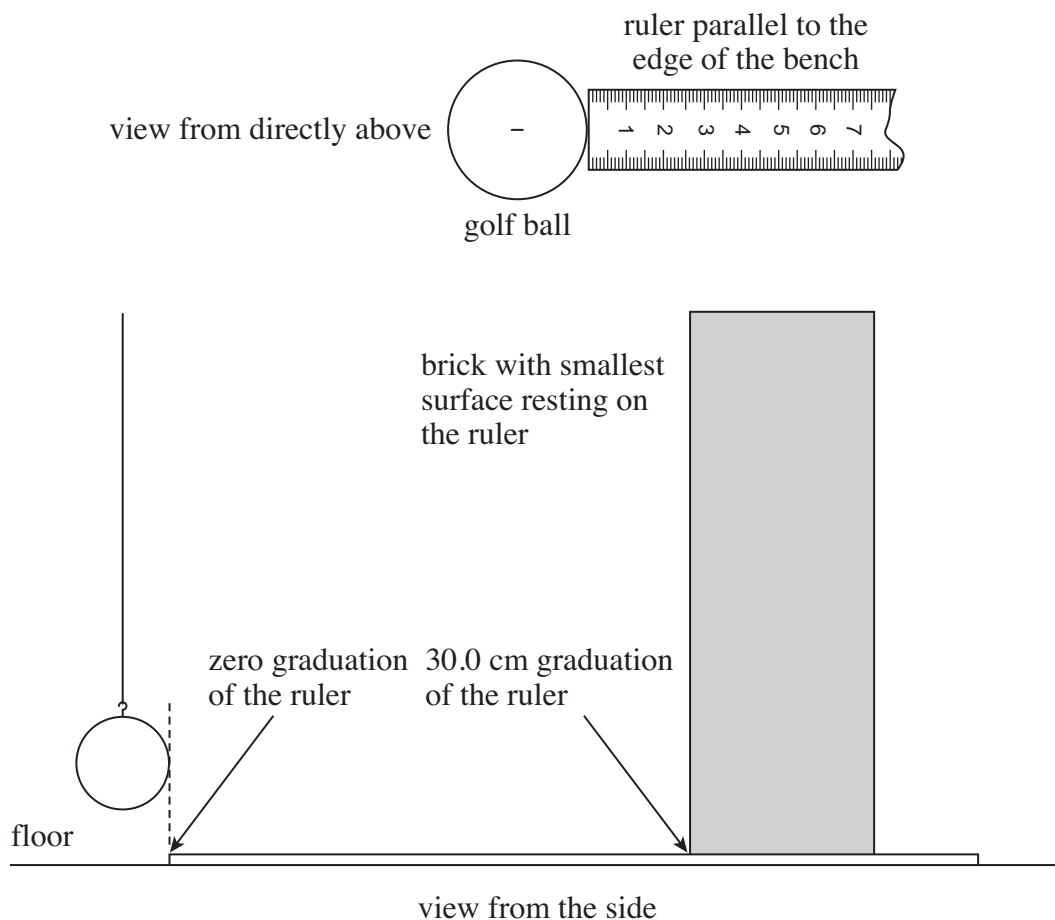
Put the ruler on the floor with the graduated face uppermost.

Place the brick on the ruler so the smallest surface of the brick is in contact with the ruler and a smooth vertical face of the brick faces the golf ball.

This nearest face of the brick should be 30.0 cm from the golf ball, as shown in **Figure 1**.

The axis of the ruler should be parallel to the edge of the bench and the zero graduation directly below the edge of the golf ball closest to the brick.

Figure 1



1 (a) Keeping the string straight, pull the golf ball to one side, so it touches the brick. Release the golf ball so that it performs simple harmonic motion in a vertical plane, directly above the ruler.

1 (a) (i) Record in the table below, A_n , the amplitude of the oscillation of the golf ball after n oscillations have been completed; use the values $n = 10, 20$ and 30 indicated in the table.
The table has been partly completed for you.

Use the additional columns in the table as required, to record repeated measurements.

A_n the amplitude of the pendulum after n oscillations						
n	A_n / cm	A_n / cm				mean A_n / cm
0	30.0	30.0				30.0
10						
20						
30						

1 (a) (ii) Determine the mean value of A_n after 10, 20 and 30 oscillations of the pendulum. Record these data in the right-hand column of the table.

1 (a) (iii) Use your data to calculate ΔA_{10} , the uncertainty in A_{10} , the amplitude after 10 oscillations.

