YISHUN SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2024
SECONDARY 4 EXPRESS

CANDIDATE NAME	

CLASS				INDEX NUMBER		

PHYSICS **6091/03**
Paper 3 Practical Test **5 August 2024**
1 hour 50 minutes

Candidates answer on the Question Paper.
Additional Materials: As listed in the Confidential Instructions

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.
All of your answers should be written in this Question Paper: scrap paper must **not** be used.
Graph paper is provided in this Question Paper. Additional sheets of graph paper should be used only if it is necessary to do so.

You will be allowed to work with the apparatus for a maximum of 55 minutes for each section.
You are expected to record all your observations as soon as they are made.
An account of the method of carrying out the experiments is **not** required.
The use of an approved scientific calculator is expected, where appropriate.

At the end of 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	
Q1	
Q2	
Q3	
Total	

This document consists of **12** printed pages and **1** blank page.

[Turn over

Section A

1 *In this experiment, you will determine a value of the specific heat capacity and heat capacity of a piece of metal.*

You are provided with

- a piece of metal tied with a loop of wire,
- a Bunsen burner with tripod and wire gauze,
- a beaker labelled A filled with water.
- an empty beaker labelled B,
- a laboratory thermometer,
- a glass rod,
- a polystyrene cup,
- a lighter,
- a stopwatch,
- supply of hot water.

(a) **(i)** Record the mass, m, inscribed on the piece of metal with a loop of wire attached. Leave your answer in SI unit.

m = ...

(ii) Measure and record the temperature Θ_w of the water in beaker A.

Θ_w = ...

[1]

(b) You are to set up the apparatus as shown in Fig. 1.1.

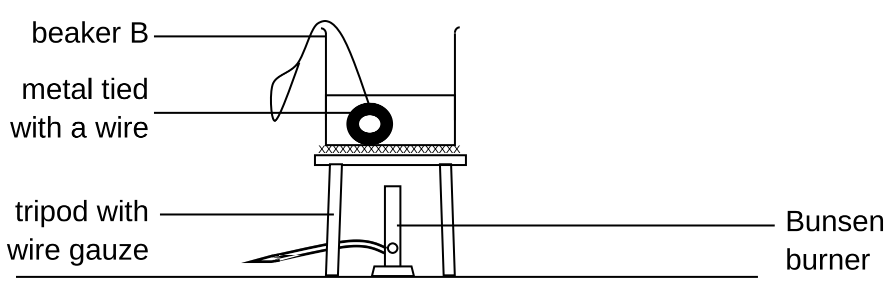

Fig. 1.1

- Place beaker B on the wire gauze and tripod.
- Place the piece of metal in beaker B. The loop of the wire tied to the piece of metal should be hanging out of the water.
- Collect a cup of hot water from the teacher's bench using the polystyrene cup.
- Pour sufficient hot water into beaker B so that it covers the piece of metal. The piece of metal can be lying on its side. Avoid pouring too much water.

(i) Light the Bunsen burner.

After heating for about 3 minutes, switch off the Bunsen burner and wait for about 30 s. Use the thermometer to record the temperature Θ_m of the water. The temperature of the water is assumed to be the same as the temperature of the piece of metal.

Θ_m = ...

(ii) Remove the thermometer from beaker B and place on the bench.

(iii) Using the glass rod to thread through the loop of wire, transfer the piece of metal from beaker B into beaker A. Place the thermometer in beaker A such that the bulb does not touch the piece of metal.

Record the highest stable temperature Θ_h of the water in beaker A.

Θ_h = ...
[1]

(c) Calculate the specific heat capacity C_m of the piece of metal using the equation

$$C_m = \frac{210\ \text{J/C} \times (\Theta_h - \Theta_w)}{m\,(\Theta_m - \Theta_h)}$$

where 210 J/°C is the heat capacity of the water in beaker A.

C_m = ... [2]

(d) Calculate the heat capacity of the piece of metal.

heat capacity = ... [1]

(e) State four reasons why the value of C_m in **(c)** is not accurate.

1 ....

....

2 ....

....

3 ....

....

4 ....

