NAME:	NO:	CLASS:

RIVERSIDE SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2022

SUBJECT	:	Physics
CODE/PAPER NO.	:	6091/03 Paper 3 Practical Test
LEVEL/STREAM	:	4 Express
DURATION	:	1 hour 50 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class 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.

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.

This document consists of **14** printed pages.

[Turn Over

Answer **all** questions.

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 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 as shown in Fig. 1.1.

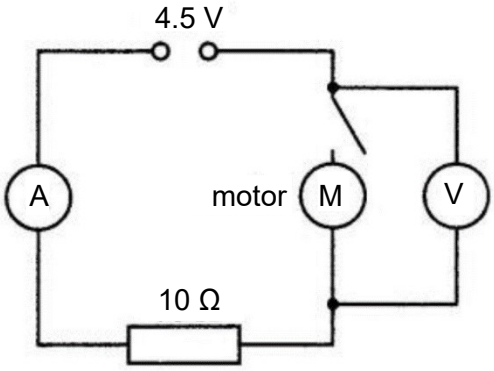

Fig. 1.1

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

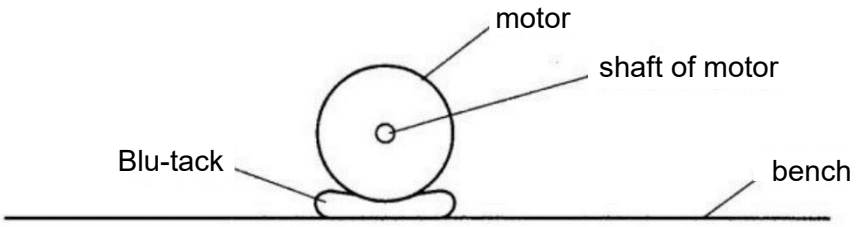

Fig. 1.2

(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 power input 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.

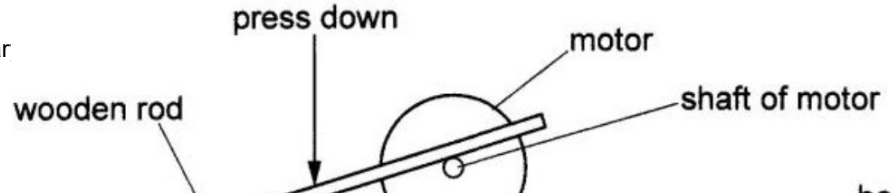

Fig. 1.3

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.

