Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

2945230625

PHYSICS **5054/31**

Paper 3 Practical Test **May/June 2023**

1 hour 30 minutes

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].

For Examiner's Use	
1	
2	
3	
4	
Total	

This document has **12** pages.

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1 In this experiment you will investigate specific heat capacity.

You are provided with:

- a 100 cm^3 beaker labelled A with a mark at the 25 cm^3 level
- a beaker of water labelled B
- a thermometer
- access to a 50 g mass at 100 °C.

(a) Pour 25 cm^3 of water from beaker B into beaker A.

Measure and record the temperature θ_1 of the water.

Place the thermometer back on the bench.

θ_1 = ... °C [1]

(b) The supervisor has placed some 50 g masses in boiling water. Each mass has been tied to a length of string.

Take beaker A to where the masses are in boiling water. Using the string, remove one mass from the boiling water and place it carefully in the beaker. Do not touch the mass. Allow the string to hang over the side of beaker A and return beaker A to your workstation.

(i) Measure and record the maximum temperature θ_2 of the water in beaker A.

θ_2 = ... °C [1]

(ii) Describe how you make sure that your value of θ_2 is as accurate as possible.

.....

.....

..... [2]

(iii) Beaker A has a capacity of 100 cm^3 and beaker B has a capacity of 250 cm^3.

Explain why beaker A is more suitable for this experiment than beaker B.

.....

..... [1]

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(iv) Calculate the specific heat capacity c_m of the 50 g mass using the equation:

$$c_m = \frac{2.1\ (\theta_2 - \theta_1)}{(100 - \theta_2)}.$$

Show your working.

c_m = ... J/(g °C) [1]

(c) (i) Describe **two** sources of error in the method used to determine c_m.

1 .....

.....

2 .....

.....

[2]

(ii) Suggest **two** improvements to the method.

1 .....

.....

2 .....

.....

[2]

[Total: 10]

2 In this experiment you will investigate a thermistor.

You are provided with:

- a battery of cells
- a switch or plug key
- a fixed resistor
- a thermistor
- a voltmeter
- a thermometer
- connecting leads
- a beaker containing ice and water.

The supervisor has assembled the apparatus shown in Fig. 2.1.

