SPH4U **Accuracy and Error Analysis**

Recall the idea of *significant digits*:

3.00×10^8 m/s:	__________ s.d.	0.0004 kg:	__________ s.d.
123 h:	__________ s.d.	456.000 W:	__________ s.d.

Also recall the rules for addition and subtraction of measured quantities:

+ and – : round to the fewest number of ________________________

Example: Three tables are measured with three different measuring tapes. One is measured to be 6.6 m long, the second is measured at 8.74 m, and the final one is found to be 4.766 m long. How long would all three tables be, if they were put end to end?

× and ÷ : round to the fewest number of

Example: A soccer field was measured to be 85.05 m long and 36 m wide. What is the area of the field?

combinations: round ____

If I was to measure the length of my Rolls-Royce convertible at 4.6 m, the *possible error* would be ±0.05 m – **half the last digit stated.**

You know that the *accepted value* for the speed of light is 3.00×10^8 m/s. If you were to conduct an experiment to measure the speed of light and you found it to be 2.83×10^8 m/s...

absolute error = (your measured value) – (commonly-accepted value)

What would your absolute error be for this experiment?

While your absolute error may seem big, it really isn't all that bad when you calculate...

$$\textit{percentage error} = \frac{\text{absolute error}}{\text{accepted value}} \times 100\%$$

What would your percentage error be for this experiment?

Carrying Errors

Addition and Subtraction: add absolute errors (or *uncertainties*)

Example: What would be the sum of 6.8 ± 0.05 m and 3.04 ± 0.008 m? The difference?

Multiplication and Division: add percentage errors

Example: If a car travels at 85 ± 0.6 km/h for 0.75 ± 0.01 h, how far does it travel?

Square root of a measured number: double the percentage error

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Activity: Using Accuracy and Error Analysis

Purpose: To determine your reaction time, and report the measurement using correct accuracy and error analysis.

Method:
1. Place your thumb and index finger 10 cm apart.
2. Get a partner to hold a metre stick so that the zero mark is between your fingers.
3. Have your partner release the metre stick, and catch it as soon as you can.
4. Record the "final" position, in *centimetres* (e.g. 27 ± 0.5 cm)

Calculations: Assuming that the acceleration due to gravity $g = 980 \pm 20$ cm·s^{-2}, calculate how long the metre stick fell before you were able to catch it.
- ☞ Use the formula $t = (2d/g)^{1/2}$
- ☞ Carry through any absolute or percentage error properly.

Neat stuff:
- ☞ See who has the faster reaction time, you or your partner
- ☞ Try starting with your fingers 8, 6, and 4 cm apart, and derive a mathematical relationship between reaction time and finger spacing.
