- *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, t₁.*	
• **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, **t₂**.* 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 / 20**.* *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)**, t₁ , t₁ , 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]

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

  a. Plot a graph of T^2 against m

  OR

  b. Plot a graph of T against $\sqrt{m}$

- an explanation of how the spring constant *k* can be found from the graph

  a. Graph of T^2 against m: gradient = $4\pi^2$ / k
                                                         Hence, k = $4\pi^2$ / gradient

  OR

  b. Plot a graph of T against $\sqrt{m}$:   gradient = 2π / $\sqrt{k}$
                                                         Hence, k = $4\pi^2$ / (gradient)^2

Exercise 2: 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.	**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 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** • dry cell, switch, connecting wires, retort • *fixed resistor • *ammeter • *potentiometer slide wire & jockey OR *rheostat • *wires of different lengths • *metre rule Draw a circuit diagram including ammeter connected correctly.	[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. • **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). • *Show analysis of the given equation!*	7. **Plot a graph** of **1/I** against **L**. *b and c can be obtained from the gradient of the graph to be plotted.*	[1]
4. 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]

Total : 8 marks

Exercise 3: Suggested Marking Scheme   [8 marks]

- *Aim: To investigate how the angle of the slope affects the acceleration of the marble*

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 / time taken by marble to roll down the slope	[1]
• **2 variables to be kept constant** • Do not accept 'same light bulb used' 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 Or any other reasonable variables which are kept constant	[1]

2. Apparatus & diagram [1]
• key apparatus (*) must be indicated in the apparatus list, or diagram, or in the procedure.
	Apparatus & diagram
	   • a 1.2 m long plank,
	   • 2 metre rules mounted on plank using Blu-tack or scotch tape
	   • a number of wooden blocks or a retort stand, boss and clamp,
	   • a protractor,
	   • a stopwatch,
	   • a marble,
	   • a 50 cm ruler,
	Draw a diagram showing the setup.
		[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.* *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. Measure the angle θ of the slope using a protractor.*	[1]
• Describe the step(s) of experiment to **measure** the <u>dependent</u> variable (directly or indirectly).	3. *Release the marble at the top of the slope, use the <u>stopwatch</u> to measure the time t taken to roll through a distance d down the slope.* 4. *Calculate the acceleration $a = 2d / t^2$ using $d = ut + \frac{1}{2} at^2$ where $u = 0$*	
• **Repeat** step(s) so as to obtain more reliable readings (where relevant) and calculate the **average** value.	5. **Repeat** <u>steps 3 & 4</u> to obtain another two sets of measurements of d and t. 6. *Calculate the **average** acceleration a.*	[1]
• **Repeat** the steps for further measurements (at least 10 sets of readings) over a suitable wide range.	7. **Repeat** <u>steps 2 to 6</u> to obtain the value of a for 9 more different values of θ. Calculate sin θ.	[1]
• **Tabulate** all measured (raw data) and calculated (processed data) values.	8. **Tabulate** all the readings of d, t, a, θ and sin θ.	
• **Plot a graph** of <u>dependent variable</u> (y axis) against <u>independent variable</u> (x axis).	9. **Plot a graph** of a against sin θ.	[1]
	Sketch and label a straight line graph passing through the origin.	
4. 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: The heavy plank may topple and 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)* • *Or any other reasonable safety precaution*	[1]

Total : 8 marks