**Preliminary Examination 2022**
**Secondary Four Express**
**Physics Paper 3 (6091/3)**

**Date of Examination: 5 August 2022** **Duration: 1 h 50 min**

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Name: _____( ) Class: _____

**READ THESE INSTRUCTIONS FIRST**

Write your name, index number and class in the spaces provided and on any separate answer paper used.
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.
Write your answers in the spaces provided on the question paper.
Graph paper is provided in this question paper. Additional sheets of graph paper should only be used 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 experiment is not required.

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

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 | |
|---|---|
| **Question** | **Marks** |
| **1** | **12** |
| **2** | **8** |
| **3** | **20** |
| **TOTAL** | **40** |

Set by: Mr Neal Cooke

Vetted by: Ms Audrey Tan, Mdm Fiona Tay & Mdm Hartati

## Section A

**1** *In this experiment, you will determine the specific latent heat of fusion of ice.*

You are provided with:

- a supply of ice,
- a styrofoam cup,
- a supply of water at room temperature,
- a measuring cylinder,
- a plastic spoon,
- a thermometer,
- a stirrer,
- some paper towels,
- a retort stand with clamp and boss.

**(a) (i)** Measure 80 $cm^3$ of water from the supply, using the measuring cylinder. This water has a mass $m_w$ = 80 g. Pour the water into the styrofoam cup. Measure and record the temperature $\theta_1$ of the water.

$\theta_1$ = ..... [1]

**(ii)** Take a spoonful of ice, pour off the excess water and dry the ice with a paper towel. Place the ice into the cup. Stir the mixture and note the temperature when all the ice has melted. Continue adding spoonfuls of dried ice and keep stirring until the temperature of the water after the ice has melted completely is below 15 °C. Record the final temperature $\theta_2$ of the water.

$\theta_2$ = ..... [1]

**(iii)** Explain why the ice needs to be dried with a paper towel.

.....

..... [1]

**(b) (i)** Carefully pour the water from the cup into the empty measuring cylinder. Measure and record the final volume of water.

final volume of water = ..... [1]

**(ii)** Calculate the volume of water produced from the melted ice.

volume of water from melted ice = ..... [1]

**(iii)** A volume of 1.0 $cm^3$ of water has a mass of 1.0 g. Calculate the mass $m_i$ of ice that was added to the water.

$m_i$ = ..... [1]

**(c) (i)** Calculate the thermal energy $Q_1$ lost by the water, initially at room temperature, using the formula

$$Q_1 = m_w c_w (\theta_1 - \theta_2)$$

where $c_w$ = 4.2 J / (g °C) and $m_w$ = 80 g.

$Q_1$ = ..... [1]

**(ii)** Using your value from **(b)(iii)**, calculate the thermal energy $Q_2$ gained by the water formed from the melted ice.

$Q_2$ = ..... [1]

**(d)** Calculate the specific latent heat of fusion *L* of ice using the formula

$$L = \frac{(Q_1 - Q_2)}{m_i}$$

*L* = …… [1]

**(e)** Describe how the temperature of the water is measured accurately when using the thermometer.

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……

…… [1]

**(f)** Identify one source of error in the experiment and explain how it affects your results.

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…… [1]

**(g)** Suggest one improvement to the experiment to improve the accuracy of your answer in part **(d)**.

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…… [1]

[Total: 12]

**2** *In this experiment, you will determine the mass of a metal disc using the Principle of Moments. You will then plan an experiment to find the mass of a metal disc by a graphical method.*

You are provided with:
- a knife-edge,
- a metre rule,
- a 100 g mass,
- a metal disc.

**(a)** You are now going to use the Principle of Moments to determine the mass *m* of the metal disc. You should aim to obtain the most accurate value for *m*.

