Anglo-Chinese Junior College

Physics Preliminary Examination
Higher 2

A Methodist Institution
(Founded 1886)

CANDIDATE NAME		CLASS	

CENTRE NUMBER	S	3	0	0	4	INDEX NUMBER					

PHYSICS **9749/04**

Paper 4 Practical

5 August 2021
2 hours 30 mins

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

READ THESE INSTRUCTIONS FIRST

Write your name and index number in the spaces at the top of this page.
Write in dark blue or black pen on both sides of the paper.
You may use an HB pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.
The use of an approved scientific calculator is expected, where appropriate. You may lose marks if you do not show your working or if you do not use the appropriate units.

Give details of your practical shift and laboratory, where appropriate, in the boxes provided.

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 Examiners' use only	
1	/ 9
2	/ 13
3	/ 21
4	/ 12
Total	/ 55

For Examiner's Use

1 In this experiment, you will investigate the equilibrium of a metre rule.

(a) **(i)** You have been provided with a metre rule with two springs attached. The distance between one end of the metre rule and the string is L, as shown in Fig. 1.1.

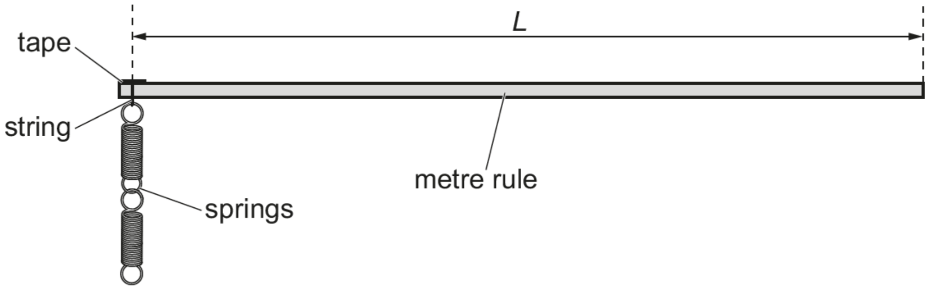

Fig. 1.1

Measure and record L.

L = …………………………….. [1]

(ii) Calculate $\frac{L}{n}$ where n = 3.

$\frac{L}{n}$ = ………………………………..

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(b) **(i)** Set up the apparatus as shown in Fig. 1.2.

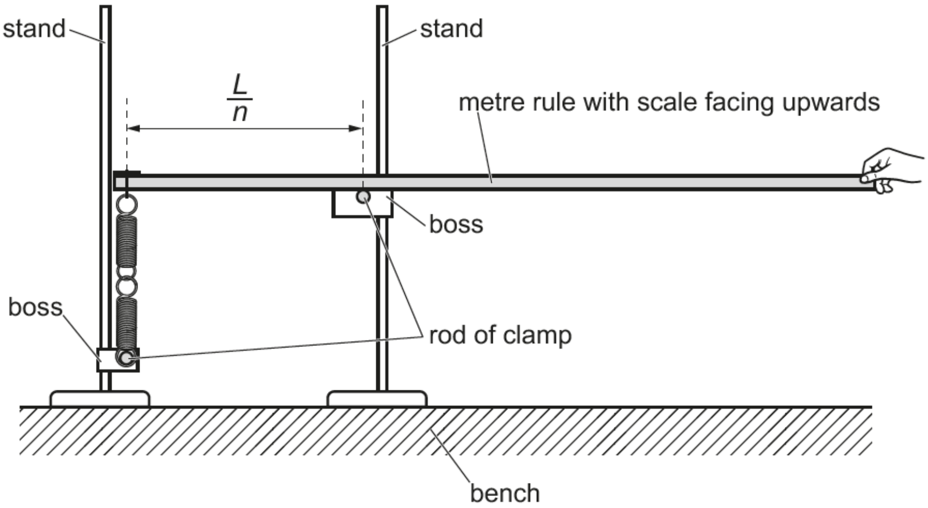

Fig. 1.2

Adjust the apparatus until the horizontal distance between the centres of the rods of the clamps is equal to your value of $\frac{L}{n}$.

Adjust the heights of the bosses so that the rule is horizontal and the springs are vertical and **unstretched** when the rule is held in position.

Gradually release the rule by lowering your hand. The rule will tilt.

The angle between the rule and the horizontal is θ, as shown in Fig. 1.3.