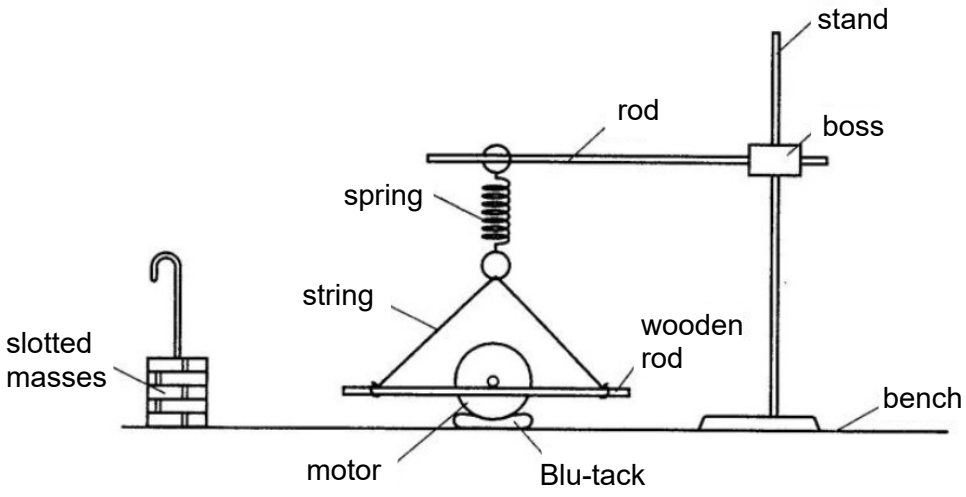

Fig. 1.4

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 a spinning mass.*

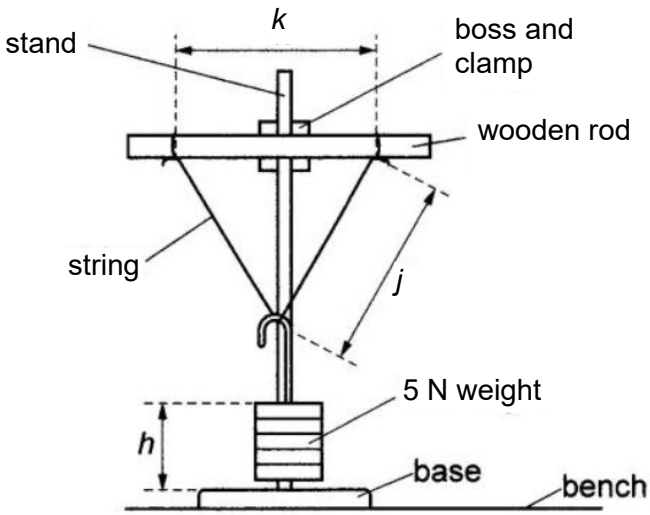
You are provided with:

- a 1 N mass-hangar with four 1 N weights
- a half-metre rule
- a length of string attached to a wooden rod
- a stopwatch
- a stand, boss and clamp.

Set up the apparatus as shown in Fig. 2.1.

Ensure that the weight is directly above the base of the stand so that it does not topple over.

Adjust the position of the boss so that the bottom of the 5 N weight is approximately 2 cm above the base of the stand.



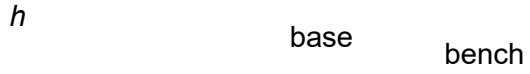


Fig. 2.1

Fig. 2.1 shows the weight and the string in the equilibrium position.

(a) Measure

the height *h* of the top of the weight above the base of the stand in the equilibrium position,

h = ...

the length *j* of one side of the string,

j = ...

the distance *k* between the two points where the string is attached to the

k = ... [1]

(b) Rotate the weight clockwise when viewed from above until *h* increases by 10 mm.
Release the weight and immediately start the stopwatch.
The time for the string to first fully unwind is *t*.
Determine an accurate value for *t*.

t = ... [2]

(c) The rate which gravitational potential energy is transferred by the spinning weight can be calculated using the equation

$$P = \frac{W \Delta h}{t}$$

where W is the weight on the string and Δh is the change in h.
Calculate P_1 using your value of t from **(b)**.

P_1 = ... [2]

(d) Remove **three** weights from the mass-hangar. Repeat **(b)** and **(c)** to obtain a new value, P_2.

P_2 = ... [1]

(e) Plan an experiment to investigate the relationship between P and W.
Your plan should include

- a list of the quantities that remain constant,
- a description of how you would perform the experiment,
- a sketch of the graph that you would plot using preliminary observations.

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…… [4]

[Total: 10]

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-hangar 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.

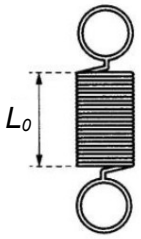

Fig. 3.1

L_0 = ……..m [1]

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

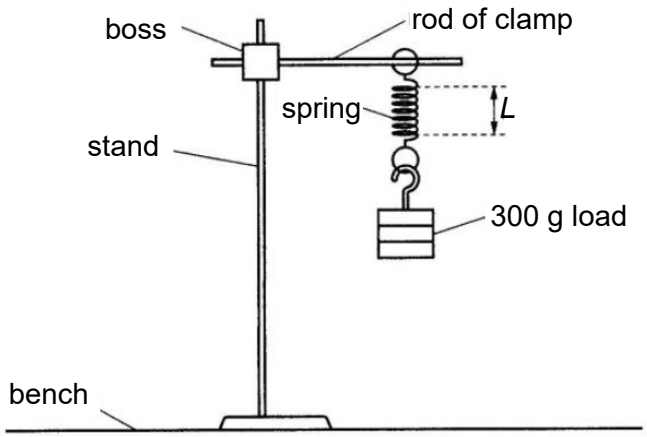

Fig. 3.2

(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.

1. ……

……..

2. ……

……..

[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.
Your data should be recorded in **SI units**.
Include your values for m = 300 g.

[4]

(d) Using the grid provided, plot a graph of E against x^2.
Draw the line of best fit. [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.

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..... [1]

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

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..... [1]

[Total: 20]