HWA CHONG INSTITUTION
JC2 Preliminary Examination
Higher 2

CANDIDATE NAME | | CT GROUP | 16S

TUTOR NAME |

PHYSICS

9749/04

Paper 4 Practical

23 August 2017

2 hours 30 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your **name, CT class** and **subject tutor's name** in the spaces at the top of this page.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paperclips, highlighters, glue or correction fluid.

Shift
Laboratory

The use of an approved scientific calculator is expected, where appropriate.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.
The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

Give details of the practical shift and laboratory where appropriate in the boxes provided.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
1	/ 15
2	/ 8
3	/ 20
4	/ 12
Total	/ 55

This document consists of 17 printed pages.

1 This investigation considers the size of the hole needed in a salt shaker for the salt to flow at a suitable rate.

(a) You have been provided with a beaker labelled **P** containing 100g of salt as shown in Fig. 1.1.

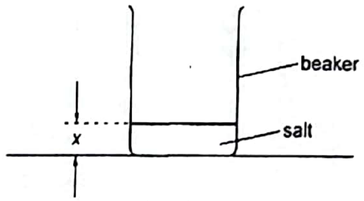

Fig 1.1

(i) Measure and record the depth x of salt in beaker **P** using the vernier caliper.

x = ... [2]

(ii) Estimate the percentage uncertainty in your value of x.

percentage uncertainty = ... [1]

(b) You have been provided with two cards. Each card has a hole of different size.

(i) Measure and record the diameter d of the **smaller** hole.

d = ... [1]

(ii) Determine the area A of the **smaller** hole.

A = ... [1]

(c) **(i)** Fill the boiling-tube, as shown in Fig. 1.2, with salt from beaker **P**.

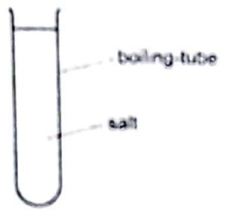

Fig. 1.2

(ii) Cover the open end of the boiling-tube with the card that has the smaller hole

Use tape to attach the card to the boiling-tube

The hole should not be covered by tape. When the boiling-tube is inverted it should not be possible for salt to leave the boiling-tube other than through the hole

(iii) Invert the boiling-tube over the empty beaker **Q**. Measure the time taken for ALL the salt to flow through the hole into beaker **Q**

It may be necessary to shake the boiling-tube gently from time to time to achieve constant flow.

Time taken = ...

(iv) Tap beaker **Q** gently on the bench to ensure that the surface of the salt is level

Measure and record the depth x of salt in beaker **Q**

x = ...

(v) Estimate the mass m of salt in beaker **Q**

m = ... [1]

(d) The recommended daily intake of salt for an adult is 5 g.

Use your data to calculate the time that a shaker with a hole the same size as that in **(c)(ii)** should be inverted to apply 5 g of salt to food.

time taken = ... [1]

(e) It is suggested that the rate of flow of salt R is proportional to the area A of the hole.

Use the card with the larger hole to take further measurements to investigate this suggestion. State and explain whether or not you agree with this suggestion.

Present your measurements and calculated results clearly.

....

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.... [6]

(f) A statement found on the internet says that:

"The salt shaker may be distinguished primarily by the size of the holes, and then by the number of holes. Salt is coarser than pepper, and needs the larger hole. It is also heavier and flows much more freely than pepper, accordingly there are often fewer holes on the salt shaker to help control the flow. However, there is no manufacturing standard."

Suggest changes that could be made to the salt investigation to study the flow of pepper from a shaker.