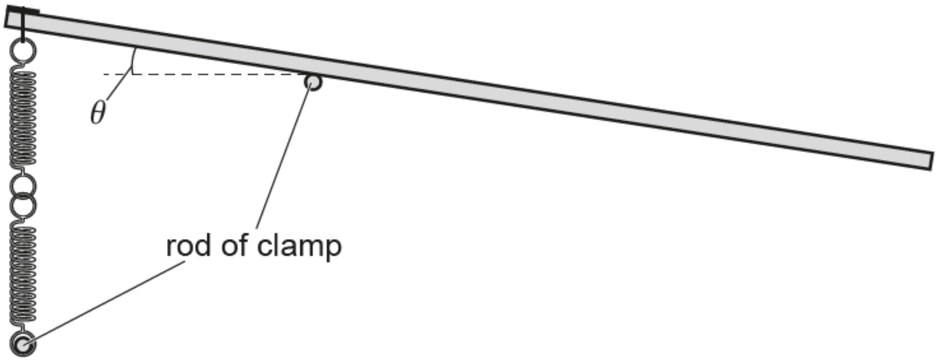

Fig.1.3

Measure and record θ.

θ = ……………………………….. [1]

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(ii) Estimate the percentage uncertainty in your value of θ.

percentage uncertainty in θ = …………………………….. [1]

(c) The quantities θ and n are related by the equation

$$\sin\theta = C\,(0.5\,n^2 - n)$$

where C is a constant.

(i) Calculate C.

C = …………………………….. [1]

(ii) If you were to repeat this experiment with increasing values of n, describe the graph that you would plot and how you would determine C.

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……………………………………………………………………………………….

…………………………………………………………………………………… [2]

For Examiner's Use

(d) Theory suggests that

$$C = \frac{Mg}{kL}$$

where

M is the mass of the metre rule given on the card
k is the spring constant of the spring system
$g = 9.81 \text{ m s}^{-2}$

Use your value of C to determine a value for k.

k = …………………………….. N m^{-1} [1]

(e) The actual value of k is 25.0 N m^{-1}.

Comment on the accuracy of your result found in **(d)**.

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……………………………………….…………………………………………… [2]

[Total: 9]

For Examiner's Use

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For Examiner's Use

2 In this experiment, you will investigate a potential divider circuit.

(a) **(i)** You have been provided with a wooden strip with some wire connected between two nails. Set up the circuit as shown in Fig. 2.1.

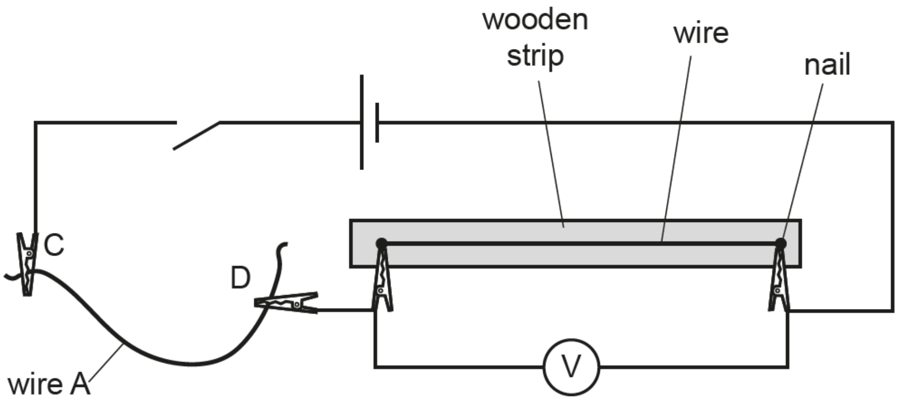

Fig. 2.1

C and D are crocodile clips. Place the clips wire A so that the length *x* of the wire between C and D is equal to the length of wire between the two nails.

Measure and record *x*.

x = ……………………………….. [1]

(ii) Close the switch. Record the voltmeter reading *V*.

V = ………………………………..

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(b) Vary x using the same wire A throughout. Repeat **(a)**.

Present your results clearly.

[5]

(c) It is suggested that the relationship between V and x is

$$\frac{1}{V} = \frac{x}{kE} + \frac{1}{E}$$

where k is a constant and E is the electromotive force (e.m.f.) of the cell.

Plot a suitable graph to determine the value for k.

k = …………………………….. [6]

For Examiner's Use

(d) Without taking further readings, sketch a line on your graph grid to show the results you would expect if the experiment was repeated with a cell that has a larger e.m.f.

Label this line **W**. [1]

[Total: 13]

For Examiner's Use

For Examiner's Use

3 In this experiment, you will investigate the amplitude of oscillations of a mass suspended from a spring.

(a) **(i)** Setup the apparatus as shown in Fig. 3.1.

