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 2012

Physics
(Specifications A and B)

PHA6/B6/XPM1

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 16.

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Section A Part 1

Follow the instructions given below.

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

No descriptions of the experiments are required.

1 You are to measure the radius of curvature, R_1, of the concave surface of a spherical mirror by measuring the period of a ball bearing rolling on the mirror.

1 (i) Use the micrometer screw gauge to make suitable measurements to determine the radius, r, of the ball bearing.

.....

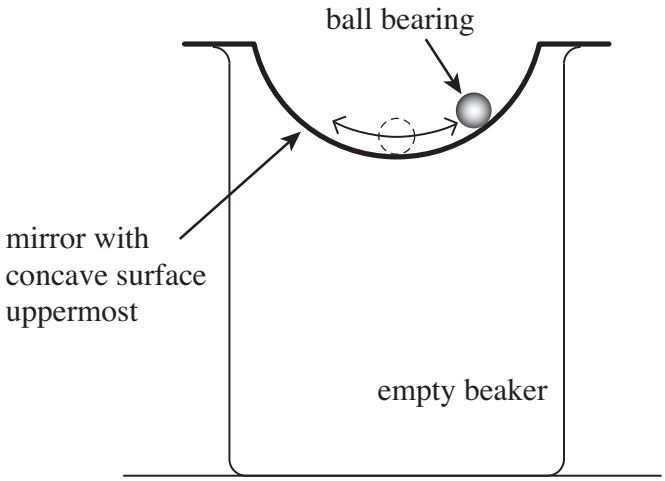
.....

r = ...

(2 marks)

1 (ii) Place the mirror on top of the empty beaker with the concave surface uppermost. Place the ball bearing near the edge of the mirror so that when released, the ball bearing performs oscillations about the centre of the mirror, as shown in **Figure 1**.

Figure 1



Make suitable measurements to determine the mean period, T_1, of the oscillations.
You may mark the inside of the mirror with a pencil to assist you with the measurement.

.....

.....

T_1 = ...

(1 mark)

Turn over ▶

1 **(iii)** It can be shown that T_1 is given by

$$T_1 = 2\pi\sqrt{\frac{7(R_1 - r)}{5g}}$$

where $g = 9.81\,\text{N kg}^{-1}$.

Using your values of r and T_1, determine R_1.

.....

.....

.....

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.....

.....

.....

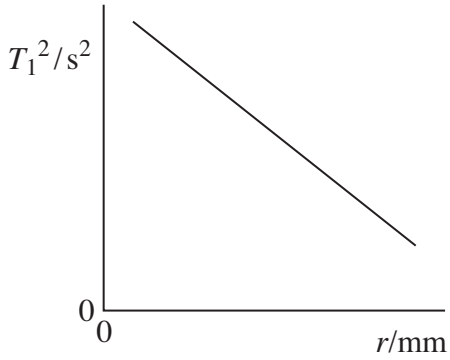
.....

R_1 = ...

(2 marks)

1 **(iv)** A student is provided with a selection of ball bearings of different dimensions. Using each of these in turn, the student obtains values of T_1 for each corresponding value of r. The student then produces the graph of T_1^2 against r shown in **Figure 2**.

Figure 2



State and explain how the value of R_1 can be obtained from this graph.

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(3 marks)

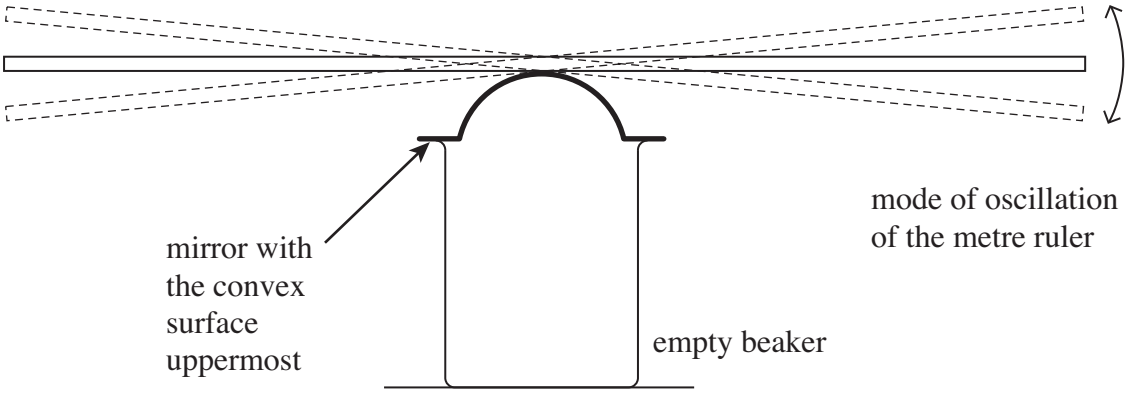
8

Turn over for next question

2 You are to measure the radius of curvature, R_2, of the convex surface of the mirror by measuring the period of an oscillating metre ruler placed on the top of the mirror.

Place the mirror on top of the empty beaker with the convex surface uppermost. Place the metre ruler, with the graduated face uppermost, on top of the mirror so that the ruler is parallel to the surface of the bench.
Slightly depress one end of the ruler then release it so that the ruler performs small-amplitude oscillations, as shown in **Figure 3**.

Figure 3



2 **(i)** Using the additional equipment provided, assemble a suitable fiducial mark, then make suitable measurements to determine the mean period, T_2, of the oscillations.

.....

.....

T_2 = ...

(1 mark)

2 **(ii)** If the thickness of the ruler is much less than its length, it can be shown that

$$R_2 \approx \frac{1}{3g}\left(\frac{x\pi}{T_2}\right)^2,$$

where x = the length of the ruler and $g = 9.81\ \mathrm{N\,kg^{-1}}$.

Using your value of T_2, determine R_2.

.....

.....

.....

R_2 = ...

(1 mark)

2 **(iii)** Show with the aid of a sketch where you positioned the fiducial mark in order to reduce uncertainty in the measurement of T_2. Explain why you chose this position for the fiducial mark.

.....

.....

.....

.....

(2 marks)

2 **(iv)** To determine T_2, a student makes five measurements of the time for 20 oscillations of the ruler.
The student's data are as follows:

20 T_2/s	**40.8**	**41.4**	**39.9**	**38.7**	**40.5**

The student uses these data to determine T_2. Calculate the percentage uncertainty in the student's result.

.....

.....

.....

.....

.....

(2 marks)

Turn over ▶

2 **(v)** It is reasonable to assume that your result for R_2 is similar to, but **not the same**, as that obtained for R_1. Give **two** reasons why you would not expect these results to be the same.

Reason 1 .....

.....

.....

.....

.....

Reason 2 .....

.....

.....

.....

.....

(2 marks)

8

END OF QUESTIONS