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$$\Delta A_{10} = \dots\dots\dots$$

(2 marks)

Question 1 continues on the next page

Turn over ►

- 1 (b) Textbooks suggest that under certain conditions the amplitude of a simple pendulum subject to air damping should decrease exponentially.

A teacher says that if the suggestion is correct, then

$$\frac{A_n}{A_{n+10}} = \text{constant}.$$

Perform suitable calculations with your data from part (a) to test the teacher's idea. State and explain your conclusion.

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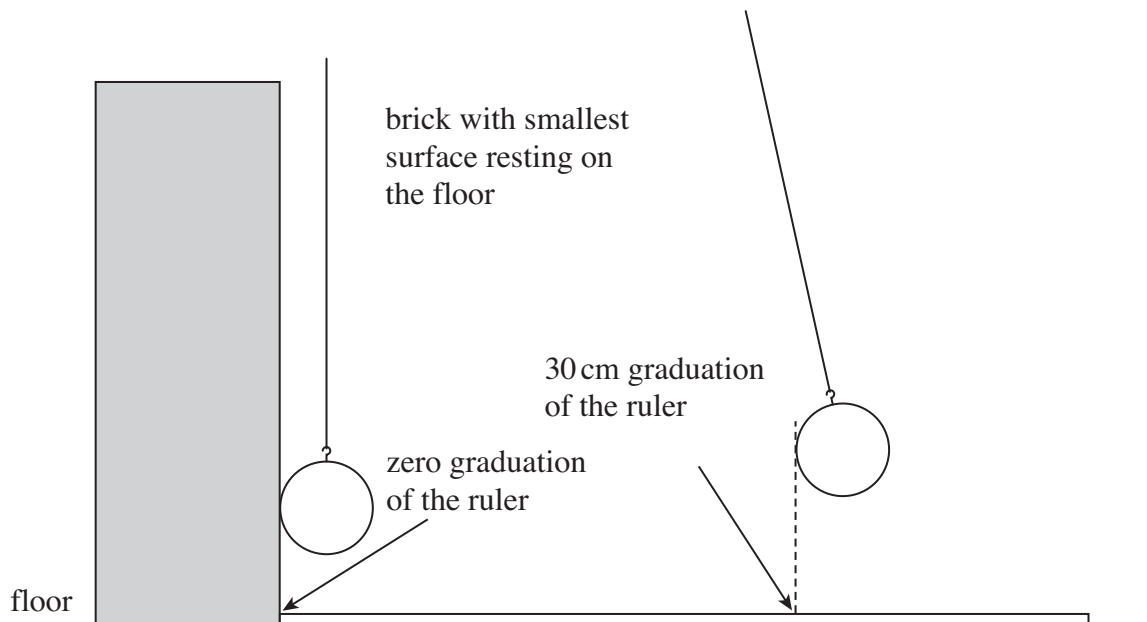
(2 marks)

- 1 (c) Using the same apparatus as in part (a), a student designs a different experiment in which energy is absorbed.

The apparatus is to be arranged as shown in **Figure 2** so that when at the equilibrium position, the golf ball rests against the brick.

The ruler is parallel to the bench and perpendicular to the brick. The graduated face of the ruler is uppermost with the zero graduation in contact with the brick.

Figure 2



Keeping the ball vertically above the ruler and the string straight, the golf ball is pulled to one side until displaced 30.0 cm horizontally and then released so it swings back to strike the brick.

A student intends to measure B , the amplitude of the oscillation of the golf ball after it has rebounded from the brick and intends to investigate whether the amplitude of the oscillation of the golf ball decreases exponentially.

The student intends to check this by calculating $\frac{B_n}{B_{n+1}}$, where B_n is the amplitude after striking the brick n times, and B_{n+1} is the amplitude after striking the brick $(n + 1)$ times.

Use the apparatus provided for part (a) to try out the student's idea and hence identify **two** difficulties in the procedure.

