Class	Index Number	Name
21S		

ST. ANDREW'S JUNIOR COLLEGE
JC 2 2022
Preliminary Examination

PHYSICS, Higher 2 **9749/04**

Paper 4 Practical **15 August 2022**
2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and Civics Group 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, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.
The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.
Give details of the practical shift and laboratory where appropriate in the boxes provided.

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.

Shift
Laboratory

For Examiner's Use	
1	/11
2	/11
3	/20
4	/13
Total	**/55**

This document consists of **20** printed pages and **2** blank pages.

1 In this experiment, you will investigate the centre of gravity of a suspended card shape.

(a) You have been provided with a card shape, as shown in Fig. 1.1.

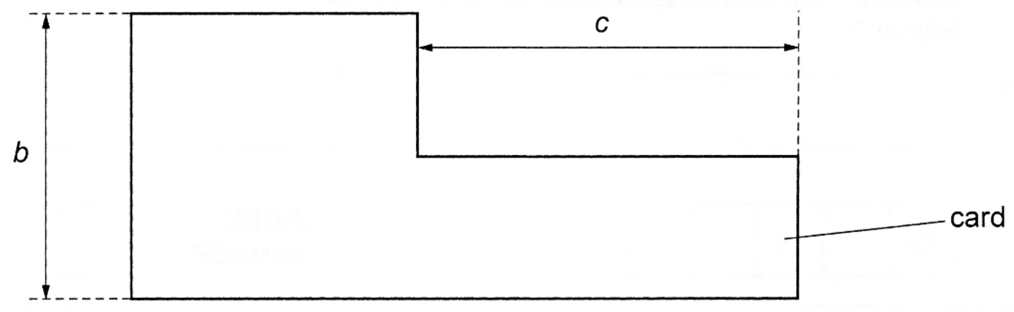

Fig. 1.1

Measure and record the lengths *b* and *c*.

b =...

c =...
[1]

(b) Use the pin to make two small holes in the card, as shown in Fig. 1.2.

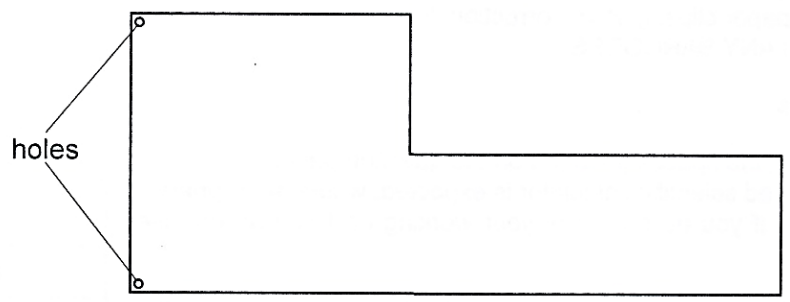

Fig. 1.2

Suspend the card as shown in Fig. 1.3. The pin should be held firmly in the clamp and the card should hang freely. The loop of string at the end of the pendulum should be attached to the pin.

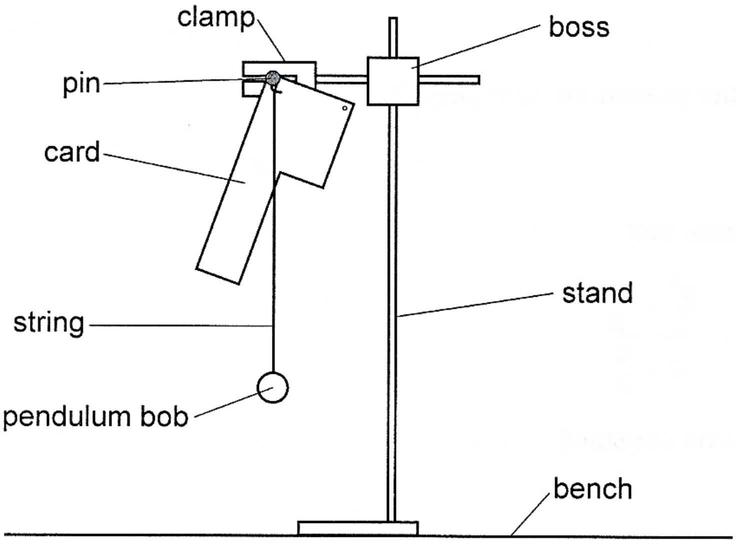

Fig. 1.3

Use the pencil to draw a line on the card along the path of the string in Fig.1.3, as shown in Fig.1.4.

