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CONVENT OF THE HOLY INFANT JESUS SECONDARY
Preliminary Examination in preparation for
the General Certificate of Education Ordinary Level 2022

CANDIDATE NAME			
CLASS		REGISTER NUMBER	

PHYSICS 6091/03

Paper 3 Practical

12 September 2022

1 hour 50 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your class, register number and name in the spaces at the top of this page.
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.
The use of an approved scientific calculator is expected, where appropriate.

Shift
Laboratory

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 Examiner's Use	
1	
2	
3	
Total	

Section A

1 *In this experiment, you will investigate the effect of a frictional load on an electric motor.*

You have been provided with:

- A 4.5 V power supply,
- a small electric motor,
- an ammeter,
- a voltmeter,
- a resistor of resistance 10 Ω,
- a switch or plug key,
- electrical leads,
- a wooden rod,
- a piece of Blu-Tack.

(a) Set up the circuit shown in Fig. 1.1.

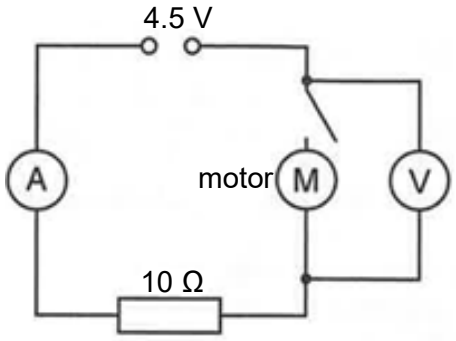

Fig. 1.1

Fix the motor to the bench using the piece of Blu-Tack, as shown in Fig. 1.2.

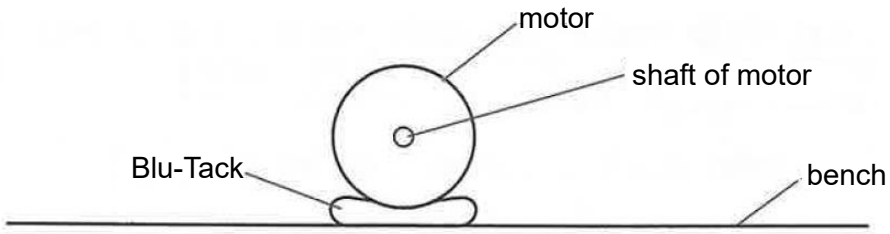

Fig. 1.2

(i) With the switch open, record the voltmeter reading V_0.

V_0 = ...[1]

(ii) Check that the shaft of the motor is free to spin by rotating it a few times by hand.

Close the switch.
Record the potential difference V_1 across the motor and the current I_1 in the circuit.

V_1 = ...

I_1 = ...[2]

(iii) Open the switch.

Calculate the input power P_1 to the motor using the equation shown.

$$P_1 = V_1 I_1$$

P_1 = ……..[1]

(b) Close the switch.

Use the wooden rod to press gently on the shaft of the motor, as shown in Fig. 1.3.

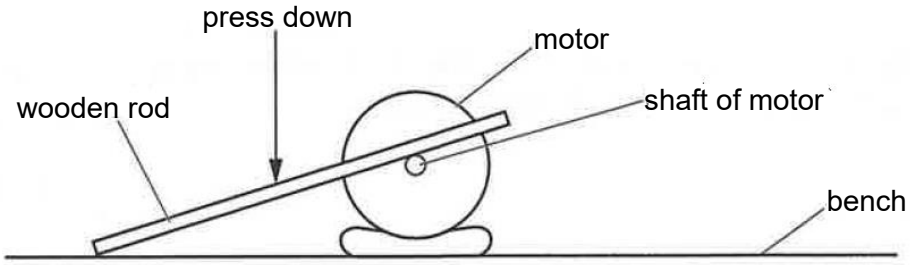

Fig. 1.3

Press down on the wooden rod until the shaft **just** stops spinning.

(i) Record the potential difference V_2 across the motor and the current I_2 when the motor is not spinning.

V_2 = ……..

I_2 = ……..[1]

(ii) Open the switch.

Calculate the resistance R of the motor using the equation shown.

$$R = \frac{V_2}{I_2}$$

R = ……..[1]

(c) Some of the input energy to the motor in **(a)(iii)** is wasted as thermal energy in the coil of the motor.

The proportion Q of the energy wasted in this way is given by the equation shown.

$$Q = \frac{I_1 R}{V_1}$$

Calculate Q.

Q = ……..[1]

(d) A student uses the apparatus shown in Fig. 1.4 to determine the minimum force F that the rod exerts on the shaft of the motor to stop it spinning.