First difficulty

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Second difficulty

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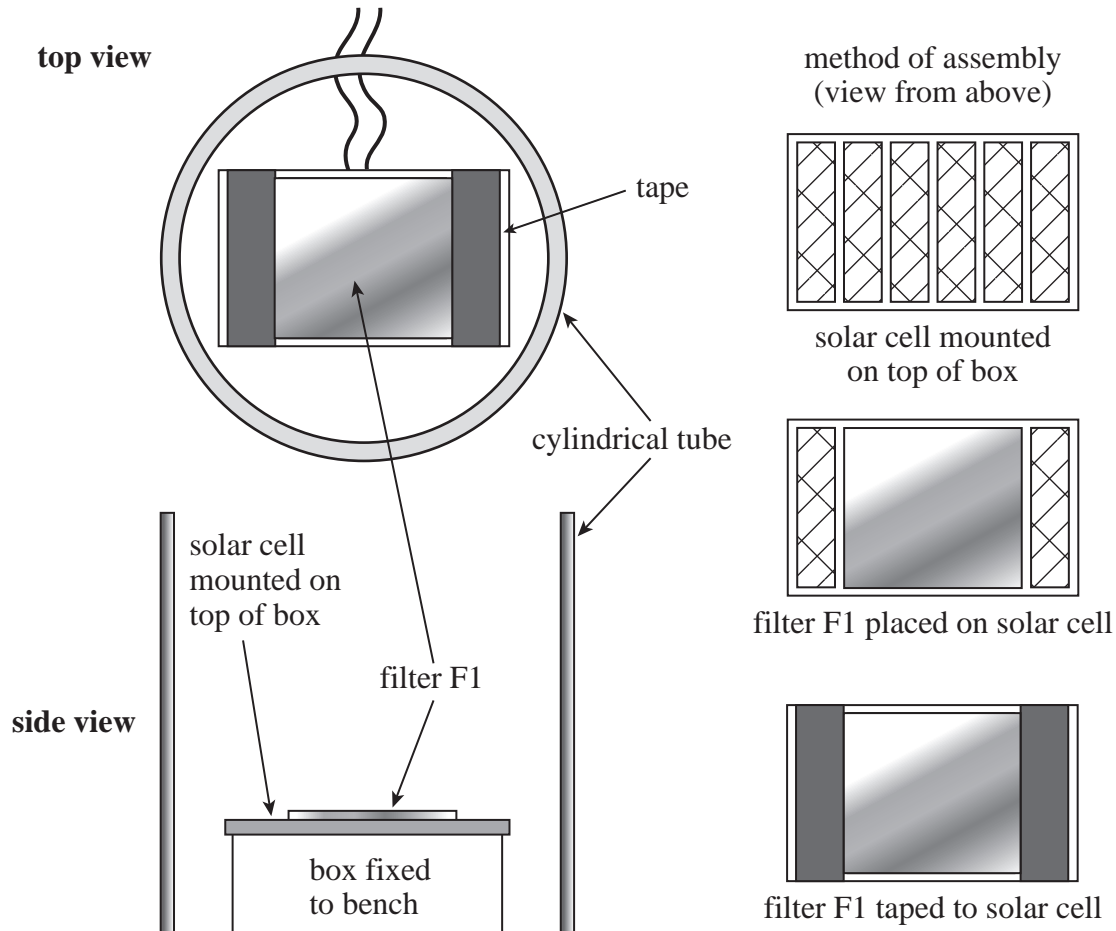
(2 marks)

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ANSWER IN THE SPACES PROVIDED**

- 2 You are to measure the output voltage of a solar cell as the intensity of light incident on it is varied by passing the light through two identical polarising filters. The general arrangement and method of assembly is shown in top and side view in **Figure 3**.

Figure 3



Filter F1 has been taped to the surface of the solar cell that is sensitive to light. The cell has been mounted on a box which has been fixed to the bench. A cylindrical tube has been placed around this arrangement to shield it from unwanted light.

Place the circular scale centrally on top of the cylindrical tube with the printed side uppermost and fix this to the tube using Blu-Tack.

Position the clamped light source so that the lamp is directly above the hole in the circular scale.

Do not adjust the height of the lamp or the output voltage of the power supply.

The filter F2 has been mounted between two pieces of circular card.

- 2 (a) (i) Position this card centrally on the circular scale so that θ , the direction of the arrow = 0° . Switch on the lamp then read and record the voltmeter reading V_0 .

$V_0 = \dots\dots\dots$

Question 2 continues on the next page

Turn over ►

- 2 (a) (ii) Keeping the card centrally on the scale, increase θ in 20° steps to obtain further values of V to complete the table.
Switch off the lamp once you have completed these measurements.

$\theta/^\circ$	V/mV	$\theta/^\circ$	V/mV	$\theta/^\circ$	V/mV
20		140		260	
40		160		280	
60		180		300	
80		200		320	
100		220		340	
120		240		360	

(1 mark)

- 2 (b) Adding a suitable scale to the vertical axis, plot on the grid on **page 9** a graph of your results from part (a)(ii).

