

Quick Reference Table

Concept	Formula	Example
Absolute Error	$(\text{Measured} - \text{Actual})$	$10.2 - 10 = 0.2$
Relative Error	$\frac{\text{Absolute Error}}{\text{Actual}}$	$0.2 / 10 = 0.02$ or 2%
Percentage Error	Relative Error $\times 100$	$0.02 \times 100 = 2\%$
Addition/Subtraction	Add absolute errors	See Q7
Multiplication/Division	Add relative errors	See Q8
Rounding Rule	Round up if next digit ≥ 5	3.146 to 2 d.p. \rightarrow 3.15
Truncation	Cut off digits beyond required place	8.976 \rightarrow 8.9

Tips for Mastery

- Always check the digit **after** the rounding place.
- Use **absolute errors** in addition/subtraction, and **relative errors** in multiplication/division.
- Keep track of **units** and **significant figures**, especially in science-based problems.

1. Rounding to Decimal Places

Question:

Round 3.14159 to 2 decimal places.

Solution:

Check the third decimal (1): it's less than 5, so no rounding up.

$$\boxed{3.14}$$

2. Rounding to Significant Figures

Question:

Round 0.004682 to 3 significant figures.

Solution:

Start counting from the first non-zero digit:

$$\boxed{0.00468}$$

(The fourth digit, 2, is less than 5 – no rounding up.)

3. Absolute Error

Question:

The true length of a table is 2.50 m, but a student measures 2.47 m. Find the **absolute error**.

Solution:

$$|2.50 - 2.47| = \boxed{0.03 \text{ m}}$$

4. Relative Error

Question:

Using the values from Question 3, find the **relative error**.

Solution:

$$\frac{0.03}{2.50} = \boxed{0.012 \text{ or } 1.2\%}$$

5. Percentage Error

Question:

A thermometer reads 24°C , but the actual temperature is 25°C . Find the **percentage error**.

Solution:

$$\text{Absolute Error} = 1^{\circ}\text{C}, \quad \frac{1}{25} \times 100 = \boxed{4\%}$$

6. Truncation vs. Rounding

Question:

Truncate 8.976 to **1 decimal place**.

Solution:

Cut off digits after the first decimal (no rounding):

$\boxed{8.9}$

(Rounding would give 9.0 instead.)

7. Propagation of Error: Addition

Question:

Two lengths are measured: 12.5 ± 0.1 cm and 8.3 ± 0.1 cm. Find the total length and its error.

Solution:

- Total = $12.5 + 8.3 = 20.8$ cm
- Total Error = $0.1 + 0.1 = 0.2$ cm

$\boxed{20.8 \pm 0.2 \text{ cm}}$

8. Propagation of Error: Multiplication

Question:

A rectangle is 5.0 ± 0.1 cm by 3.0 ± 0.1 cm. Estimate the area and its error.

Solution:

- Area = $5.0 \times 3.0 = 15.0 \text{ cm}^2$
- Relative Error = $0.1/5.0 + 0.1/3.0 = 0.02 + 0.033 \approx 0.053$
- Absolute Error = $15.0 \times 0.053 \approx 0.8 \text{ cm}^2$

$$15.0 \pm 0.8 \text{ cm}^2$$

9. Real-Life Approximation

Question:

A speedometer reads 60 km/h with a 5% margin of error. What is the possible range of actual speed?

Solution:

- Error = $0.05 \times 60 = 3 \text{ km/h}$
- Range = 60 ± 3

$$57 \text{ km/h to } 63 \text{ km/h}$$

10. Error in Scientific Notation

Question:

A value is written as 4.2×10^3 m with a 5% error. What is the absolute error?

Solution:

- Value = 4,200 m
- Error = $0.05 \times 4,200 = \boxed{210 \text{ m}}$