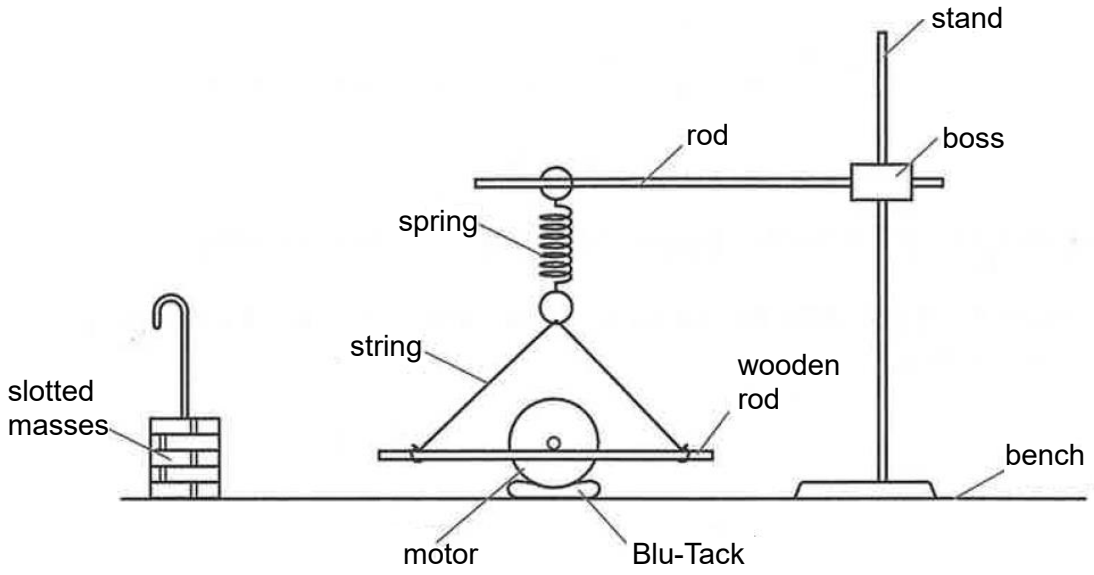

Fig. 1.4

Describe how F may be determined using the apparatus in Fig. 1.4.

……..

……..

……..

……..

…… [2]

(e) Suggest a change to the apparatus in Fig. 1.4 so that F can be measured **directly**.

……..

…… [1]

[Total: 10]

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

You have been provided with

- a support,
- two metre rules,
- a glass ball,
- a stopwatch,
- Blu-Tack,
- a 30 cm ruler,
- a piece of cloth to act as a stop.

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

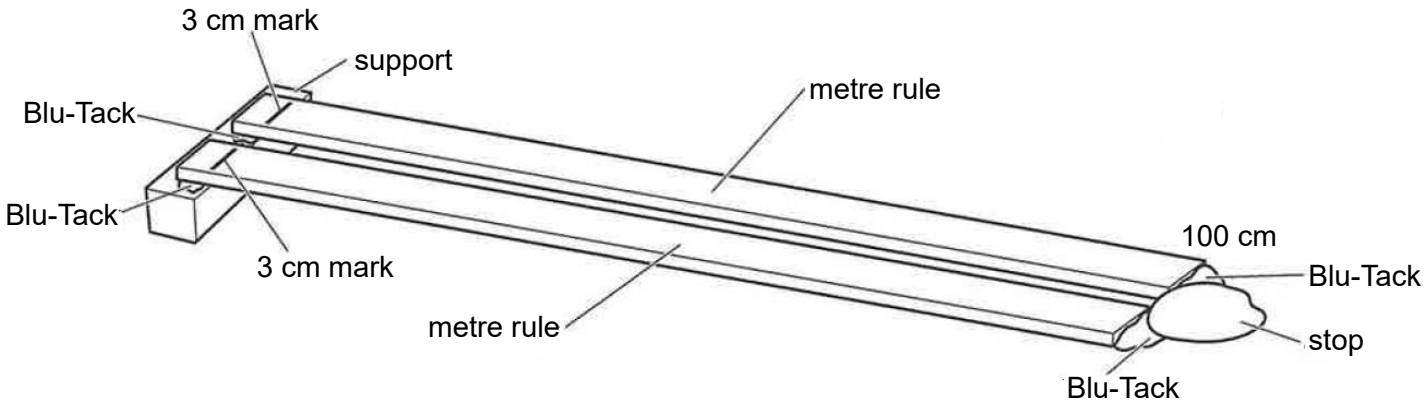

Fig. 2.1

Place the support on the bench with the side marked 'Top' facing upwards. Place the two metre rules on the support. Use a small piece of Blu-Tack 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 the gap between the metre rules is 5 mm along the length of the metre rules. Fix the metre rules to the bench at the 100 cm ends with Blu-Tack.

