2025 S4 Physics Practical Trial (27 June)

Return and Checking of Scripts
July 2025

Some takeaways from doing the Trial Practical

- Understanding the seating arrangement in the labs (each science will have a different seating plan - so don't mix them up!)
- Understanding the format of the paper with the two 55-minute sessions
- Better idea of the type of questions that will appear
- Understanding of what to do when the apparatus appears to be faulty

What you will get from going through the paper now

- An understanding of how the Physics teachers mark a practical paper
- An appreciation of what are the import points for you to revise
- Knowing which instruments you are not so comfortable with yet and so will need to practice
- Remember to write down which lab you are in. i.e. **Phy/ Bio/ Chem** & Lab **1/2/3**

Answers & Marks Allocation

QUESTION 1

Question 1

Some observations:

- Students should displace the mass slightly. Avoid hitting the bench.
- Some students displaced the spring-mass system in the horizontal direction instead.

Question 1

In this experiment, you will investigate the period and the mass of the spring-mass system.

You are provided with:

- retort stand
- spring
- mass hanger
- 30 cm ruler
- stopwatch

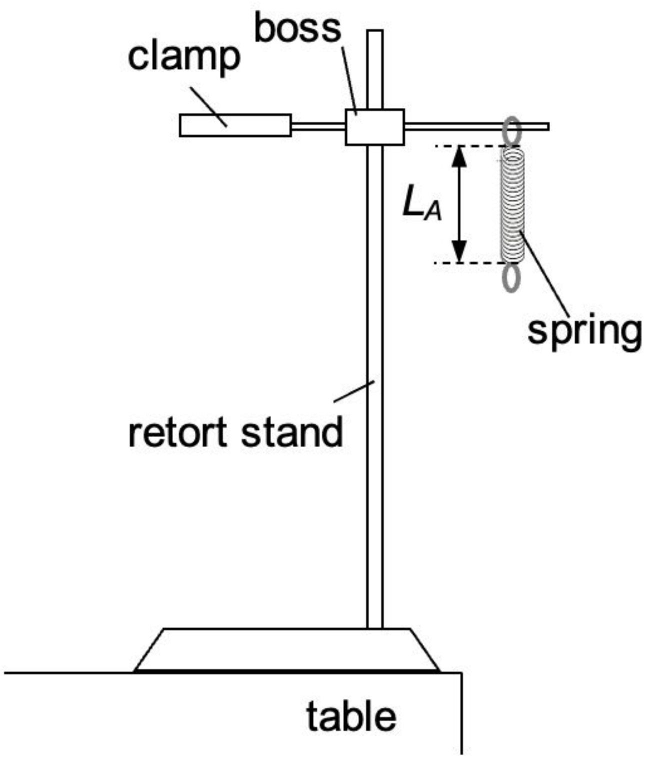


Fig. 1.1

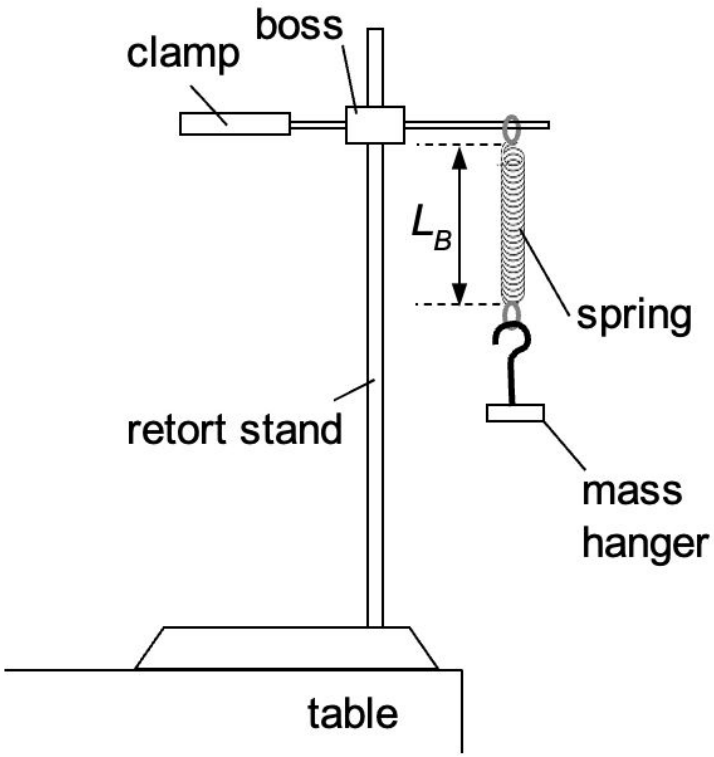


Fig. 1.2

Displace the mass vertically and release.

