

# WORK LIKE A PHYSICIST

## UNIT REVIEW

AFTER LESSONS 7–8

Mixed exam-style questions from the whole unit, a fix-it log and the Physicist's toolkit.

*"It doesn't matter how beautiful your theory is ... If it doesn't agree with experiment, it's wrong."*

RICHARD FEYNMAN, PHYSICIST



NAME

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CLASS

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TEACHER

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SCORE / 40

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# UNIT REVIEW

Mixed questions from the whole unit, like a real exam. Try each question without looking back. The Physicist's toolkit is on the last page: use it only after you have tried every question. Then mark your answers with your teacher and fill in the “fix it” log.



AQA-STYLE

## MIXED EXAM PRACTICE

40 marks, about 45 minutes

- 1 **Timing a toy car.** A student times how long a toy car takes to roll down a ramp from two different heights.

| Ramp height / cm | Trial 1 / s | Trial 2 / s | Trial 3 / s | Mean / s |
|------------------|-------------|-------------|-------------|----------|
| 10               | 1.52        | 1.48        | 1.50        | 1.50     |
| 20               | 1.10        | 1.14        | 1.12        |          |

- (a) Calculate the mean time for the 20 cm ramp. Write it in the table. [2 marks]

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- (b) Calculate the uncertainty in the mean time for the 20 cm ramp. Use [2 marks]  
 uncertainty = (largest – smallest) ÷ 2

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- (c) The stopwatch reads to 0.01 s. Its resolution is 

|        |       |     |
|--------|-------|-----|
| 0.01 s | 0.1 s | 1 s |
|--------|-------|-----|

[1 mark]

- (d) Suggest **one** advantage of using light gates instead of a hand-operated stopwatch. [1 mark]

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**2 Keeping it warm.** A student investigates how the **thickness of insulation** around a beaker of hot water affects the **temperature drop** in 10 minutes.

(a) The independent variable is [1 mark]

|                             |                      |                          |
|-----------------------------|----------------------|--------------------------|
| the thickness of insulation | the temperature drop | the starting temperature |
|-----------------------------|----------------------|--------------------------|

(b) The dependent variable is [1 mark]

|                             |                      |                     |
|-----------------------------|----------------------|---------------------|
| the thickness of insulation | the temperature drop | the volume of water |
|-----------------------------|----------------------|---------------------|

(c) Name **two** control variables. [2 marks]

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(d) The thickness of insulation is 

|           |            |
|-----------|------------|
| categoric | continuous |
|-----------|------------|

 so the results [1 mark]  
should be shown on a 

|           |            |
|-----------|------------|
| bar chart | line graph |
|-----------|------------|

**3 Random or systematic?**

(a) Tick **one** box in each row. [3 marks]

| PROBLEM                                                        | RANDOM<br>ERROR          | SYSTEMATIC<br>ERROR      |
|----------------------------------------------------------------|--------------------------|--------------------------|
| A newtonmeter reads 0.5 N with nothing hanging on it.          | <input type="checkbox"/> | <input type="checkbox"/> |
| The person timing reacts a little differently in each trial.   | <input type="checkbox"/> | <input type="checkbox"/> |
| A scale is always read from slightly above, at the same angle. | <input type="checkbox"/> | <input type="checkbox"/> |

(b) How should the student correct every reading from the newtonmeter? [1 mark]

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**4** **Precise or accurate?** Three students measure the length of a rod. Its true length is **50.0 cm**.

| Student | Reading 1 / cm | Reading 2 / cm | Reading 3 / cm |
|---------|----------------|----------------|----------------|
| A       | 49.9           | 50.1           | 50.0           |
| B       | 48.2           | 48.3           | 48.2           |
| C       | 47.0           | 52.5           | 50.4           |

(a) Whose readings are precise but **not** accurate? 

|   |   |   |
|---|---|---|
| A | B | C |
|---|---|---|

 [1 mark]

(b) Whose readings are both precise and accurate? 

|   |   |   |
|---|---|---|
| A | B | C |
|---|---|---|

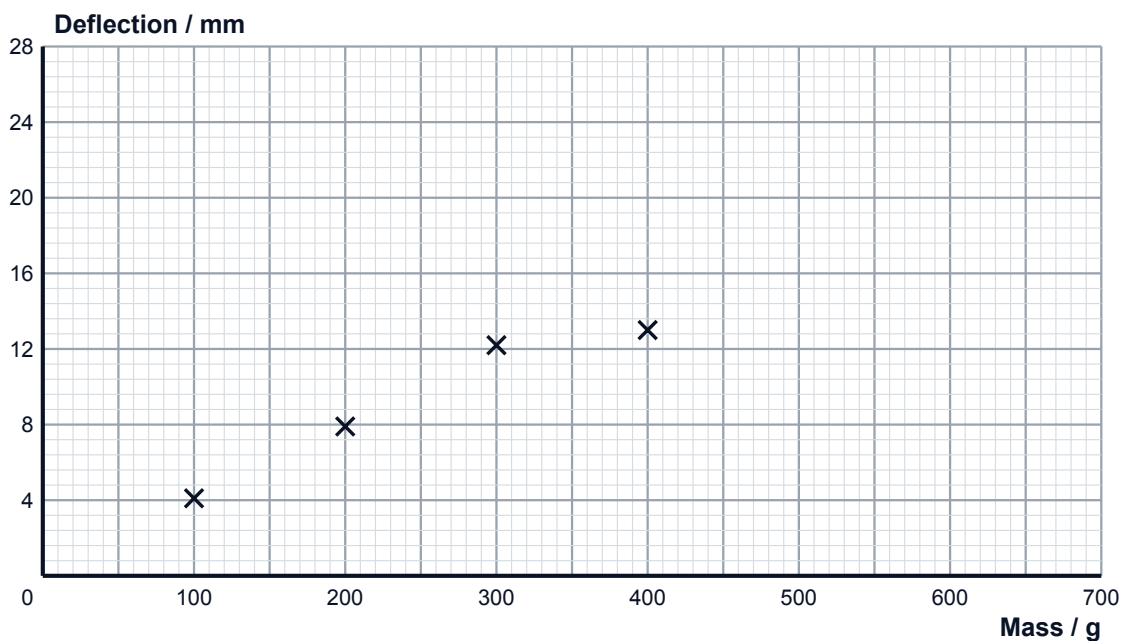
 [1 mark]

