Anglican High School
Secondary Four
Preliminary Examination 2022

S4

CANDIDATE NAME

CENTRE NUMBER	S					INDEX NUMBER				

PHYSICS **6091/03**

Paper 3 Practical Test

13 September 2022

1 hour 50 minutes

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, index number and name 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.
DO **NOT** WRITE IN ANY BARCODES.

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.

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	
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Total	

This document consists of **12** printed pages and **2** blank pages

Section A

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

You are 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.

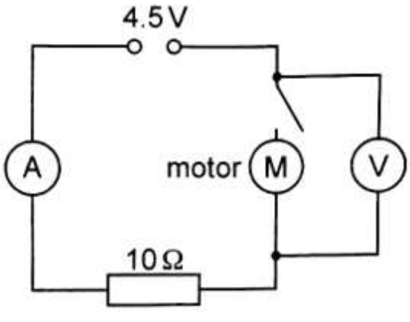

Fig. 1.1

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

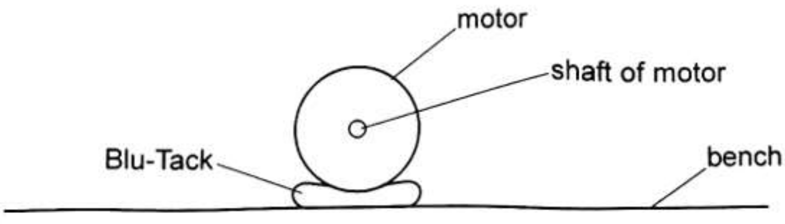

Fig. 1.2

(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.

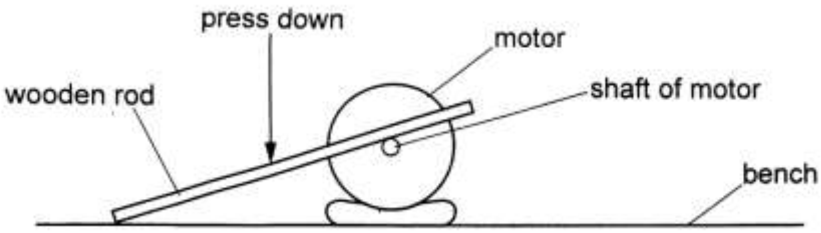

Fig. 1.3

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]

Open the switch.

(ii) 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.

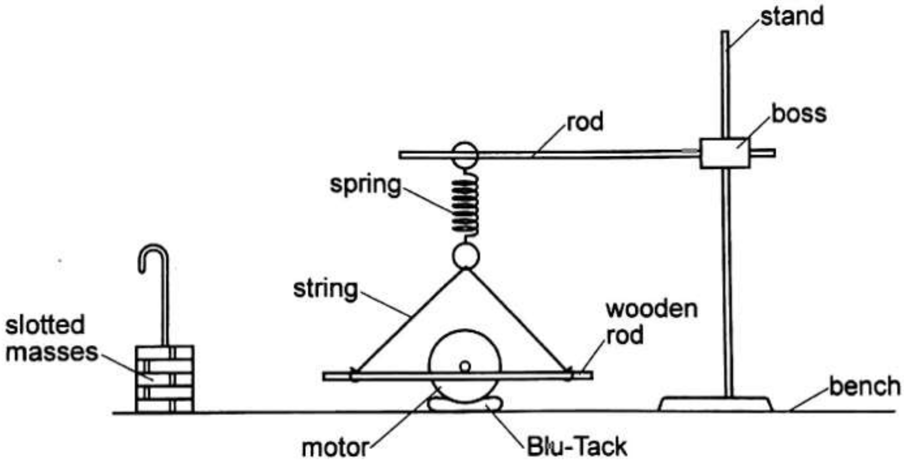

Fig. 1.4

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

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.... [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 oscillation of a metre rule with an attached mass.*

You are provided with

- a stopwatch,
- a metre rule with a hole at the 2 cm mark,
- a half-metre rule,
- a cork with an optical pin,
- a retort stand, boss and clamp,
- a 100 g mass,
- some modelling clay

The apparatus has been set up for you, as shown in Fig. 2.1.

Ensure that the metre rule is not in contact with the cork.

