

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

ANSWER EDITION FOR TEACHERS AND SELF-MARKING



NAME

CLASS

TEACHER

SCORE / 40

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	1.12

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

$$(1.10 + 1.14 + 1.12) \div 3 = 3.36 \div 3 \text{ (1)}$$

$$= 1.12 \text{ s (1)}$$

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

$$(1.14 - 1.10) \div 2 \text{ (1)}$$

$$= 0.02 \text{ s (1)}$$

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

0.01 s	0.1 s	1 s
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 [1 mark]

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

There is no human reaction time when starting and stopping the timer (1).

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
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(b) The dependent variable is [1 mark]

the thickness of insulation	the temperature drop	the volume of water
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(c) Name **two** control variables. [2 marks]

Any two (1 each): volume of water; starting temperature; type of insulation; room temperature; size of beaker.

(d) The thickness of insulation is categoric continuous so the results [1 mark]

should be shown on a bar chart line graph

Both needed (1).

3 Random or systematic?

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

PROBLEM	RANDOM ERROR	SYSTEMATIC ERROR
A newtonmeter reads 0.5 N with nothing hanging on it.	☐	☒
The person timing reacts a little differently in each trial.	☒	☐
A scale is always read from slightly above, at the same angle.	☐	☒

One mark for each correct row (3).

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

Subtract 0.5 N from each reading (or zero the newtonmeter first) (1).

- 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 why C's readings are still not precise. [2 marks]

The readings are spread out, from 47.0 cm to 52.5 cm, so they are not close to each

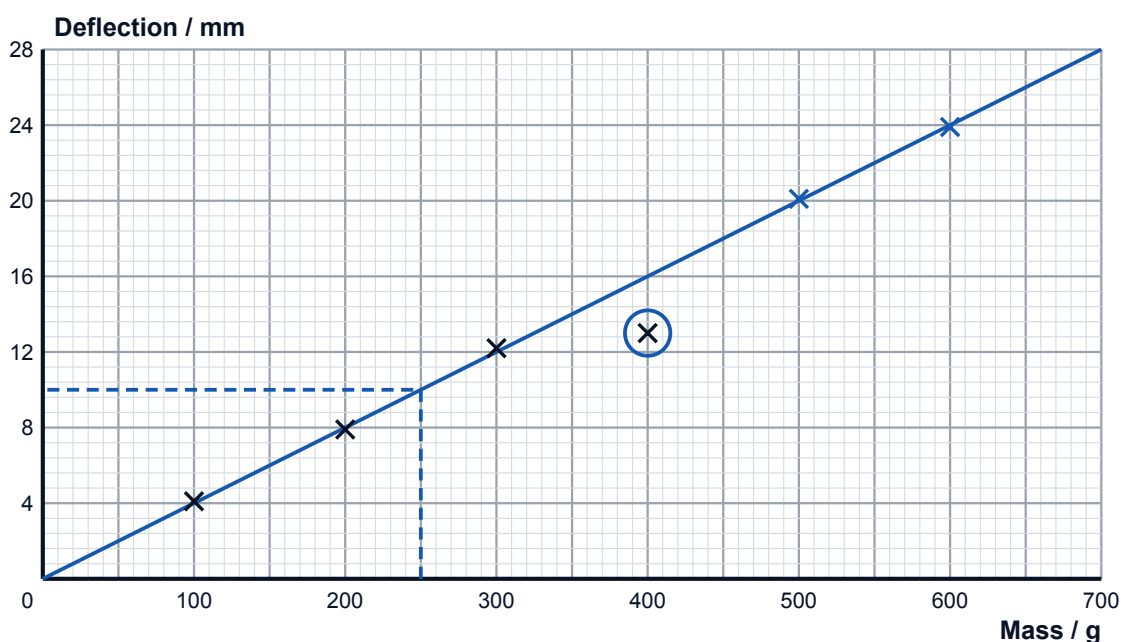
other (1);

the random errors happen to cancel out in the mean (1).

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]

(500, 20.1) (1); (600, 23.9) (1), each within half a small square.

(b) Draw a ring around the anomalous result.

[1 mark]

400 g, 13.0 mm (1).

(c) Draw a line of best fit.

[1 mark]

One ruled straight line through the origin and the other points, ignoring 400 g (1).

(d) Use your graph to find the deflection for a mass of 250 g. Deflection =

[1 mark]

10 mm

A sagging beam (continued).

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

Repeat the 400 g measurement (and leave it out of the line if it is still anomalous) (1).

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

The deflection is directly proportional to the mass (1)

because the graph is a straight line through the origin (1).

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

Mass, the independent variable, is continuous (1).

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

INVESTIGATION	BAR CHART	LINE GRAPH
How the type of ball affects its bounce height	☒	☐
How the temperature of a wire affects its resistance	☐	☒
How the colour of a surface affects its temperature rise in sunlight	☒	☐

One mark for each correct row (3).

- 7 **Plan an investigation.** A student wants to find out how the **height** a ball is dropped from affects the **height it bounces**. Describe a method the student could use. Include how to make it a fair test and how to make the results repeatable. **[6 marks]**

Level 3 (5–6): a clear, logical method a stranger could follow, with the variables

controlled and repeats used. Level 2 (3–4): a method with some detail, missing a step or

a control. Level 1 (1–2): simple statements, not in a logical order. Points: drop the ball

from a measured height using a metre rule held vertically; measure the bounce height at

eye level (or film it against the rule); change the drop height, at least five values (e.g. 20

to 100 cm); same ball, same surface, release without pushing; repeat each height three

times and calculate a mean; check any anomalous result; plot bounce height against

drop height.

- 8 **Whose results can you trust?** Two groups did the bounce investigation. Group A took one reading for each drop height. Group B took three readings and calculated a mean.

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

Repeats show whether the readings are close together / let anomalous results be

spotted (1);

the mean reduces the effect of random errors (1).

(b) Group B publish their method and results so that other scientists can check them. This is called **[1 mark]**

a fair test

peer review

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.