Question 1(a)

Measure the unstretched length L_A of the coiled part of the spring with a ruler and record it.

L_A = ... [1]

Accepted	Remarks
L_A = 8.5 cm **Accept within 8.0 cm to 9.0 cm**	• must have units • must be to correct d.p (for ruler) • should be clearly indicated as m, cm or mm NOT M, CM or MM

Question 1(b)

Measure the stretched length L_B of the coiled part of the spring.

L_B = ……………………

Accepted	Remarks
L_B = 9.5 cm	• unit and d.p

Question 1(c)

Use the equation $e = L_B - L_A$ to calculate the extension e of the spring.

e = ... [1]

Accepted	Remarks
e = 1.0 cm **(accept within 10%)**	• Correct d.p. and units

Question 1(d)

Measure and record the time taken t_1 for the mass to complete 15 oscillations. Repeat to obtain a second set of reading for t_2.

t_1 = ...; t_2 = ... [1]

Accepted	Remarks
t_1 = 10.9 s, t_2 = 11.0 s	• Correct d.p. and units • stopwatch should be read to 1 d.p. due to large uncertainty of human reaction time.

Question 1(e)

Determine the period for the oscillation, *T*.

T = ... [1]

Accepted	Remarks
Period = (10.9 + 11.0) / (2 × 15) ***T* = 0.730 s**	• Correct s.f. and units

Question 1(f)

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,
- A sketch of the graph that you would obtain if the suggested relationship is correct,
- An explanation of how you would obtain the values of a and b from your graph.

Question 1(f)

- The quantities that you should keep constant,

Accepted (ANY 2 of the following)

- **unstretched length of spring**
- **stiffness of spring or spring constant**
- **initial displacement of the mass**

Usually you will be asked to state IV & DV as well, as a good practice, always state IV, DV and 2 CV at the start.

Question 1(f)

- A detailed description of how you would perform the experiment,

Accepted

Vary *e* by adding more slotted masses each time for 9 more values of mass.
repeat steps (b) and (c) to obtain extension

Measure and record the time taken, t_1 and t_2, for N oscillations, making sure that the value of t is more than 10 s each time. Determine the period T of the oscillations.

Calculate T^2.

Question 1(f)

- A suitable table in which to display your measurements and calculated values (you do not need to enter any data into the table),

Accepted

m / g	L_B / cm	e / cm	t_1 / s	t_2 / s	N	T / s	T^2 / s^2

accepted if m was not present.

N not needed if it was clear that the number of oscillations remained constant.

do not write in words, use the assigned notations

Question 1(f)

- A statement of the graph that you would plot to test the relationship,

Accepted

Plot a graph of T^2 against e

Question 1(f)

- A sketch of the graph that you would obtain if the suggested relationship is correct,

Accepted

Straight line graph with axes labelled.

y-intercept labelled as b

origin must be indicated

many lost this mark for not indicating b and origin

Question 1(f)

- An explanation of how you would obtain the values of a and b from your graph.

Accepted

States that a is obtained from the gradient and b is the vertical intercept (allow BOD from graph)

Details of how to find the gradient are not required.

QUESTION 2

Question 2(c)

Use a protractor to measure and record the angle of incidence *i* on the insert. Label *i* on the insert.

i = ... [1]

