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 Subsidiary Examination
June 2009

Physics PHA3/B3/X

(Specifications A and B)

Unit 3 Investigative and Practical Skills in AS Physics
Route X Externally Marked Practical Assignment (EMPA)

Section A Task 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. Answers written in margins or on blank pages will not be marked.
- 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 Task 1 is 14.

SECTION A TASK 1

Follow the instructions given below.

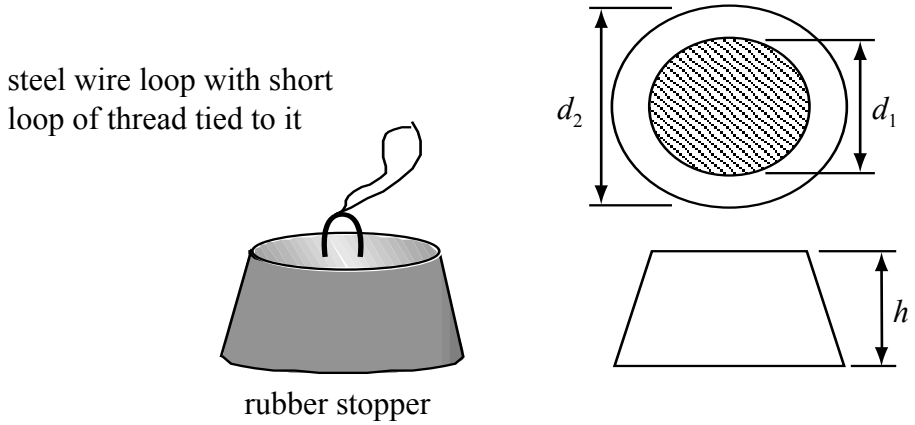
Provide the information required in the spaces provided.

No description of the experiment is required.

You are to measure the volume of a rubber stopper by two different methods.
A steel wire loop has been fixed to the stopper. A short loop of thread has been tied to this steel loop.

1 This method of finding the volume of the stopper involves making measurements, using vernier callipers, of the dimensions shown in **Figure 1**.

Figure 1



1 (a) Make suitable measurements to determine

1 (a) (i) the smaller diameter, d_1, of the circular surface of the stopper

.....

.....

1 (a) (ii) the larger diameter, d_2, of the circular surface of the stopper

.....

.....

1 (a) (iii) the height, h, of the stopper.

.....

.....

(2 marks)

1 (b) Ignoring the steel wire loop, evaluate the volume, V, of the stopper,

where $V = \dfrac{\pi h(d_2^3 - d_1^3)}{12(d_2 - d_1)}$

.....

.....

.....

.....

$V =$ .....

(2 marks)

1 (c) Outline **one** difficulty you encountered when measuring the different dimensions of the stopper.

.....

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.....

.....

(1 mark)

