

1.3 Use scientific units and notation to check a measurement claim

Name: _____ Class: _____ Date: _____

Total: 28 marks

KEY WORDS units • precision • accuracy

Objective

Use scientific units and notation to check a measurement claim. This is original GAC013-aligned practice, not an official assessment. All supplied case data and review records are fictional; explicitly cited historical context is factual. The case data are invented for learning; they are not findings about a real school, country or population. Use the supplied evidence and do not invent missing observations.

1 Key knowledge and worked examples

■ **Key knowledge: a quantity needs its definition, unit and sensible reported precision**

Units identify the scale used for a physical quantity. Conversions preserve the quantity while changing its numerical representation. Average speed is distance travelled divided by elapsed time. **Precision** concerns closeness of repeated measurements, while **accuracy** concerns closeness to a suitable reference or true value. Close repeats do not prove accuracy. Report digits supported by the measurements and avoid claiming uncertainty that was not established.

■ **Source A: text or task brief**

Fictional trolley record: total travelled distance 3.60 m; elapsed time 48.0 s. The written task assumes these supplied values and asks for average speed. Three repeated timer readings for a separate fixed event are 10.1 s, 10.1 s and 10.2 s. A suitable independent reference measures that event as 12.0 s.

A separate paper square has side length 10.0 cm. Use $1\text{ m} = 100\text{ cm}$ and $1\text{ m}^2 = 10,000\text{ cm}^2$. No uncertainty budget or acceleration measurements are supplied.

■ Source B: response or review record

Student notes: “Average speed = time divided by distance = 13.3 m/s. Ten centimetres is 0.010 m, so the square area is 0.010 m². The three timer readings are close, therefore accurate. Every calculated result should show eight decimal places. The trolley’s average speed proves it travelled at a constant speed.”

■ Worked example: write the equation before the conversion and substitution



Known: distance 3.60 m and elapsed time 48.0 s. Why divide distance by time?
Average speed is the distance travelled per unit time.

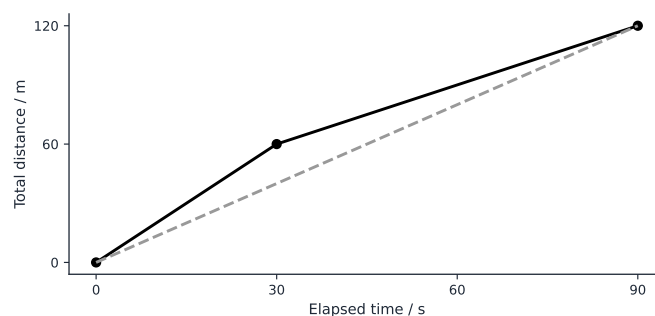
$$v_{\text{avg}} = \frac{d}{t}$$

$$v_{\text{avg}} = \frac{3.60 \text{ m}}{48.0 \text{ s}} = 0.0750 \frac{\text{m}}{\text{s}}$$

This is an average for the whole interval. It does not state the speed at every moment.

■ Worked application: Average the whole trip, not the two speeds

A separate invented journey covers 60 m in 30 s and then another 60 m in 60 s. Segment speeds are 2 and 1 m s⁻¹. Whole-trip average speed is total distance divided by total elapsed time: $v_{\text{avg}} = (60 + 60)/(30 + 60) = 4/3 \text{ m s}^{-1}$. The unweighted mean of the two speeds, 1.5 m s⁻¹, is wrong because the segments take different times. Include any stationary waiting time in the total if it belongs to the stated journey. The result still gives no claim about acceleration or instantaneous speed.



2 Practice

2.1 State the equation for average speed and its SI unit. [2]

2.2 Convert 10.0 cm to metres and calculate the square's area in m². [2]

2.3 Calculate the trolley's average speed with a suitable number of significant figures. [3]

2.4 Explain what the repeated timer readings show about precision and accuracy. [3]

3 Exam-style questions

3.1 Evaluate the student notes with six corrections or limits.

[6]

3.2 Write an 80–110-word corrected measurement note explaining the result and its limits. [8]

[8]

3.3 A fictional journey covers 40 m in 20 s and 60 m in 60 s. Calculate its whole-trip average speed and explain why averaging the two segment speeds without weights gives a different answer. [4]