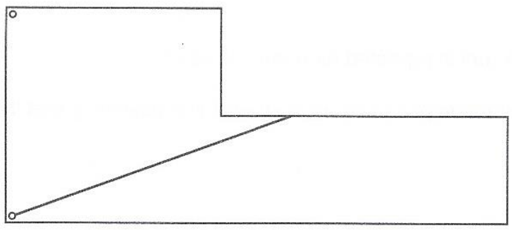

Fig. 1.4

Repeat the procedure using the other hole in the card. The two lines will cross at the centre of gravity G, a distance *y* above the longest edge of the card, as shown in Fig.1.5.

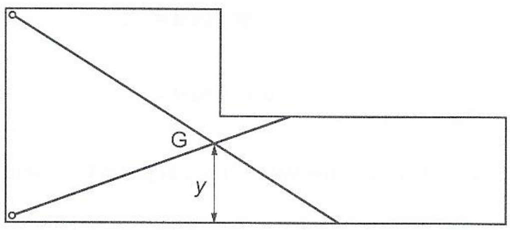

Fig. 1.5

Measure and record *y*.

y =……………………………….…….[2]

(c) **(i)** Reduce *c* by 6 cm by cutting the card at right-angles to its longest edge.

Measure and record *c*.

c = ………………………………[1]

(ii) Repeat the procedure from page 3.

y = ………………………………[1]

(d) Theory suggests that

$$y = \frac{\frac{b^2}{2}+\frac{bc}{8}}{b+\frac{c}{2}}$$

where *b* remains constant.

(i) Calculate the value of *y* when *c* is reduced by another 6 cm.

y = ………………………………[1]

(ii) The experiment is repeated for more values of *c*.

State the graph to plot to obtain a straight line assuming that the theory is correct.

....

....

....[1]

(iii) State expressions for the gradient and y-intercept of the line.

gradient = ……………………………………..

y-intercept =…………………………………[2]

(iv) Explain, without calculation, why the value of y is equal to 6 cm when $c = 0$.

....

....

....

....

....[2]

[Total: 11]

2 In this experiment, you will investigate an electrical circuit.

(a) Set up the circuit shown in Fig. 2.1.

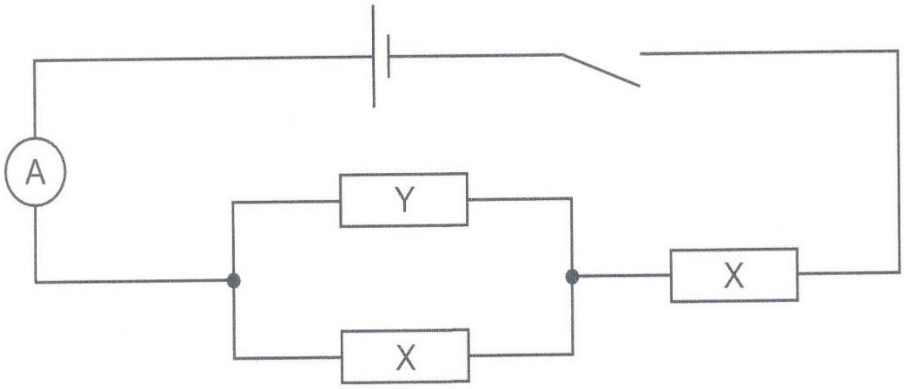

Fig. 2.1

The value of the resistance of Y is R_Y. Its value should be 10 Ω.

Record R_Y.

R_Y = ...

Close the switch.

Measure and record the ammeter reading I_1.

I_1 = ...

Open the switch.

Change the positions of the resistors Y and X, as shown in Fig. 2.2.

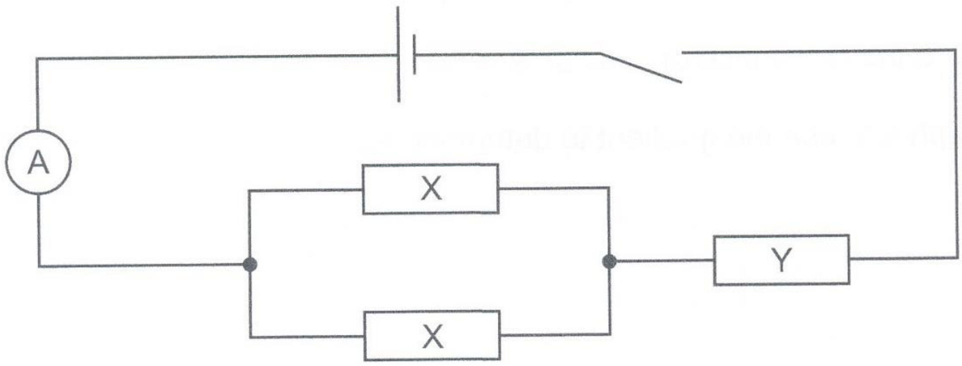

Fig. 2.2

Close the switch.

