PEICAI SECONDARY SCHOOL
SECONDARY FOUR EXPRESS
PRELIMINARY EXAMINATION 2021

CANDIDATE NAME

CLASS

REGISTER NUMBER

PHYSICS

6091/03

Paper 3 Practical

17 August 2021

1 hour 50 minutes

Candidates answer on the Question Booklet.

Additional Materials: As listed in the Confidential Instructions

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number 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.

For Examiner's Use	
1	
2	
3	
Total	

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.

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

Setter: Mr. Andy Yeo

1 *In this experiment, you will investigate the refraction of light passing through a glass block.*

You are provided with

- 4 optical pins,
- a softboard,
- a protractor,
- a glass block,
- a half metre rule,
- a piece of A4 paper.

(a) (i) Place the glass block, with its larger face down, at the centre of the piece of A4 paper supplied. Draw the outline of the glass block. Label it as **ABCD**, as shown in Fig. 1.1.

Fig. 1.1

(ii) Remove the block and draw a normal **NL** at the centre of side **AB**. Label the point **E** where the normal crosses **AB**. Label the point **M** where the normal crosses **CD**.

(iii) Draw a line **FE** at an angle, ***i*** = 30º with the normal, as shown in Fig. 1.1.

(iv) Replace the glass block on the A4 paper. Place two pins P_1 and P_2 on the line **FE**. Label the positions P_1 and P_2.

(v) Observe the images of P_1 and P_2 through side **CD** of the block so that the images of P_1 and P_2 appear to be in a straight line.

(vi) Place two further pins P_3 and P_4 between your eye and the block so that P_3 and P_4 are aligned with the images of P_1 and P_2 so that all four pins appear to be in a straight line. Label the positions P_3 and P_4.

(vii) Remove the glass block.

(viii) Draw a line joining the positions of P_3 and P_4. Continue the line until it meets the side **CD** and label this point **J**. Continue the same line until it meets normal **NL** and label this point **K**. [1]

(b) (i) Measure and record the angle α between the line joining the positions of P_3 and P_4 and the line **KL**.

α = ... [1]

(ii) Measure and record the length x between points **M** and **K**, leaving your answer in cm.

x = ... [1]

(c) A student suggests that the angle α should always be equal to the angle of incidence i.

State whether your results support this suggestion. Justify your answer by reference to the readings.

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..... [1]

Insert the A4 paper of your ray diagram into this Question Paper between pages 2 and 3.

(d) Plan

It is known that the relationship between ***i*** and ***r*** is

$\sin i = n \sin r$,

where ***n*** is the refractive index of the glass block and is a constant

i is the angle of incidence of an incident ray

r is the angle of refraction of a refracted ray within the glass block

Using the same apparatus as in Fig. 1.1, plan an experiment to

investigate this relationship.

Your plan should include

- a detailed description of how you would perform the experiment,

- a suitable table in which to display your measurements and calculated values (you do **not** need to enter any data into the table),

- a statement of the graph that you would plot to test the relationship,

- a statement of how the refractive index can be determined from the graph.

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[Total: 10]

2 *In this experiment, you will investigate the speed of a glass marble rolling down an inclined track.*

You are provided with

- a wooden support,
- two metre rules,
- a glass marble,
- a stopwatch,
- plasticine,
- a 30 cm ruler,
- a piece of cloth to act as a stop.

Set up the apparatus, as shown in Fig. 2.1.

