

## Accuracy and Precision in Measurements

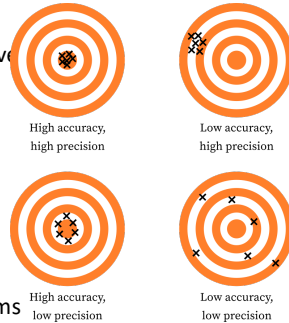
### Accuracy

How close a measurement is taken relative to the correct true value

### Precision

How close a series of measurements taken together are to each other

Measurement sets can be accurate and/or precise. A and P are not linked to each other directly, but independent terms



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## Accuracy and Precision Relationship

Known Correct (*accurate*) Measurement:  $12.0 \pm 0.5g \text{ CO}_2(g)$

Precise Measurement defined as  $\pm 0.3g$  or better

Good Accuracy Good Precision	Good Accuracy Poor Precision	Poor Accuracy Good Precision	Poor Accuracy Poor Precision
12.0g	11.7g	16.4g	5.6g
12.1g	12.4g	16.5g	18.4g
12.0g	11.5g	16.3g	8.4g
12.1g	11.8g	16.4g	12.9g
11.9g	12.5g	16.5g	10.4g
$\pm 0.1g, 11.9 - 12.1$	$\pm 0.5g, 11.5 - 12.5$	$\pm 0.1g, 16.3 - 16.5$	$\pm 12.8g, 5.6 - 18.4$

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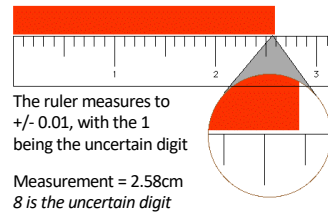
## Accuracy and Precision in Measurements

### Accuracy in Written Measurements

Any measurement can have any number of true, and one estimated digits in its quantity. The estimated digit is the *uncertain digit*

In any measurement one uncertain digit always exists\*

The uncertain digit is always one digit smaller than the *resolution*, the smallest marking on the scale or measuring device



\* Numbers known exactly (counts / conversion factors) have no uncertain digits

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