Measure and record the ammeter reading I_2.

I_2 = ...

Open the switch. [1]

(b) Vary R_Y and repeat **(a)**.

Present your results clearly.

[3]

(c) I_1, I_2 and R_Y are related by the expression

$$\frac{I_1}{I_2} = \frac{R_Y}{2R_X} + \frac{1}{2}$$

where R_X is the resistance of resistor X.

Plot a graph and use the gradient to determine R_X.

R_x = ……………………………………………

[5]

(d) By considering the value of $\frac{I_1}{I_2}$ when $R_Y = R_X$, describe another way in which the graph can be used to determine R_X.

……………………………………………………………………………………………........

……………………………………………………………………………………………........

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

(e) The experiment is repeated with a larger value of R_X.

Sketch a line on your graph grid on page 9 to show the expected result.

Label this line W. [1]

[Total: 11]

3 In this experiment, you will observe the motion of two simple pendulums, and measure the interval between successive times at which the pendulums are moving together.

You will investigate how this time interval is affected when the length of one of the pendulums is changed.

(a) Set up two pendulums side by side as shown in Fig. 3.1, with each string clamped between two wooden blocks.

Set the length of pendulum A to about 0.65 m.

Pendulum A should be left at its set length throughout the experiment.

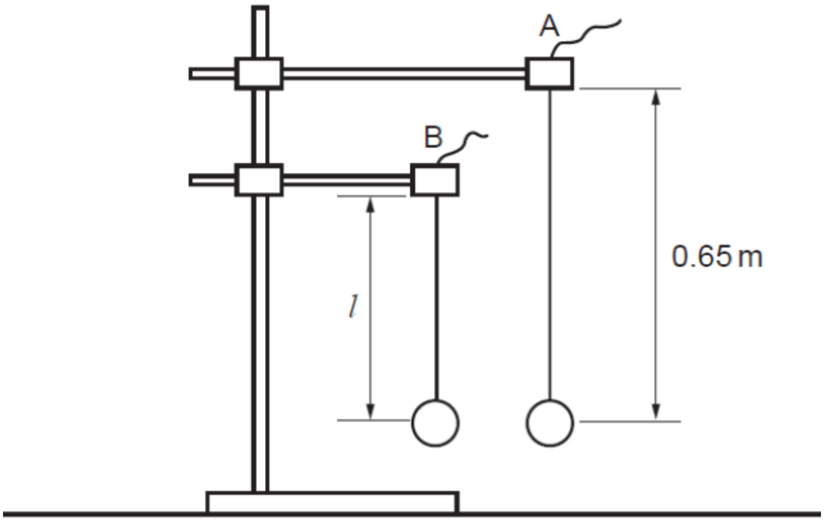

Fig. 3.1

(b) **(i)** Adjust pendulum B so that its length *l* is about 0.5 m.

Measure and record the value of *l*.

l = ………………………………. [1]

(ii) Estimate the percentage uncertainty of *l*

percentage uncertainty in *l* = ………………………………. [1]

(c) Set both pendulums into motion with small oscillations.

Start the stopwatch when the two pendulums are lined up as shown in Fig. 3.2 and are moving in the same direction.

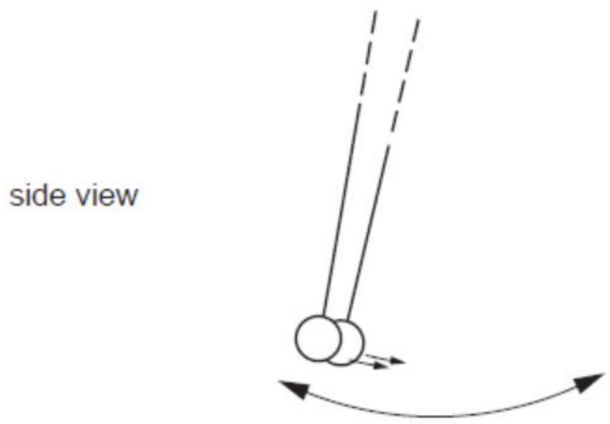

Fig. 3.2

(i) Determine the time *t* that elapses before the next occasion when the two pendulums are lined up and moving in the same direction.

t = …………………………… [1]

(ii) Calculate the percentage uncertainty of *t*.

percentage uncertainty of *t* = …………………………… [1]

(d) Change the length of *l* to about 0.4 m.

Repeat **b(i)** and **c(i)**.

l = ……………………………

t = …………………………… [2]

(e) It is suggested that

$$\frac{1}{t} = \frac{k}{\sqrt{l}}$$

where *k* is a constant

(i) Use your values from **(b)(i)** , **(c)(i)** and **(d)** to determine two values of *k*. Give your values of *k* to an appropriate number of significant figures

first value of *k* = ……………………………

second value of *k* = ……………………………

[1]

(ii) Justify the number of significant figures given in your values of *k.*

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

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

(iii) State whether the results of your experiment support the suggested relationship.

