中正中学 义顺

CHUNG CHENG HIGH SCHOOL (YISHUN)

2021 Preliminary Examination

Secondary Four Express

CANDIDATE NAME			
CLASS		INDEX NUMBE R	

PHYSICS

6091/03

Paper 3 Practical

15 September 2021

Additional Materials: NIL

1 hour 50 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number in the spaces at the top of this page.
Write in dark blue or black pen.
You are to use a soft pencil for any diagrams or graphs.
Do not use paper clips, glue, correction fluid or correction tape.

Answer **all** questions in the spaces provided on the Question paper.
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 Candidate's use	
Shift	**Laboratory**
For Examiner's Use	
Total	

Setter: Mr Han Ji

Section A (20 marks)

1 *In this experiment, you will investigate a system comprising of two springs and a metre rule with a mass suspended on it. The system is in equilibrium.*

You have been provided with

- two small steel springs labelled A and B with loops of thread at one end,
- two stands, clamps and bosses,
- a metre rule,
- a 300 g mass with a loop of thread,
- a half-metre rule,
- a set square.

(a) Measure and record the unstretched lengths l_A and l_B of the coiled part of each spring, as shown in Fig 1.1.

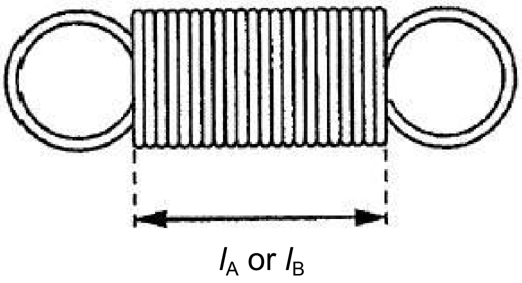

Fig 1.1

l_A = ……………, l_B = …………… [1]

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

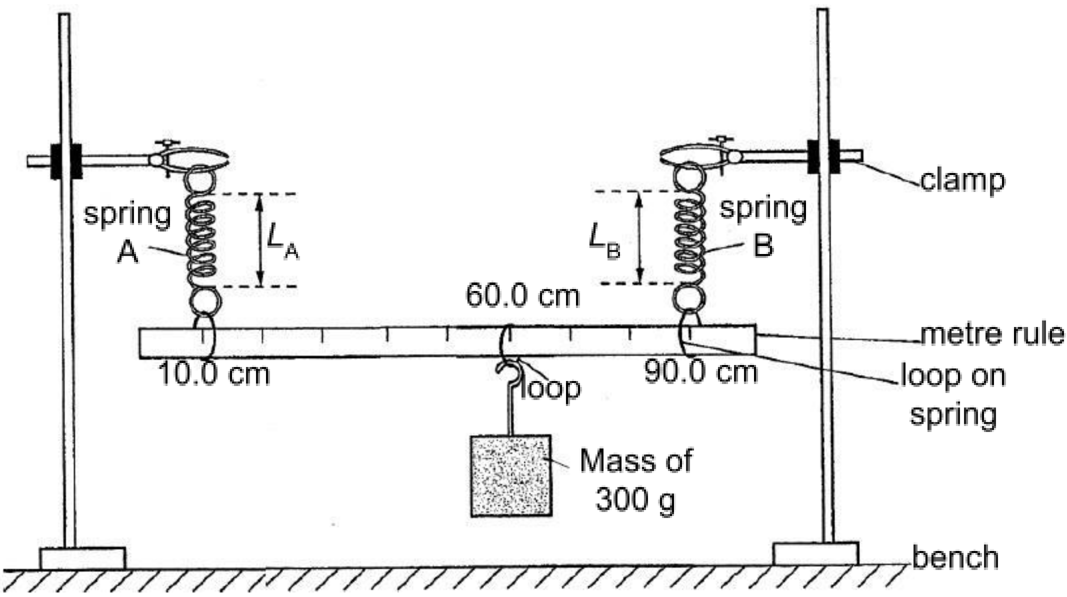

Fig 1.2

- Suspend a string from each clamp.
- Pass the metre rule through the loop of thread on the 300 g mass.
- Suspend the metre rule and mass from the loops of thread on each spring. The loops should be positioned at the 10.0 cm and 90.0 cm marks on the metre rule, and the mass should be suspended from the 60.0 cm mark.
- Adjust the separation of the clamps to ensure that both springs are vertical.

(c) Adjust the height of each clamp to make the metre rule horizontal.

Describe how you checked that the metre rule was horizontal. You may indicate on Fig 1.2 if you wish.

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.... [1]

(d) Measure the stretched length L_A and L_B of the coiled part of each spring, as shown in Fig 1.2.

L_A = …………… [1]

L_B = …………… [1]

(e) Calculate the extension e_A and e_B of each spring.

e_A = ……………, e_B = …………… [1]

(f) Calculate $\frac{e_A}{e_B}$.

