



2022 Sec 4 Physics Practical Exam

Revision Exercise (1)

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 an instrument before using it!

Instrument	Function	Precision (with units)	Range (with units)	Notes (proper use, precaution)
metre rule		Length: smallest division!		
vernier calipers	To measure lengths (e.g. external diameter, depth & internal diameter)	Length: smallest division!		
micrometer screw gauge	To measure small lengths	Length: smallest division!		
digital stopwatch				
laboratory thermometer (alcohol)	To measure temperature	Half the smallest division		
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 a retort stand and simple pendulum

Apparatus retort stand, boss-head & clamp, split cork, pendulum bob, thread & scissors, stop-watch

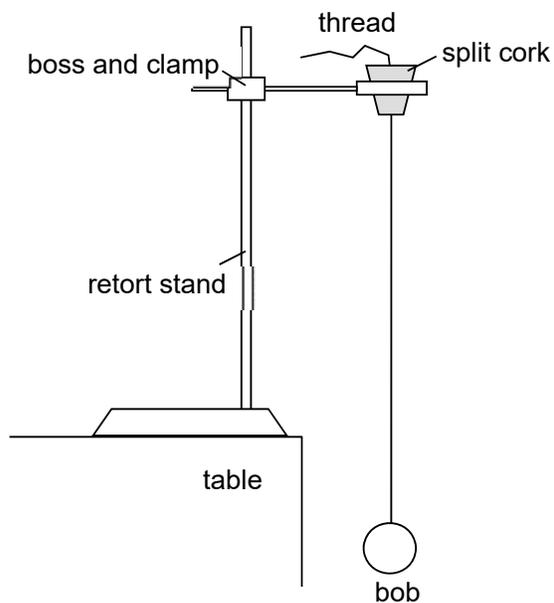


Fig. 1.1

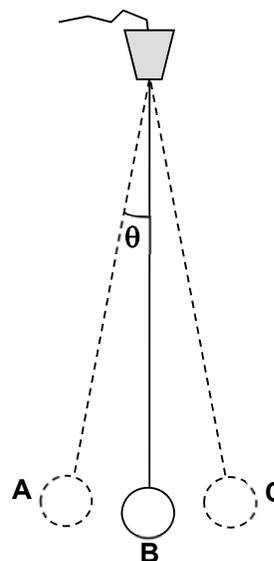


Fig. 1.2

Checkpoints:

1. Indicate on Fig. 1.1 the length of the pendulum and label it as L .
2. Set up the apparatus as shown with $L = 60$ cm.
3. How would you ensure the stability of the set-up?

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4. Indicate on Fig. 1.2 the path of the pendulum as it completes one oscillation.
5. State the recommended minimum number of oscillations n to find the period T : $n = \dots\dots\dots$

6. Describe how you would ensure accurate counting of the oscillations.

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7. How many times do we need to repeat the time measurement for a certain length L ? $\dots\dots\dots$

Note: Always familiarise yourself with an instrument before using it!

Instrument	Function	Precision (with units)	Range (with units)	Notes (proper use, precaution)
electronic balance				
spring balance		Half the smallest division		
measuring cylinder		Half the smallest division		

Activity 3: Measurements with mass, weight & volume

Apparatus retort stand, boss-head & clamp, spring balance, 100 ml measuring cylinder, slotted masses with holder, electronic balance

Procedure

1. Weigh the slotted masses with holder on the electronic balance and record its mass, m .
2. Suspend the spring balance from the clamp of the retort stand, and hang the slotted masses and holder from the spring balance. Record the reading of the spring balance, F .
3. Use the measuring cylinder to determine the volume of a 20 g mass.
4. Record the initial volume, V_i and final volume, V_f readings to determine the volume of a 20 g mass.
5. Determine the volume of a 20 g mass, V_m

Record of readings

$m =$ $F =$

$V_i =$ $V_f =$

Calculation

$V_m =$

Questions

1. State **one** precaution that you have taken in this activity.

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2. Explain how the volume of the 20 g mass is determined with a high precision.

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Note: Always familiarise yourself with an instrument before using it!

Instrument	Function	Precision (with units)	Range (with units)	Notes (proper use, precaution)
metre rule/ 30 cm ruler		Length: smallest division!		
protractor		Angle: smallest division!		

Measurements in light experiments

Activity 4: Use of lens system

Apparatus convex lens, lens holder, torch, screen, metre rule, set square

Diagram

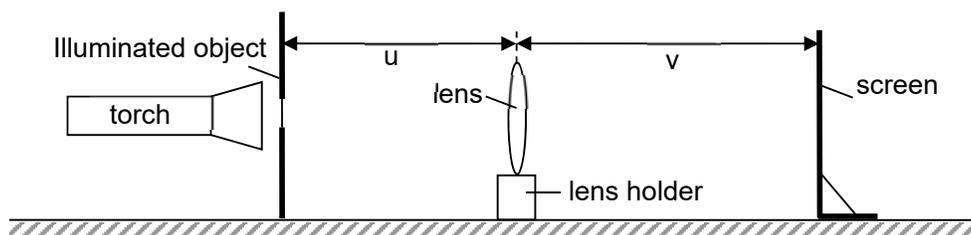


Fig. 4.1

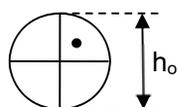


Fig. 4.2:
Front view of illuminated object

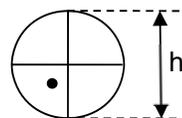


Fig. 4.3

Procedure

1. Set up the lens, illuminated object and screen as shown above.
2. Measure the height of the illuminated object h_o .
3. Move the lens until the magnification of the image is about 1.5.
4. Measure the height of the sharp image obtained on the screen h_i .
5. Measure the object distance u and image distance v .
6. Hence, calculate the magnification of the object.