Justify your conclusion by referring to your values in **(b)(ii)** and **(c)(ii)**.

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…………………………………………………………………………………………………..

…………………………………………………………………………………………………..

………………………………………………………………………………………..……[2]

(iv) Using the results obtained in **(e)(i)**, calculate the number of times pendulum B which is initially in phase will go out of phase and back in phase again in 1 minute when *l* is 10 cm.

number of times = ……………………………. [1]

(f) Describe a significant source of uncertainty or limitation of the procedure for this experiment.

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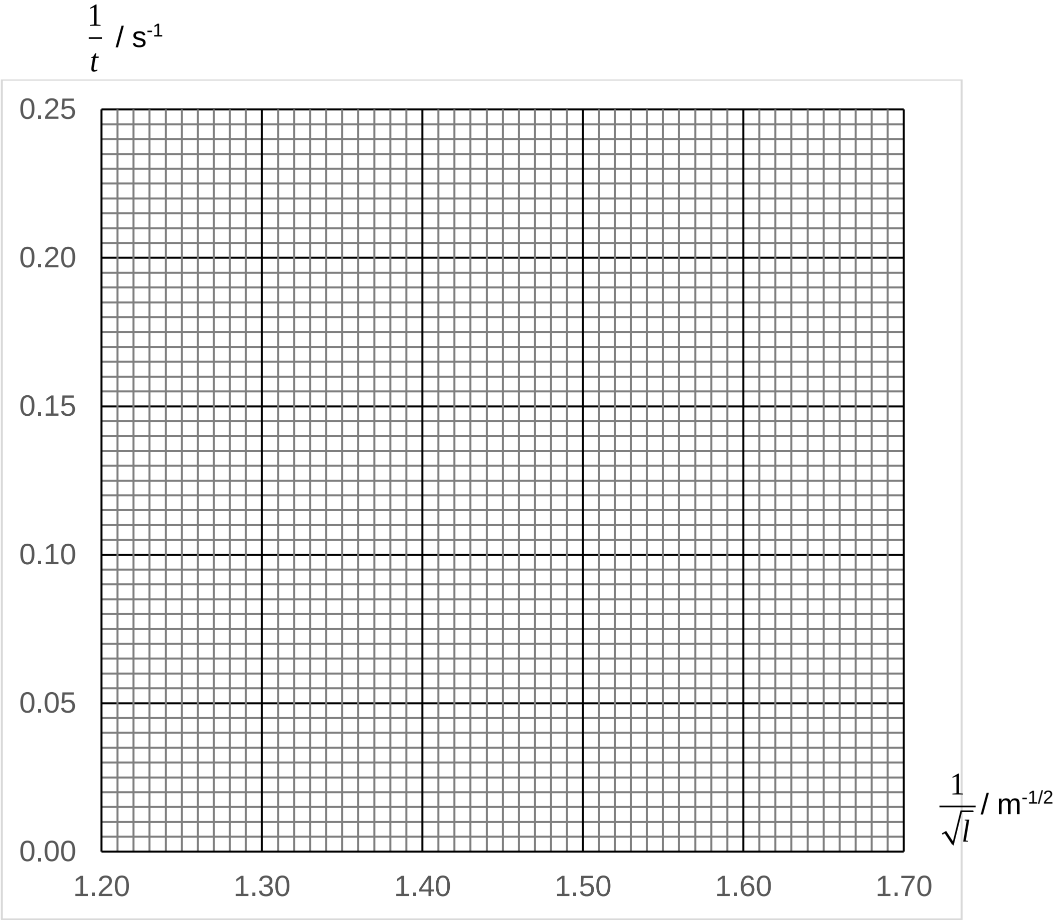
………………………………………………………………………………………………….

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

(g) In a separate investigation, the length *l* of pendulum B was varied. The following results of $\frac{1}{t}$ and $\frac{1}{\sqrt{l}}$ were recorded.

$\frac{1}{t}$ / s^{-1}	0.03	0.05	0.08	0.13	0.18
$\frac{1}{\sqrt{l}}$ / $m^{-1/2}$	1.29	1.35	1.40	1.50	1.60

(i) Plot $\frac{1}{t}$ against $\frac{1}{\sqrt{l}}$ on the grid and draw the straight line of best fit. [2]



(ii) With reference to the graph in **(g)(i)**, make a conclusion on whether $\frac{1}{t}$ is directly proportional to $\frac{1}{\sqrt{l}}$.

