



2018 Sec 4 Physics Practical

June Revision Exercise (1) – Suggested Answers

Name: _____ () Class: 4/ _____ Date: _____

Practical Assessments Skills

A. Manipulation, measurement and observation (MMO)

Students should be able to:

- set up apparatus correctly by following written instructions or diagrams
- use **common laboratory apparatus** and **techniques** to collect data and make observations
- describe and explain how apparatus and techniques are used correctly
- make and record **accurate** observations with good details and measurements to an appropriate degree of **precision**
- make appropriate decisions about measurements or observations

- **Note:** *Always familiarise yourself with the instruments before using them!*

Instrument	Function	Precision (with units)	Range (with units)	Notes (proper use, precaution)
metre rule	To measure length	Length: smallest division! 1 mm or 0.1 cm	0 to 100.0 cm	
vernier calipers	To measure lengths (e.g. external diameter, depth & internal diameter)	Length: smallest division! 0.01 cm	0 to 15.00 cm	
micrometer screw gauge	To measure small lengths	Length: smallest division! 0.001 cm	0 to 2.500 cm (or 25.00 mm)	Use ratchet to close the final gap. Ensure lock is not on when using.
digital stopwatch	To measure time	0.01 s	Depends on digital display	
laboratory thermometer (alcohol)	To measure temperature	0.5 °C	-10.0 to 110.0 °C	
beaker	To contain a liquid	not applicable as it is usually not used to determine the volume of liquids.	not applicable	breakage
spirit level	To check if a surface is horizontal (or at a required orientation)	not applicable	not applicable	the bubble will appear at the centre between two parallel lines if the surface is at a required orientation

Activity 1: Setting up the retort stand and simple pendulum

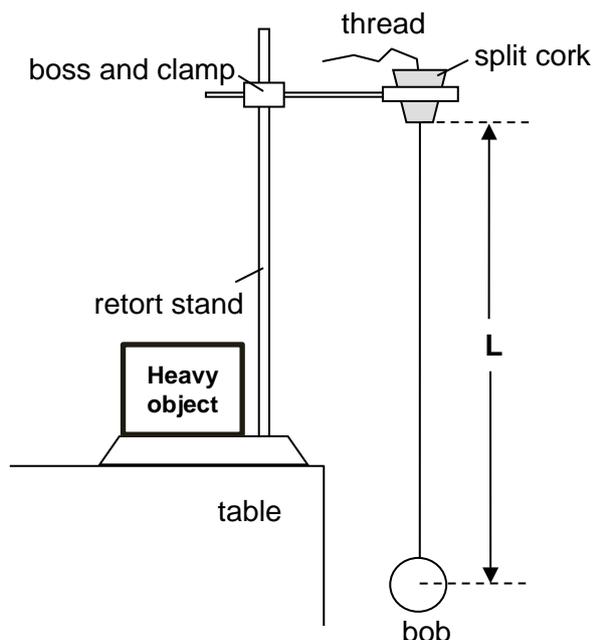


Fig. 1.1

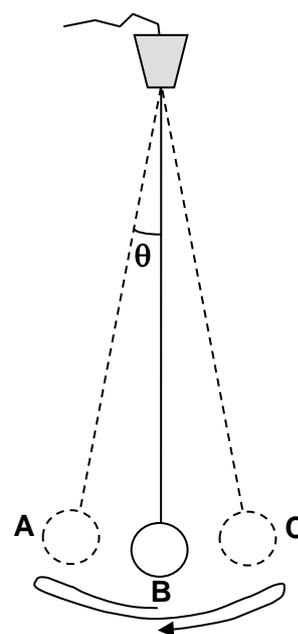


Fig. 1.2

1. See Fig. 1.1.
3. Place a heavy object at the base of the retort stand to ensure it will not topple (see Fig. 1.1).
4. See Fig. 1.2. Alternately, $A \rightarrow B \rightarrow C \rightarrow B \rightarrow A$.
5. $n = 20$ [Note: If the oscillations in an experiment stop earlier, n may be less e.g. 15 or 10].
6. Use a reference vertical line (e.g. retort stand) at the centre of the oscillation when counting the oscillations.
7. Two, then take average
8. Record the time taken for the pendulum to complete n oscillations for $L = 60$ cm in the table below.

