2024 4E Prelim Paper 3 Practical Test Marking Scheme

Question 1

(a)	l = **2.1 cm** d = **1.6 cm**	[1] [1]
(b)	m = **5.3 g** n = **30** N = **34**	 [1] [1]
(c)	D = **0.0700 cm**	[1]
(d)(i)	L = **171 cm**	[1]
(d)(ii)	V = **0.658 cm^3**	[1]
(d)(iii)	ρ = **8.06 g / cm^3**	[1]
(e)	*Source of error:* **1. Precision of the ruler is only 0.1 cm** **2. There is a portion of wire between the coiled part and the 2 turns on each end that is not accounted for.** *Effect on calculated value of ρ:* **1. Value of V is overestimated, so calculated value of ρ may be smaller than the actual value of ρ.** **2. Value of V is underestimated, so calculated value of ρ may be larger than the actual value of ρ.**	 [1] [1]
	Total marks:	10

Question 2

(a)	θ = (results to be updated on practical dry run)	[1]
(b)	r = (results to be updated on practical dry run)	[1]
(c)	T = (results to be updated on practical dry run)	[1]
(d)	*Planning mark allocation:* *Variables – 1m, 1m* *Performing experiments (starting value of independent variable, measuring dependent variable & 5 more values to obtain more readings, table) – 1m, 1m* *Statements and sketch of graphs – 1m, 1m* *How to achieve accurate results – 1m*	 [7]

Plan 1

Independent variable: **distance that the piece of Blu-Tack moves *d***
Dependent variable: **time taken for the piece of Blu-Tack to reach the bottom of the cylinder *T***
Control variable: **type of oil, radius of the piece of Blu-Tack *r*.** [1]

1. Fill the measuring cylinder such that the height of the column of oil is 5 cm so that the **distance that the piece of Blu-Tack moves is d = 5 cm.**

2. Place the piece of Blu-Tack at the top of the oil as shown in Fig. 2.1. Use the string to hold the piece of Blu-Tack so that it just touches the surface of the oil in the measuring cylinder.

   Release the string and start the stop-watch. Stop the stopwatch when the piece of Blu-Tack reaches the bottom of the measuring cylinder. **Record the time T_1 taken for the piece of Blu-Tack to reach the bottom of the cylinder.**

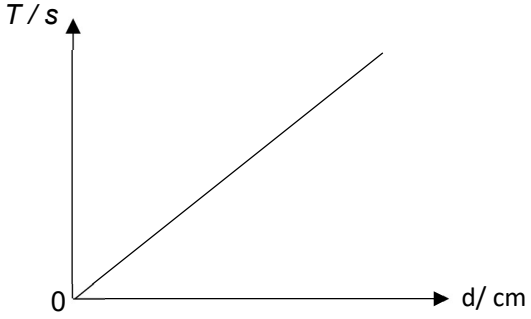
3. **Repeat step 2 two more times to obtain T_2 and T_3 and find the average value T_{avg} to achieve accurate results.** [1]

4. Repeat steps 1 – 3 for **five further values of d (8 cm, 10 cm, 12 cm, 15 cm, 18 cm).**

5. **Record the values of d, T_1, T_2, T_3, and T_{avg} in a table.** [1]

6. **Plot the graph of T_{avg} against d.**

   If the suggested relationship is correct, we will obtain the following graph:



[1]

The graph should be a straight line passing through the origin if T is directly proportional to d.

Plan 2

Independent variable: **radius of the piece of Blu-Tack *r***
Dependent variable: **time taken for the piece of Blu-Tack to reach the bottom of the cylinder *T***
Control variable: **type of oil, distance that the piece of Blu-Tack moves *d*** [1]

1. Roll a ball of Blu-Tack and attach a string to it such that the **radius of the piece of Blue-Tack is r = 1 cm**.

2. Place the piece of Blu-Tack at the top of the oil as shown in Fig. 2.1. Use the string to hold the piece of Blu-Tack so that it just touches the surface of the oil in the measuring cylinder.

   Release the string and start the stop-watch. Stop the stopwatch when the piece of Blu-Tack reaches the bottom of the measuring cylinder. **Record the time T_1 taken for the piece of Blu-Tack to reach the bottom of the cylinder.**

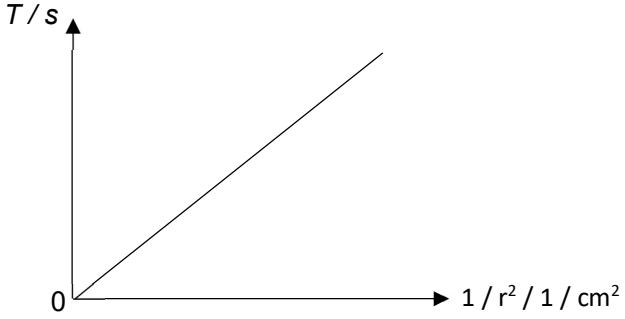
3. **Repeat step 2 two more times to obtain T_2 and T_3 and find the average value T_{avg} to achieve accurate results.**