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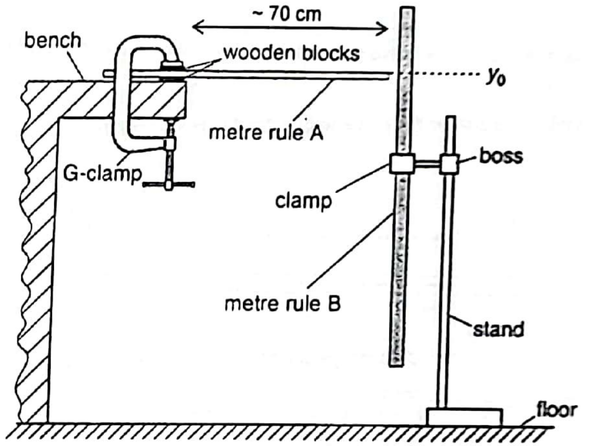
.... [2]

[Total: 15 marks]

2 In this experiment you will investigate the deflection of a loaded metre rule.

(a) (i) Set up the apparatus as shown in Fig. 2.1.



y_0 is the point on rule B level with the top of rule A.

Fig. 2.1

(ii) Record the reading y_0.

y_0 = ... [1]

(iii) Place a 200 g mass on the end of rule A as shown in Fig. 2.2.

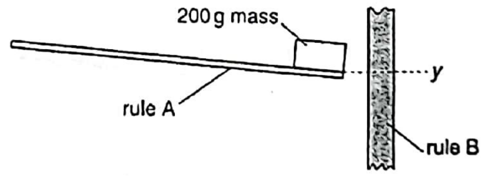


Fig. 2.2

y is the point on rule B level with the top of rule A.

(iv) Record the reading y.

y = ...

(v) Remove the 200 g mass from rule A.

(vi) Calculate the deflection $(y - y_0)$.

$(y - y_0)$ = ... [1]

(vii) Determine the percentage uncertainty in $(y - y_0)$

percentage uncertainty in $(y - y_0)$ = ... [1]

(b) (i) Repeat (a)(ii).

y_0 = ...

(ii) Place the 200 g mass at a position approximately halfway along rule A.

(iii) Repeat (a)(iv), (a)(v) and (a)(vi) with the 200 g mass placed at a position approximately half way along rule A.

y = ...

$(y - y_0)$ = ...

(c) (i) It is suggested that:

"If both masses are placed on rule A in different positions at the same time, the deflection will equal the sum of the deflections for each mass on its own."

Take more readings to investigate this suggestion. Present your results in a table. **[2]**

(ii) State whether or not the results of your experiment support the suggestion.

Justify your answer by referring to your calculated percentage uncertainty in **(a)(vii)**.

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.... [1]

(d) (i) State a significant source of error in this experiment.

....

....

.... [1]

(ii) Suggest one improvement that could be made to the experiment to address the source of error identified in **(d)(i)**. You may suggest the use of other apparatus or a different procedure.

....

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.... [1]

[Total: 8 marks]

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You may not need to use all of the materials provided.

3 In this experiment, you will determine the resistivity of a metal in the form of a wire.

(a) (i) Measure and record the diameter d of the short sample of wire that is attached to the card. You may remove the wire from the card.

d = ... [1]

(ii) Calculate the cross-sectional area A of the wire, in m^2, using the formula

$$A = \frac{\pi d^2}{4}$$

A = ... m^2

(b) (i) Use the wire attached to the metre rule, one of the voltmeters and one of the resistors to set up the partial circuit shown in Fig. 3.1.

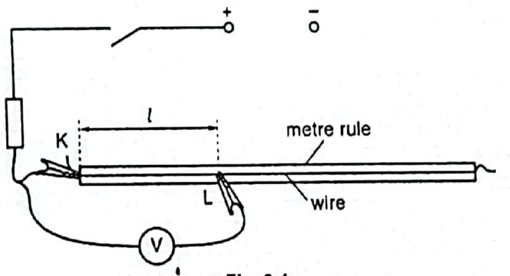

Fig. 3.1

There are two crocodile clips, one labelled K and the other labelled L.
Place K and L so that the distance l between them is approximately 30 cm.

(ii) Measure and record the distance l between K and L.

l = ...m

(iii) Use the other resistor and the other voltmeter to complete the circuit shown in Fig. 3.2.