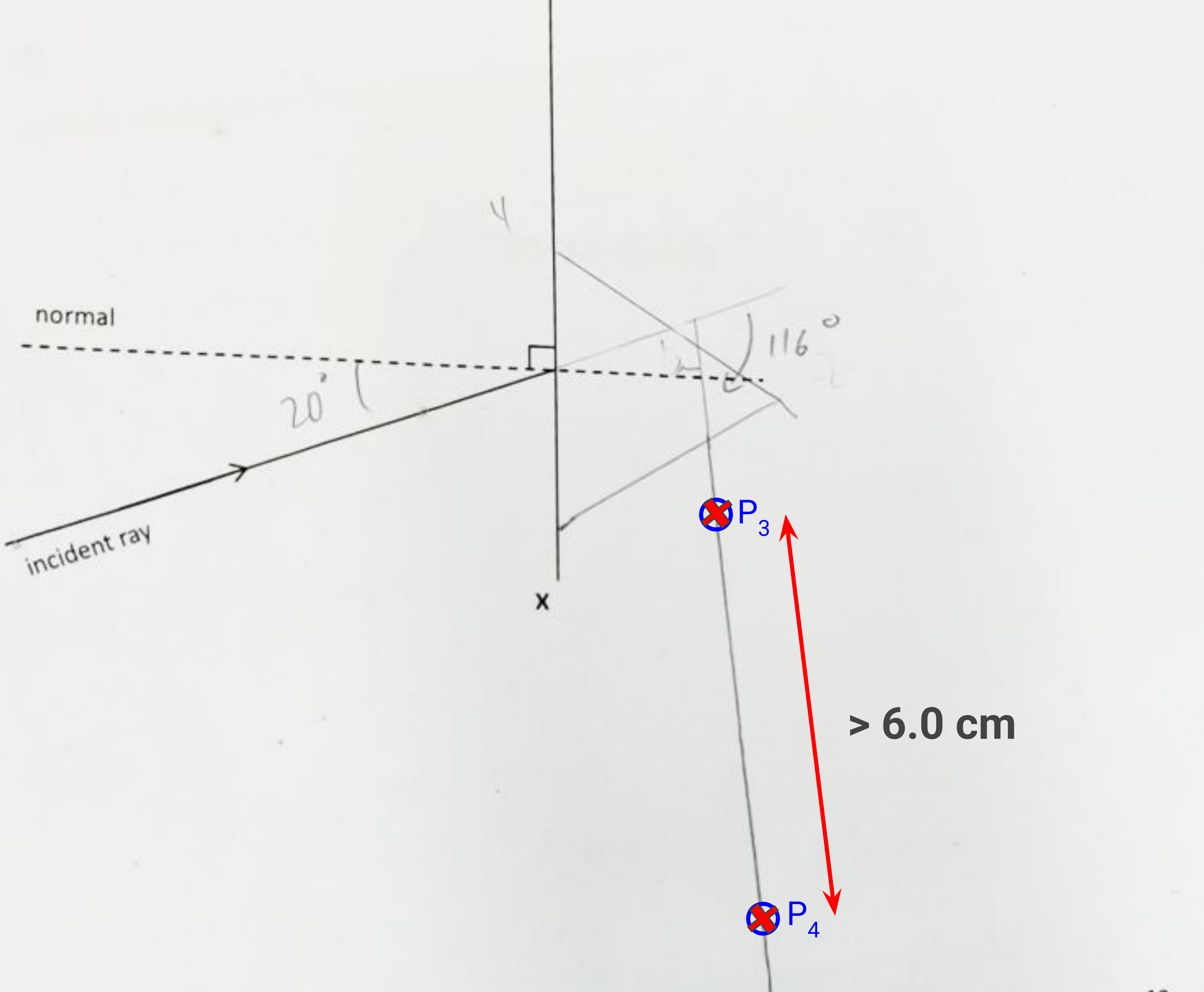
Accepted	Remarks
$i = 20°$	• Must be labelled i (or 20°) on the paper

Question 2(f)

Remove the pins and the prism. Draw a line through the pinholes at P_3 and P_4 and extend this line to meet side XZ. Mark and label the positions of P_3 and P_4.

[1]

Accepted	Remarks
At least 6.0 cm apart between the pins	• do not pin on the edge of the prism



