2024 Sec 4 Physics Planning Exercises 1 to 4

- *Leave a line spacing between steps.*
- *Use clues from the given problem & apparatus.*

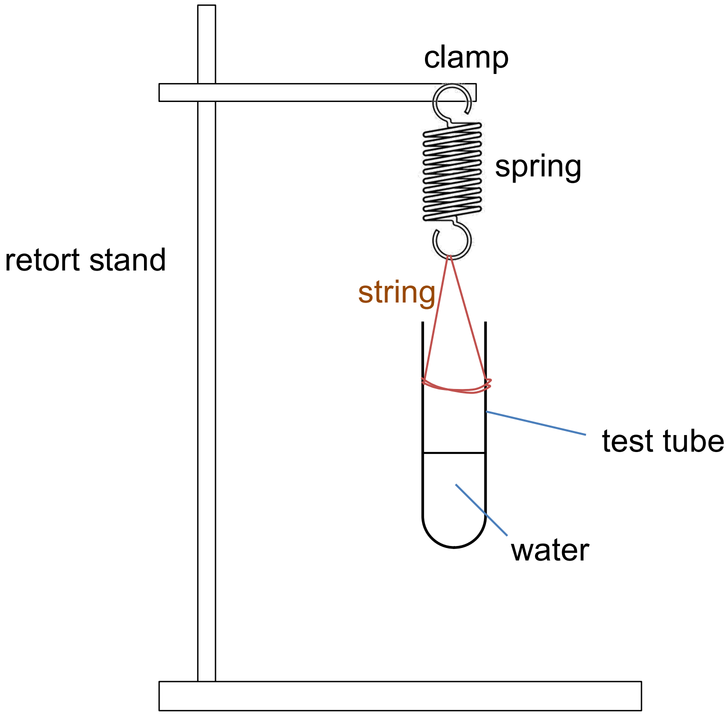
Exercise 1A: Suggested Marking Scheme [8 marks]

- ***Aim: To investigate how the volume/mass of the test-tube affects the period of oscillation***

Key points/Remarks	Sample	Mark
1. Key variables [2] • The independent & dependent variables are to be used consistently throughout the plan.	**Independent variable:** • volume V **or** mass m of **water (load)** **Dependent variable:** • period T **or** frequency f of the oscillation	[1]
• **2 variables to be kept constant** • Do not accept 'location of experiment is the same' etc which are not measurable.	**2 variables to be kept constant:** 1. length of unloaded spiral spring is constant 2. initial length of pull (extension) of the spring before release Or any other reasonable variables which are kept constant Award 1 mark if **at least one** variable to be kept constant correct	[1]
2. Apparatus & diagram [1] • key apparatus (*) must be indicated in the apparatus list, or diagram, or in the procedure.	**Apparatus & diagram** • metre rule, strings, retort stand, boss and clamp • *stopwatch • *boiling tube • *spiral spring • *water • *measuring cylinder (if volume) • *electronic balance (if mass)	[1]
3. Experimental procedure [4] • *Reallocate the marks accordingly if the procedure is written in a different sequence and is still coherent.*	***Experimental procedure*** *1. Set up the apparatus as shown in the diagram above.* • ***spiral spring supported** by the retorted stand* • *boiling tube **with water** attached to the spring* *Or shown in the diagram drawn.*	
• **Measure** the <u>independent</u> variable	*2. Measure the volume **V** of the water with the <u>measuring cylinder</u>* *Or* *Measure the mass **m** of the water (load) with the <u>electronic balance</u>*	[1]
• Describe the step(s) of experiment to **measure** the <u>dependent</u> variable (directly or indirectly).	*3. Pull the boiling tube **vertically** downwards before release.* *4. Measure the time taken for (at least) **10** oscillations with a <u>stopwatch</u>. Record the time, t_1.*	
• **Repeat** step(s) so as to obtain more reliable readings (where relevant) and calculate the **average** value.	*5. **Repeat** <u>steps 3 and 4</u> to measure the time taken for another 10 oscillations. Record the time, t_2.* *6. Calculate the **average** time, t_{ave} from the two readings.* *7. Calculate the period of the pendulum, **T** from the equation $T = t_{ave} / 10$.* *(And Calculate the frequency of oscillation f, where f = 1/T)*	[1]
• **Tabulate** all measured (raw data) and calculated (processed data) values.	*8. **Tabulate** all the readings of **V** (or **m**), t_1, t_1, t_{ave}, **T** (and **f**)*	
• **Repeat** the steps for further measurements (at least 10 sets of readings) over a suitable wide range.	*9. **Repeat** <u>steps 2 to 8</u> for another **9** values of **V** (or **m**) over a suitable wide range.*	[1]
• **Plot a graph** of <u>dependent variable</u> (y axis) against <u>independent variable</u> (x axis).	*10. **Plot** a graph of T against V (or m) to deduce the relationship.*	[1]
4. Safety Precaution [1] • State one precaution to ensure the **safety** of the experimenter and those around him/her, or to **prevent any damage** to the apparatus.	***Safety precaution*** • *Position the retort stand away from the edge of the bench (or place a weight on its base) to prevent it from toppling and hitting someone.* • *Or any other reasonable safety precaution*	[1]

