Anglican High School
Secondary Four
Preliminary Examination 2023

S4

CANDIDATE NAME

CLASS 4

CLASS INDEX

PHYSICS

6091/03

Paper 3 Practical Test

14 August 2023

1 hour 50 minutes

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, index number and name on all 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 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	
2	
3	
Total	

This document consists of **12** printed pages.

Section A

1 *In this experiment, you will investigate the mass and volume of a brass mass.*

You are provided with:

- a brass mass
- a ruler
- two set squares
- an electronic balance

(a) **(i)** Describe one precaution you must take before measuring the mass of the brass mass using an electronic balance.

……

…… [1]

(ii) Measure and record the mass of the brass mass.

mass = …… [1]

(b) **(i)** Draw a labelled diagram to show how to use the ruler and the set squares to measure the diameter of the brass mass.

[2]

(ii) Measure and record the diameter *d* of the brass mass.

d = …… [1]

(c) **(i)** Measure and record the total length *l* of the brass mass, as shown in Fig. 1.1.

Fig. 1.1 (not to scale)

l = …….. [1]

(ii) Estimate the volume *V* of the brass mass using the equation

$$V = \frac{\pi}{4} ld^2$$

V = ……..… [1]

(iii) The volume calculated in **(c)(ii)** is an estimate of the volume of the brass mass.

Explain why it is only an estimate and whether it is a good or poor estimate of the actual volume of the brass mass.

……

……

…….... [2]

(iv) Describe how the method for determining the volume of the brass mass may be improved.

……

……

……... [1]

[Total: 10]

2 *In this experiment, you will investigate the deviation of a ray of light passing through a glass block.*

You are provided with

- a rectangular block
- an illuminated slit
- a 30 cm ruler
- a protractor

(a) Fig. 2.2 is on page 5 of your question paper. **On Fig. 2.2**,

(i) draw a normal to the line XY at point M, above and below the line XY,

(ii) draw a line from M at an angle of 60° to the normal towards the top left edge of the page. Label this line L.

(iii) Extend this line from M to the bottom right edge of the page. Label this line K.

[1]

(b) Place the block on Fig. 2.2, with one of its long sides on the line XY. The top left-hand corner of the block should be at X, as shown in Fig. 2.1.

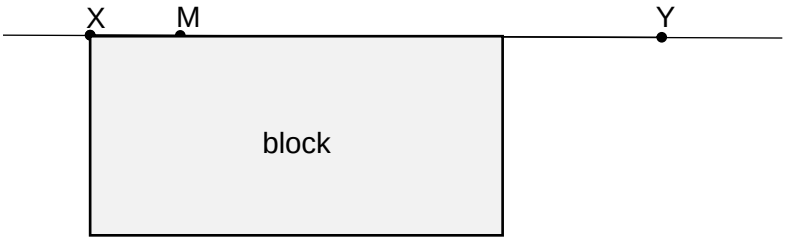

Fig. 2.1

(c) **(i)** On Fig. 2.2, draw the outline of the block.

(ii) Position the illuminated slit so that a ray of light passes along line L from the top left edge of the page towards M.

(iii) On Fig. 2.2, mark and label two points P_1 and P_2 on the ray that leaves the block. You should choose the position of these two points so that the position of the ray can be accurately drawn. [1]

(d) **(i)** Remove the block. Draw a line through P_1 and P_2 to touch the outline of the block at a point. Label this point N.

(ii) Draw a straight line from M to N and measure the length *l* of the line MN.

. *l* = ... [1]

(iii) Measure the perpendicular distance *d* between the line K and the line through P_1 and P_2.

d = ... [1]

(iv) Calculate $\frac{d}{l}$ **.**

$\frac{d}{l}$ = ... [1]

Fig. 2.2

(e) A student claims that the value of $\frac{d}{l}$ is linearly related to θ, the angle the ray of light from the illuminated slit makes to the normal.

Using the same apparatus, plan an experiment to find out if the student's claim is correct.

Your plan should include

- a list of quantities that you should keep constant,
- a detailed description of how you will perform the experiment,
- a statement of the graph that you would plot to test the relationship,
- a sketch of the graph that you would obtain if the suggested relationship is correct.

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…….. [5]

[Total: 10]

Section B

3 *In this experiment, you will determine the specific heat capacity of cooking oil.*

You are provided with:

- an arrangement of resistors to act as a heater
- an ammeter
- a voltmeter
- a power supply
- a switch
- leads and crocodile clips.