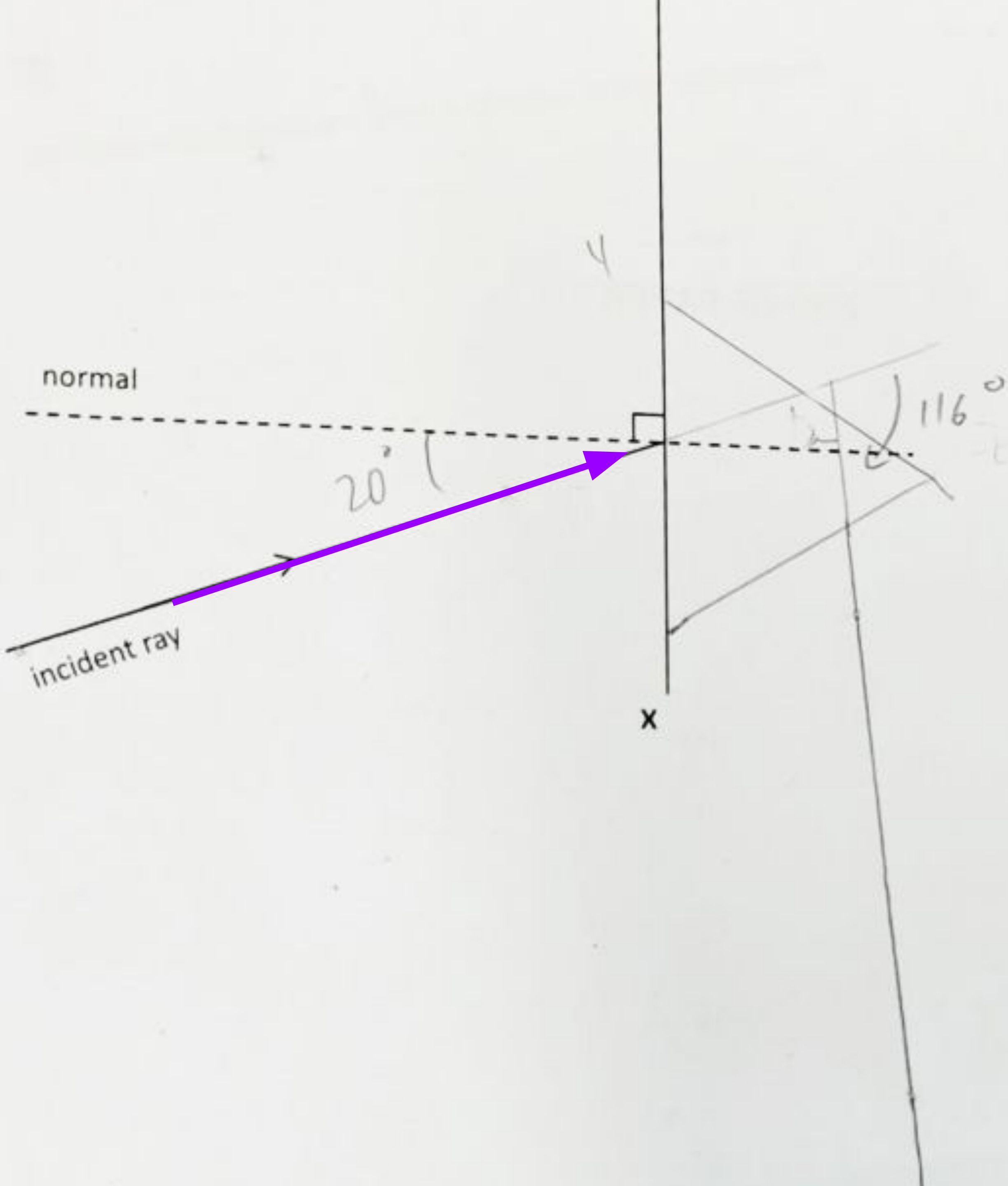
normal
20°
116°
incident ray
X
P3
P4
> 6.0 cm

Question 2(g)

