2025 Physics Prelim Practical Exam Mark Scheme

Q1(minus 1 mark maximum for precision, unit and sf respectively)

(a) (i) V_T = 11.5 cm^3 [1] (to nearest 0.5 cm^3 and between 9.0 to 15.0 cm^3)

(ii) V_1 = 1.92 cm^3 [1] ((a)(i) ÷ 6 with correct unit and sf)

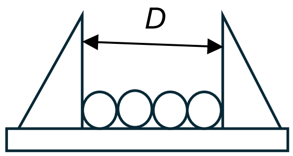
(b) (i) l = 15.0 cm [1] (in cm ± 0.2 cm from supervisor value to the nearest 0.1 cm)

(ii) D = 2.1 cm [1] (± 0.3 cm to the nearest 0.1 cm)

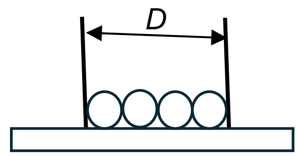
(iii) d = 0.53 cm [1] ((b)(ii) ÷ 4 with correct unit and sf)

(iv) correct use of <u>set squares</u> at each end lined up <u>with rule</u> or correct diagram

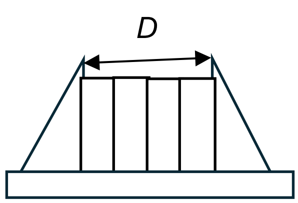
accept:



or



reject:



Set squares may go under the straw

(v) V_2 = 3.3 cm^3 [2] (correct calculation, answer in cm^3 and rounded off to 2 s.f.)

(c) Any 2:

- air bubbles in the straw in method 1
- internal volume is smaller than external volume
- straw became squashed / damaged
- small amount of water may remain in the straw
- water sticks to the finger
- some water falls out during transfer in method 1
- straw not completely filled
- the measuring cylinder is not dry / there is some water in the measuring cylinder

Q2 (minus 1 mark maximum for precision, unit and sf respectively)

(a) L = 16.5 cm [1] (to nearest 0.1 cm) (actual values may vary)

(b) It is difficult to determine the centre of the adhesive putty as the putty is not uniform.
OR:
It is difficult to determine the centre of the spring as the adhesive putty is covering it.

Reject: the rod is not vertical
Reason: The ruler used to measure L need not be vertical.

(c) Any 1:

- there is a weight / weights placed on each base
- bosses are attached as low as possible
- d is not too large / the spring is not too stretched

(d) Show evidence of at least 5 oscillations and repeating the experiment twice to obtain the average reading. [1]

T = 0.785 s [1] (correct unit & s.f.)

Example:
Average time for 5 oscillations = 3.94 + 3.91 / 2 = 3.93 s.
T = 3.93 / 5 = 0.785 s

(e) Planning

1 m for each of the 5 bullet points:

1. Identify d and L to be kept constant respectively for 2 experiments [1]
2. Includes taking average timing and repeating for 5 different sets of values (specify by how much)
   (Plot a graph of dv against iv is marked together with bullet 3)
3. Sketch both graphs correctly (correct shape and axes). [1]
4. Value of a correctly explained in both experiments. [1]

*If student only performs one experiment, the **maximum** mark is 2 out of 4.

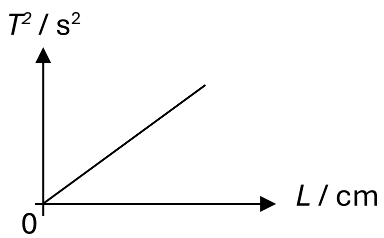
5. Explanation for precaution: any one of the following [1]

(i) View the oscillation of the rod from above and use the middle of the oscillation (fiducial marker). This is to determine accurately the start and end of an oscillation.
(ii) Take the time taken for 5 / 10 oscillations to reduce error due to human reaction time.
(iii) Take average readings to reduce unpredictable error.
(iv) The amplitude / angle of oscillation must not be too large (less than 10^{o}). This is to ensure that the equation is valid.

Experiment 1:
Keep *d* constant
Procedure

Step 1: Setup the apparatus shown in Fig 2.2. Let L = 16.0 cm and determine the period T of the oscillating rod as described in procedure 2(d).
Step 2: Repeat step 1 to get an average value of T.
Step 3: Repeat steps 1 to 2 for 5 more sets of readings by decreasing the length L by 1.0 cm each time.
Step 4: Calculate T^2 and tabulate all readings.
Step 5: Plot a graph of T^2 against L (accept T^2 against *L* / d since *d* is a constant)

Sketch of graph:



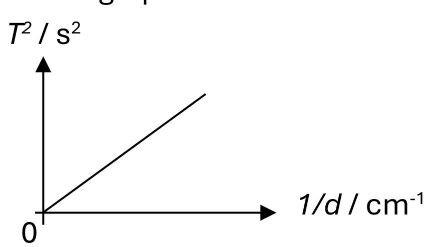
gradient = *a / d*
a = gradient x *d*
(accept *a* = gradient of graph of T^2 against *L* / d)

Experiment 2: Keep *L* constant

Procedure

Step 1: Setup the apparatus shown in Fig 2.2. Let *d* = 26.0 cm and determine the period T of the oscillating rod as described in procedure 2(d).
Step 2: Repeat step 1 to get an average value of T.
Step 3: Repeat steps 1 to 2 for 5 more sets of readings by decreasing the length *d* by 1.0 cm each time.
Step 4: Calculate T^2 and tabulate all readings.
Step 5: Plot a graph of T^2 against 1/*d* (accept T^2 against *L* / d since *L* is a constant)

Sketch of graph:



gradient = *aL*
a = gradient / *L*
(accept *a* = gradient of graph of T^2 against *L* / d)

The values of a from both graphs should be the same.

Q3 (minus 1 mark maximum for precision, unit and sf respectively)

(b) V_s = 4.50 V [1] (to the nearest 0.05 V; reject values larger than 4.50 V)

(Values larger than 4.50 V indicates that the switch is not closed.)

(c)

(i) θ at least 70.0 °C [1]

0.50 V < V_{AB} < 2.50 V [1]

(ii)

θ / °C	V_{AB} / V	V_t / V	I / A	R_t / Ω
82.0	1.85	2.95	0.0394	74.9
78.0	1.80	3.00	0.0383	78.3
74.0	1.70	3.10	0.0362	85.7
70.0	1.45	3.35	0.0309	109
66.0	1.35	3.45	0.0287	120
62.0	1.25	3.55	0.0266	134
58.0	1.10	3.70	0.0234	158
54.0	1.00	3.80	0.0213	179
50.0	0.90	3.90	0.019	200

θ / °C	V_{AB} / V	V_t / V	I / A	R_t / Ω
77.0	1.65	3.15	0.0351	89.7
74.0	1.55	3.25	0.0330	98.5
71.0	1.50	3.30	0.0319	103
68.0	1.40	3.40	0.0298	114
65.0	1.30	3.50	0.0277	127
62.0	1.20	3.60	0.0255	141
59.0	1.10	3.70	0.0234	158
56.0	1.00	3.80	0.0213	179
53.0	0.95	3.85	0.020	190
50.0	0.90	3.90	0.019	200

- headings + units in the top row [1]
- at least 8 readings including the readings from part (i)[1]
- $V_t = V_s - V_{AB}$ calculated in column 3 and $I = V_{AB} \div 47$ calculated in column 4 [1]
- $R_t = V_t \div I$ calculated in column 5 [1]
- the resistance increases with decreasing temperature [1]
- correct precision for θ and V_{AB} [1] (ecf if precision error already deducted in earlier part)

- correct d.p. for V_t and s.f. for I and R_t [1] (ecf if sf error already deducted in earlier part)

(d)(i)

- Axes labelled with units and correct orientation [1]
- Suitable scale, ⩾ ½ page in both directions [1]
- Two points plotted correctly (check two points) [1]
- best fit curved line and fine points or crosses [1]

(ii)

- tangent at 65 ºC [1]
- calculation of gradient to 2 or 3 s.f. [1]
- dotted triangle with one side at least five cm long [1] (can review)

(e) Make sure the thermistor is fully submerged at all times so that the temperature measured by the thermometer is the same as the temperature of the thermistor.
OR:
Stir the water to ensure that the temperature measured by the thermometer is the same as the temperature of the thermistor.
OR:
Position the eye such that the line of sight is level with the (bottom of the) meniscus and at right angles with the thermometer scale to prevent parallax error.
(reject at eye level)
OR:
To prevent parallax error, place the eye at right angles with the ammeter and voltmeter scales such that the image of the pointer in the mirror is covered by the pointer.

(f) Any 2:

- The thermometer is touching the beaker / too far from the thermistor, hence it may not be measuring accurately the temperature of the thermistor.
- The amount of hot water that is removed may not be the same as the amount of cooler water that replaces it (as the dropping pipette has no markings).
  (unable to carry out the procedure on page 10 - replacing removed hot water with a similar volume of cold water)
- It is difficult to look at both the voltmeter and thermometer at the same time, hence the temperature and voltage recorded may not be accurate.
- The circuit is switched on for a long period of time. The resistor heats up and its resistance changes (no longer 47 Ω). This affects the accuracy of the calculation of current I ($I = V_{AB} / 47$).

- The circuit is switched on for a long time causing the value of Vs to decrease. Hence the calculation of Vt and Rt will not be accurate.

Reject parallax error as it is not a procedure