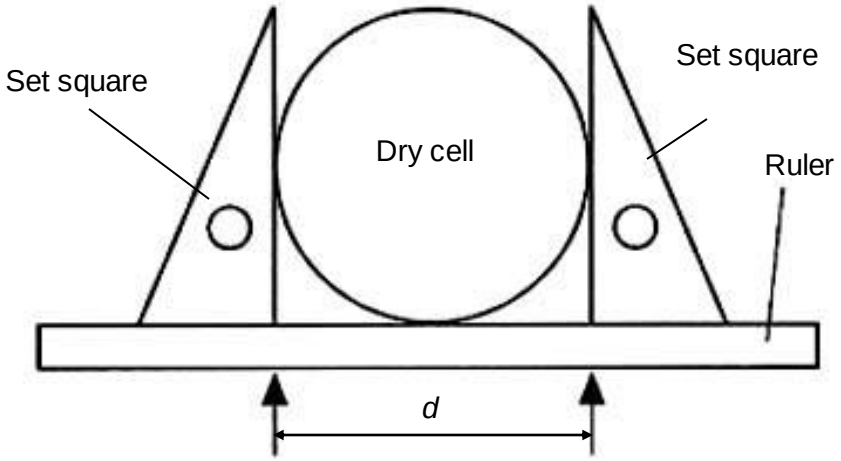
4E Prelim 2023 Physics P3

Paper 3 Section A (20 marks)

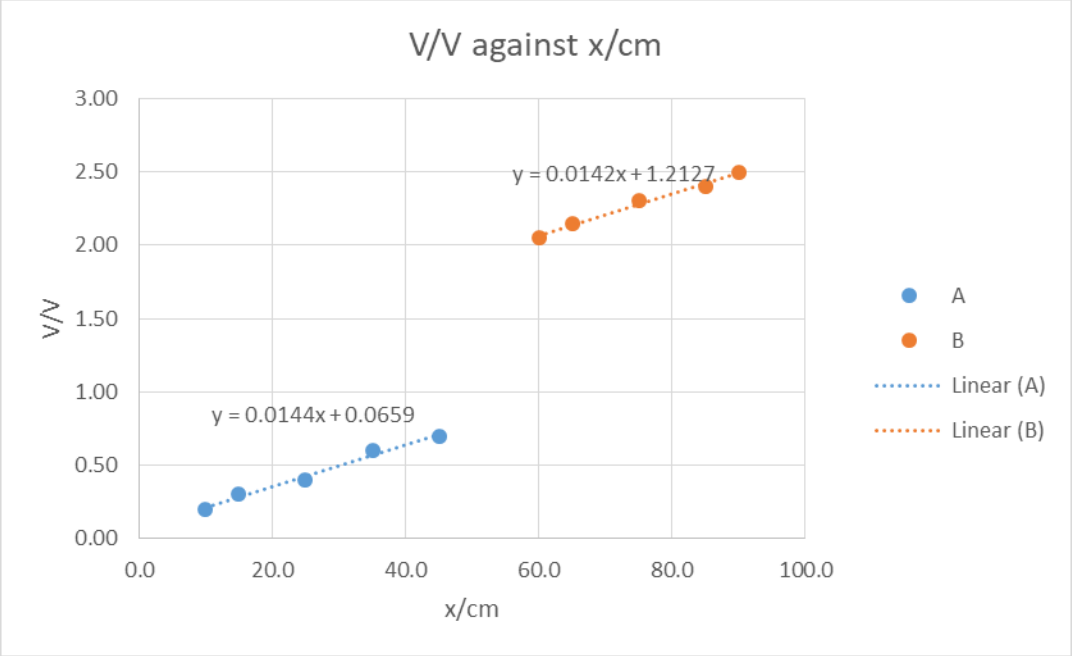
1a	**W** marked near the centre of line **XY** on **Fig. 1.1**, in line with line **LM**.	[1]
1bi	The **larger the angle of rotation** of the block, the **larger the displacement** from **W**.	[1]
1bii	The **clockwise rotation of the block will displace the ray of light towards X**, while the **anticlockwise rotation of the block will displace the ray of light towards Y**. * *The results of both clockwise and anticlockwise rotations must be explicitly stated in the answer.*	[1]
1c	As the block is rotated through large angles, **the ray of light will pass through the short edges of the glass block instead of the long edges**, thus **(b)** cannot be answered.	[1]
1d	correct constant (the direction of rotation of the glass block, light ray should enter and exit only the long edges of the glass block, the spot on the glass block should always be directly above the spot S) **[1]** *(*Any 1)* correct independent variable (angle of rotation of the block about **S**, θ). **[1]** correct dependent variable (displacement of the ray from point W, *d*). **[1]** correct measurement and recording of *d* **[1]** *(* averaging is not necessary)* plots a suitable graph (*d* against θ). **[1]** sketch of the graph (linear graph that cuts through the origin with a positive gradient). **[1]**	[6]
	Total	[10]
2ai	Ensure that the electronic balance does not have zero error. / TARE	[1]
2aii	mass measured to the nearest 0.1 g with unit.	[1]