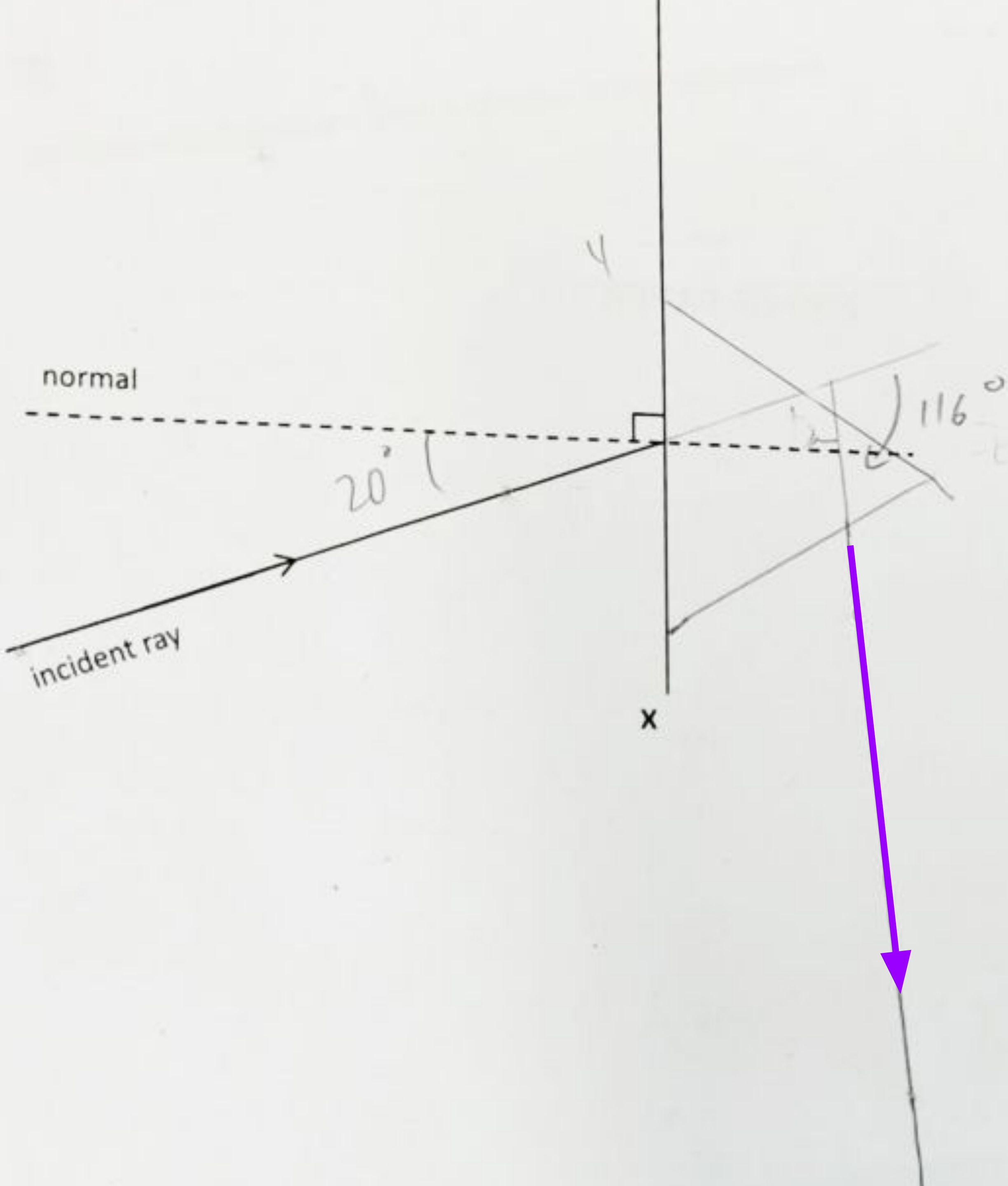
Measure the angle of deviation for the ray emerging from side XZ with respect to the incident ray (from P_1 and P_2).

angle of deviation = ... [2]

Accepted	Remarks
Angle of deviation = 116º	• Correct d.p. and units. • Accept within 111º and 121º



normal
incident ray
20°
116°
Y
X



normal
incident ray
X
20°
116°

Question 2(h)

Explain why it is not possible to see the pins P_1 and P_2 through the prism on side YZ.
.... [1]

Accepted	Remarks
Total reflection occurs on side YZ, light will not escape from side YZ	•

Question 2(i)

State two precautions you have taken for this experiment.

.... [1]

Accepted	Remarks
• **Use a protractor or set-square to ensure that the pins are placed vertically upright so that the alignment of the pin(s) and image(s) would be accurate.** • **The two pins that are used to locate the path of a light ray are placed more than 5.0 cm apart to minimise errors in the location of rays.**	Precautions are **“things that you did to give you better results, or make the experiment safer”** but were **not** told to do in the instructions. They should not be so obvious that they are expected.

Question 2(i)

State two errors that are difficult to eliminate for this experiment. [2]

Accepted	Remarks
• **placing the pin so that is is vertical.** • **accurately placing the pin to align with the refracted image of the pin.**	It is usual to be asked for **precautions OR errors**. Not so common to be asked for both (as there is often some overlap)

Question 2(j)

State why it is not practical to use a plastic prism for the experiment.

.... [2]

Accepted	Remarks
Plastic has a lower refractive index to air, total reflection may be less likely to occur on side YZ.	•

QUESTION 3

Question 3(a)

Measure and record the e.m.f. *E* of the two dry cells connected in series.