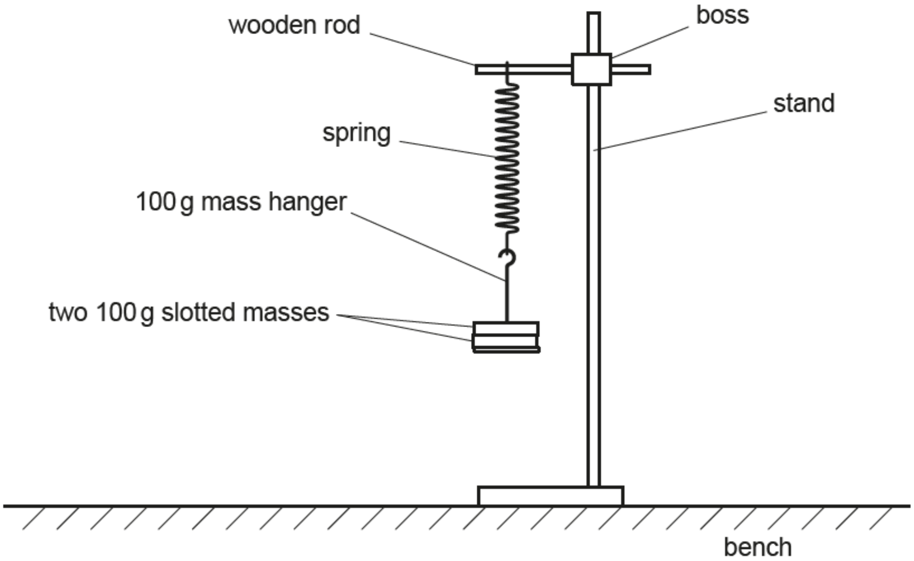

Fig. 3.1

Pull the mass hanger and slotted masses down through a short distance. Release them so that they oscillate vertically.

Measure and determine the period T of the oscillations.

T = …………………………….. s [1]

(ii) Calculate the spring constant k using

$$k = \frac{4\pi^2 M}{T^2}$$

where M = 0.300 kg.

k = …………………………….. N m^{-1} [1]

[Turn over

For Examiner's Use

(b) Slide the two 100 g slotted masses to the top of the mass hanger as shown in Fig. 3.2.

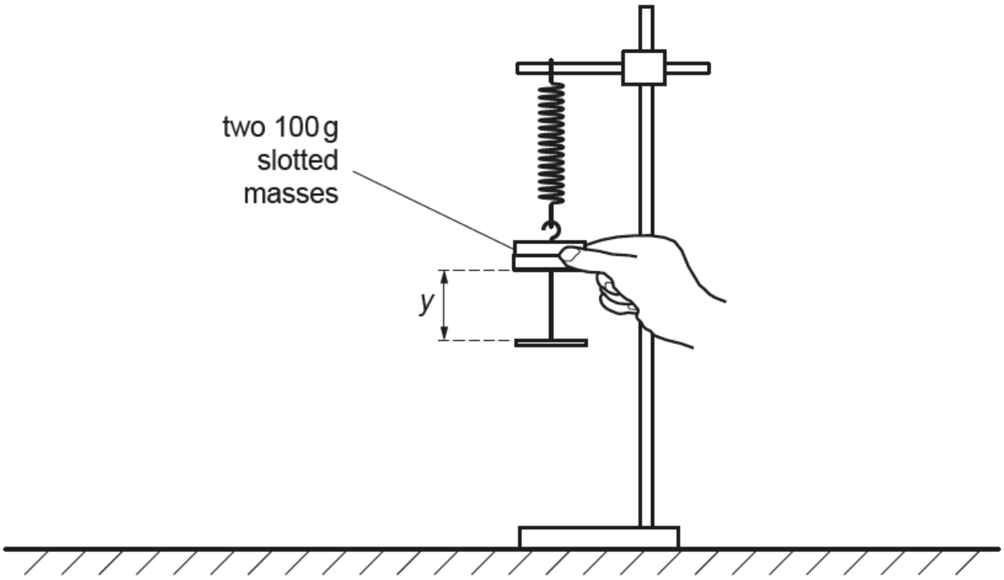

Fig. 3.2

The height of the slotted masses above the base of the mass hanger is *y*, as shown in Fig. 3.2.

Measure and record *y*.

y = …………………………….. m [1]

(c) Drop the two 100 g slotted masses. The masses and the mass hanger will oscillate vertically, as shown in Fig. 3.3.