....
[4]

[Total: 9]

2 *In this experiment, you will investigate the oscillation of a spring.*

You have been provided with

- a spring,
- a stand with boss and clamp,
- a 200 g slotted mass,
- a half-metre rule.

(a) Measure and record the unstretched length *L* of the coiled part of the spring, as shown in Fig. 2.1.

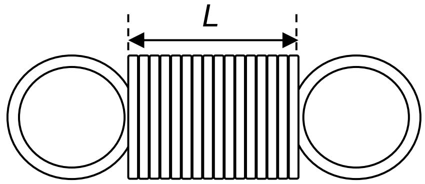

Fig. 2.1

L = ……………………. [1]

(b) You are to set up the apparatus as shown in Fig. 2.2.

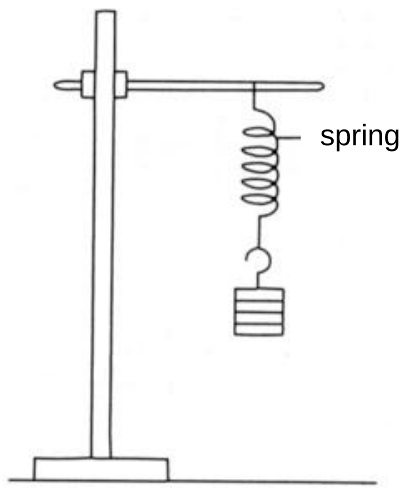

Fig. 2.2

Place the slotted mass of 200 g at the end of the spring.

(i) State the weight *W* of the 200 g slotted mass. Take *g* as 10N/kg.

W = ……………………. [1]

(ii) Measure and record the new length L_1 of the coiled part of the spring and determine the extension e of the spring using the equation

$$e = L_1 - L$$

L_1 = …………………….

e = …………………….

[1]

(c) The slotted mass pulls the spring with a force equivalent to its weight W and the relationship between W and e is given by the equation

$$W = ke$$

where k is the spring constant of the spring. This value of k remains constant as long as the weight hanging on the spring is not large enough to stretch it permanently.

Calculate k and express the answer in SI unit.

k = ……………………. [1]

(d) Describe one way to obtain a more accurate value of k.

……………………………………………………………………………………………………….

……………………………………………………………………………………………………. [1]

(e) **Plan**

If we pull the mass down slightly and release, the spring will oscillate vertically.

A student claims that the period of the vertical oscillation T, may be written in the form

$$T = \left(\frac{0.4W}{k} \right)$$

Plan an experiment to investigate the student's claim. You may use the apparatus provided and include any other common apparatus found in a science laboratory.

You plan should:

- explain briefly how you would perform the experiment,
- draw a table, with column headings, to show how to display the range of readings,
- a statement of the graph that you should plot,
- a plot of the graph,
- an explanation on how k could be found from the graph.

……………………………………………………………………………………………………….

……………………………………………………………………………………………………….

……………………………………………………………………………………………………….

[6]

[Total: 11]

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Section B

3 *In this experiment, you will investigate the potential difference (p.d.) across a resistance wire.*

You are provided with

- a resistance wire taped to a metre rule
- an ammeter
- a voltmeter
- a power supply
- a switch
- a jockey
- six leads with crocodile clips at both ends.