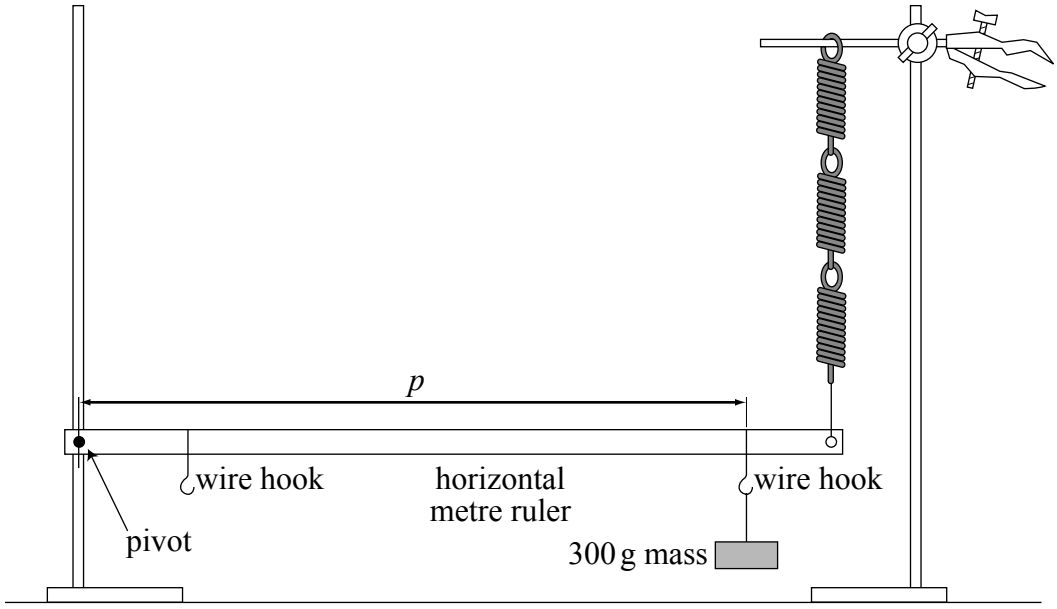
Turn over for the next question

2 This method of finding the volume of the stopper involves making indirect measurements of the mass and density of the stopper.

2 (a) You are provided with a ruler pivoted close to one end. The free end of the ruler is supported by three coupled springs.
Do not adjust the height of the bosses attached to either of the clamp stands.

2 (a) (i) Two wire hooks are attached to the ruler; these can slide freely along the length of the ruler.
Using the wire hook that is further from the pivot, suspend the 300 g mass from the ruler and adjust the position of the mass until the ruler is horizontal, as shown in **Figure 2**.
Ensure the three coupled springs remain vertical.

Figure 2

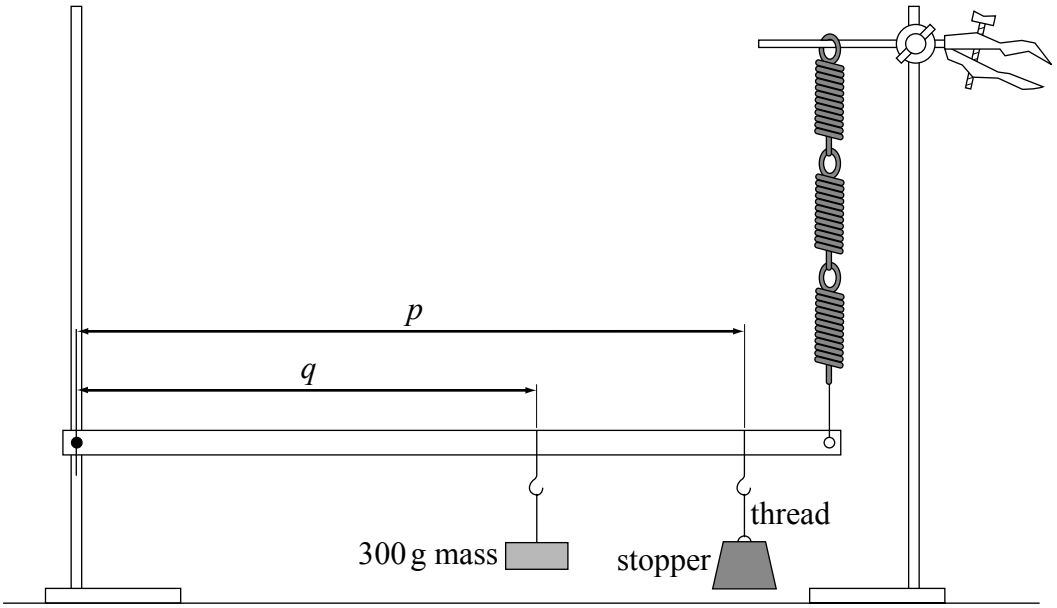


Measure and record the horizontal distance, p, between the pivot and the point of suspension of the 300 g mass.

p = ...