4. Repeat steps 1 – 3 for **five further values of r (1.2 cm, 1.4 cm, 1.6 cm, 1.8 cm, 2 cm).**

5. **Record the values of r, 1 / r^2, T_1, T_2, T_3, and T_{avg} in a table.** [1]

6. **Plot the graph of T_{avg} against 1 / r^2.**

   If the suggested relationship is correct, we will obtain the following graph:



[1]

The graph should be a straight line passing through the origin if T is directly proportional to 1 / r^2.

Total marks: 10

Question 3

(ai) V_1 = **1.10 V** [1]

I_1 = **0.14 A** [1]

(aii) R = **7.86 Ω** [1]

P = **0.154 W** [1]

(b)

***L* / cm**	***V* / V**	***I* / A**	***R* / Ω**	***P* / W**
100.0	**1.10**	**0.14**	**7.86**	**0.154**
80.0	**1.30**	**0.15**	**8.67**	**0.195**
60.0	**1.60**	**0.16**	**10.0**	**0.256**
40.0	**1.90**	**0.18**	**10.6**	**0.342**
20.0	**2.30**	**0.20**	**11.5**	**0.460**
10.0	**2.60**	**0.21**	**12.4**	**0.546**
5.0	**2.80**	**0.22**	**12.7**	**0.616**

[5]

Heading and units in heading, at least 6 readings, no units in table [1]

(c) **Graph**

Scale – at least half the grid provided, consistent scale [1]
Lines – curved line of best fit line [1]
Axes – labelled with title/ unit, starting values clearly stated [1]
Points – plotted accurately [1] [4]

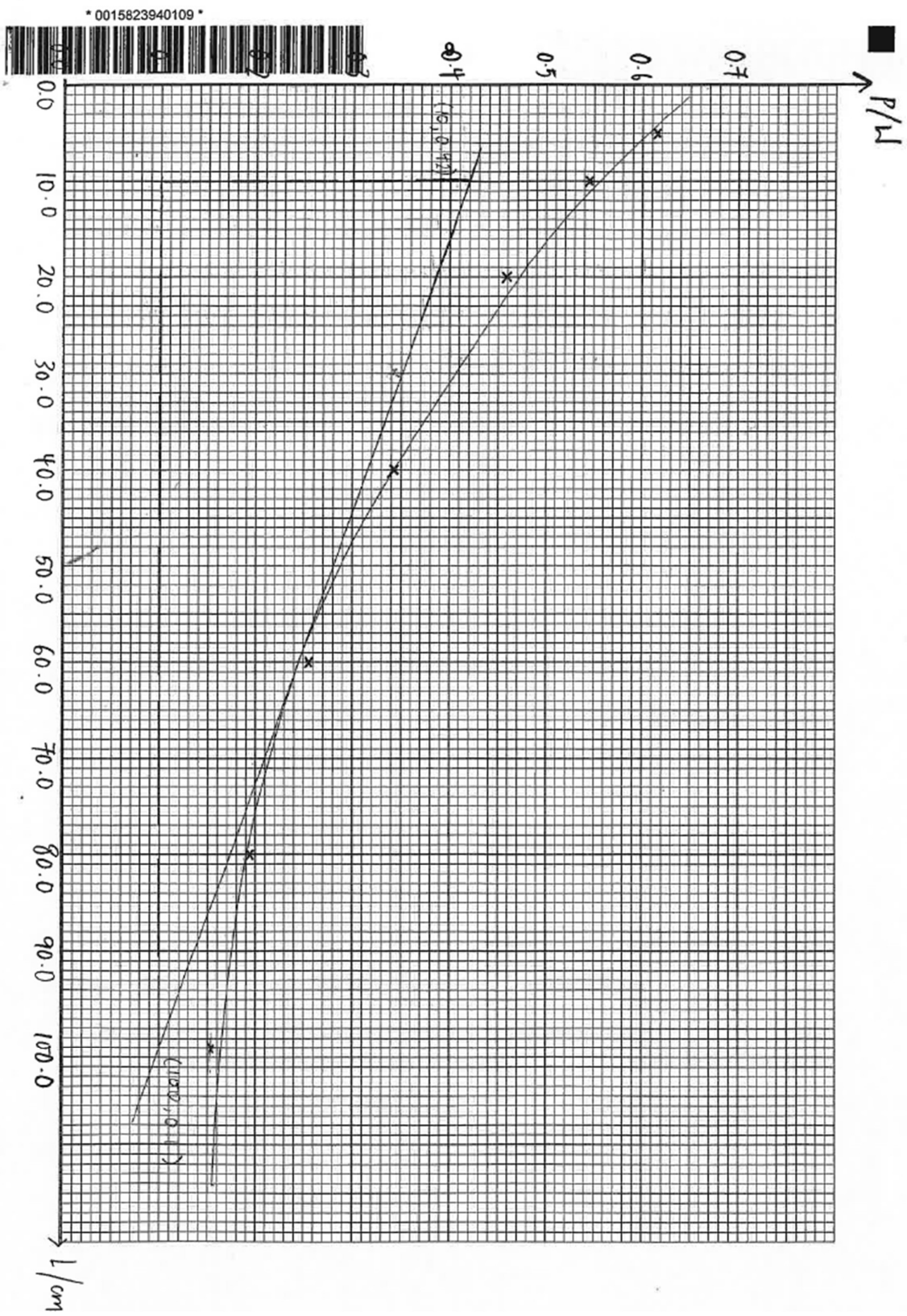
(d) Tangent drawn at L = 60.0 cm [1]