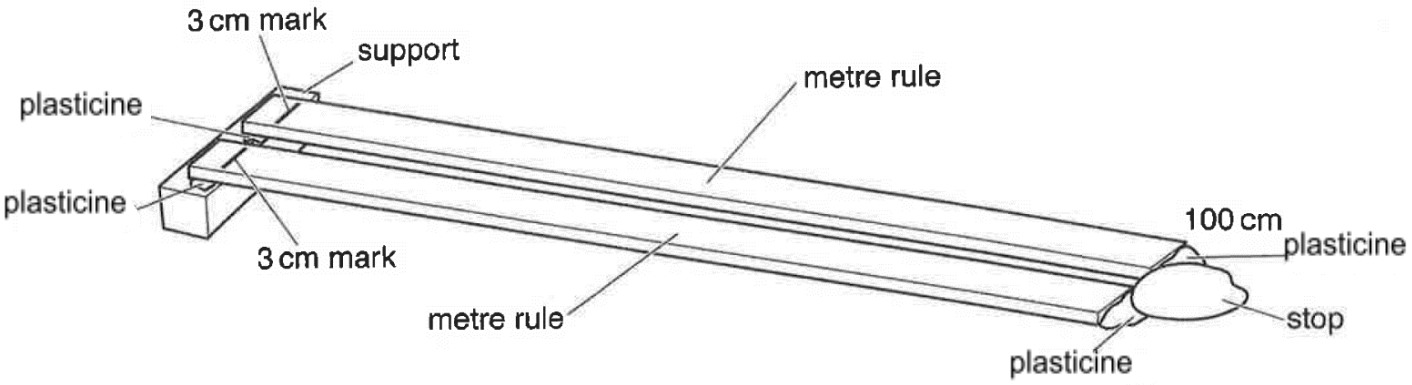

Fig. 2.1

Place the wooden support on the bench. Place the two metre rules on the support. Use a small piece of plasticine for each metre rule to prevent them from moving on the support.

The metre rules should be placed on the support at the 3 cm marks and 5 mm apart.

Ensure that, as much as possible, the gap between the two metre rules is 5 mm along the entire length of the metre rules. Fix the metre rules to the bench at the 100 cm ends with plasticine.

(a) Measure the height h of the lower surface of the metre rules above the bench at the 0 cm mark, as shown in Fig. 2.2.

Fig. 2.2

h = ...

(b) Place the centre of the marble at the 1 cm mark on the metre rules.
Release the marble and start the stopwatch.
Stop the stopwatch when the ball hits the stop at the end of the track.
The reading on the stopwatch is t_0.

(i) Record your value for t_0.

t_0 = ... [1]

(ii) Replace the ball at the 1 cm mark.
Reset the stopwatch.
Release the ball and start the stopwatch.

Stop the stopwatch when the ball passes the 51.0 cm mark on the track.
The reading on the stopwatch is t_1.

Record your value for t_1.

t_1 = ... [1]

(c) The average speed of the ball is calculated using the formula shown.

$$average\ speed = \frac{distance\ travelled}{time\ taken}$$

(i) In **(b)(i)** the ball travels 99.0 cm.

Calculate the average speed v_0 of the ball for this distance.

v_0 = ... [1]

(ii) In **(b)(ii)**, the ball travels 50.0 cm.

Calculate the average speed v_1 of the ball for this distance.

v_1 = ... [1]

(d) Calculate the acceleration *a* of the ball along the track using the equation shown.

$$a = 2\left(\frac{v_0 - v_1}{t_0 - t_1}\right)$$

a = ... [1]

(e) A student suggests that the acceleration of the marble down the slope is given by

$$a = g \sin \theta$$

where the acceleration of free fall g = 10 m/s^2 and θ is the angle shown in Fig. 2.3.

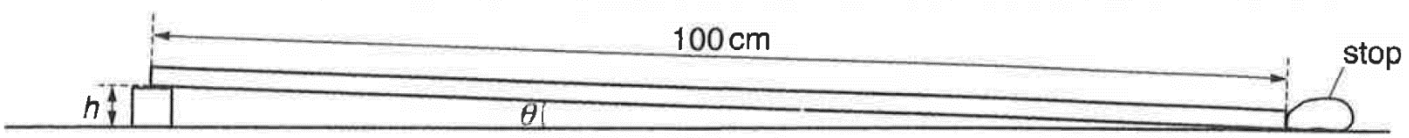

Fig. 2.3

(i) Use your value of *h* from **(a)** to calculate the acceleration a using the equation in **(e)**.

a = …….. [1]

(ii) Explain whether your value for *a* in **(d)** supports the suggestion made by the student in **(e)**.