Record of readings and calculations

$h_o /$	$h_i /$	magnification

$u /$	$v /$	magnification

Formula used:

Questions

1. Magnification can be calculated using the object and image heights, or the object and image distances. Explain which method should be used.

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2. State **one** precaution that you have taken in this activity.

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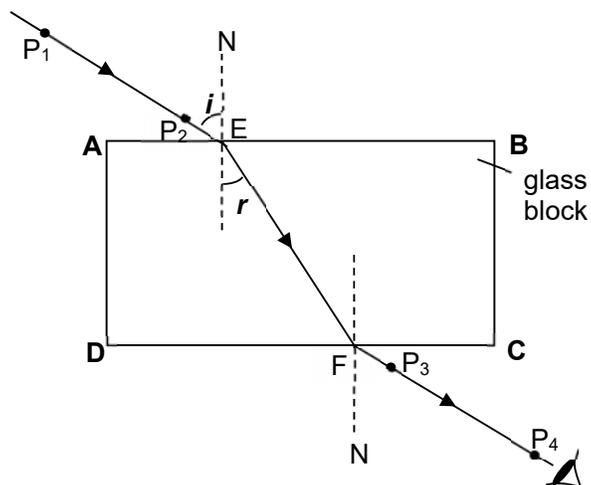
3. Explain **one** significant source of experimental error in this activity.

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Activity 5: Use of glass block and optical pins

Apparatus glass block, optical pins, pin board (soft board), protractor, plain paper

Diagram



Procedure

1. Place the rectangular glass block with its biggest area on the sheet of plain paper and draw its outline ABCD.
2. Remove the glass block and at point E, draw the normal line N at 90° to the line AB.
3. Use a protractor to mark off an angle of incidence i of 35° and draw a line to represent an incident ray.
4. Replace the glass block at the drawn outline ABCD on the paper.
5. Insert two optical pins P_1 and P_2 on the line that makes an angle of incidence i of 35° to the normal.
6. Position your eye to view the images of P_1 and P_2 on the side CD of the glass block. Insert pins P_3 and P_4 such that they are aligned with the images of P_1 and P_2 .
7. Remove the pins and the glass block. Draw a line through the pin-holes at P_3 and P_4 to meet CD at F. Draw a line to join the points E and F to form the path of the refracted ray.
8. Measure the angle of refraction r and calculate the values of $\sin i$ and $\sin r$.

Record of readings and calculations

angle of incidence i	angle of refraction r	$\sin i$	$\sin r$

Questions

1. State **one** precaution that you have taken in this activity.

.....

2. Explain **one** significant source of experimental error in this activity.

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2022 Sec 4 Physics Practical Exam – Revision Exercise (1)

Proposed Answers

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
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

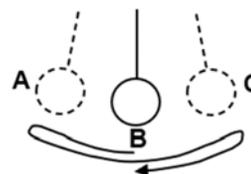


Fig. 1.2

- Show on Fig. 1.1 (to centre of bob).
- Place a heavy object at the base of the retort stand to ensure it will not topple (can also show on Fig. 1.1).
- See Fig. 1.2. [Alternately, $A \rightarrow B \rightarrow C \rightarrow B \rightarrow A$, less accuracy counting from extreme position]
- $n = 20$ [Note: If the oscillations in an experiment stop earlier, n may be less e.g. 15 or 10].
- Use a reference vertical line (fiducial line) (e.g. retort stand) at the centre of the oscillation when counting the oscillations.
- Two, then take average
- 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 $T = \langle t \rangle / 20$

- Ensure that the angular displacement θ (shown in Fig. 1.2) is smaller than 5° to reduce the effects of air resistance on the oscillation.

Activity 2: Measuring lengths

- 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

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	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

- 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°	

Measurements in light experiments

Activity 4: 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	1.5
1 d.p.	1 d.p.	least s.f. of u and v

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

Questions

- 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 $u = (0.1 / 24.5) \times 100\%$

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

Activity 5: 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.

2022 Sec 4 Physics Practical Exam – Revision Exercises (1) & (2)

Summary of List of Apparatus

- 01 set of each item unless otherwise stated.

Activities	Apparatus		Remarks
<p>Activity 1</p> <p>Setting up a retort stand and simple pendulum</p>	<ul style="list-style-type: none"> • retort stand, boss-head & clamp, • split cork • pendulum bob • thread & scissors • stop-watch 		
<p>Activity 2</p> <p>Measuring lengths</p>	<ul style="list-style-type: none"> • vernier calipers • micrometer screw gauge • spirit level • 250 ml beaker • small white block 		
<p>Activity 3</p> <p>Measurements with mass, weight & volume</p>	<ul style="list-style-type: none"> • retort stand, boss-head & clamp • spring balance • 100 ml measuring cylinder • slotted masses with holder • electronic balance 		
<p>Activity 4</p> <p>Use of lens system</p>	<ul style="list-style-type: none"> • convex lens • lens holder • torch • screen • metre rule • set square 		
<p>Activity 5</p> <p>Use of glass block and optical pins</p>	<ul style="list-style-type: none"> • glass block • 04 optical pins • pin board (soft board) • protractor • plain paper 		
<p>Activity 6</p> <p>Measurements in electricity experiments</p>	<ul style="list-style-type: none"> • battery of 2 dry cells in series • 2 V accumulator • plug-key switch • voltmeter (0 – 3 V) • ammeters (0 – 1 A & 0 – 3 A) 	<ul style="list-style-type: none"> • 03 different fixed resistors • jockey • bare wire AB mounted on a metre-rule • connecting wires with crocodile clips 	