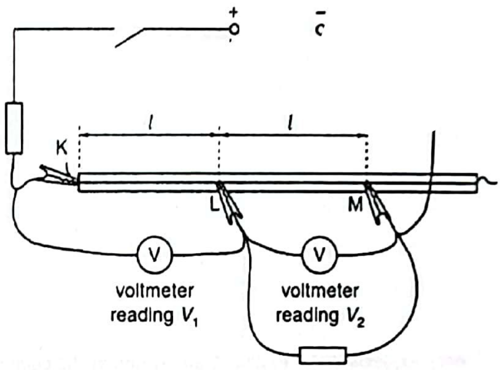

Fig. 3.2

(iv) Place the crocodile clip M at a distance l from L. The value of l should be the same as in (b)(ii).

(c) (i) Switch on the power supply.

(ii) Record the voltmeter readings V_1 and V_2 as shown in Fig. 3.2.

V_1 = ...V

V_2 = ...V
[1]

(iii) Switch off the power supply.

(d) Repeat steps **(b)(ii)**, **(b)(iv)** and **(c)** to obtain further sets of readings for l, V_1 and V_2. For each set of readings, l should be greater than 20 cm, while distances KL and LM should both be l.

[7]

(e) Theory suggests that l, V_1 and V_2 are related by the equation

$$\frac{V_1}{V_2} = Pl + Q$$

where P and Q are constants.

Plot a suitable graph to determine P and Q.

P = ...

Q = ...[4]

[3]

[Turn over

(f) Comment on any anomalous data or results that you may have obtained. Explain your answer.

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....[1]

(g) The resistivity ρ of the material of the wire, in Ω m, can be found using the relationship

$$\rho = PAR$$

where $R = 10\ \Omega$

Use your answers in **(a)(ii)** and **(e)** to calculate a value for ρ.

ρ = ... Ω m [1]

(h) (i) State one significant source of error in this experiment.

....

....[1]

(ii) Suggest an improvement that could be made to the experiment to address one of the sources of error identified in **(h)(i)**. You may suggest the use of other apparatus or a different procedure.

....

....[1]

[Total: 20 marks]

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4 Concrete is widely used for construction and its manufacture contributes 5% to the world's carbon dioxide (CO_2) production. One way of reducing the amount of CO_2 produced could be to use less cement in the production of concrete.

A company is producing concrete with low cement content and wishes to see how the material behaves under a compressive force. A compressive force applied to a concrete object will reduce the length of the object in the direction of the force very slightly.

The reduction in length of the object is to be measured using a strain gauge.

When a wire has its length changed, its resistance changes. A strain gauge consists of a length of thin wire as shown in Fig. 4.1.

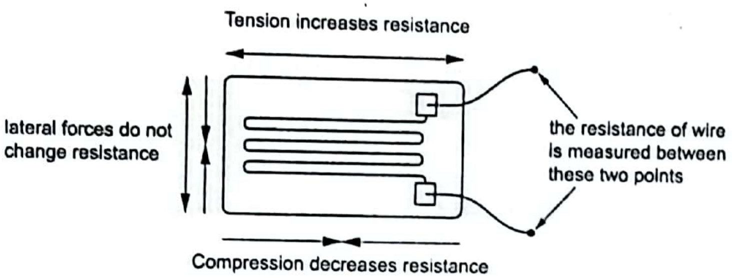

Fig. 4.1

The gauge consists of a wire wound backwards and forwards and embedded in thin plastic. The plastic is then bonded firmly to the specimen being investigated.

The relation between change in resistance ΔR and change in force ΔF is

$$\Delta R = k(\Delta F)^n$$

where k and n are constants.

You are provided with some heavy masses, a low voltage power supply and other equipment usually found in a Physics laboratory.

Design an experiment to determine the value of n for compressive forces applied to a small concrete cylinder along its axis.

You should draw a labelled diagram to show the arrangement of your apparatus and you should pay particular attention to

(a) the equipment you would use,
(b) the procedure to be followed,
(c) how the compressive force and change in resistance are measured,
(d) the control of variables,
(e) any precautions that would be taken to improve the accuracy and safety of the experiment.

Diagram

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[Turn over