$\frac{e_A}{e_B}$ = …………… [1]

(g) Plan

For a horizontal metre rule with negligible mass, the value of $\frac{e_A}{e_B}$ is related to the distance x from spring A to the suspended mass by the equation

$$\frac{e_A}{e_B} = D\left(\frac{1}{x}\right) - 1$$

where D is the constant horizontal distance between the two springs, and $0 < x < D$.

Using the same apparatus as in Fig 1.2, plan an experiment to investigate this relationship.

Your plan should include

- a list of quantities that remain constant,
- a description of how you would perform the experiment,
- a statement of the graph you would plot to test the relationship,
- a sketch of the graph,
- expected values for the gradient and the intercept.

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[4]

2 *In this experiment, you will investigate filament lamps in series and in parallel.*

You are provided with

- a power supply,
- a switch,
- three identical filament lamps each in a holder,
- an ammeter,
- a voltmeter,
- connecting leads,

Set up the circuit as shown in Fig 2.1.

power supply

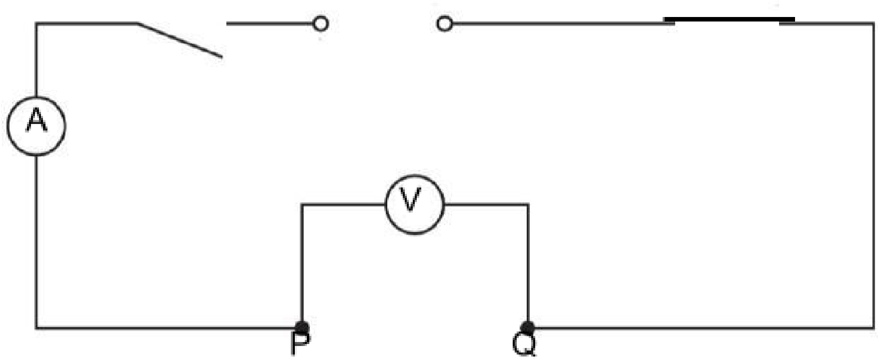

Fig 2.1

(a) Connect one filament lamp between points P and Q.

Switch on the circuit.

Record the potential difference *V* and current *I* in the table in Fig 2.2.

Switch off the circuit.

(b) Repeat the procedure in **(a)** with:

- two filament lamps in series
- two filament lamps in parallel

between P and Q.

Switch off the circuit when you have completed your measurements.

(c) Calculate the effective resistance of *R* for each arrangement.

Record your answers in the table in Fig 2.2.

	V / V	*I* / A	*R* / Ω
one lamp			
two lamps in series			
two lamps in parallel			

[4]

Fig 2.2

(d) The effective resistance of lamps in series and in parallel are given by the relationship

$$R = R_1 + R_2$$

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

Calculate the resistance of each filament lamp with the values of *R* when

(i) two lamps are connected in series.

resistance = …………… [1]

(ii) two lamps are connected in parallel.

resistance = …………… [1]

(e) Suggest one possible reason to account for the difference between the value of *R* when one lamp is connected (between P and Q) and

(i) the calculated resistance of one lamp in **(d)(i)**,

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(ii) the calculated resistance of one lamp in **(d)(ii)**.

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(f) Explain why the lamps glow less brightly when they are connected in series as compared to when they are connected in parallel.

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Section B (20 marks)

3 *In this experiment, you will investigate the bending of light by a glass block.*

You are provided with

- a glass block,
- three optical pins,
- 6 pieces of plain A4 sized paper,
- a softboard,
- a 30 cm plastic ruler,
- a protractor.

(a) Using the plain A4 sized paper, draw two lines AB and CD such that they are parallel to the edges of the paper and they cross approximately at the centre of the paper. The shorter line is AB while the longer line is CD.

(b) Insert two pins P_1 and P_2 on the line CD, with P2 being 45 mm away from the intersection of lines AB and CD as shown in Fig 3.1.