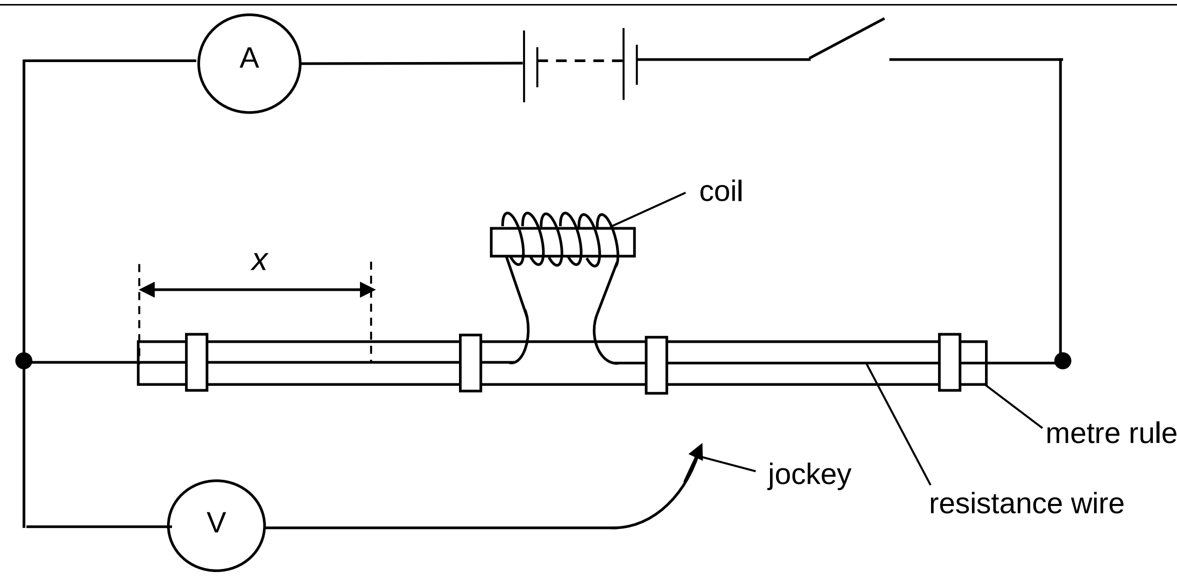

Fig. 3.1

(a) Assemble the apparatus as shown in Fig. 3.1. Close the switch.

Record the current I shown on the ammeter.

I = ………………………… [1]

(b) Place the jockey on the resistance wire for the distance x = 10 cm.

Record the potential difference (p.d.) V shown on the voltmeter.

V = ………………………… [1]

	(c)	Repeat **(b)** with the jockey placed on the wire at x = 15 cm, 25 cm, 35 cm, 45 cm, 60 cm, 65 cm, 75 cm, 85 cm and 90 cm. Open the switch. Record your values for V and x in a suitable table. Include your values from **(b)**. [4]
	(d)	Using the grid provided, plot two graphs of V against x on the same page. Start your axes at the origin (0,0). The x-axis must start at 0 cm and end at 100 cm. Draw two lines of best fit, ● one from x = 10 cm to x = 45 cm, label this **A**, ● one from x = 60 cm to x = 90 cm, label this **B**. [4]

	(e)	Determine	
		(i)	the gradient G_A of the line **A**, G_A = ………………………… [1]
		(ii)	the p.d. V_A when x = 0 cm for line **A**, V_A = ………………………… [1]
		(iii)	the gradient G_B of line **B**, G_B = ………………………… [1]
		(iv)	the p.d. V_B when x = 0 cm for line **B**, V_B = ………………………… [1]
	(f)	It is suggested that G_A should be equal to G_B. State whether you agree with this suggestion. Justify your answer by reference to your results. ……………………………………………………………………………………………… ……………………………………………………………………………………………… ……………………………………………………………………………………………… [2]	

	(g)	An estimate for the length of *L* of resistance wire in the coil can be determined from the equation $$L = \frac{2\,(V_B - V_A)}{(G_A + G_B)}$$ Determine *L*. *L* = ………………………… [2]
	(h)	Suggest **two** reasons why the actual length *L* of the resistance wire in the coil is different from the value calculated in **(g)**. 1 …………………………………………………………………………………………… …………………………………………………………………………………………… 2 …………………………………………………………………………………………… …………………………………………………………………………………………… [2]

[Total: 20]

End of Paper

Answers

1 **(a)** **(i)** Mass is recorded as 0.050 kg. Θ_w is recorded to 0.5 °C and is close to room temp. [1]

(b) **(i)** Θ_m is recorded to 0.5 °C and is above 80 °C.

