Numerical Data

- 2 types:

1. exact numbers
   - obtained by counting
   - no uncertainty
   e.g. 24 students in the classroom

2. approximate numbers
   - obtained by measurement
   - uncertainty from human error and the instrument used
   e.g. 61.5 + 0.5 mL of water

61.5 mL
61.2 mL
61.4 mL
61.5 mL

When reporting approximate numerical data, always record numbers you can read with certainty plus one more which is estimated. These numbers are called **significant digits (figures)**.

uncertain

Significant Digits

The rules:

1. 1....9 are always significant
2. 0's between non-zero digits are always significant
3. 0's to the right of non-zero numbers are significant
4. 0's to the left of non-zero numbers are **not** significant

e.g.
1. 12.7 → 3 sig digs (Rule #1)
2. 209 → 3 sig digs (Rule #1,2)
3. 2500.04 → 6 sig digs (Rule #1,2)
4. 0.00345 → 3 sig digs (Rule #1,4)
5. 0.070 → 2 sig digs (Rule #1,3,4)

Rounding Rules

1. < 5 do not change (round down)
2. > 5 increase by one (round up)
3. = 5 nearest even # (odd → round up, even → round down)

e.g. 1. 22.23 (3 sig digs) → 22.2 (Rule #1)
2. 22.28 (3 sig digs) → 22.3 (Rule #2)
3. 22.50 (2 sig digs) → 22 (Rule #3)
4. 21.50 (2 sig digs) → 22 (Rule #3)
5. 22.5003 (2 sig digs) → 23 (Rule #2)

Calculations Using Significant Digits and Rounding Rules

1. **Multiplication and Division**

- do operation
- round off the answer so it has the same number of **significant digits** as the number in the question with the fewest significant digits

e.g. 0.004 25 x 15.203 = 0.064 012 75

3 5 = 0.0646

Answer should have
3 significant digits

2. **Multiplication and Division**
- do operation

- round off the answer so it has the same number of **decimal places** as the number in the question with the fewest decimal places

e.g. 12.2 + 10.00 + 0.375 = 22.575

1 2 3 = 22.6

Round to 1 decimal place