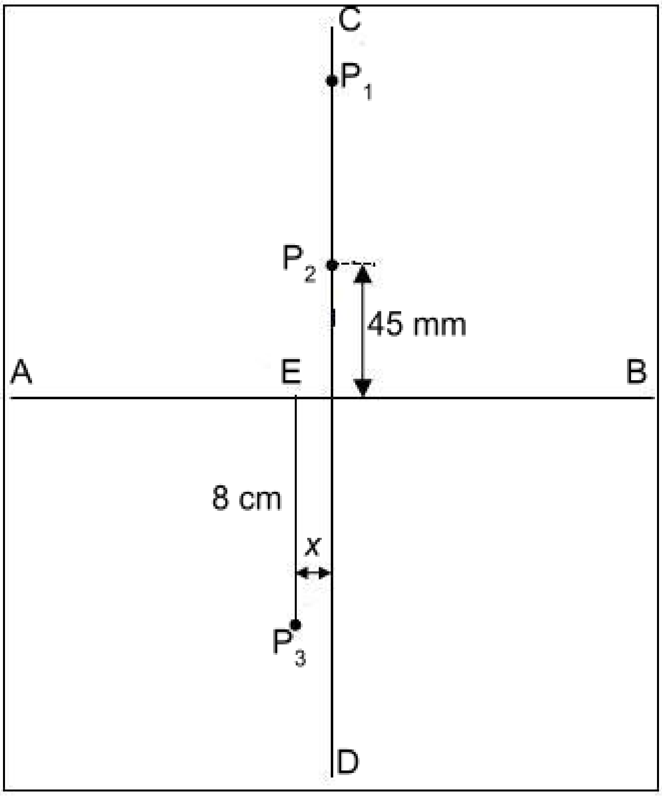

Fig 3.1

P_3 is a third pin inserted so that x, its perpendicular distance from CD, is 1.0 cm. The perpendicular distance of P_3 from line AB is 8.0 cm.

From P_3, draw a line parallel to CD, which cuts AB at E as shown in Fig 3.1.

Record the value of x in mm.

x = …………… mm [1]

(c) Place the largest face of the glass block around the centre of the paper. Ensure that the block touches P_2 as shown in Fig 3.2. Turn the glass block until P_3 appears in line with the image of P_1 and P_2 as seen through the glass block.

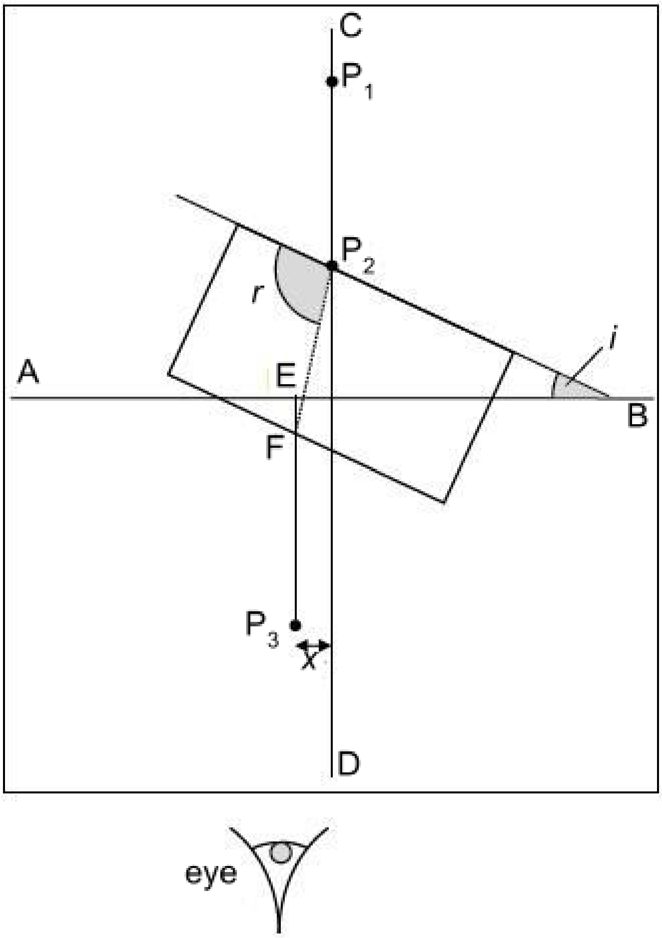

Fig 3.2

(d) Using a pencil, draw a line along the longer edge of the glass block that touches P_2. Extend this line until it cuts AB.

Draw line along the other longer edge of the glass block. Extend this line until it cuts the line from P_3 to E. Mark this point as F.

Draw a line from P_2 to F.

Two angles, *i* and *r*, are formed as shown in Fig 3.2 with all the lines drawn.

(e) Measure and record the angles *i* and *r*.

i = …………… [1]

r = …………… [1]

(f) Using your results from **(e)**, calculate the value of *y* using the equation

$$y = -\frac{\cos r}{\sin(r - i)}$$

y = …………… [1]

(g) By placing P_3 at different distances from line CD, repeat **(b)** to **(f)** to obtain five more sets of data for 10 mm < *x* < 40 mm.

Use a fresh piece of paper for each set of measurements.

Record your results of *x*, *i*, *r* and *y* in a table. Include a column for $\frac{1}{x}$. [4]

(h) It is suggested that the relationship between *y* and *x* is given by the equation

$$y = G(\frac{1}{x}) + C$$

where *G* and *C* are constants.

Using the grid on the next page, plot a graph of y against $\frac{1}{x}$. Your axes should start from the origin. [4]

(i) Determine from the graph the constants *G* and *C*.

G = …………… [3]

C = …………… [1]

(j) Comment on the relationship between *y* and $\frac{1}{x}$.

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(k) Identify a source of error and explain how it affects your measurements.

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