2bi	 **[1]** for correct diagram **[1]** for correct labelling of diagram	[2]
2bii	*d* measured to the nearest 0.1 cm with unit and in range 3.1 cm to 3.5 cm	[1]
2ci	*l* measured to the nearest 0.1 cm with unit and in range 5.7 cm to 6.4 cm	[1]
2cii	Correct calculation of *V* with working and correct s.f. (2 s.f) and unit.	[1]
2ciii	The dry cell is not a regular cylinder. It has a small protruding part and *l* includes it. **[1]** As the length of the protruding part of the cell is very small compare to the length of the body of the cell, the estimate is a good one. **[1]**	[2]
2civ	The volume of the main body of the cell and the protruding part can be measured separately. The sum of the two volumes will be the total volume of the cell.	[1]
	Total	[10]

Paper 3 Section B (20 marks)

3a	*I* measured to the nearest 0.01 A with unit and in range 0.32 A to 0.36 A.	[1]
3b	*V* measured to the nearest 0.05 V with unit and in range 0.19 V to 0.21 V.	[1]

3c	10 sets of data with correct trend, *x* increases, *V* increases. **[1]** Table with quantities *x* and *V* with correct units. **[1]** All values of *x* to 1 d.p. **[1]** All values of *V* to 2 d.p. **[1]** **e.g** x/cm | V/V 10.0 | 0.20 15.0 | 0.30 25.0 | 0.40 35.0 | 0.60 45.0 | 0.70 60.0 | 2.05 65.0 | 2.15 75.0 | 2.30 85.0 | 2.40 90.0 | 2.50	[4]

3d	Correct Axes **[1]** Correct Scale **[1]** Correct Points **[1]** 2 x Correct Best Fit Lines **[1]** **E.g.**  	[4]
3ei	Correct gradient calculated from the student's graph. - Correct working - Correct answer (according to student's graph) - Correct unit (V cm^{-1}) - 2 or 3 s.f.	[1]
3eii	Correct y-intercept from the student's graph. - Correct answer (according to student's graph) - Correct unit (V) - Correct d.p according to student's graph	[1]
3fi	Correct gradient calculated from the student's graph. - Correct working - Correct answer (according to student's graph) - Correct unit (V cm^{-1}) - 2 or 3 s.f.	[1]

3fii	Correct y-intercept from the student's graph. - Correct answer (according to student's graph) - Correct unit (V) - Correct d.p according to student's graph	[1]
3g	According to student's data. **E.g.** Yes. **[1]** The percentage error between G_A and G_B is less than 3%. **[1]**	[2]
3hi	Correct L calculated. - Correct working **[1]** - Correct answer (in range of 77.0 cm to 85.1 cm), s.f.(2 or 3) and unit **[1]**	[2]
3hii	1. The wire that lies outside the coil is not entirely straight, thus not aligned exactly parallel with the ruler and the intended markings of the ruler. **[1]** 2. There are certain lengths of wire extending from the ends of the ruler, thus measurement of x is not accurate. **[1]**	[2]
	Total	[20]

Suggested Answer

Independent variable: Angle of rotation of the block about **S**, θ

Dependent variable: Displacement of the ray from point **W**, *d*

Variables to be kept constant:

- The direction of rotation of the glass block
- Light ray should enter and exit only the long edges of the glass block
- The spot on the glass block should always be directly above the spot **S**.

Procedure:

1. Position the illuminated slit at the top of the page so that a single ray of light is along line **LM** on **Fig. 1.1**.
2. Place the block inside the area marked **ABCD** with the short edges of the block parallel to **LM** on **Fig. 1.1**.
3. Adjust the position of the block so that the spot in the centre of the block is directly above point **S** on **Fig. 1.1** and the ray of light passes through point **W** on line **XY**.
4. Rotate the block clockwise slowly through approximately 10˚ about point **S**. Keep the spot in the centre of the block directly above point **S**.
5. Mark the point where the ray of light crosses the line **XY**.
6. Measure and record the distance between **W** and the point, *d*, with a ruler.
7. Repeat steps 4 to 6 for further seven values of θ.
8. Tabulate the readings of θ and *d*.
9. Plot a graph of *d* against θ and study the relationship between the displacement of the ray from point **W** and the angle of rotation of the block about point **S**.