G = **- 0.00356 W / cm** [1]

(e) *Trend:*
The graph of P against L is a curve. As the value of L increases, the value of P decreases at a decreasing rate, i.e. the gradient of the curve gets gentler as L increases. [1]
P is inversely proportional to L. [1]

(f) *Sources of error:*
1. **There are kinks in the wire and the wire cannot be straightened on the ruler, affecting the measurement of length L.**
2. **The wire and the circuit components become hot after some time and resistance increases, affecting the voltmeter and ammeter readings.** [1]
3. **The voltmeter and ammeter readings fluctuate, making it difficult to record an exact value of V and I.** [1]

Total marks: 20



End of Marking Scheme

PHYSICS

Paper 6091/03
Practical

General comments

Most candidates were able to demonstrate their practical and mathematics skills well.

Better performing candidates ensured that all experimental readings were taken to the required accuracy, and numerical answers were expressed to an appropriate number of significant figures or to the relevant number of decimal places. Some candidates showed an inconsistency in their application of decimal places. Better performing candidates showed all steps in a calculation. Some candidates either did not show a unit or stated an incorrect one.

Comments on specific questions

Section A

Question 1

(a) Most candidates correctly measured the length and the diameter of the spring. Some candidates incorrectly stated their answer to the nearest 0.1 mm, which is not possible with a standard ruler.

(b) Most candidates correctly stated the number of turns.

(c) Many candidates calculated the correct value for D. Some used $1 / n$ instead of l / n.

(d) Most candidates carried out the necessary substitutions, using their values correctly. In stronger responses, all steps in a calculation were shown. Most candidates stated the correct units.

(e) Few candidates gave complete answers, with many not being specific enough about how the increase or decrease in values of length, diameter, or number of turns affected the value of ρ. This led to insufficient detail being seen for the effect on ρ.

Question 2

(a) Most candidates correctly recorded the temperature to the required number of decimal places.

(b) Most candidates did not repeat the necessary measurement of the diameter, find the average and hence state the radius. Many candidates just stated a single value for the radius.

(c) Almost all candidates answered this question correctly.

(d) Many candidates did not realise that they needed to plan more than one experiment. A few candidates planned a completely incorrect experiment, which indicated that they did not use the provided bullet points as a guide. There were some candidates who just copied the instructions from **(c)**.

Many candidates identified at least one key control variable. Some candidates did not state which variable they were keeping constant. Many candidates were aware that at least five values of the independent variable were needed. Most candidates were able to describe one precaution that was needed and to correctly draw an appropriate sketch graph.

Section B

Question 3

(a) Most candidates correctly read the meters to the required number of decimal places and proceeded to calculate R and P to the required number of significant figures. Some candidates did not show their calculations.

(b) The presentation of the table was generally very good, with all columns having the correct headings and units. Most candidates had a good range of values for length (L). Few candidates took enough readings to give a clear trend in their graph.

(c) The standard of graph plotting was generally good. There were very few inappropriate scales seen and the axes were correctly stated by almost all candidates. Some candidates had difficulty in drawing a smooth curve.

(d) Most candidates were able to draw an acceptable tangent and evaluate the gradient, including the negative sign. Only a few candidates used a triangle that was too small.

(e) Most candidates stated that the power decreased as length increased, with many candidates realising that the relationship was not linear. Some candidates gave a good explanation for the trend in the graph being linked to the current–voltage–power equation.

(f) Many candidates did not realise they needed to relate their answer to the method used to determine G. Many candidates referred to kinks in the wire, heating effect of a current or inaccuracy in the length of the wire. Some candidates stated that there would be difficulty in drawing a best-fit curve, or exactly where to draw the tangent.