……………………………………………………………………………………………

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……………………………………………………………………………………[3]

(h) The period T of a pendulum when it oscillates with small oscillations is said to be related to the length of the pendulum L as shown.

$$T = P\sqrt{L} \ ,$$

where P is a constant

Using the set up in **(a)** with a single pendulum, design an experiment to determine the value of constant P.

Your account should include:

- the equipment you would use
- the experimental procedure
- how you would use the results to determine P.

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....[3]

[Total: 20]

4 Creep is the name given to the slow deformation of solid materials over an extended period of time when the material experiences stresses, which are below that required to reach the elastic limit. The *stress* exerted on a solid is defined as the applied force per unit cross-sectional area on the material and it is responsible for the elongation of the material along the axis of the force. Another measure of the deformation of an object is the *strain*, which is defined as the extension per unit length of the object. The ratio of stress to strain for a material is called the Young's Modulus of the material. It is a constant of the material.

An example of a situation where creep occurs is in the blades of a high temperature gas turbine. The operating temperature of the turbine is fairly close to the melting point of the material from which the blades are made. Therefore the blades are subject to creep and gradually become elongated as the turbine is used. This is illustrated in Fig. 4.1.

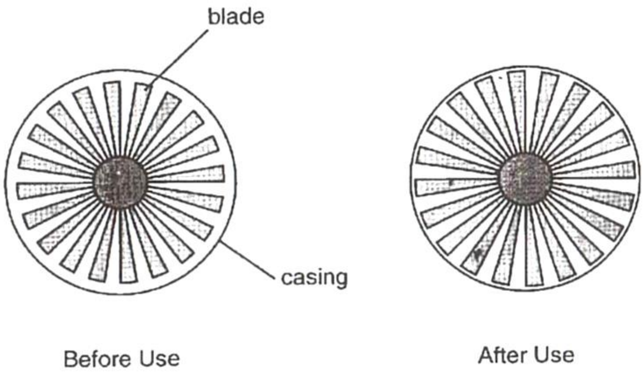

Fig. 4.1

The clearance between the blades and the casing is very small. This clearance decreases during the life of the turbine due to the creep in the blades. Therefore, it is important to engineers to have information about the creep process so that the life expectancy of the blades can be determined and damage to the engine can be prevented.

The length of a wire made of lead changes with time (i.e. creeps) as the temperature, T, of the wire and the load, m, which it supports are changed. The change in length, ΔL, is related to the temperature, T, of the wire and the load, m by the relationship

$$\Delta L = k\, T^{p}\, m^{q}$$

where k and p and q are constants.

You are provided with lead wires, a long box with toughened glass sides, some masses and an electrical heater.

Design an experiment to determine the values of p and q.

Draw a diagram to show the arrangement of your apparatus. Pay particular attention to:

- the equipment you would use
- the procedure to be followed
- the control of variables
- how the values of p and q are determined from your readings, and
- any precautions that should be taken to improve the accuracy and safety of the experiment.

Diagram

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[Total: 13]

[End of Paper]

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Mark Scheme of Q1 of Prelim Pract 2022 (Centre of gravity of card: 2021 Q1)

	Marking Point	**Mark**	**Score**
	☐ Recorded **at least 2 values** and **average** of *b* & *c* to **nearest mm** ☐ Accuracy: **11.5 cm ≤ b ≥ 12.5 cm ; 15.5 cm ≤ c ≥ 16.5 cm**	1	
	☐ Recorded **at least 2 values** and **average** of *y* to **nearest mm** ☐ Accuracy: **4.6 cm ≤ y ≥ 5.0 cm**	1 1	
(c)(i)	☐ Recorded **at least 2 values** and **average** of *c* to **nearest mm** ☐ Accuracy: **9.5 cm ≤** c **≥ 10.5 cm**	1	
(c)(ii)	☐ Recorded **at least 2 values** and **average** of *y* to **nearest mm** ☐ **5.0 cm ≤ y ≥ 5.5 cm**	1	
(d)(i)	Calculated Quantities: ☐ Accuracy of Calculation **5.2 cm ≤ y ≥ 6.0 cm** {value of b = 12.0 cm, c = 4.0 cm} ☐ **Number of sf in *y*: 2 or 3 sf** { must be same or one more than the least sf among *b* and *c* }	1	
(d)(ii)	Linerisation of equation ☐ Plot *y* (*b* + *c*/2) vs c, (A) or, y vs $\frac{\frac{b^2}{2}+\frac{bc}{8}}{b+\frac{c}{2}}$, (B) or, y vs (4b+c)/(2b+c) , (C) etc Thus, in (A), Y = *y* (*b* + *c*/2) & X = c; In (B), Y = y & X = $\frac{\frac{b^2}{2}+\frac{bc}{8}}{b+\frac{c}{2}}$; while in (C), Y = y & X = (4b+c)/(2b+c)	1	
(d)(iii)	Determination of Gradient and y-intercept {No ECF} ☐ State: gradient = *b*/8 & y-intercept = $b^2/2$, for (A) or, gradient = 1 & y-intercept = 0 for (B) or, gradient = b/4 & y-intercept = 0 for (C) { Units for gradient & intercept: not assessed }	1(grad) 1(intercept)	