(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 glass ball at the 1 cm mark on the metre rules.
Release the ball and immediately start the stopwatch.
The time taken for the ball to reach the end of the track is t_0.

Determine an accurate value for t_0.

t_0 = ……[2]

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

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

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

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

v_0 = ……[1]

(d) Replace the ball at the 1 cm mark.
Reset the stopwatch to zero.
Release the ball and start the stopwatch.
Stop the stopwatch when the ball reaches the 51.0 cm mark on the track.
The reading on the stopwatch is t_1. Record your value for t_1.

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

t_1 = ……

v_1 = ……[1]

(e) It is suggested that v_0 should be equal to v_1.
Explain whether your values of v_0 and v_1 support this suggestion.

……..

…… [1]

(f) Plan an experiment to investigate the relationship between average speed and height *h*.

Your plan should include

- the quantities that you should keep constant,
- 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,

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....[5]

[Total: 10]

[Turn over

Section B

3 *In this experiment, you will determine the focal length of a converging lens.*

You have been provided with

- a converging lens,
- an illuminated object,
- a lens holder,
- a light source,
- a screen,
- a metre rule,
- a set square.

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

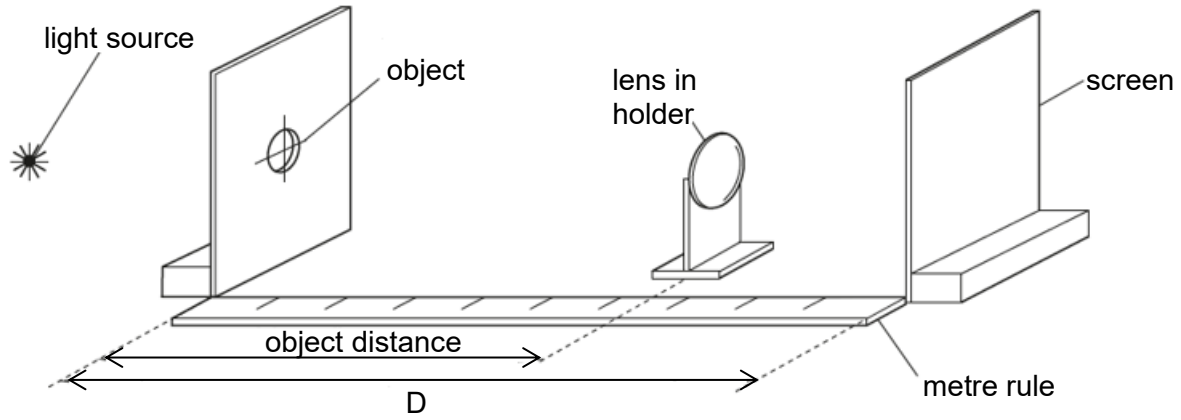


Fig. 3.1

The object is at the 0.0 cm end of the rule and the screen is at the 100.0 cm end.

(i) By only changing the position of the lens, obtain an image on the screen that is **smaller** than the object. Describe the technique that you use to obtain an image that is in sharp focus.

……

……

…… [1]

(ii) Determine an accurate value for the object distance u_s, between the object and the lens, when the image is **smaller** than the object and is in sharp focus on the screen.

u_s = ……[1]

(b) By only changing the position of the lens, obtain an image on the screen that is **larger** than the object.

(i) Determine the new value for the object distance u_L when the image is **larger** than the object and in sharp focus on the screen.

u_L = ...

(ii) In order to change from an image that is smaller than the object to an image that is larger than the object, the lens has been moved a distance *d*.

1. Calculate *d* using $d = u_s - u_L$.

d = ...

2. Calculate *y* using $y = D^2 - d^2$,
where D is the distance between the object and the screen.

y = ...
[2]

(c) Repeat **(a)(ii)** and **(b)** using different values of D in the range $60\,\text{cm} \leq D \leq 100\,\text{cm}$.
The object should remain at the 0.0 cm mark on the rule and the position of the screen should be changed to give different values of D.

Record your results for D, u_s, u_L, d and y in a table. Include your initial results from **(a)(ii)** and **(b)**.