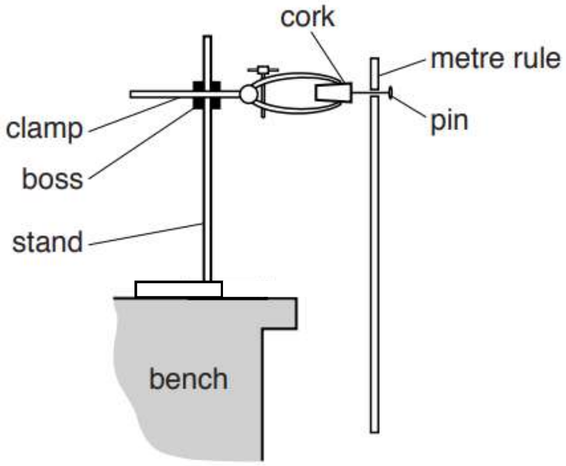

Fig. 2.1 (side view)

(a) Use the modelling clay to attach the mass to the rule. The bottom edge of the mass should be level with the 34 cm mark of the scale on the right-hand side of the rule. A front view of the arrangement is shown in Fig. 2.2 and a side view in Fig. 2.3. Ensure that the mass is firmly attached to the rule.

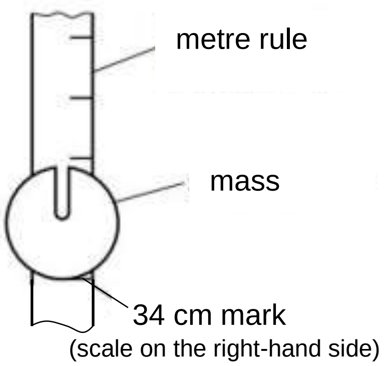

Fig. 2.2 (front view)

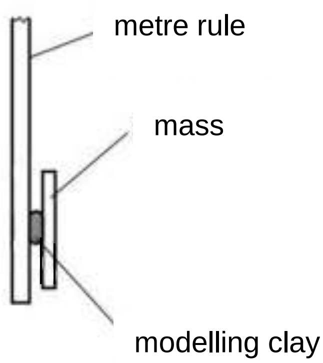

Fig. 2.3 (side view)

(b) The distance from the optical pin to the centre of the mass is *x* as shown in Fig. 2.4.

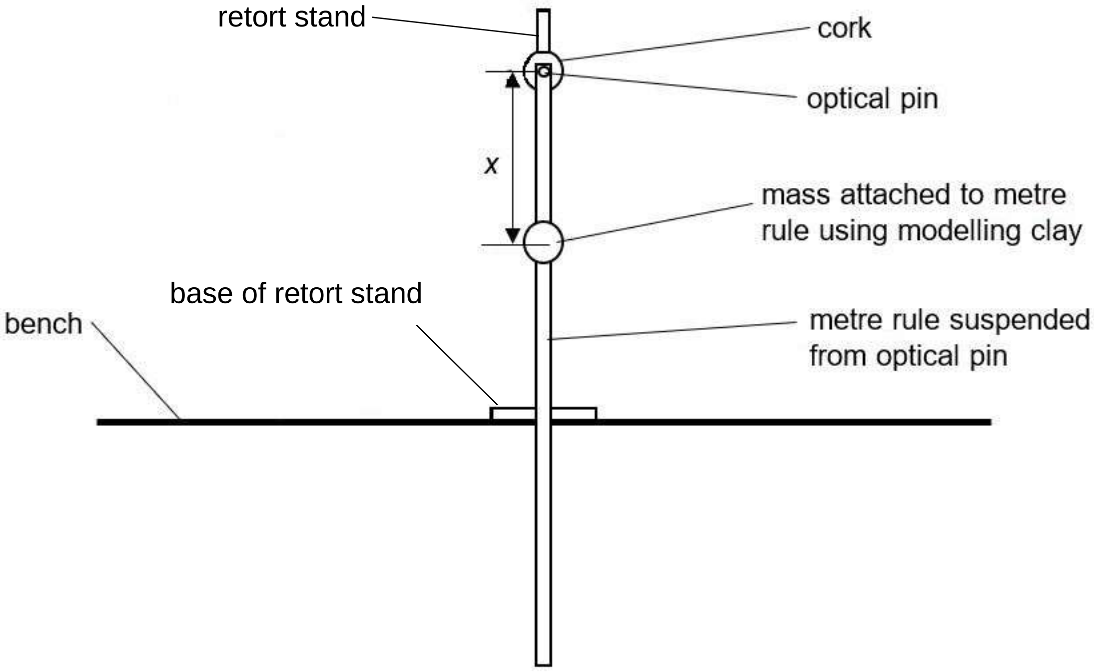

Fig. 2.4 (front view)

Measure the distance *x*.

x = ……………………………………………. [1]

(c) Displace the metre rule by a small angle. Release the metre rule and allow it to oscillate.