(iv)	Why y = 6 cm when c = 0 (without calculation): □ State: shape of cardboard becomes a **square.** □ State: centre of gravity of a square is at its geometrical centre (hence y = b/2 = 6 cm)	1 1	
	Total	11	

Mark Scheme of Q2 of Prelim Pract 2022 (Changing Resistances in a circuit: 2021 Q2)

	Marking Point	Mark	Score
	□ Recorded value of R_Y as provided**, ie 10 Ω**	nil	
	□ Recorded value of I_1 to **one dp in mA** (or 4 dp in A).	nil	
	□ Recorded value of I_2 to **one dp in mA** (or 4 dp in A) in (a) and in (b)	1	
(b)	Minimum Sets of Raw Data Tabulated □ Collected **6 sets** of raw data (ie of R_Y**,** I_1 **&** I_2) without help. Deduct 1 m if student requires assistance.	1	
	Column Headings & Tabulation & Correct Precision for R_Y & I_1 & I_2 □ Each **column heading** (of R_Y**,** I_1 , I_2 and I_1/I_2) contains a quantity and a unit. I_1/I_2 has no unit. ECF for wrong unit of I_2. □ **First set** of readings taken in (a) is recorded in this table. □ R_Y recorded as labelled ie to **nearest ohm** & I_1 & I_2 to **1 dp in mA**	1	
	Calculated Quantities: □ Precision & Consistency of Recording **All** values of I_1/I_2 recorded to **same no. of s.f. or one more, consistently** as their corresponding raw data (I_1 & I_2). *Thus* I_1/I_2 **are recorded to 3 sf for all values, or to 4 sf for all values.** □ Accuracy of Calculation **All** values of I_1/I_2 correctly calculated.	1	
	Penalty for a Constant value for either I_1 & I_2: *deduct 3 marks:* *2 m from (b) Minimum Sets & Accuracy of Calculation, &* *1 m from (c) Correct Trend*		

(c)	<u>Graph: Scale, Size & Axes</u> ☐ Sensible scales, no **awkward scales** (eg 3 units into 10 small squares) ☐ Plots occupy **at least ½ of graph grid in both x & y directions** ☐ Successive scale markings: **no more than 20 small squares apart**. ☐ Axes labelled with the quantity & unit	1	
(c)	<u>Plotting of Points</u> ☐ **ALL** observations in table must be plotted ☐ **Precise** to within **half a small square**. ☐ **Thickness** of plots (ie the crosses) ≤ **½ small square**	1	
(c)	<u>Best fit line & Anomaly</u> ☐ Line drawn with **approx. equal number of points on either side** of line (anomalous pts not considered). ☐ ≥ **5 non-anomalous pts**, (ie **allow 1 anomalous** plot only if 6 are plotted; anomaly must be **<u>clearly indicated</u>** (eg by a circle or labelled.) ☐ Line is **not kinked/ disjointed** or **thicker than ½ small square** ☐ **Correct Trend**: straight line with positive gradient	1	
(c)	<u>Linearisation of Eqn</u> ☐ Stated **explicitly**: $\frac{1}{2R_x}$ **= gradient** of graph (of I_1/I_2 vs R_Y)	1	
(c)	<u>Determination of Gradient and R_X</u> ☐ **Hypotenuse** of triangle > ½ length of line drawn ☐ **No obscurity of the 2 pts** used for gradient calculation (Hence for eg, these 2 pt on triangle must **not** be "highlighted") ☐ 1. Recorded the **4 coordinates** accurately to precision of **3 s.f.** 2. Recorded the **4 coordinates** to precision of **½ small square** {ie the no. of dp for y-coordinates must follow no. of dp for ½ small sq for the y-scale & the no. of dp for x-coordinates must follow the no. of dp for ½ small sq for the x-scale }, 3. Recorded **x-coordinates** to **2 sf** (since R_Y is given to 2 sf), **or**, **2 + 1** = **3 sf**; **y-coordinates** recorded to **3 sf** (since I_1 & I_2 are measured to 3 sf), **or**, **3 + 1** = **4 sf** } ☐ R_X determined correctly from graph { = $\frac{1}{2x\ Gradient}$ } & recorded to **2 sf** (since R_Y has 2 sf), **3 s.f. or 4 s.f.** ☐ **Unit for R_X: Ω**	1	
(d)	☐ When $R_Y = R_X$, $I_1/I_2 = 1$. ☐ Value of R_X is that value of R_Y where $I_1/I_2 = 1$ *{which is read-off the graph.}*	1	