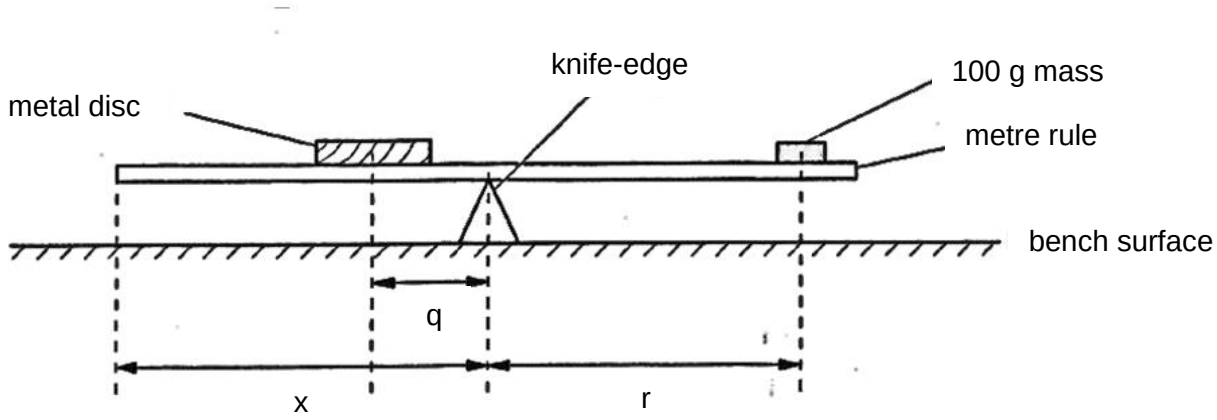


**Fig. 2.1**

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

Before placing the metal disc and 100 g mass on the metre rule, adjust distance *x* such that the metre rule rests horizontally on the knife edge.

Place the metal disc along the metre rule. Adjust the position of the metal disc and the 100 g mass until the metre rule rests horizontally.

Determine the distance *q* between the centre of the metal disc and the knife-edge and the distance *r* between the knife-edge and the centre of the 100 g mass.

*q* = ……..

*r* = …….. [1]

**(b)** Calculate the mass *m* of the metal disc in grams using the formula

$$m = \frac{100r}{q}$$

*m* = …….. [1]

**(c)** The equation in **(b)** may be written in the form

$$mq = 100r$$

where *m* is the mass of the metal disc in grams.

Plan an experiment, using this equation and a graphical method, to find a value for *m*.
Your plan should include

- a description of how you would perform the experiment,
- a statement of the graph that you would plot,
- an explanation of how *m* would be found from the graph,
- a description of one source of error and how it affects the results.

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…… [6]

[Total: 8]

## Section B

**3** *In this experiment, you will investigate the power dissipated in resistors that are connected in a circuit.*

You are provided with:

- two 2.2 Ω resistors,
- two 10 Ω resistors,
- two 1.5 V cells with holder,
- one switch,
- an ammeter,
- a voltmeter,
- some connecting leads.

The experiment has been set up for you as shown in Fig. 3.1.

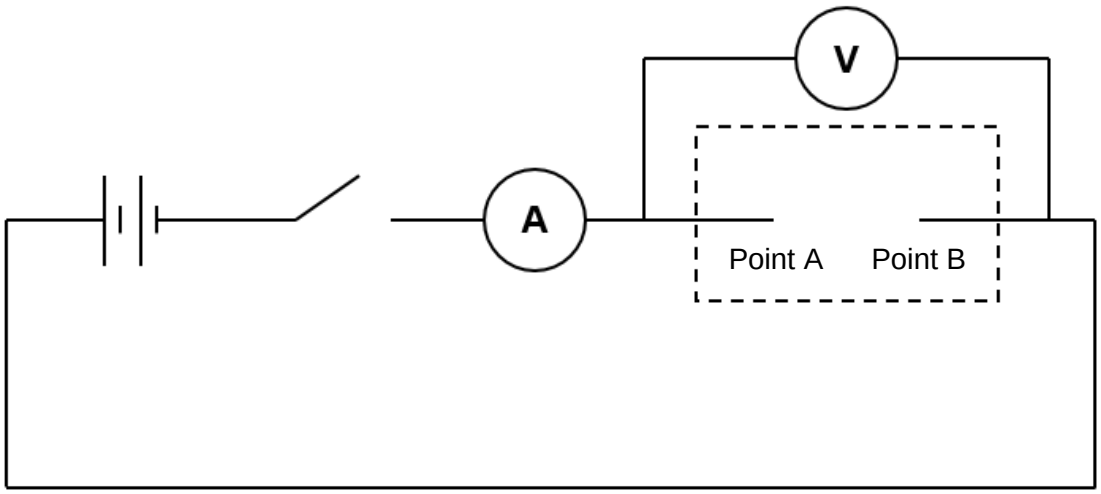



**Fig. 3.1**

**(a)** Connect one 10 Ω resistor between points A and B.

**(i)** Close the switch. Measure and record the potential difference *V* between points A and B, and the current flowing through the circuit, *I*.

*V* = ……..…….....  [1]

*I* = ……..…….....  [1]

**(ii)** Describe how you ensured that the potential difference *V* was measured accurately.

……...

……...  [1]

**(iii)** Explain why the ammeter is placed in series with points A and B while the voltmeter is placed in parallel with points A and B.

……...  [1]

**(iv)** Calculate the power *P* dissipated in the resistor.

*P* = ……..... [1]

**(b)** **(i)** Connect the two 10 Ω resistors in a series arrangement between points A and B. Record the values of *V* and *I*.