E = ...[1]

Accepted	Remarks
E = 2.85 V **range of 2.50 V to 3.20 V**	• 2 d.p. (to 0.05 V with unit)

Question 3(b)(iii)

Measure and record the length *L* of the resistance wire between X and J.

Record the voltmeter reading *V*.

L = ...

V = ...
[1]

Accepted	Remarks
L: range of 45.0 cm to 55.0 cm	• L - **[to 1 d.p. (to 0.1 cm with unit)]**
V: At least 1.00 V	• V - **[2 d.p. (to 0.05 V with unit)]**

Question 3(b)(iv)

Record the ammeter reading I.

I = ...[1]

Accepted	Remarks
At least 0.15 A	• 1 d.p. to 0.01 A with unit

Question 3(b)(v)

Calculate the resistance R of the rheostat using the formula

$$R = \frac{V}{I}$$

Express your answer to an appropriate number of significant figures.

R = ...[1]

Accepted	Remarks
R = 2.15 / 0.14 = 15 Ω	• R: calculated correctly • apply least s.f. of the V and I values substituted, with unit.

Question 3(c)

By placing the jockey at different positions on the resistance wire, repeat **(b)(iii)** and **(b)(iv)** for further values of *L*, where *L* ≥ 10 cm.

For each value of *L*, adjust the slider on the rheostat until the ammeter reading is approximately the same value as in (b)(iv).

Record all measurements for *L*, *V* and *I*, including those from **(b)(iii)** and **(b)(iv)**. [4]

Accepted

L / cm	I / A	V / V
10.0	0.14	2.60
30.0	0.14	2.35
50.0	0.14	2.15
70.0	0.14	1.90
85.0	0.14	1.80
100.0	0.14	1.60

Remarks

- at least 6 sets of data (L, V, I) with correct trend, V decreases as L increases
- I remains approximately constant (allow (b)(iv) ± 0.01 A)
- Range of L of at least 60.0 cm
- Table headers with correct units
- All values of V to 0.05 V, I to 0.01 A and L to the nearest mm (0.1 cm)
- Deduct 1: if data for 50.0 cm is missing from table.

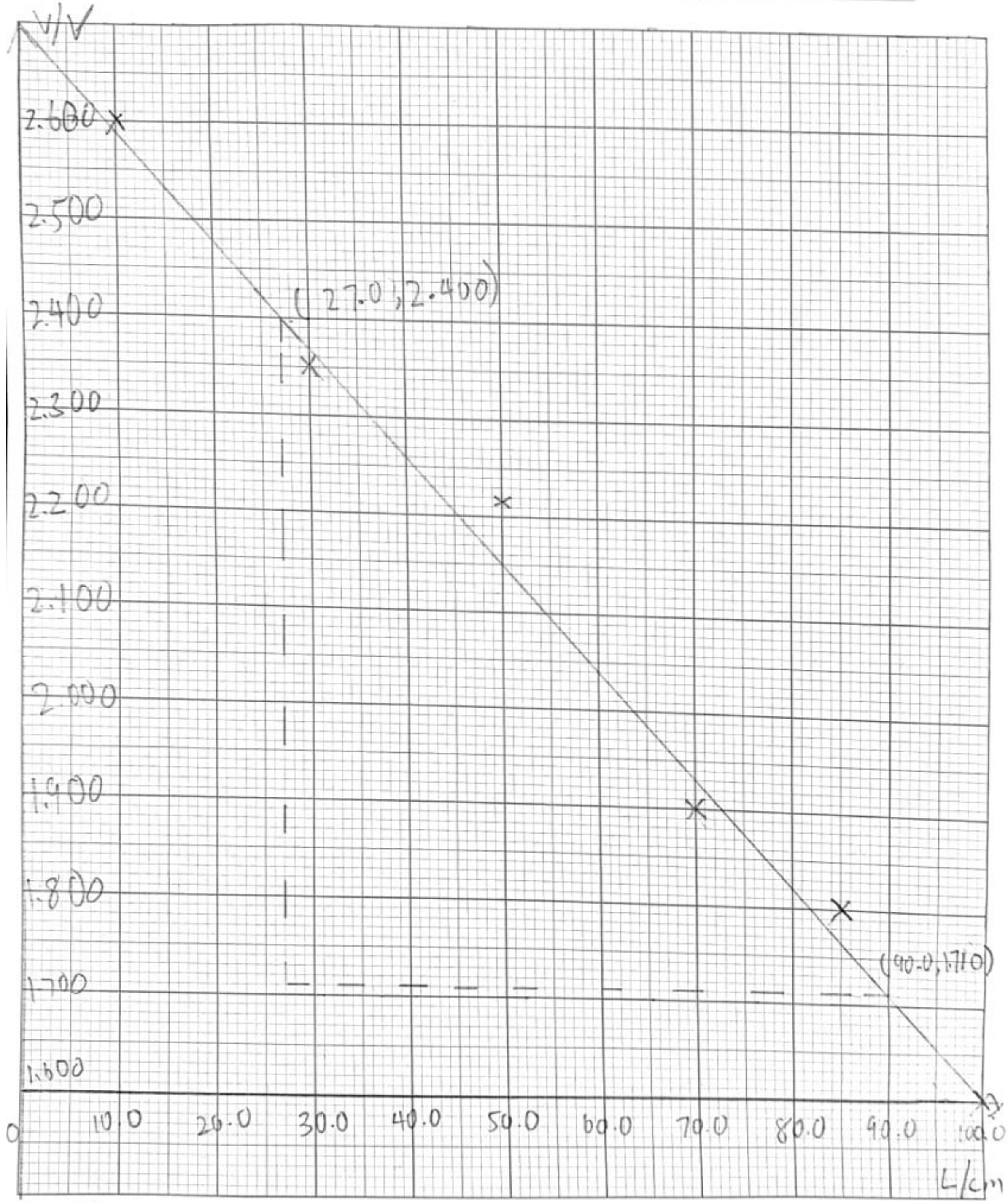
Question 3(d)