(2 marks)

- 2 (c) (i) Read from your graph, and record below, V_{\max} and V_{\min} , the maximum and minimum values of V .

$$V_{\max} = \dots\dots\dots$$

$$V_{\min} = \dots\dots\dots$$

- 2 (c) (ii) Hence estimate the amplitude, A , of the variation V with θ .

$$A = \dots\dots\dots$$

- 2 (c) (iii) Identify and explain from your graph any value of θ for which the experimental arrangement is most sensitive to changes in θ .

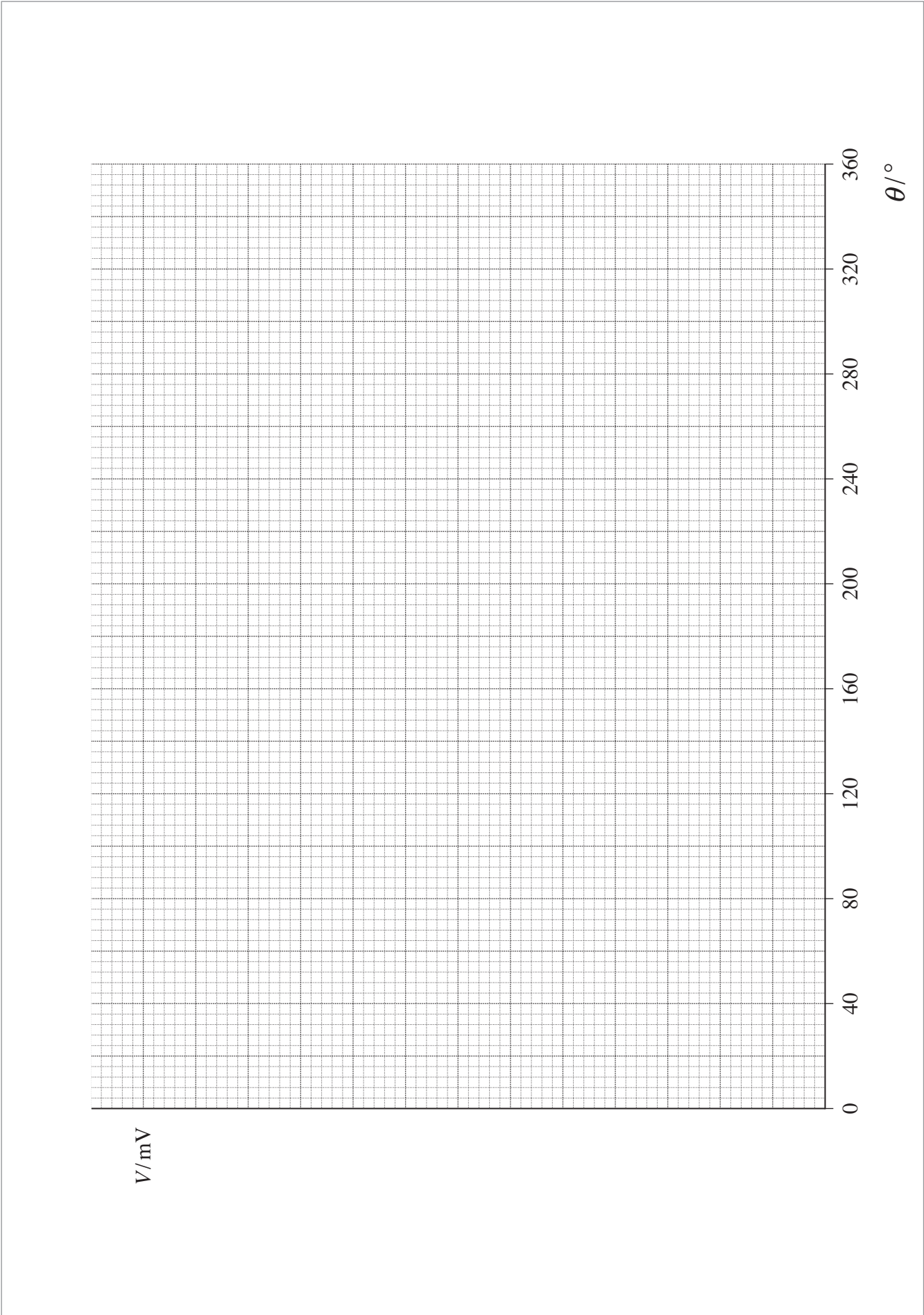
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(3 marks)



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Turn over ►

2 (d) A student performs the experiment but fails to keep the edge of the card containing the filter F2 centrally on the circular scale.

2 (d) (i) State and explain the effect this may have on the readings of V .

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2 (d) (ii) State **one** procedure that the student could take so that this error can be avoided.

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(3 marks)

9

END OF SECTION A PART 1

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