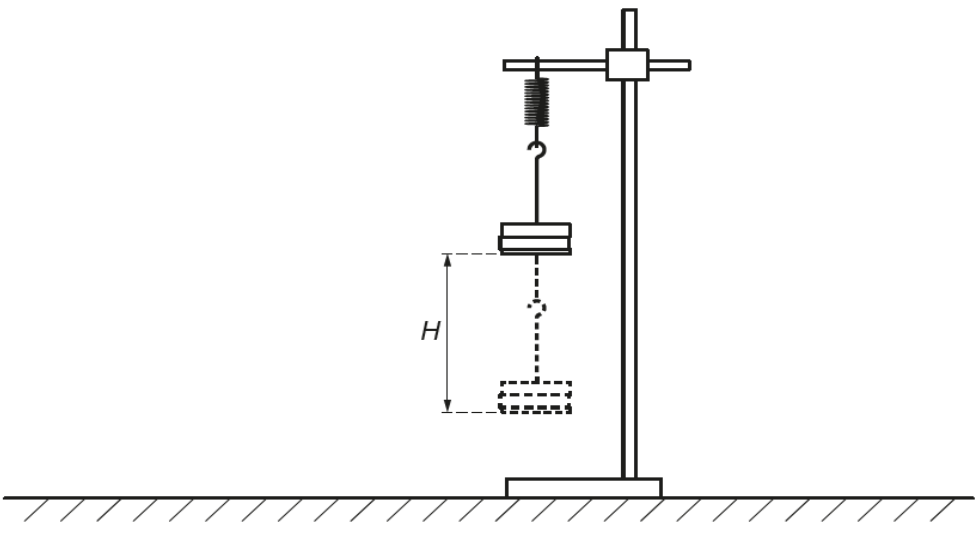

Fig. 3.3

For Examiner's Use

The distance between the lowest and highest positions of the oscillating mass hanger is H, as shown in Fig. 3.3.

Measure and record H.

H = …………………………….. m [2]

(d) Estimate the percentage uncertainty in your values of H.

percentage uncertainty in H = …………………………….. [1]

(e) Repeat **(b)** and **(c)** but this time sliding the two slotted masses approximately half-way up the mass hanger.

y = …………………………….. m

H = …………………………….. m

[2]

(f) **(i)** Suggest one significant source of uncertainty in this experiment.

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(ii) Suggest an improvement that could be made to the experiment to reduce the uncertainty identified in **(f)(i)**.

You may suggest the use of other apparatus or a different procedure.

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For Examiner's Use

(g) It is suggested that the relationship between H and y is

$$H = c\sqrt{y}$$

where c is a constant.

(i) Using your data from **(b)**, **(c)** and **(e)**, calculate two values of c.

first value of c = ……………………………..

second value of c = ……………………………..

[1]

(ii) Justify the number of significant figures you have given for your values of c.

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(iii) Explain whether your results in **(g)(i)** support the suggested relationship.

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For Examiner's Use

(h) A circular card, as shown in Fig. 3.4, is now attached to the base of the slotted masses in Fig. 3.1. A student wants to determine if the diameter of the card is proportional to the period of the oscillations of the new setup.

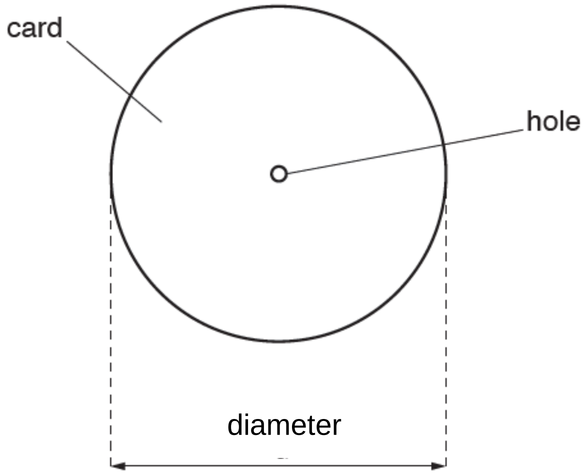

Fig. 3.4

Plan an investigation to verify if the student's hypothesis is true. You will be provided with several cards of varying diameters.

You may suggest the use of any additional apparatus commonly found in a school laboratory. Your answer should include a diagram and your experimental procedure.

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[Turn over

For Examiner's Use

(j) You will now investigate the motion of mass suspended from springs

Set up the apparatus as shown in Fig. 3.5.