(e)	<u>Analysis</u> □ line W: **below original graph** (ie **no intersection**) with a **gentler gradient**. {Explanation: gradient = $\frac{1}{2R_x}$, so when R_X increases, gradient decreases. Y-intercept is unchanged (at ½) }	1	
	Total	11	

Mark Scheme of Q3 of Prelim Pract 2022
(Time interval betw successive in-phase positions of 2 pendulums)

	Marking Point	Mark	Score
(b)(i)	Measurement and Observation { l about 0.5 m} ☐ Recorded ≥ **2 values** of l and **average** to **nearest mm,** 0.1 cm or 0.001 m. ☐ Accuracy: **0.450 m ≤ l ≥ 0.550 m**	1	
(b)(ii)	☐ {Challenging condition} hence, Δl **= 3 - 5 mm** ☐ Calculated percentage uncertainty, $\frac{\Delta l}{l}$ x 100% = (value ≈ 0.6 **) (1 or 2 sf)** {Considered 'challenging' because it's a measurement to an **inaccessible pt** (centre of bob)}	1	
(c)(i)	Measurement and Observation ☐ Accuracy: **10 s ≤ t ≥ 17 s** ☐ Recorded ≥ **2 values of *t***, and **ave** to **nearest 0.1 s if Δt ≤ 2 .0 s** {**If Δt > 2 .0 s,** *t* shd be recorded to the **nearest 1 s** }	1	
(c)(ii)	☐ Δt = **0.3 to 0.5 s if Δt ≤ 2 .0 s** {Challenging condition} = **½ the Range**, if **Δt > 2 .0 s {Very Challenging condition}** ☐ Calculated percentage uncertainty, $\frac{\Delta t}{t}$ x 100% = …….. **(1 or 2 sf)**	1	
(d)	☐ Recorded ≥ **2 values** of ***l*** and **average** to **nearest mm,** 0.1 cm or 0.001 m. { l about 0.4 m} ☐ Recorded ≥ **2 values of *t*** to **nearest 0.1 s if Δt ≤ 2 .0 s** {**If Δt > 2 .0 s,** *t* shd be recorded to the **nearest second}** ☐ Value of *t* should be **smaller than that in (c)(i).** {Accuracy: not assessed; FYI 5.5 s ≤ t ≥ 6.5 s }	1 1	
(e)(i)	☐ Calculated correctly **two values** of *k* **with unit** and recorded to the **least no. of sf among *t* and *l*** {or 1 more}. ☐ **Unit: $m^{0.5}$ s^{-1}**	1	
(e)(ii)	☐ E.g. "*Since the* (**measured) quantity with the least number of sf**, ***which is*** *{either t or l* ***}****, (has x significant figures), I recorded k also to x significant figures { or x +1 more }.*"	1	
(e)(iii)	of Relationship ☐ Calculated $\frac{\lvert k_1 - k_2 \rvert}{k_{ave}}$ x 100 % correctly	1	

	☐ Compared $\frac{\lvert k_1 - k_2 \rvert}{k_{ave}}$ x 100 % with the **<u>sum</u> of half the value of (b)(ii) and that of (c)(ii)** & concluded that **results do not support the suggestion** if $\frac{\lvert k_1 - k_2 \rvert}{k_{ave}} > \frac{1}{2}\left(\frac{\Delta l}{l}\right) + \frac{\Delta t}{t}$ or, **results support the suggestion** if $\frac{\lvert k_1 - k_2 \rvert}{k_{ave}} \leq \frac{1}{2}\left(\frac{\Delta l}{l}\right) + \frac{\Delta t}{t}$	1	
(e)(iv)	☐ Number of times calculated correctly: $= \frac{60}{t}$ where $t = \frac{\sqrt{l}}{k}$, l = 0.1 m & value of k to be used = **<u>average</u>** of k_1 & k_2 .	1	
(f)	• It is difficult to judge *when* pendulums are exactly lined up (as this occurs only at an instant in time & there is parallax error), or , • It is difficult to measure the length l since the <u>cg of the bob is inaccessible</u>, or, • 2 values of k are <u>not enough to draw a valid conclusion on whether k is a const.</u>	1	
(g)(i)	<u>Plotting of Points</u> ☐ **ALL 5** observations in table must be plotted ☐ **Precise** to within **half a small square**. ☐ **Thickness** of plots (ie the crosses) ≤ **½ small square** <u>Best fit line & Anomaly</u> ☐ Line drawn **with approx. equal number of points on either side** of line (anomalous pts not considered). ☐ Line is **not kinked/ disjointed** or **thicker than ½ small square**	} 1 } 1	
(g)(ii)	☐ Stating either the y-intercept, or, the x-intercept is not zero ☐ <u>Correct explanation for deduction above</u>: Eg. Value of the x-intercept (1.24 $m^{-1/2}$) is significantly far from x = 0 (read from graph or by calculation). (FYI: gradient ≈ 0.5 $m^{0.5}$ s^{-1} & y-intercept ≈ -0.62 s^{-1}) ☐ <u>Correct conclusion based on correct deduction that y-intercept is not zero</u>: Since graph does not pass through the origin, $\frac{1}{t}$ is not directly proportional to $\frac{1}{\sqrt{l}}$.	1 1 1	