*V* for series arrangement = ……..... [1]

*I* for series arrangement = ……..... [1]

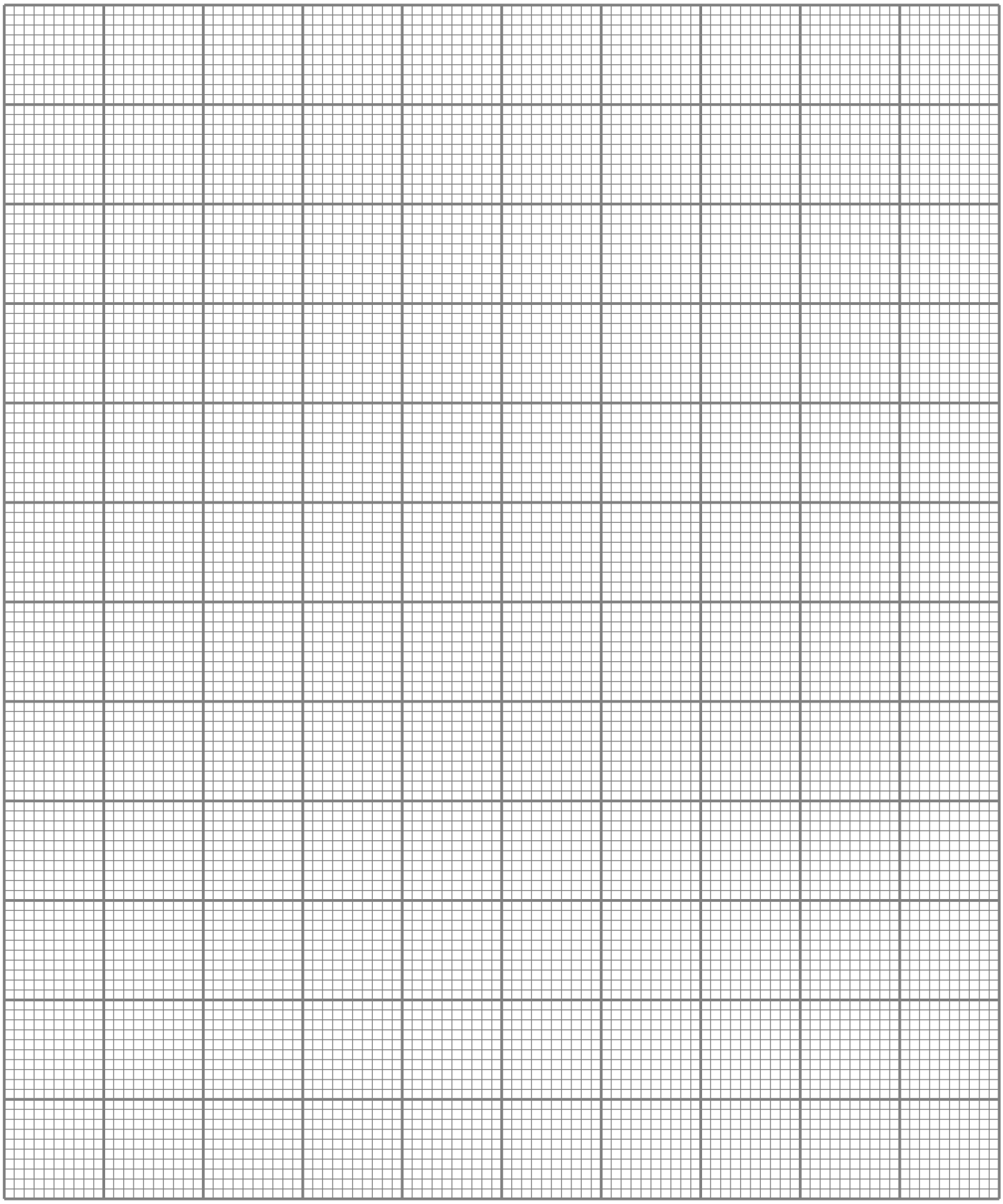
**(ii)** Using the values of *I* and *V* in part **(b)(i)**, calculate the power *P* for a series arrangement.

*P* for series arrangement = ……..... [1]

**(iii)** Using a combination of series or parallel arrangements for the 2.2 Ω and 10 Ω resistors, obtain 4 further sets of values of *R*, *V*, *I* and *P*. The range of resistance should be between 2.2 Ω and 20 Ω.

Record the values in a table in the space below. Include values of *R*, *V, I* and *P* calculated in parts **(b)(i)** and **(b)(ii)**. [4]

**(c)** On the grid provided, plot a graph of power *P* against resistance *R* and draw a best-fit line. [4]



**(d)** Use your graph to determine the value of $R$ that gives a power dissipation of 0.4 W.

$R$ = ……..... [1]

**(e)** Identify a source of error in this experiment and explain how it affects your results.

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…… [2]

**(f)** Suggest one improvement to the experiment to improve the accuracy of the results.

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…… [1]

[Total: 20]

**End of Paper 3**