Sample readings below for $n = 20$:

L / m	t_1 / s	t_2 / s	$\langle t \rangle / \text{s}$	T / s
0.600	31.75	31.53	31.64	1.582
3 d.p.	2 d.p.	2 d.p.	2 d.p. (average has same d.p. as readings)	same s.f. as $\langle t \rangle$

Formulae used: $\langle t \rangle = \frac{1}{2} (t_1 + t_2)$ and $T = \langle t \rangle / 20$

9. Ensure that the angular displacement θ (shown in Fig. 1.2) is smaller than 5°
[Note: This is a small angle approximation that would ensure that the period & frequency of the pendulum is independent of θ .]
10. Temperature of the water = 32.0°C (e.g.) (record to 0.5°C)
11. Use a retort stand, boss-head and clamp to hold the thermometer in a fixed vertical position. The bulb of the thermometer should be fully submerged in water and not in contact with the wall or the bottom of the beaker. Also ensure that the scale of the thermometer is not blocked from your view.

Activity 2: Measuring lengths

1. All readings including average recorded to same d.p.

	1 st reading / cm	2 nd reading / cm	average / cm	sample readings / cm
h	2 d.p	2 d.p	2 d.p	8.94
d _i	2 d.p	2 d.p	2 d.p	6.40
d _e	2 d.p	2 d.p	2 d.p	6.82

- 2.

	1 st reading / mm	2 nd reading / mm	average / mm	sample readings / mm
L	2 d.p	2 d.p	2 d.p	22.02
B	2 d.p	2 d.p	2 d.p	7.24
H	2 d.p	2 d.p	2 d.p	13.11

3. To account for non-uniformity in the lengths due to imprecise manufacturing

OR The block may not be perfectly uniform.

Instrument	Function	Precision (with units)	Range (with units)	Notes (proper use, precaution)
electronic balance	To measure mass	*0.01 g	Depends on balance provided	
spring balance	To measure force	Half the smallest division 0.05 N	0 to 5.00 N	
measuring cylinder	To measure volume	Half the smallest division 0.5 cm ³	0 to 100.0 cm ³	

** depends on balance actually provided; 0.1 g precision electronic balance also available.*

Activity 3: Measurements with mass, weight & volume

sample readings below (given slotted masses with holder \approx 250 g)

$$m = 249.93 \text{ g}$$

$$F = 2.50 \text{ N}$$

$$V_i = 44.5 \text{ cm}^3$$

$$V_f = 51.5 \text{ cm}^3$$

$$V_m = (51.5 - 44.5) / 3 = 2.3 \text{ cm}^3$$

(use all three 20 g masses provided)

Questions

1.

Measurement of	Precautions
m	The electronic balance was ensured to have no zero error before any measurement was made (OR The "tare" button was pressed before any measurement was made).
F	The spring balance was ensured to have no zero error before any measurement was made.
V_i, V_f	<ul style="list-style-type: none">The measuring cylinder was ensured to be completely dry before any measurement was made.The 20 g mass was placed gently into the measuring cylinder with water without splashing, by tilting the cylinder.The measuring cylinder was shaken gently to remove any bubbles around the slotted masses completely immersed in the water.

2. The total volume of all the 20 g slotted masses available was measured before taking the average.

Instrument	Function	Precision (with units)	Range (with units)	Notes (proper use, precaution)
metre rule (or 30 cm ruler)	To measure length	Length: smallest division! 0.1 cm	0 to 100.0 cm (or 0 to 30.0 cm)	
protractor	To measure angle	Angle: smallest division! 1°	0 to 180°	

Activity 4: Measurements in light experiments

Activity 4.1: Use of lens system

Sample readings below:

h_o / cm	h_i / cm	magnification
1.3	1.9	1.5
1 d.p.	1 d.p.	least s.f. of h_o and h_i

u / cm	v / cm	magnification
24.5	36.5	1.49
1 d.p.	1 d.p.	least s.f. of u and v

Formula used: magnification = v / u = h_i / h_o

Questions

1. The method using u and v should be used. The lengths u and v are much larger (than h_o and h_i) so their measurements would have smaller percentage errors, and the magnification calculated would have higher precision.

E.g. percentage error of $u = (0.1 / 24.5) \times 100\%$

2. The set square was used to accurately align the position of the illuminated object with respect to the metre rule.
3. There was human judgement error in determining the sharpest image of the object observed to measure the image distance.

Activity 4.2: Use of glass block and optical pins

angle of incidence i	angle of refraction r	$\sin i$	$\sin r$
35°	23°	0.574	0.391

(1 more s.f. than the angle)

Questions

1. The optical pins were ensured to be vertical during the measurements.

Each pair of optical pins on each side of the glass block were ensured to be at least 5.0 cm apart.

2. There may be human judgement error in determining the alignment of the optical pins and their images through the glass block.

The size of the holes made by the optical pins may be large and affect the accuracy of the lines drawn to represent the refracted rays.