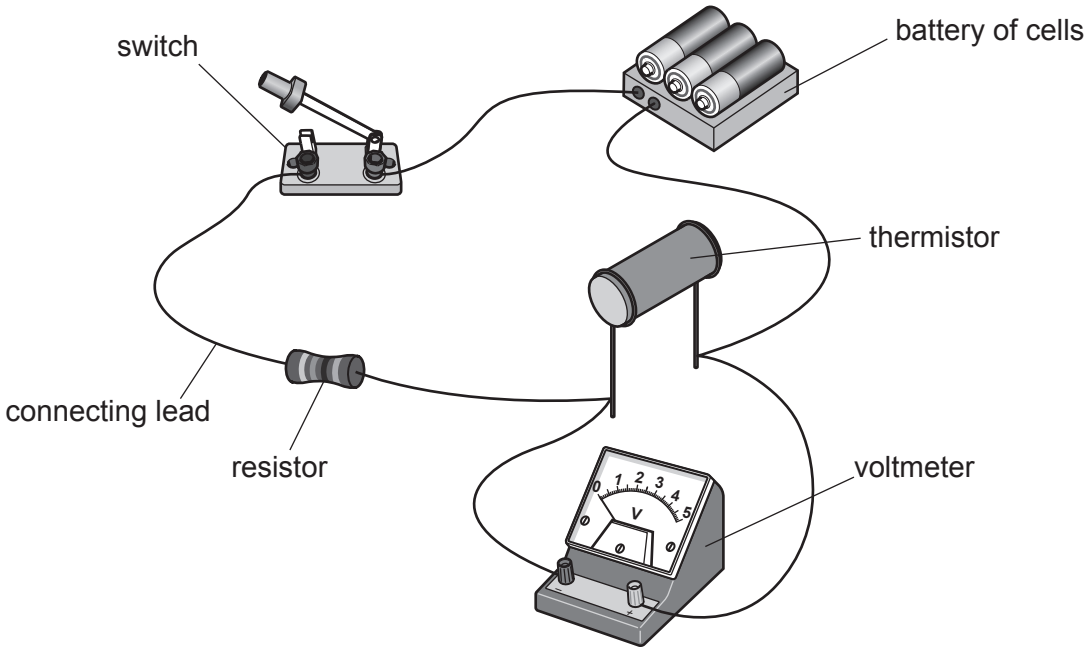


Fig. 2.1

(a) Draw a circuit diagram of the circuit.

[3]

(b) There is a thermometer attached to your bench by a small amount of adhesive putty.

Record the temperature T_W on the thermometer. This is room temperature.

Close the switch.

Record the reading V_W on the voltmeter

Open the switch.

T_W = ... °C

V_W = ... V [1]

(c) There is a beaker containing ice and water near the thermistor.

Carefully move the beaker closer to the circuit and submerge the thermistor in the cold water in the beaker.

Wait about one minute until the reading on the voltmeter is steady.

Record the new voltage V_C.

Remove the thermistor from the cold water.

V_C = ... V [1]

(d) **(i)** Assume that the temperature T_C of the ice and water is 0 °C.

Calculate the average change in voltage for one degree temperature change ΔV_{AV} using the equation:

$$\Delta V_{AV} = \frac{(V_C - V_W)}{(T_W - T_C)}$$

State the unit of your answer.

ΔV_{AV} = ... unit ..... [2]

(ii) Use your answer to **(d)(i)** to predict the voltage V_{PB} across the thermistor when the thermistor is at body temperature. Body temperature is 37 °C.

You may assume that the average change in voltage for one degree temperature change ΔV_{AV} is constant.

V_{PB} = ... V [1]

(iii) A student suggests that if the thermistor is held between a thumb and forefinger for two minutes, the reading on the voltmeter will be the same as the predicted voltage V_{PB} in **(d)(ii)**.

Two quantities are considered to be equal, within the limits of experimental accuracy, if their values are within 10% of each other.

Hold the thermistor between your thumb and forefinger for two minutes, until the voltmeter shows a new steady reading.

Read and record this voltage V_{AB}.

State whether the student's results indicate that V_{PB} and V_{AB} are equal within the limits of experimental accuracy.

Support your statement with a calculation.

V_{AB} = ... V

calculation

statement .....

..... [2]

[Total: 10]

3 In this experiment you will investigate a falling mass.

You have been provided with:

- a pulley attached to a stand
- two 100 g mass hangers attached by a length of string
- a metre rule
- a stop-watch
- one piece of adhesive putty labelled 5.0 g
- four other pieces of putty each with mass 2.0 g.

The supervisor has set up the apparatus as shown in Fig. 3.1.

Do **not** remove the pulley from the stand.

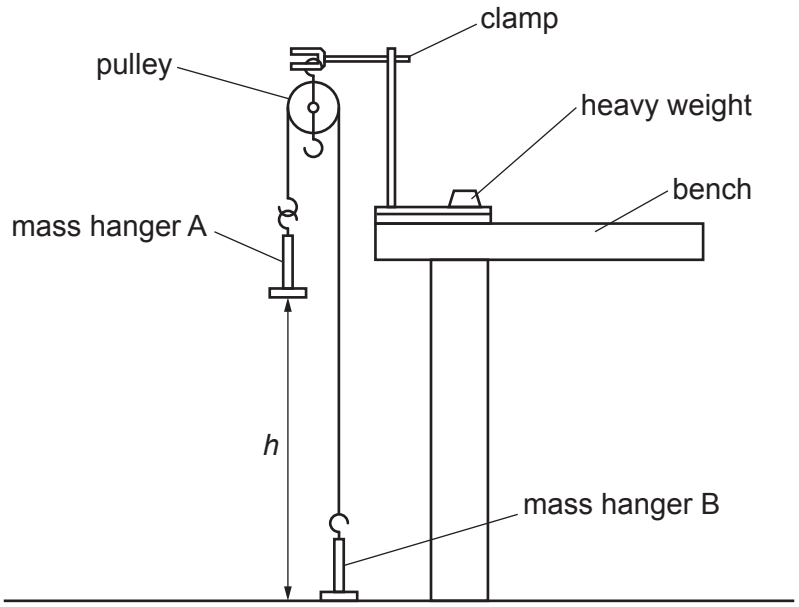


Fig. 3.1

(a) The bottom of mass hanger A is at a height *h* above the floor as shown in Fig. 3.1.

(i) Measure *h*.

h = ... cm [1]

(ii) Describe **one** source of error when measuring *h* and suggest **one** improvement to the procedure to reduce this error.

source of error .....

.....

improvement .....

.....

[2]

(b) Place the piece of adhesive putty labelled 5.0 g on mass hanger A.

(i) Take **two** measurements t_1 and t_2 of the time it takes for the mass hanger to fall to the floor and determine the average time t_{AV} for the mass hanger to fall to the floor.

You may need to give the hanger a gentle push to start the movement.

Show your working.

t_{AV} = ... [2]

(ii) Add one 2.0 g piece of adhesive putty to hanger A. There is now a total mass m of 7.0 g of putty on the hanger. Repeat **(b)(i)**.

Continue adding further 2.0 g masses, one at a time, and repeating **(b)(i)** until there is a total mass m of 13.0 g of putty on the hanger.

Record all your measurements, including **(b)(i)**, in Table 3.1. Complete the headings and give units.

Table 3.1

total mass m of putty on hanger			
5.0			

[3]

(c) On the grid provided on page 9, plot a graph of time t_{AV} on the y-axis against the total mass m of putty on the x-axis.

Draw the best-fit curve. [4]

(d) Describe the relationship between t_{AV} and m shown by the graph.

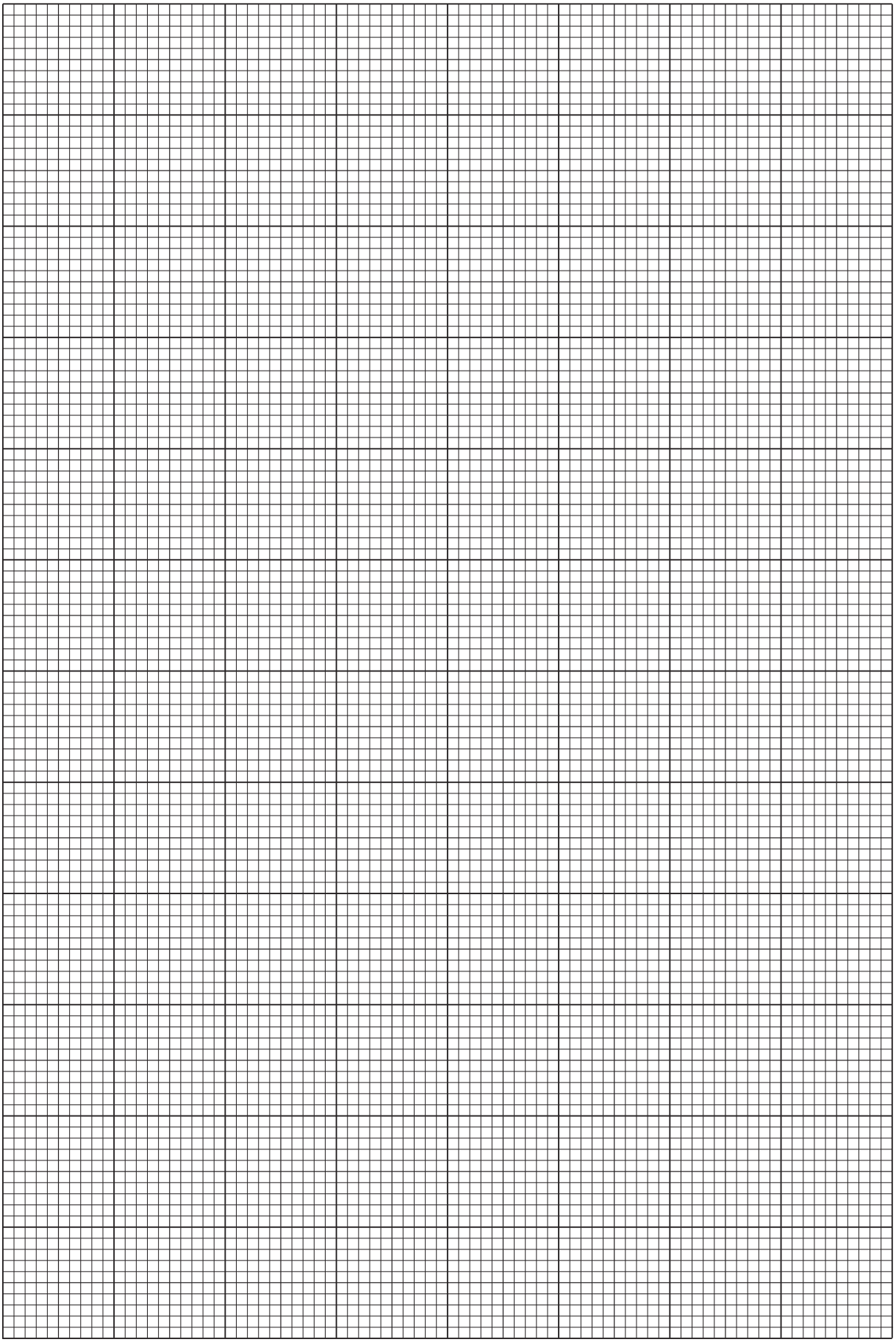
.....

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..... [2]

[Total: 14]

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4 A student attaches a propeller to an electric motor driven by a 0 to 12 V d.c. power supply as shown in Fig. 4.1.

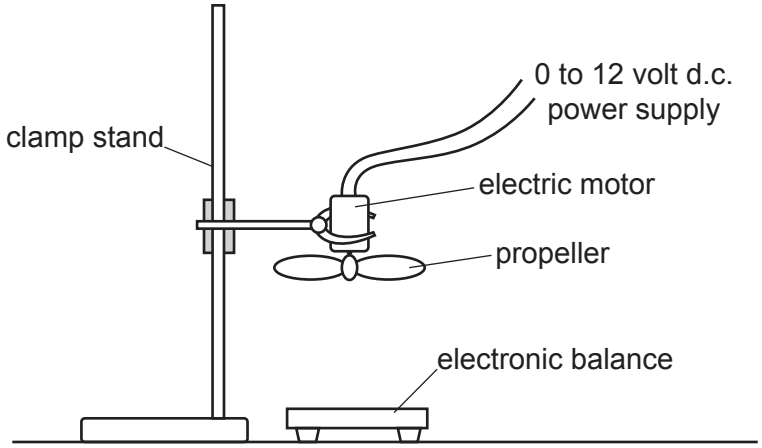


Fig. 4.1

Moving air from the propeller exerts a force on the balance.

Plan an experiment to investigate how this force varies with the voltage of the power supply.

The following apparatus is available:

an electric motor
an electronic balance
a power supply
a propeller
a voltmeter.

You can also use other apparatus and materials that are usually available in a school laboratory.

You are **not** required to do this investigation.

In your plan, you should:

- explain briefly how to carry out the investigation
- state the key variables to control
- draw a table, with column headings, to show how to display your readings (you are **not** required to enter any readings in the table)
- explain how to use your readings to reach a conclusion.

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