Physics ATP

Shortcut notes for Paper 6 — Alternative to Practical

Measurement · Density · Moment · Spring · Pendulum · Cooling & heating · Circuits · Lens · Refraction · Graphs · Plan · Symbols

Highlighted = points that come up in many practicals

Measurement of physical quantities

1 How measuring cylinder is read
- Line of sight perpendicular to scale of measuring cylinder

2 Why line of sight perpendicular to scale
- Avoid parallax error

3 Why read bottom of meniscus
- Very small volume difference between top and bottom of meniscus

4 Why measure 5 marble instead of 1
- Diameters of marbles may vary, find average

5 Why is it appropriate to record volume of measuring cylinder to the nearest 1cm³
- Measuring cylinder can only be read to nearest 1cm³

6
Measuring cylinder: precision at least 1cm³
Thermometer: precision at least 1°C
Metre rule: precision at least 0.1cm
Electronic balance: precision at least 0.1g

7 Larger values are likely to produce a more accurate result
- Because errors have less effect

8 Accuracy of measurement
- Suggestion: difficult to measure irregular shape
- Improvement: Repeat & take average

9 Whether metre rule is horizontal
- Using spirit level
- OR measure height of the metre rule above the bench from both sides (must be equal)

10 Whether metre rule is vertical
- Using set square, put set square so that one side of the set square is parallel to the bench, while other side of the set square is parallel to the metre rule

11 Measure diameter of cylinder or sphere
- Place it between two vertical blocks and measure the distance between two vertical blocks
- Collect them together in a row between two vertical blocks, measure the total distance between two vertical blocks then divide by number of balls to get one ball's diameter

12 Measure circumference of cylindrical shaped object (cup, test tube, beaker)
- Wind a string around it 10 times, mark the length, unwind it, divide the length by 10

Source of inaccuracy:
- Thick string
- Marks are thick
- Leaving space between turns
- Winding turns at angles
- Stretching of the string

Accuracy Precaution
- Thin string
- Thin marks
- Tangent turns without spacing
- More number of turns
- Make sure string not stretched

Density

- Line of sight perpendicular to scale of measuring cylinder
- Read from bottom of the meniscus
- Thin string
- Let all water drip back into cylinder by gently shaking solid
- Put solid gently to prevent splashing
- Ensure measuring cylinder is on horizontal surface
- To measure mass of empty measuring cylinder: dry measuring cylinder before weighing it/ weigh before adding water

Moment

1 Describe a method to find the point at which the metre rule is as near to being balanced as possible.

- Find the point where the ruler just tips one way.
- Move the ruler to find the point which it just tips the other way.
- The balance point is between these where the ruler tips either way

2 Difficulty for balancing

- Judging position of centre of load
- Masses sliding on ruler

3 Difficult to put the mass accurately because the mass is larger than the ruler.

- Mark centre line of mass and edge of rule
- OR Measure the width of the mass and add ½ the width to mark at edge of mass

4 Mass may slip over the ruler

- Stick the mass with ruler

5 Accuracy Precautions

- Repeat to find average
- Line of sight perpendicular to the scale of ruler

6 Determine position of the centre of the mass of ruler

- Balance ruler on pivot with no load
- Pivot point is at the centre of mass of ruler

7 Add a small piece of clay to one end of the metre rule to correct the problem of imbalance mass of metre rule. Suitable change?

- No, mass of clay increases the mass of metre rule
- Yes, mass of clay is only a small percentage of the mass of ruler

8 How modify experiment if centre of mass at 49.7cm instead of 50.0cm

- Take readings from 49.7 to calculate

Spring / Hooke's Law

1 Clamp may topple, spring might overstretch

- Use small/lighter loads

2 Source of inaccuracy

- Spring extension is not proportional with load/ exceeds the limits of proportionality

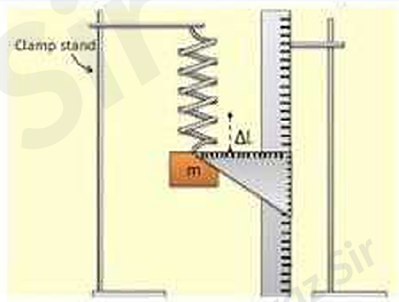
3 Accuracy Precaution

- Repeat to find average
- Line of sight perpendicular to the scale of ruler
- Wait until spring stops vibrating
- Always measure from the same point of spring
- Use set square to ensure ruler perpendicular to bench surface
- Use set square to measure length
- Clamp ruler in place

4 Control variable

- Same spring diameter
- Same spring thickness
- Same number of coils
- Same coil spacing (before stretched)

5 Draw position of set square



Timing, motion or oscillation

1 Accuracy Precaution

- No air currents
- Greater number of oscillations (Take the time of a great number of oscillation then divide the time measured by the number of swings to get period of oscillation)
- Measure the length from the centre of the bob
- Metre rule should be close to pendulum as much as possible
- Use set square as horizontal reference
- Line of sight perpendicular to the scale of ruler
- Repeat to find average

2 Why measure time of 20 swings rather than 1 swing is more accurate?

- Timing error has less effect/ smaller % uncertainty
- Reduce error of reaction time
- Time of one swing is too small to be measured

3 Why measure time of 200 oscillation isn't suitable?

- Pendulum may stop
- Student may lose count

4 Why different results obtained from different experiments?

- Student didn't react quickly when the pendulum started
- Difficulty to measure the length from the centre of bob

5 Control variable (depends)

- Shape/ size of bob
- Length of string
- Number of oscillation

6 Mass and Angle (height where pendulum released) does not affect period of oscillation

7 Reduce unwanted energy transfer

- Apply oil on the fixed point of the pendulum (reduce friction)
- Remove air particles from around the pendulum (reduce air resistance)

