Errors and Uncertainty

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1.

A student carries out a series of determinations of the acceleration of free fall *g*. The table shows the results.

g/m s^{-2}
4.91
4.89
4.88
4.90
4.93
4.92

What can be said about this experiment?

A It is accurate and precise.

B It is accurate but not precise.

C It is not accurate and not precise.

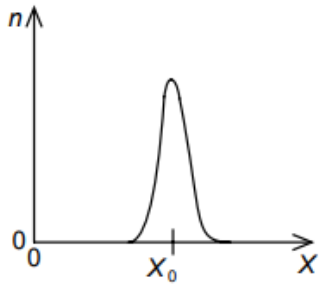
D It is not accurate but is precise.

2.

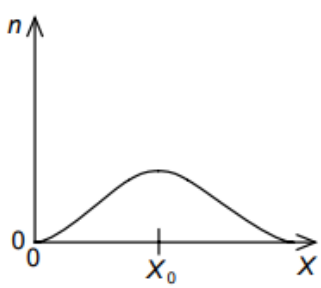
A quantity X is measured many times. A graph is plotted showing the number n of times a particular value of X is obtained. X has a true value X_0.

Which graph could be obtained if the measurement of X has a large systematic error but a small random error?

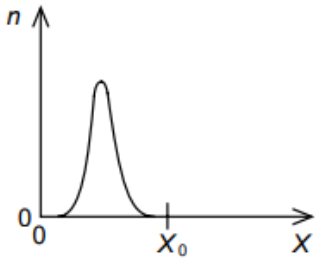
A



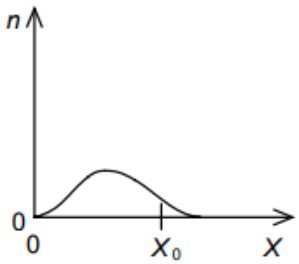
B



C



D



3.

A student makes measurements from which she calculates the speed of sound as 327.66 m s^{-1}. She estimates that her result is accurate to ±3 %.

Which of the following gives her result expressed to the appropriate number of significant figures?

A 327.7 m s^{-1} **B** 328 m s^{-1} **C** 330 m s^{-1} **D** 300 m s^{-1}

4.

A steel rule can be read to the nearest millimetre. It is used to measure the length of a bar whose true length is 895 mm. Repeated measurements give the following readings.

length / mm	892, 891, 892, 891, 891, 892

Are the readings accurate and precise to within 1 mm?

	results are accurate to within 1 mm	results are precise to within 1 mm
A	no	no
B	no	yes
C	yes	no
D	yes	yes

5.

A student finds the density of a liquid by measuring its mass and its volume. The following is a summary of his measurements.

mass of empty beaker = $(20 \pm 1)\,g$

mass of beaker + liquid = $(70 \pm 1)\,g$

volume of liquid = $(10.0 \pm 0.6)\,cm^3$

He correctly calculates the density of the liquid as $5.0\,g\,cm^{-3}$.

What is the uncertainty in this value?

A $0.3\,g\,cm^{-3}$ **B** $0.5\,g\,cm^{-3}$ **C** $0.6\,g\,cm^{-3}$ **D** $2.6\,g\,cm^{-3}$

6.

A micrometer screw gauge is used to measure the diameter of a small uniform steel sphere. The micrometer reading is 5.00 mm ± 0.01 mm.

What will be the percentage uncertainty in a calculation of the volume of the sphere, using these values?

A 0.2% **B** 0.4% **C** 0.6% **D** 1.2%

7.

In a simple electrical circuit, the current in a resistor is measured as (2.50 ± 0.05) mA. The resistor is marked as having a value of 4.7 Ω ± 2 %.

If these values were used to calculate the power dissipated in the resistor, what would be the percentage uncertainty in the value obtained?

A 2% **B** 4% **C** 6% **D** 8%

8.

Quantity X has a fractional uncertainty of x. Quantity Y has a fractional uncertainty of y.

What is the fractional uncertainty in $\frac{X}{Y^2}$?

A $x + y$ **B** $x - y$ **C** $x + 2y$ **D** $x - 2y$

9.

A person calculates the potential difference across a wire by using the measurements shown.

Which measured quantity has the greatest contribution to the percentage uncertainty in the calculated potential difference?

	quantity	value	uncertainty
A	current / A	5.0	±0.5
B	diameter of wire / mm	0.8	±0.1
C	length of wire / m	150	±5
D	resistivity of metal in wire / Ω m	1.6×10^{-8}	$\pm 0.2 \times 10^{-8}$

10.

A digital meter has an accuracy of ±1%.

The meter is used to measure the current in an electrical circuit.

The reading on the meter varies between 3.04 A and 3.08 A.

What is the value of the current, with its uncertainty?

A (3.06 ± 0.02) A

B (3.06 ± 0.04) A

C (3.06 ± 0.05) A

D (3.06 ± 0.07) A