[4]

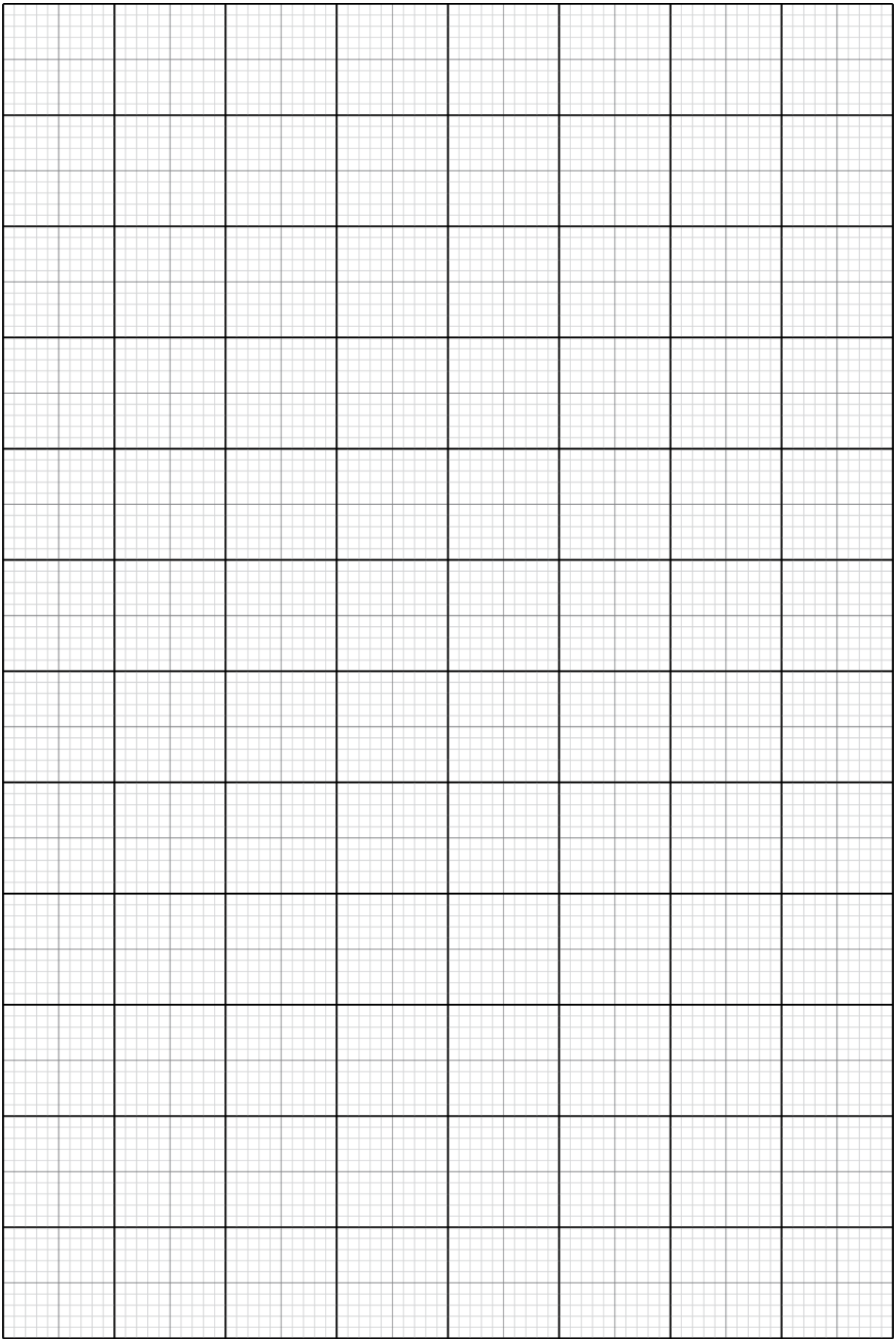
(d) Using the grid provided, plot a graph of y against D. [4]

(e) **(i)** Determine the gradient G of your graph. Show clearly how you obtained the necessary information from your graph.

G = ...[2]

(ii) Calculate the numerical value f of the focal length of your lens using $f = \frac{G}{4}$.

f = ...[1]



(f) Describe the relationship between *y* and the distance *D*.
Explain your answer.

……..……..……..

..……[2]

(g) Identify one possible source of error in this experiment.

Suggest an improvement that would reduce this error.

source of error ……..…

……..……..……...

improvement…….……...……

……[2]

(h) The lens used in this experiment could be used in a camera.

Using your value of focal length *f*, suggest how far should the object be placed from the lens to obtain a diminished image.

..……[1]

[Total: 20]