8 Period of oscillation: time taken for the pendulum to make one COMPLETE oscillation

Cooling and heating

1 Accuracy Precaution

- Avoid thermometer touching beaker
- Wait until reading stops rising
- Stir before reading
- Line of sight perpendicular to the scale of thermometer
- Insulator to prevent heat loss
- Lid to prevent heat loss

2 Control variables

- Volume of water
- Surface area of beaker
- Same starting temperature

3 Increase rate of cooling of hot water

- Use wider beaker increase surface area of water
- Use smaller volume of water
- Stir the water
- Remove lid
- Paint beaker black
- Blow air over water surface
- Change beaker to better conductor container

4 Explain why rate of cooling decreases by time / Why the initial rate of cooling is greater than the final rate of cooling

- Because liquid temperature becomes near to the room temperature
- Justification: Calculate rate of cooling (diff in temp / time interval) and compare

5 Correlation between the initial temperature (higher or lower than room temperature) and rate of cooling

- Calculate rate of cooling (diff in temp/ time interval) and compare

Electric circuit of a resistor

1 Advantage of variable resistor

- Easier to obtain range of current
- Can easily set current to chosen values

2 Accuracy Precaution

- Line of sight perpendicular to the scale of ammeter/voltmeter
- Repeat to find average
- Check ammeter/voltmeter for zero-error
- Overcome heating up of wires: switch on and off between readings, use low current

3 If got diode in question, question ask for what student done incorrectly:

- Diode in wrong direction

4 Why resistance of lamp filament not constant in the experiment

- Filament changes brightness
- Change in temperature of filament

Optic lens

1 How to find the position of the sharpest image?

- Move the screen back and forth slowly
- Darkened room

2 **Using ruler to measure height of image**

- Difficulty: ruler & hand is going to get in the way of light
- Improvement: Use translucent screen (and measure from the back)

3 Accuracy Precaution

- Darker room
- Object and lens same height from bench - if not image may not appear on screen
- Object, lens and screen perpendicular to bench
- Line of sight perpendicular to the scale of ruler
- Repeat to find average

4 **Why object, lens and screen should be perpendicular to the bench**

- To be able to achieve a sharp/ complete/ focused image, no distorted image

5 **Method 1: No need use measurement of height of image to calculate focal length**

Method 2: Does include measurement of height of image

Suggest which method to find value of focal length might be more accurate

- Method 1, because difficult to measure the height of the image when projected on vertical screen

Refraction / reflection

1 Accuracy Precaution

- View bases of pins
- Place pins as far apart as possible (more than 5cm)
- Ensure pins are vertical
- Draw thin lines (use sharp pencil)
- Use thin pins

2 **Why look from the base**

- No concern about pins not being vertical
- Base of pins lies on the ray
- Base closest to perpendicular to the plane

3 Source of inaccuracy:

- Thickness of light ray
- Thickness of pins
- Thickness of line drawn (not sharp pencil)
- Difficult to judge centre of ray

4 **Whether two pins are suitable distance**

- No
- Because too close/ must be as far as possible

5 **Suitable distance between two pins**

- 5 cm (or above)

Others

Graph:

- See trend: plot graph _____ (y-axis) against _____ (x-axis)
- if question say must start at origin, then it's confirm straight line
- but if no need start from origin, then may be curve, may be straight
- if can connect most dots with few anomalies then need touch most of the dots
- if dots scattered, then just draw a line of symmetry (left and right side about the same number of dots)

- How many d.p. or s.f. always follow the d.p. or s.f. of the given data
- If question never say how many s.f./d.p. or no given data: voltmeter (1 d.p.), ammeter (2 d.p.), resistance (2 s.f.)

ALWAYS REMEMBER **WRITE UNIT**

ALWAYS REMEMBER **COMPLETE COLUMN HEADINGS**

'within the limits of experimental accuracy'

$$\%\ difference = \frac{big\ value - small\ value}{small\ value} \times 100\%$$

If <10% → within limits

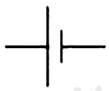
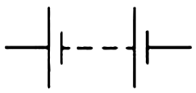
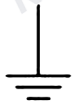
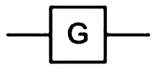
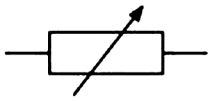
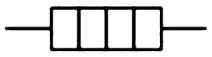
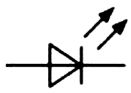
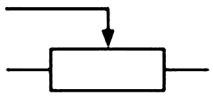
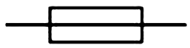
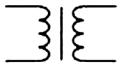
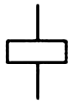
If >10% → exceeds limits

Plan Experiment

7 marks

1. **Determine the manipulated variable and responding variable.**
2. **Determine the constant variable.**
3. **Describe the experiment.**
4. **Repeat the experiment for different values (5 values)**
5. **Repeat each value 3 times to obtain the average.**
6. **Table (headings with quantity and unit)**
7. **How to reach a conclusion?**
   - Draw graph: Responding variable (y-axis) vs manipulated variable (x-axis)
   - Compare readings in table to find correlation/ Compare readings in table to find if/how (independent variable) changes (dependent variable)

Electrical symbols

cell		switch	
battery of cells	 or 	earth or ground	
power supply		junction of conductors	
d.c. power supply		lamp	
a.c. power supply		motor	
fixed resistor		generator	
variable resistor		ammeter	
thermistor		voltmeter	
light-dependent resistor		diode	
heater		light-emitting diode	
potential divider		fuse	
transformer		relay coil	
magnetising coil		electric bell	

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