The heater is made from five resistors connected in parallel. Do **not** separate the resistors.

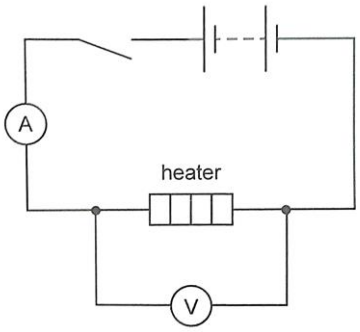


Fig. 3.1

Assemble the apparatus shown in Fig. 3.1. Close the switch. Take the readings in **(a)** and then immediately open the switch.

(a) Record the current I.

I = ……

Record the potential difference V across the heater.

V = ……

[1]

Disconnect the voltmeter from the circuit.

(b) You are also provided with:

- a beaker containing cooking oil held in a clamp, boss and stand
- a second boss and clamp
- a thermometer
- a stopwatch

Arrange the apparatus shown in Fig. 3.2 with the heater placed in the cooking oil. The thermometer should be placed close to, but not in contact with the heater.

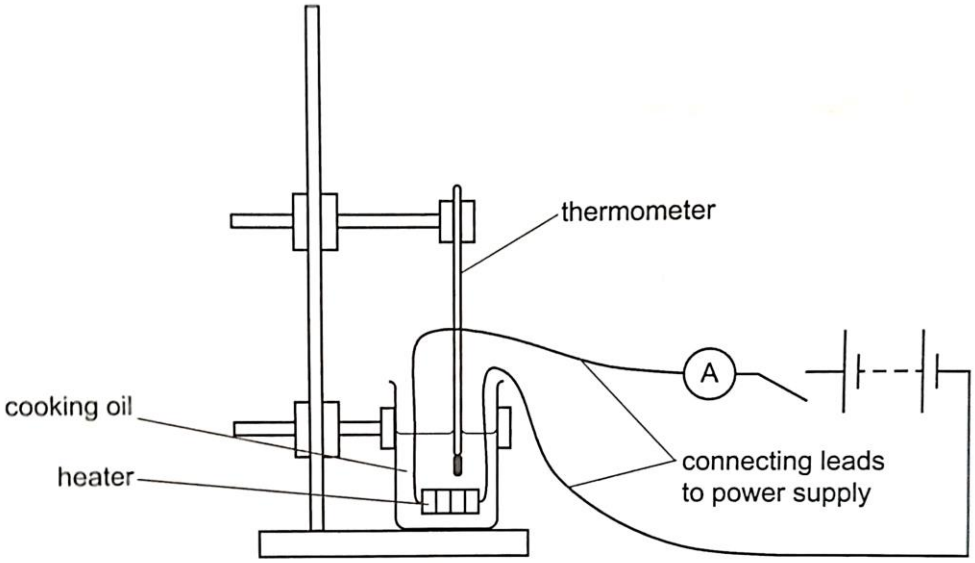


Fig. 3.2

(i) Suggest **one** way in which you assembled the apparatus to make the temperature readings accurate.

……..

……

[1]

(ii) Measure and record the starting temperature θ_0 of the cooking oil.

θ_0 = ……. [1]

(iii) Calculate the mass m of the cooking oil using the equation

$$m = \rho v$$

where the density of the oil ρ is 0.90 g / cm^3 and the volume of oil v is 40 cm^3.

m = …… [1]

(c) Close the switch and start the stopwatch.
Stop the stopwatch when the temperature of the oil has increased by $\Delta\theta$ = 2.0 °C.

Open the switch.

Convert the reading on the stopwatch into seconds.
Record the reading *t* in seconds.

t = ……..…….

Use the values of *V* and I recorded in **(a),** and the equation $E = V\,I\,t$, to calculate the energy *E* supplied to the oil.

E = ……...

Calculate the specific heat capacity c_1 of the oil using the equation

$$c_1 = \frac{E}{m\Delta\theta}$$

c_1 = ……. [3]

(d) Reset the stopwatch.

Measure and record the temperature θ of the oil at time t = 0 seconds.

θ = ...

Close the switch and start the stopwatch.

In a suitable table, record the reading on the stopwatch, t in seconds, each time the temperature θ of the oil increases by 1.0 °C. Include the temperature θ of the oil at time t = 0 s in the table.

Continue the experiment until the temperature θ of the oil has increased by 6.0 °C.

Open the switch and stop the stopwatch.