(iii) Θ_h is recorded to 0.5 °C and is slightly above Θ_w. [1]

(c) C_m is correctly calculated and expressed to correct SF and units. [1 + 1]

(d) Heat capacity is correctly calculated and expressed to correct SF and units. [1

(e) Energy is lost by mass to the surrounding during the transfer from beaker B to A.
The thermometer absorb energy from the hot water in beaker A OR thermometer transfer energy to the water in beaker A.
The loop of wire transfer energy to the water in beaker A.
Energy is lost by water in beaker A to the surrounding when the temperature is not recorded.
Beaker A absorb energy from the water. [4]

2 **(a)** L is correctly measured and recorded to 0.1 cm. [1]

(b) **(i)** W is recorded as 2.0 N. [1]

(ii) L_1 and e are recorded to 0.1 cm and e is correctly calculated. [1]

(c) k is correctly calculated and expressed to correct SF and unit. [1]

(d) Clamp the ruler next to the spring to take measurement OR take multiple reading with different weights and obtain the average readings. Reject other answers, e,g. ensure ruler is parallel to the spring or upright without any concrete methods. [1]

(e) <u>Procedures for 1st set of readings:</u>
Place a weight of 2.0 N on the spring. Pull and release to oscillate the spring.
Record the time for 10 oscillations using stopwatch t_1.
Repeat a second time and record time for another 10 oscillations t_2.
Find average time for 10 oscillations $t_{avg} = ½ (t_1 + t_2)$
Calculate period T using $t_{avg} ÷ 10$.

Calculate $\sqrt{W}$. [1]

<u>Procedures for other sets of readings:</u>
Repeat above for 5 other weights e.g. 0.5 N, 1.0 N. 1.5 N. 2.5 N and 3.0 N. [1]
<u>Tabulation:</u>

W / N	$\sqrt{W}$ / $N^{1/2}$	t_1 / s	t_2 / s	t_{avg} / s	T / s

[1]
<u>Graph Statement:</u>

Plot a graph of T against $\sqrt{W}$ [1]

<u>Shape of Graph</u>
Straight line graph through origin. [1]
<u>Finding k:</u>
$k = 0.4\pi^2/m^2$ [1]

<table>
<tr><td>3</td><td>(a)</td><td>I is correctly measured and expressed to correct precision. About 0.26 A[1]</td></tr>
<tr><td></td><td>(b)</td><td>V is correctly measured and expressed to correct precision. About 0.15 V [1]</td></tr>
<tr><td></td><td>(c)</td><td>10 sets of values including values in (b) are recorded. [1]
Units in headings [1]
x are recorded correctly to the correct precision and V are recorded correctly to the correct precision. [1]
V has correct trend. [1]

<table><tr><td>x / cm</td><td>V / V</td></tr></table></td></tr>
</table>

10.0	0.15
15.0	0.20
25.0	0.30
35.0	0.45
45.0	0.60
60.0	1.70
65.0	1.80
75.0	1.90
85.0	2.00
90.0	2.10

	(d)		Axis [2]: No odd scale, axis labelled every 2 cm. [1] Axes start from 0 to 100 and start at the origin (0,0) [1] Points [1]: Points are correctly plotted and marked with a reasonable size X. Graph [1]: Best fit graphs are drawn for **A** and **B.**
	(e)	**(i)**	Triangle or coordinates of the points used to calculate gradient is shown on graph. Gradient is correctly calculated and expressed to the correct SF. [1] About 0.013
		(ii)	Correct value of V_A is derived from graph. Expressed to the precision of half smallest grid square. [1] 0 V
		(iii)	Triangle or coordinates of the points used to calculate gradient is shown on graph. Gradient is correctly calculated and expressed to the correct SF. [1] About 0.014 *Note: **e(i)** and **e(iii)** will only be deducted once.*
		(iv)	Correct value of V_B is derived from graph. Expressed to the precision of half smallest grid square. [1] About 0.88 V
	(f)		It is not true as the values of G_A and G_B are largely differently. OR It is true as the values of G_A and G_B are very close. [1] Quantify by calculating and showing the magnitude of the difference between G_A and G_B. [1]
	(g)		L is correctly calculated based on data collected [1] Expressed to the correct SF. [1] About 65 cm
	(h)		1. Kinks in the wire increases the resistance of the wire, and affects *V*. [1] 2. Heating effect due to the current changes the resistance of the resistance wire. This affects *V*. [1]