Errors and Uncertainties

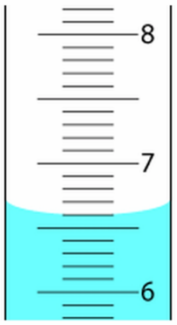
Errors

Two types of errors can occur when conducting an experiment:

Random errors occur sometimes when **measuring** is involved. Sometimes the values are **above or below the true value.** We can minimise the effect of random errors by taking **more repeat readings** and **calculating a new mean**.

Systematic errors occur when the **same error is made repeatedly** and **the difference from the true value is the same** every time. Sometimes these can be fixed if they are known. For example, if you weigh the mass of something and forget to take into the account the mass of the container, you can deduct this mass at the end.

Sarah is measuring some solutions for her experiment. She misreads from the top of the meniscus instead of the bottom.



Which type of error is this? _____

How can it be fixed?

_____

_____

_____

Aaron is doing an experiment involving the temperature. He measures the temperature three times. During one of the readings, he accidentally lifted the thermometer out of the solution when measuring.

Which type of error is this? _____

How can it be fixed?

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Uncertainty

When measuring in science, the **uncertainty** is the **amount of error** we have in a measurement in which the true value can be expected to lie within.

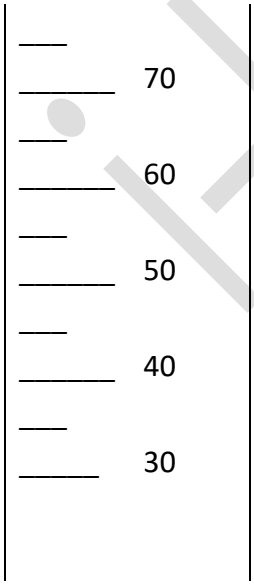
Every **analogue measuring instrument** has an uncertainty which is **plus or minus (±) half the smallest scale division**. For example, when reading from a thermometer, we may read the temperature as 30°C. However, due to the 1°C divisions on the thermometer, the true value could be 30.5°C or even 29.5°C. Therefore, we write the temperature as 30 ± 0.5°C.

When using a **digital measuring instrument** such as a digital scale, the uncertainty is **plus or minus (±) the smallest division on the display.** For example, if a digital scale reads 1.69, it is to two decimal places and the smallest scale division is 0.01. Therefore, the reading would be 1.69 ± 0.01g.

For **repeated measurements**, the uncertainty is **plus or minus (±) half the range**.

What are the smallest scale divisions and uncertainty for these measuring instruments?

Thermometer



Smallest Scale Division	Uncertainty