Total : 8 marks

Diagram



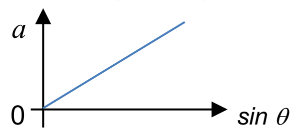
Exercise 1B: Suggested Marking Scheme

- a list of quantities that remain constant
    - length of unloaded spiral spring is constant
    - use a constant initial length of pull (extension) of the spring before release
    - mass of boiling tube / test tube
    - elasticity of spring / spring constant
- a description of how you would perform the experiment (done in **Planning Exercise 1A**)
- a statement of the graph that you would plot to test the relationship
- an explanation of how the spring constant *k* can be found from the graph

	Option A	**Option B**
Analysis of equation:		
Graph to plot?	*Plot a graph of* T^2 *against m*	*Plot a graph of T against* $\sqrt{m}$
How to find k?	*gradient =* $4\pi^2 / k$ *Hence,* $k = 4\pi^2 / \text{gradient}$	*gradient =* $2\pi / \sqrt{k}$ *Hence,* $k = 4\pi^2 / (\text{gradient})^2$

Exercise 2: Suggested Marking Scheme [8 marks]

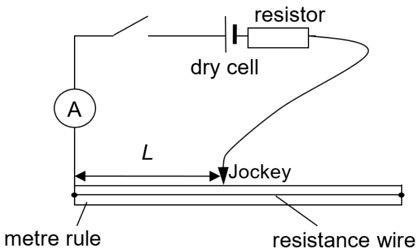
- ***Aim: To verify that the acceleration of a rolling marble is directly proportional to the angle of the slope***

Key points/Remarks	Sample	Mark
1. Key variables [2] • The independent & dependent variables are to be used consistently throughout the plan.	**Independent variable:** • angle of slope θ from the ground **Dependent variable:** • acceleration a of the marble down the slope	[1]
• **2 variables to be kept constant** • Do not accept 'same plank' etc. which is not measurable.	**2 variables to be kept constant:** • mass of marble used • material and texture of plank used • distance travelled by the marble down the slope, *s* Or any other reasonable variables which are kept constant	[1]
2. Analysis of variable • find acceleration a?	$s = ut + \frac{1}{2} a t^2 = \frac{1}{2} a t^2$ when $u = 0$ $a = 2s / t^2$	
3. Apparatus & diagram [1] • key apparatus (*) must be indicated in the apparatus list, or diagram, or in the procedure.	**Apparatus & diagram** (Draw a diagram showing the setup.) • a 1.2 m long plank, • 2 metre rules mounted on plank with Blu-tack/scotch tape • a number of wooden blocks or a retort stand, boss & clamp, • a protractor, • a stopwatch, • a marble, • a 50 cm ruler	[1]
4. Experimental procedure [4] • *Reallocate the marks accordingly if the procedure is different but still coherent.*	***Experimental procedure*** *1. Set up the apparatus as shown in the diagram above. Or shown in the diagram drawn.*	
• **Measure** the <u>independent</u> variable	*2. Set up the plank held with a retort stand clamp or supported with wooden blocks.* *3. Measure the angle θ = 10° of the slope using a <u>protractor</u>. <u>Calculate sin θ.</u>*	[1]
• Describe the step(s) of experiment to **measure** the <u>dependent</u> variable (directly or indirectly). • **Repeat** step(s) so as to obtain more reliable readings (where relevant) and calculate the **average** value.	*4. Release the marble at the top of the slope, use the <u>stopwatch</u> to measure the time t_1 to roll through a distance s down the slope. Measure s with a <u>metre rule</u>. Repeat to obtain t_2 and find the average time <t>.* *5. Calculate the acceleration <u>$a = 2s / \langle t \rangle^2$</u>*	[1]
• **Repeat** the steps for further measurements (at least 10 sets of readings) over a suitable wide range.	*6. **Repeat** <u>steps 2 to 5</u> to obtain the value of a for 9 more different values of θ from 20° to 80°.*	[1]
• **Tabulate** all measured (raw data) and calculated (processed data) values.	*7. **Tabulate** all the readings of θ, sin θ, t_1, t_2, $\langle t \rangle$ and a.*	
• **Plot a graph** of <u>dependent variable</u> (y axis) against <u>independent variable</u> (x axis).	*8. **Plot a graph** of a against sin θ.*	[1]
	Sketch and label a straight-line graph passing through the origin.  	
5. Safety Precaution [1] • State at least one precaution to ensure the **safety** of the experimenter and those around him/her, or to **prevent any damage** to the apparatus.	***Risk**: Heavy plank/wooden blocks may topple & cause injury.* ***Safety precaution*** • *Ensure the wooden blocks are stacked up in a stable manner / the retort stand is away from the edge of the bench (or place a weight on its base)* • *Ensure marbles are picked up from the floor to prevent anyone from stepping on them and slipping.* • *Set up the apparatus on the floor.*	[1]