(h)	<u>Appropriate measuring instruments used:</u> ☐ Measure length of pendulum using a **metre rule**, & measure oscillation time using a **stopwatch**. <u>Procedure</u> ☐ Measure **time for *N* oscillations** using a stopwatch and **calculate period *T*. Formula for T** must be cited. ☐ **Repeat** the experiment for **different values of *L*** <u>Analysis</u> ☐ Either, • Plot graph of T against $\sqrt{L}$: ⇒ P = gradient, or • Plot lg T against lg L : ⇒ lg P = y-intercept. ⇒ $P = 10^{y\text{-intercept}}$	1 1 1	
	Total	20	

Q4 Mark Scheme and Examiner's Comments

<u>Independent & Dependent Variables</u> Independent variables: **Temperature *T*** of wire (Expt 1), **load *m*** supported by wire (Expt 2) Dependent variable: **Change in length Δ*L*** of wire (both Expts 1 & 2) **<u>Control of Variables</u> (**both expts**)**: { Any 1} 1) Initial length of the wire is **<u>kept constant</u>.** 2) Diameter/cross-sectional area {not: thickness} of wire is <u>kept constant</u>. 3) Duration/time of heating of wire is <u>kept constant</u>.	1 1	

Labelled diagram of workable experiment showing: wire subjected to a load (masses) **along its length**, in a long box; electrical heater (in the box) **with power supply**. No need to show thermometer. • Use of a **thermostat** to set temperature. {Must be **explicitly stated**}. • Measure **mass *m*** using mass **<u>balance</u>** & measure **temperature *T*** using **<u>thermocouple</u> (**or **<u>thermometer</u>).** (If slotted masses are used, no measuring instrument for mass is required.) • Measure **extension of wire** using a **<u>travelling microscope</u>**. <u>Expt 1:</u> **Keeping mass *m* constant**, **vary temperature *T* <u>by changing thermostat setting or the power/voltage supplied to heater</u>.** <u>Expt 2</u>: **Keeping temperature *T* constant, vary mass *m* <u>by changing the number of slotted masses</u>.**	1 1 1 1 1 1	
<u>Analysis</u> { $\Delta L = k\,T^p m^q \Rightarrow \lg \Delta L = p \lg T + q \lg m + \lg k$ } For constant *m (Expt 1)*, plot **graph of lg Δ*L* against lg *T*,** $\Rightarrow$ ***p* = gradient** For const *T (Expt 2)*, plot **graph of lg Δ*L* against lg *m*,** $\Rightarrow$ ***q* = gradient**	 1 1	
<u>Precautions to improve Safety</u> (Any one) Use <u>goggles to protect the eyes</u> (in case wire snaps). Use <u>tongs or heatproof gloves to handle the hot wires</u> (e.g. when there is a need to keep the wire from moving while measuring extension). Set up apparatus (vertically) above a bucket of sand (to reduce impact on the ground in case wire snaps).	Max 1	
<u>Precautions to improve Accuracy/Additional Details/Good Design Features (</u>Any two) Perform a <u>preliminary experiment</u> <u>to gauge the range of loads</u> that can be used to produce a <u>measurable change in length</u> without causing wire to snap. Use a <u>kink-free wire</u> OR a <u>fresh wire</u> after each reading.	Max 2	

Use a <u>long wire</u> to obtain <u>measurable extensions.</u> Perform the experiment over a <u>sufficiently long period of time</u> to obtain <u>measurable extensions.</u> Check periodically to ensure that the <u>point of suspension of wire at the ceiling does not sag</u> (due to excessive weight of the suspended masses). If thermostat is not used, wrap the box with lagging material (to minimize heat loss)		
Total	13	

<u>Diagram</u><u>: Suggested setup: </u> (N2000 P4 Q3)