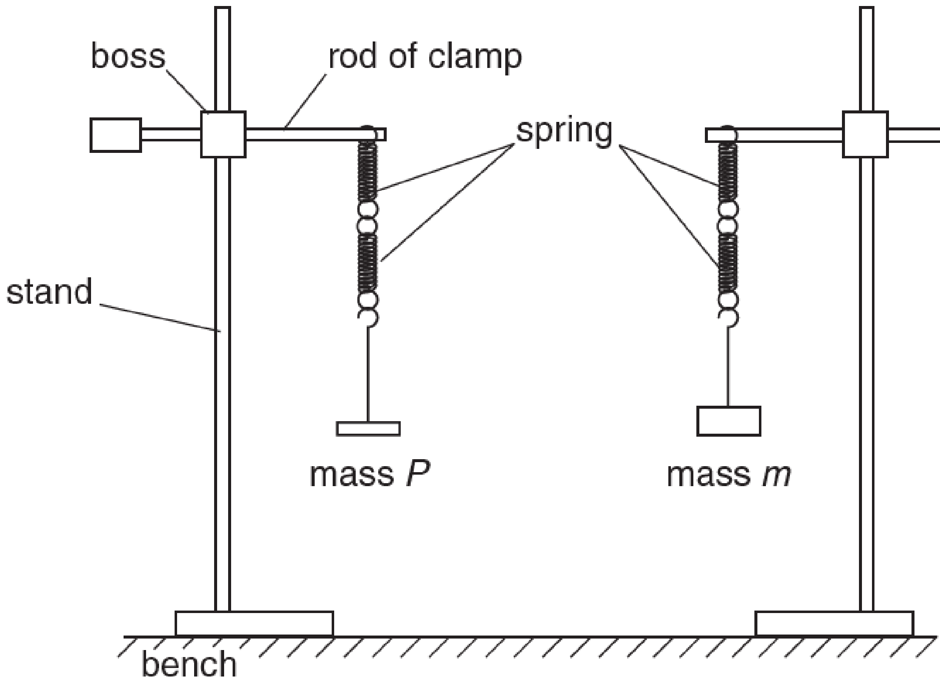

Fig. 3.5

The mass P must be 200 g **and must remain constant throughout the experiment**.
The mass m should be 250 g.

(i) Pull both masses down through a short distance. Release both masses at the same time.
Start the stopwatch when the masses are back in step and reach the lowest point together for the first time.

Measure and record the time t for the masses to reach the lowest point together for the sixth time.

t = …………………………….. [1]

For Examiner's Use

(ii) Repeat **(j)(i)** for at least two more values of m in the range of 250 g to 300 g.

Tabulate these results. Include the results from **(j)(i).**

[2]

(iii) Comment on the trend in your results.

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[Total: 21]

For Examiner's Use

4 An experiment is carried out to investigate the rate of flow of water through a horizontal tube.

The rate of flow of water per unit time F (volume per unit time) through a tube depends on several variables, such as the pressure difference across the tube, viscosity of the liquid, the length of the tube and the radius of the tube.

A metal container with a hole at the side where a narrow horizontal tube can be secured to it with the use of a stopper as shown in Fig 4.1. h is the difference in height between the centre of the hole on the container and the water level while l is the length of the tube. The metal container can be continuously supplied with water from a tap.

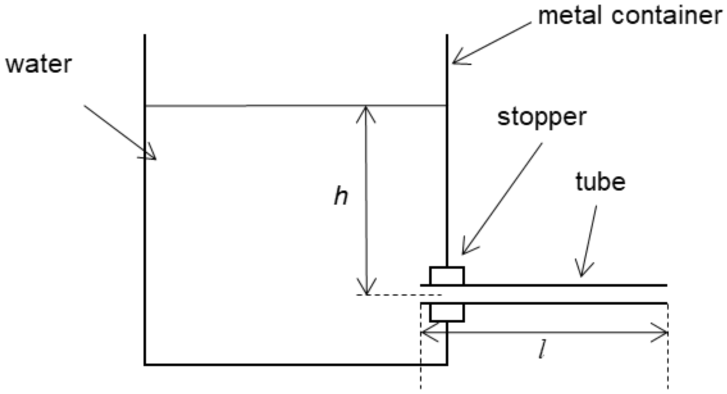

Fig 4.1

It is suggested that the relationship between F, h and l is

$$F = \frac{k\, d^4\, h^n}{l^m}$$

where d is the diameter of the tube and k, n and m are constants.

Design an experiment to determine the values of n and m.

You are provided with tubes of various lengths.

You should draw a diagram showing the arrangement of your apparatus and you should pay particular attention to

(a) the equipment you would use
(b) the procedure to be followed
(c) how the rate of flow and the depth of the water are measured
(d) how the data would be analysed
(e) any precautions that should be taken to improve the accuracy and safety of the experiment.

For Examiner's Use

Diagram

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