Determine an accurate value for the period *T* of the oscillating metre rule.

T = ……………………………………………. [2]

(d) Suggest why the metre rule will eventually come to a stop if it is allowed to oscillate freely.

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……………………………………………………………………………………………………. [1]

(e) Plan

A student suggests that T^2 is linearly related to x^2.

Plan an experiment to investigate this relationship.

Your plan should include

- the quantities that you will keep constant,
- a detailed description of how you will perform the investigation,
- an indication of how you will achieve the accurate results,
- a statement of the graph you would plot to test the relationship,
- a sketch of the graph you would obtain if the suggested relationship is correct.

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[Total: 10]

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Section B

3 *In this experiment, you will investigate the energy stored in a stretched spring.*

You are provided with:

- a spring,
- a 50 g mass-hanger and five 50 g masses,
- a half-metre rule,
- a 30 cm ruler,
- a stand, boss and clamp.

(a) Measure the length L_0 of the unstretched spring, as shown in Fig. 3.1. Give your answer in metres.

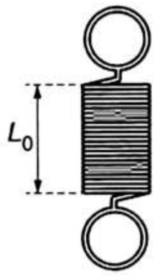

Fig. 3.1

L_0 = ... m [1]

(b) Set up the apparatus shown in Fig. 3.2.

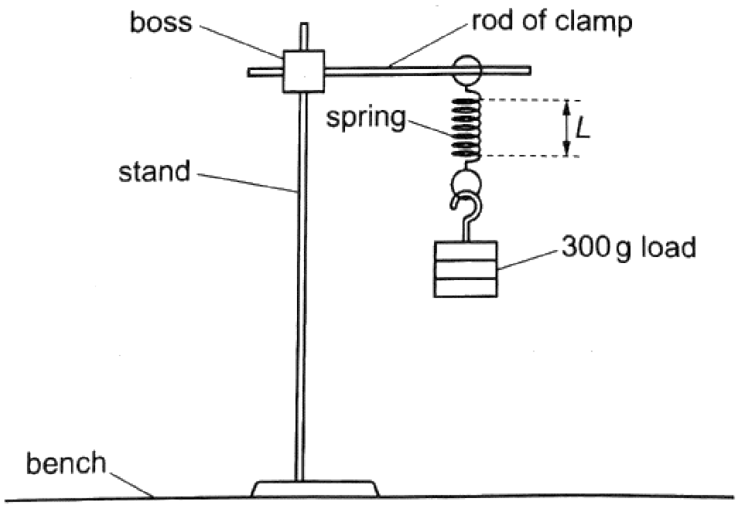

Fig. 3.2

(i) Measure the stretched length L of the spring and determine the extension x of the spring using the equation $x = L - L_0$.

L = ...

x = ...

[2]

(ii) Describe two ways in which you ensured your value for x was accurate.

....

....

....

.... [2]

(iii) Use your value of x from **(b)(i)** and the equation $k = \frac{mg}{x}$ to calculate the spring constant k of the spring where m is the mass suspended from the spring in kg and g is 10 N / kg.

k = ... [2]

(iv) The elastic potential energy E stored in the spring is given by the equation shown.

$$E = \frac{mgx}{2}$$

Calculate E.

E = ... [1]

(c) Using further values of *m*, determine the extension of the spring and the elastic potential energy stored using the equation in **(b)(iv)**.

Show your values for *m*, *L*, *x*, x^2 and *E* in a suitable table with headings.
Include your values for *m* = 300 g. [4]

(d) Using the grid provided, plot a graph of *E* against x^2. [4]

(e) **(i)** Determine the gradient *G* of your line.

G = ... [2]

(ii) It is suggested that *G* = 0.5k.

Explain whether your values of *G* and *k* support this suggestion.

....

.... [1]

(f) Use your results to predict the energy stored in the spring when *m* = 600 g.

....

.... [1]

[Total: 20]

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