Total : 8 marks

Exercise 3: Suggested Marking Scheme [8 marks]

- ***Aim: To investigate how the length of the resistance wire affects the electric current***

Key points/Remarks	Sample	Mark
1. Key variables [2] • The independent & dependent variables are to be used consistently throughout the plan.	**Independent variable:** • length ***L*** of resistance wire **Dependent variable:** • electric current ***I***	[1]
• **2 variables to be kept constant** • Do not accept 'same ammeter used' etc. which is not measurable. • *Can show analysis of the given equation here.*	**2 variables to be kept constant:** • cross-sectional area of resistance wire • resistance wires of the same metal (resistivity) Or any other reasonable variables which are kept constant *Note: Award 1 mark if **at least one** variable to be kept constant correct.*	[1]
2. Analysis of equation:	$I(1 + bL) = c$ ➔ $(1 + bL)/c = 1/I$ ➔ $1/I = (b/c)L + 1/c$ $Y = mX + C$ ➔ plot $(1/I)$ vs L	
3. Apparatus & diagram [1] • key apparatus (*) must be indicated in the apparatus list, or diagram, or in the procedure. 	**Apparatus & diagram** • dry cell, switch, connecting wires, retort • *fixed resistor *[to protect circuit component from any large initial current]* • *ammeter • *potentiometer slide wire & jockey OR *rheostat • *resistance wires of different lengths • *metre rule Draw a circuit diagram including ammeter connected correctly <u>in series</u>.	[1]
4. Experimental procedure [4] • *Reallocate the marks accordingly if the procedure is written in a different sequence and is still coherent.*	***Experimental procedure*** *1. Set up the apparatus as shown in the diagram above.* • ***Fixed resistor** in series with dry cell* *Or shown in the diagram drawn.*	
• **Measure** & record the <u>independent</u> variable	*2. Measure and record the length **L** of the resistance wire used using the <u>metre rule</u>.*	[1]
• Describe the step(s) of experiment to **measure** the <u>dependent</u> variable (directly or indirectly).	*3. Close the switch and record the electric current reading **I** shown on the <u>ammeter</u> in series with the resistance wire.*	
• **Tabulate** all measured (raw data) and calculated (processed data) values.	*4. Calculate **1/I**.* *5. **Tabulate** all the readings of **L, I** and **1/I**.*	[1]
• **Repeat** the steps for further measurements (at least 10 sets of readings) over a suitable wide range.	*6. **Repeat** <u>steps 2 to 7</u> for another **9** resistance wires with different length **L**, to obtain current **I**, over a suitable wide range.*	[1]
• **Plot a graph** of <u>dependent variable</u> (y axis) against <u>independent variable</u> (x axis).	*7. **Plot a graph** of **1/I** against **L**.* *b and c can be obtained from the graph to be plotted.* *y intercept = 1/c ➔ c = 1/ (y intercept)* *gradient = b/c ➔ b = gradient × c*	[1]
6. Safety Precaution [1] • State at least one precaution to ensure the **safety** of the experimenter and those around him/her, or to **prevent any damage** to the apparatus.	***Safety precaution*** • *Connect a fixed resistor (or maximum value on rheostat) in series with the dry cell in the circuit to prevent a large current from flowing and damaging the circuit components.* • *Or any other reasonable safety precaution*	[1]

Alternative of graph to plot: ***I*** *against* ***IL*** **Total : 8 marks**