(c) The mean of C’s readings is 49.97 cm, very close to the true length. Explain [2 marks]  
why C’s readings are still not precise.

5

**A sagging beam.** A student hangs masses on the middle of a wooden beam and measures how far it sags (the deflection).

| Mass / g        | 100 | 200 | 300  | 400  | 500  | 600  |
|-----------------|-----|-----|------|------|------|------|
| Deflection / mm | 4.1 | 7.9 | 12.2 | 13.0 | 20.1 | 23.9 |



(a) Plot the results for 500 g and 600 g on the graph. [2 marks]

(b) Draw a ring around the anomalous result. [1 mark]

(c) Draw a line of best fit. [1 mark]

(d) Use your graph to find the deflection for a mass of 250 g. Deflection = [1 mark]  
 \_\_\_\_\_ mm

**A sagging beam** (continued).

(e) What should the student do about the anomalous result? **[1 mark]**

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(f) Write a conclusion. Use the shape of the graph. **[2 marks]**

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(g) Explain why a line graph is the right choice for these results. **[1 mark]**

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**6** **Choosing a graph.** Tick **one** box in each row to show how the results should be presented. **[3 marks]**

| INVESTIGATION                                                        | BAR<br>CHART             | LINE<br>GRAPH            |
|----------------------------------------------------------------------|--------------------------|--------------------------|
| How the type of ball affects its bounce height                       | <input type="checkbox"/> | <input type="checkbox"/> |
| How the temperature of a wire affects its resistance                 | <input type="checkbox"/> | <input type="checkbox"/> |
| How the colour of a surface affects its temperature rise in sunlight | <input type="checkbox"/> | <input type="checkbox"/> |

7

8

(a) Explain why Group B's results are more trustworthy. **[2 marks]**

(b) Group B publish their method and results so that other scientists can check [1 mark]

**a control variable**



| Q | What went wrong? | The correct physics (or method) is... | Lesson to revisit |
|---|------------------|---------------------------------------|-------------------|
|   |                  |                                       |                   |
|   |                  |                                       |                   |
|   |                  |                                       |                   |
|   |                  |                                       |                   |
|   |                  |                                       |                   |
|   |                  |                                       |                   |

My score: \_\_\_\_\_ / 40. Two things I will practise before the test:

\_\_\_\_\_

# THE PHYSICIST'S TOOLKIT

Everything you need for the whole unit, on one page. Fold the corner: you will come back to it.

## THE THREE VARIABLES

**Independent** the one thing you change

**Dependent** the thing you measure

**Control** everything you keep the same

Ask: "How does *independent* affect *dependent*?"

## TWO KINDS OF DATA

**Continuous** any value on a scale: length, time, mass → **line graph**

**Categoric** names or groups: material, colour → **bar chart**

Test: is there a value in between?

## THE TWO CALCULATIONS

**mean = total of the trials ÷ number of trials**

**uncertainty = (largest – smallest) ÷ 2**

Write the result as mean ± uncertainty, e.g. 1.22 s ± 0.03 s.

## PRECISE OR ACCURATE?

**Precise** repeats close *to each other*

**Accurate** close *to the true value*

**Resolution** the smallest change an instrument can detect

You can be precise and still wrong.

## THE TWO ERRORS

**Random** scatters repeats both ways. **Repeat and take a mean.**

**Systematic** shifts every reading the same way. **Find the cause; repeats do not help.**

## CHOOSING A SCALE

Largest value ÷ number of big squares, then round **up** to 1, 2, 5, 10, 20 or 50 per big square. Equal steps. Use most of the grid.

## ANOMALOUS RESULTS

**Spot** it (far from the trend) → **check** the recording, maths and method → **repeat** if you can. Mistake found: correct it. No cause: keep it, circle it, report it, and leave it out of the best-fit line. Never delete it silently.

## CONCLUSION AND EVALUATION

**Conclude:** "As X increased, Y increased", with two values and units. Straight or curved?

**Evaluate:** a strength, a weakness, a named error, and an improvement that fixes it. Never just "human error".

## GRAPH CHECKLIST

- Title: what against what
- Independent variable on the x-axis
- Both axes labelled, with units: "Ramp height / cm"
- Scale in equal steps that fills the grid
- Means plotted as small, accurate crosses
- One best-fit line: never dot-to-dot
- Bar chart: equal bars, equal gaps, axis from 0
- Anomalous results circled, or "none"

## THE RULE THAT DECIDES YOUR GRAPH

**Continuous independent variable** → **line graph**. **Categoric independent variable** → **bar chart**.

It depends on what you *changed*, not on what you measured.