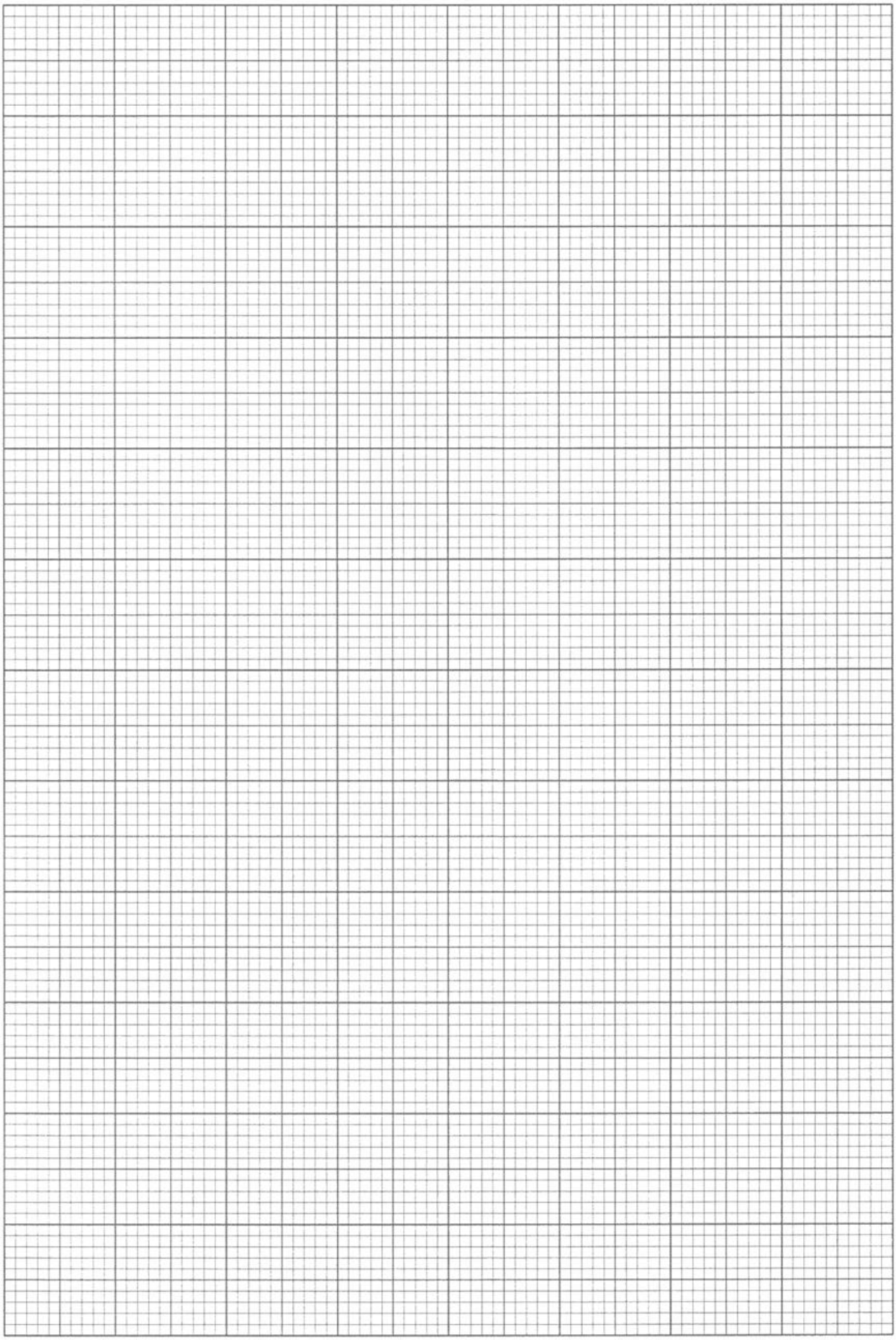
[3]

(e) **(i)** Calculate E, the total energy supplied for each value of t.

Record your values in a separate column of the table. [1]

(ii) Using the grid provided, plot a graph of E against θ.

Draw the line of best fit. [4]



(f) Determine the gradient G of the line of best fit.

G = …… [2]

Calculate a second value of c_2, the specific heat capacity of the oil, using the equation

$$c_2 = \frac{G}{m}$$

where m is the mass of oil calculated in **(b)(iii)**.

c_2 = …… [1]

(g) Explain **two** sources of error in the experimental procedure that cause the value of c_1 to be different from the value of c_2.

1. ……

……

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2. ……

……

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[2]

[Total : 20]

End of paper