Past-paper walk-through

Errors and uncertainties ▪ 1.3

eXercise

Questions in this set

- 9702/11 N25 Q2 ▪ 1 mark
- 9702/12 N25 Q2 ▪ 1 mark
- 9702/12 N25 Q4 ▪ 1 mark
- 9702/14 N25 Q2 ▪ 1 mark
- 9702/14 N25 Q3 ▪ 1 mark
- 9702/35 N25 Q2 ▪ 20 marks
- 9702/11 J25 Q2 ▪ 1 mark
- 9702/11 J25 Q3 ▪ 1 mark
- 9702/12 J25 Q3 ▪ 1 mark
- 9702/12 M25 Q12 ▪ 1 mark

Questions in this set

- 9702/22 M25 Q1 ▪ 7 marks

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

Question 2

9702/11 N25 ▪ Q2 ▪ 1 mark

Two quantities are measured.

$$L = 6.8 \pm 0.1 \text{ cm}$$

$$T = 2.42 \pm 0.08 \text{ s}$$

L and T are related to X by the equation shown.

$$X = \frac{4\pi^2 L}{T^2}$$

What is the calculated value and uncertainty of X? **[1]**

Question 2

A $45.8 \pm 0.2\ \text{cm}\,\text{s}^{-2}$

B $45.8 \pm 0.3\ \text{cm}\,\text{s}^{-2}$

C $46 \pm 2\ \text{cm}\,\text{s}^{-2}$

D $46 \pm 4\ \text{cm}\,\text{s}^{-2}$

Solution 2

A 45.8 ± 0.2 cm s^{-2}

B 45.8 ± 0.3 cm s^{-2}

C 46 ± 2 cm s^{-2}

D 46 ± 4 cm s^{-2} ✓

Why

- $X = 4\pi^2 L/T^2 = 4\pi^2(6.8)/2.42^2 = 45.8$ cm s^{-2}.
- T is squared, so $\Delta X/X = \Delta L/L + 2\Delta T/T = 1.5\% + 6.6\% = 8.1\%$, giving $\Delta X \approx 4$ cm s^{-2}.
- C forgets to double the time's share; the value is then rounded to match, so 46 ± 4.

Question 2

9702/12 N25 ▪ Q2 ▪ 1 mark

What describes a set of data with a high precision? **[1]**

A data measured using equipment with small scale divisions

B data that is close to the accepted value

C data with each value having a low uncertainty

D data with repeats that are close to each other

Solution 2

A data measured using equipment with small scale divisions

B data that is close to the accepted value

C data with each value having a low uncertainty

D data with repeats that are close to each other ✓

Why

- Precision is about how closely repeated readings agree with each other.
- B is the definition of accuracy – closeness to the accepted value.
- A and C describe the instrument's resolution, which permits precision but does not demonstrate it.

Question 4

9702/12 N25 ▪ Q4 ▪ 1 mark

A ball is released from rest. The distance the ball falls and the time the ball takes to fall that distance are both measured.
The percentage uncertainty in the measured distance is negligible. The percentage uncertainty in the measured time is 4%.
The distance and the time are then used to calculate the acceleration of free fall.
Air resistance is negligible.
What is the percentage uncertainty in the calculated value of the acceleration of free fall? **[1]**

A 2%

B 4%

C 8%

Question 4

D 16%

Solution 4

A 2%

B 4%

C 8% ✓

D 16%

Why

- From $s = \frac{1}{2}gt^2$, the acceleration is $g = 2s/t^2$.
- The time is squared, so its percentage uncertainty is doubled: $2 \times 4\% = 8\%$.
- The distance contributes nothing here, so B – forgetting to double – is the trap.