…….

…….

……...[2]

(f) State one source of error in obtaining the values of t_0 and t_1 and suggest one way to improving the accuracy of the experiment.

source of error ……

……...

improvement ……...

……...

……...

[2]

[Total: 10]

3 *In this experiment, you will determine the resistance of a resistor.*

You are provided with

- two dry cells,
- a length of resistance wire attached to a metre rule,
- an ammeter,
- a switch,
- a voltmeter,
- a jockey J,
- connecting wires,
- resistor **R**.

(a) Set up the circuit as shown in Fig. 3.1.

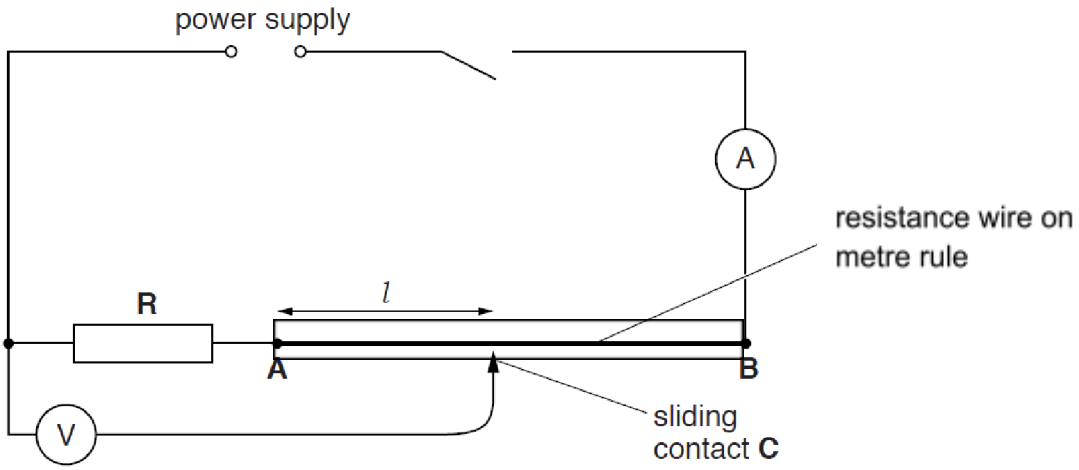

Fig. 3.1

(b) **(i)** Close the switch. Measure the current I in the circuit.

I = ...[1]

(ii) Place the jockey J at a distance L = 20.0 cm from **A**.
Record the potential difference V. Open the switch.

V = ...[1]

(c) Repeat **(b)** for more values of L to obtain different sets of readings for L *and* V. Record your results for L *and* V in a table. Include the results from **(b)** in your table. [5]

(d) Use the grid provided, plot a graph of *V*/V against *L*/cm. Draw the straight line of best-fit through your points. [5]

(e) **(i)** Determine the gradient of the line of best fit. Show clearly on your graph how you did this.

gradient = ……. [2]

(ii) From your graph, determine the y-intercept *Y*.

Y = …….. [1]

(iii) Calculate the ratio $\frac{Y}{I}$, by taking I from **(b)(i)**.

$= \frac{Y}{I}$ ..... [1]

(f) The ratio from **(e)(iii)** is equivalent to a physical property of an electrical component in Fig. 3.1.

State the

(i) electrical component,

.....

(ii) the physical property and

.....

(iii) its unit.

..... [1]

(g) Assuming the experiment is repeated by replacing wire AB with a thinner wire of the same material and length. On the same grid, sketch the graph of V against L.

Label this graph **G**.

[1]

(h) It is known that changes in temperature affect the resistance of the wire.

State how temperature affects the resistance of the wire and how you can limit the temperature changes when carrying out this experiment.

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..... [2]

[Total: 20]