Using the grid provided on page 9, plot a graph of *V* against *L*.

Draw the line of best fit. [4]

Remarks

- Axes labelled with units and correct orientation
  - (*V* on y-axis and *L* on x-axis)
  - (allow ecf from wrong unit in table but not no units)
  - Intersection correctly labelled
- Suitable scale with plotted points occupying ≥ half the graph grid in both directions
- All points plotted correctly (≤ ½ small square from the correct position)
- Best fit line



V/V
2.600
2.500
2.400
2.300
2.200
2.100
2.000
1.900
1.800
1.700
1.600
(27.0, 2.400)
(90.0, 1.710)
0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
L/cm

Question 3(e)(i)

Determine the gradient G of the graph. Show your working clearly.

G = ...[2]

Accepted	Remarks
G = (2.400–1.710) / (27.0–90.0) (read to half smallest square) $= -0.0110$ (V cm^{-1})	• Use of a triangle that uses more than half the drawn line • Gradient triangle and coordinates clearly labelled on graph • Correct calculation of gradient (units ignored) (accept 2 or 3 s.f.)

Question 3(e)(ii)

Hence, or otherwise, determine the vertical intercept C of the graph.

C = ……………………[1]

Accepted	Remarks
$C = 2.690$	• C read correctly from the graph (to the nearest half a smallest square), or calculated correctly using linear law.

Question 3(f)

Describe the relationship between *V* and *L*.

.... [1]

Accepted

V decreases linearly as L increases

Question 3(g)

State one significant source of error in this experiment.

.... [1]

Accepted

- **The resistance wire had kinks (bends) along its length, hence the length measured is not accurate**
- **The internal resistance of the ammeter / dry cells / connecting wires is not negligible (any one object) Hence, the total resistance of the circuit was affected.**
- **The internal resistance of the voltmeter was not infinite. A small current could flow through the voltmeter. Hence the current measured by the ammeter was not the actual current flowing through the rheostat.**

Question 3(h)(i)

Measure the record the diameter of the resistance wire.

d = ...[1]

Accepted	Remarks
d **= 0.32 mm**	• Evidence of repeated readings • correct d.p. and units

Question 3(h)(ii)

The resistivity ρ of the material of the resistance wire and the gradient G of the graph are related by the expression

$$G = -\frac{4\rho I}{\pi d^2}$$

Calculate the resistivity ρ of the resistance wire.

ρ = ...[2]

Accepted	Remarks
$\rho = 0.011\,\pi\,(0.032)^2 / (4 \times 0.20)$ **$= 4.4 \times 10^{-5}\ \Omega$ cm**	• Resistivity calculated correctly with the correct unit (e.g. Ω m, Ω cm)

END