2 (a) (ii) Without changing the position of the hook, carefully remove the 300 g mass and use the thread to suspend the stopper from the hook.
Use the additional hook to suspend the 300 g mass from the ruler at a point between the stopper and the pivot.
Adjust the position of this hook until the ruler is once again horizontal, as shown in **Figure 3**.

Figure 3



Measure and record the horizontal distance, q, between the pivot and the point of suspension of the 300 g mass.

q = ...

2 (a) (iii) Evaluate the mass, m, in g, of the stopper, where $m = \dfrac{300\,(p - q)}{p}$

.....

.....

m = ...

2 (a) (iv) Explain how you ensured that the metre ruler was horizontal before you measured p and q.

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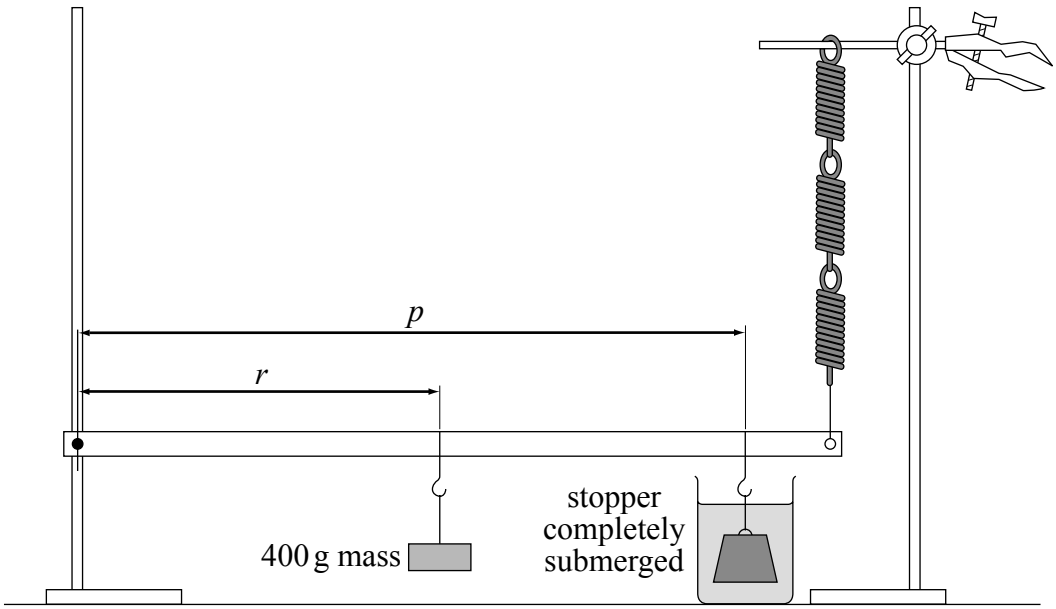
(3 marks)

Turn over ▶

2 (b) **Without changing *p*,** carefully position the empty beaker directly below the stopper then pour water into the beaker until the stopper is completely submerged.
Using the additional 100 g slotted mass, increase the total mass suspended to 400 g.
Adjust the position of the hook from which the 400 g mass is suspended until the ruler is once again horizontal, as shown in **Figure 4**.

Figure 4



2 (b) (i) Measure and record *r*, the horizontal distance between the pivot and the point of suspension of the 400 g mass.

r = ...

2 (b) (ii) Determine ρ_s, the density of the rubber stopper, given by $\rho_s = \rho_w \times \frac{3(p-q)}{(4r-3q)}$

The density of water, ρ_w, = 1000 kg m^{-3}.

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ρ_s = ...

2 (b) (iii) State and explain which of the linear measurements, p, q and r, has the greatest percentage uncertainty.

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(3 marks)

2 (c) Use your answers to parts 2(a)(iii) and 2(b)(ii) to determine the volume, V, of the stopper.

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.....

.....

$V =$ .....

(3 marks)

END OF QUESTIONS

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED