



XINMIN SECONDARY SCHOOL
新民中學
SEKOLAH MENENGAH XINMIN

Preliminary Examination 2026

CANDIDATE NAME

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CLASS

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INDEX NUMBER

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PHYSICS

6091/03

Paper 3 Practical Test

Secondary 4 Express

14 AUG 2026

Setter: Ms Cindy Oh

Vetter: Mr Koh Tat Siang

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, correction fluid or highlighters.

Answer **all** questions.

All 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 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 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.

Shift
Laboratory

For Examiner's Use	
Section A	20
Section B	20
Total	40
Parent's Signature	

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Section A

1 In this experiment, you will investigate energy transfers.

You are provided with:

- a retort stand with two bosses and a clamp
- a pulley
- a spring with a length of string tied to each end; one long piece and one shorter piece
- a load
- a card stating the values of the spring constant k and the weight W of the load
- a half-metre rule.

Set up the apparatus as shown in Fig. 1.1.

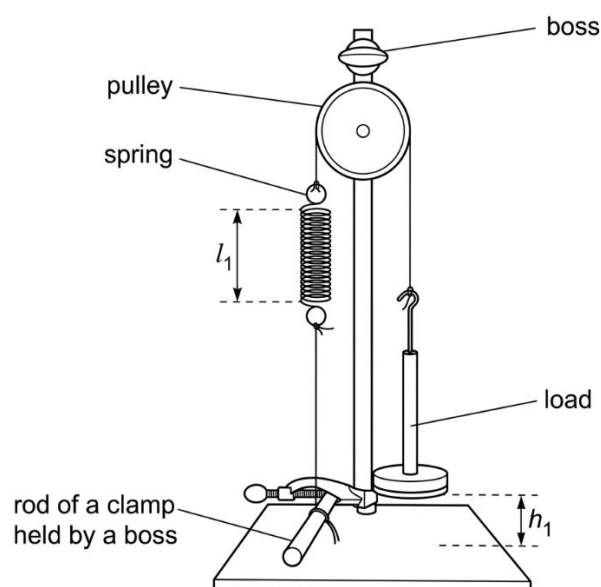


Fig. 1.1

Mount the pulley with its centre at a height of 40.0 cm above the base of the retort stand.

Tie the longer string to the load, and tie the shorter string to the rod at the base of the retort stand.

Adjust the lengths of the strings such that the spring is unstretched, the bottom of the load is resting on the base of the retort stand, and there is no slack in the strings.

Then adjust the height of the boss at the top of the retort stand such that the spring becomes stretched, and the bottom of the load is 3.0 cm above the base of the retort stand.

(a) (i) Measure and record in metres:

- the length l_1 of the stretched spring,

$$l_1 = \dots\dots\dots \text{ m}$$

- the height h_1 of the bottom of the load above the base of the retort stand.

$$h_1 = \dots\dots\dots \text{ m} \quad [1]$$

(ii) Use your hand to lift the load until the extension of the spring just becomes zero.

Measure and record in metres:

- the length l_2 of the unstretched spring,

$$l_2 = \dots\dots\dots \text{ m}$$

- the new height h_2 of the bottom of the load above the base of the retort stand.

$$h_2 = \dots\dots\dots \text{ m} \quad [2]$$

(b) The values of the spring constant k of the spring and the weight W of the load are recorded on the piece of card.

(i) Calculate the decrease in the energy stored in the elastic potential store of the spring using the equation

$$E_{ep} = 0.5 k (l_1 - l_2)^2$$

$$E_{ep} = \dots\dots\dots [2]$$

(ii) Calculate the increase in the energy stored in the gravitational potential store of the load using the equation

$$E_{gp} = W (h_2 - h_1)$$

$$E_{gp} = \dots\dots\dots [1]$$

- (c) When the load moves down to its original position, energy is transferred from the E_{gp} store to the E_{ep} store.

Calculate the value of $\frac{E_{ep}}{E_{gp}}$.

$$\frac{E_{ep}}{E_{gp}} = \dots\dots\dots [1]$$

- (d) Two students perform the experiment using identical springs and loads. The apparatus is arranged in an identical way. Both students measure l and h accurately.

The students calculate different values of $\frac{E_{ep}}{E_{gp}}$.

State **two** significant sources of error in this experiment.

Suggest **one** improvement that could be made to the experiment to address one of these sources of error.

source of error 1

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source of error 2

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improvement

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..... [3]

[Total: 10]

2 In this experiment, you will investigate the focal length of a combination of lenses.

You are provided with:

- a pair of converging lenses mounted on a block
- a torch
- a screen
- a retort stand, boss and clamp
- a 50 cm rule.

Set up the apparatus as shown in Fig. 2.1.

There is a card with a triangular hole mounted on the front of the torch.

Use the retort stand, boss and clamp to hold the torch level with the centre of the lenses. Place the torch so that the triangle is at the 0.0 cm mark on the 50 cm rule. Switch on the torch.

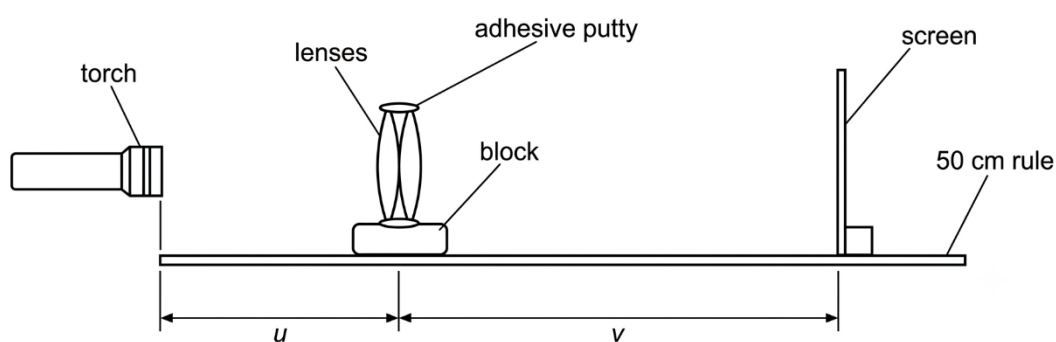


Fig. 2.1

Place the centre of the combination of lenses at $u = 15.0$ cm and move the screen until a focused image of the triangle is formed on the screen. The distance v is measured between the centre of the combination of lenses and the screen where the image is focused.

- (a)** Describe the steps used to ensure a **focused image** of the triangle forms on the screen when the screen is in the **correct position**.

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[3]

- (b) Determine an accurate value for the distance v .

$v = \dots\dots\dots$ [2]

- (c) A student learns the lens formula, given by

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v},$$

where f is the focal length of the combination of lenses, u is the object distance and v is the image distance.

She suggested an alternative formula, given by

$$uv = f(u + v).$$

- (i) Prove that the student's alternative formula is correct. [1]

- (ii) Plan an experiment to determine the focal length of the combination of lenses using the alternative formula.

In your plan, you should:

- describe briefly how to do the experiment accurately
- draw a table, with column headings, to show how to display the range of readings
- sketch the graph that you would obtain
- explain how to determine the focal length of the combination of lenses if the student's alternative formula is correct.

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[4]

[Total: 10]

Section B

3 In this experiment, you will investigate the specific heat capacity of brass.

You are provided with:

- a source of tap water,
- a measuring cylinder,
- a polystyrene foam cup,
- a retort stand with a boss and a clamp,
- a thermometer,
- a plastic stirrer and
- two 100 g brass slotted mass with a loop of string immersed in an ice-water bath.

Set up the apparatus as shown in Fig. 3.1.

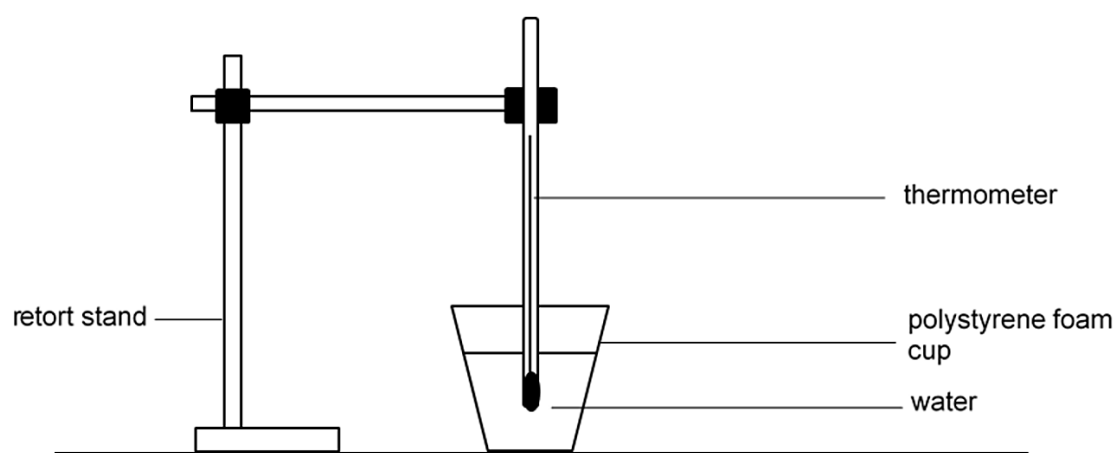


Fig. 3.1

- (a) (i) Use the measuring cylinder to collect 60.0 ml of tap water.
Measure and record the volume V of the tap water.

Pour the tap water into the polystyrene foam cup.
Measure and record the temperature T_{warm} of the tap water.

$$V = \dots\dots\dots [1]$$

$$T_{\text{warm}} = \dots\dots\dots$$

- (ii) Given that the density of water is 1.0 g ml^{-1} , calculate the mass m_w of the tap water.

$$m_w = \dots\dots\dots [1]$$

- (b) The temperature of the ice-water bath, which is also the temperature T_{cold} of the brass slotted masses in it, is 0°C .

Ensure that there is always ice in the ice-water bath by adding more ice (available at teachers' bench) when needed.

Collect one 100 g brass slotted mass by its loop of string .
Ensure that there is no ice nor water on the brass slotted mass.

Fully submerge the brass slotted mass into the tap water in the polystyrene foam cup. Ensure that the mass does not touch the sides of the cup by holding on to the loop of string.

Stir the water in the cup with a plastic stirrer.
Measure and record the **lowest** temperature T_{final} of the water.

$$T_{final} = \dots\dots\dots [1]$$

- (c) Record your values of V , m_w and T_{final} in a table.

Include columns for $\frac{1}{m_w}$ and $\frac{1}{T_{final}}$.

For values of V from 60.0 ml to 110.0 ml, determine the corresponding values of m_w , T_{final} , $\frac{1}{m_w}$ and $\frac{1}{T_{final}}$.

Ensure that the initial temperature of the brass slotted mass used for each value of V is at 0°C by using the two brass slotted masses alternately.

Record all of your measurements and calculations in your table. [5]

- (d) (i) Using the grid provided, plot a graph of $\frac{1}{T_{final}}$ against $\frac{1}{m_w}$.
Draw the line of best fit.

[4]



- (ii) Determine the gradient G of the line of best fit.

$$G = \dots\dots\dots [2]$$

- (iii) It is suggested that

$$G = \frac{c_b \times m_b}{c_w \times T_{warm}},$$

where m_b is the mass of the brass slotted mass,
 c_b is the specific heat capacity of brass and
 c_w is the specific heat capacity of water.

Given that the specific heat capacity of water c_w is $4.2 \text{ J (g } ^\circ\text{C)}^{-1}$, calculate the specific heat capacity of brass c_b .

$$c_b = \dots\dots\dots [2]$$

- (iv) Determine the y-intercept Y of the line of best fit.

It is also suggested that

$$Y = \frac{1}{T_{warm}}.$$

State whether your values of Y and T_{warm} in (a) support this suggestion.

$$Y = \dots\dots\dots$$

.....
 [2]

- (e) Describe **one** source of error.
Suggest **one** improvement to reduce this error.

source of error

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improvement

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[2]

[Total: 20]

End of paper

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