A. Significant Digits

1. Non-zero digits are always significant.
   127.34 grams = 5 significant digits (s.d.)

2. All zeroes between nonzero digits are significant.
   1205 m = 4 s.d.

3. All final zeroes to the right of a decimal point are significant.
   21.50 grams = 4 s.d.

4. Zeroes used only for spacing the decimal are not significant.
   0.0025 = 2 s.d.

5. Scientific notation is used to indicate if zeroes at the end of measurements are significant.
   - When adding & subtracting – round off or drop digits until the answer has the same number of decimal places as the fewest being added or subtracted.
   - When multiplying & dividing - round the final answer to the least number of significant digits.

B. Scientific Notation

Expresses a number by writing it in the form $a \times 10^n$ where a is ≤1 but <10 and the digits in the coefficient a are all significant.

To change from standard form to scientific notation:
1. Place a decimal after the first non-zero digit.
2. Count the number of spaces you moved the decimal. This is the exponent of 10.
3. Look at the direction you moved your decimal:
   Left = positive exponent (e.g. 10^4)
   Right = negative exponent (e.g. 10^{-4})
   In other words, if the original number is larger than 1, the exponent is positive.
   If the original number is smaller than 1, the exponent is negative.
4. Write the numerical value in scientific notation.

To change from scientific notation to standard form:
1. Move the decimal to the right for a positive exponent of 10.
2. Move the decimal to the left for a negative exponent of 10.
3. Write the value in standard form.

Examples:

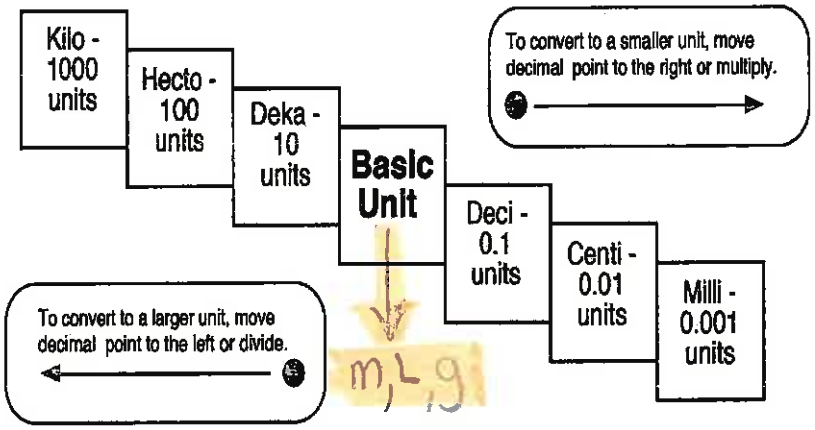
a) 1571 → 4 sd
b) 19001 → 5 sd
c) 2.620 → 4 sd
d) 0.02620 → 4 sd
e) 2.00×10^4 → 3 sd
   1.902×10^{-3} → 4 sd
f) 12.2 + 13.92 + 14.111 = 40.2
g) $3.6 \times 10.22 \times 1.09 = 40 = 4.0 \times 10^1$

$10{,}700 \rightarrow 1.07 \times 10^4$
$0.107 \rightarrow 1.07 \times 10^{-1}$

$3.6 \times 10^3 \rightarrow 3600$
$3.6 \times 10^{-2} \rightarrow 0.036$

C. Converting Units

To convert prefixes, such as when using the same base unit, simply move the decimal.



To convert derived units, remember that multiplying or dividing by 1 does not alter an equation.

1 hr = 3600 s
1 y = 365 d
1 mile = 5280 ft.
1 m = 3.28 ft.

Examples:

a) 50 m → ___ km
0.05 km

b) 1200 hg → ___ g
120000 g

c) 1000 mL → ___ L
1 L

Common Conversion Factors		Example Problems:
Mass	1000 g = 1 kg	How many grams are in 32.5 kg? $32.5\,kg \times \frac{1000\,g}{1\,kg} = 32{,}500\,g$
Length	1000 mm = 1 m 100 cm = 1 m 1000 m = 1 km	How many millimeters are in 8.45 km? $8.45\,km \times \frac{1000\,m}{1\,km} \times \frac{100\,cm}{1\,m} \times \frac{10\,mm}{1\,cm} = 8450000\,mm$
Time	60 s = 1 min 60 min = 1 hr 24 hrs = 1 day	How many seconds are in 2.5 days? $2.5\,d \times \frac{24\,h}{1\,d} \times \frac{3600\,s}{1\,h} = 216{,}000\,s$

$\frac{65\,miles}{h} \times \frac{5280\,ft}{1\,mile} \times \frac{1\,m}{3.28\,ft} \times \frac{1\,h}{3600\,s} = 29\,m/s$

Ignore coefficients

D. Unit/Dimensional Analysis

Most physical quantities have dimensions that can be used to help solve problems.

Variable	Unit
x	m
v	m/s
t	s
a	m/s^2

E. Formula Manipulation

RULE #1: you can add, subtract, multiply and divide by anything, as long as you do the same thing to both sides of the equals sign.

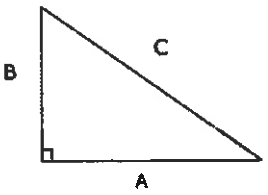
RULE #2: to move or cancel a quantity or variable on one side of the equation, perform the "opposite" operation with it on both sides of the equation.

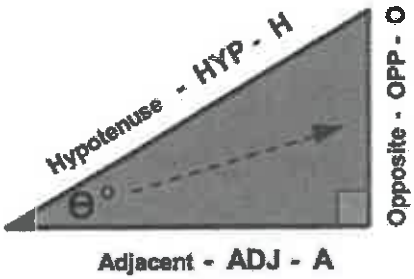
F. Solving Problems - GRASP Method

1. *Given* – state the known quantities
2. *Required* – state what is unknown
3. *Analyze* – determine the equation(s) to be used, check for like units, organize the steps to solve, draw a picture if needed
4. *Solve* – solve for the unknown variable
5. *Paraphrase* – make sure the answer makes sense and is in correct units and sig digits

G. Trigonometry

$A^2 + B^2 = C^2$





Name	Ratio	Expression
Sine	O / H	Sinθ
Cosine	A / H	Cosθ
Tangent	O / A	Tanθ

We use "SOH-CAH-TOA" to help us remember the Ratios

SOH is short for **Sine** = Opposite / Hypotenuse = O / H
CAH is short for **Cosine** = Adjacent / Hypotenuse = A / H
TOA is short for **Tangent** = Opposite / Adjacent = O / A

Examples:

$$x = vt + \frac{1}{2}at^2$$

Show this equation is dimensionally correct:

$[m] = \left[\frac{m}{s}\right][s] + \left[\frac{m}{s^2}\right][s]^2$

$= [m] + [m]$

$[m] = [m]$

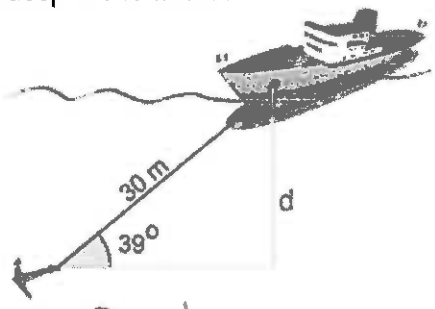
$$a = \frac{v_f - v_i}{\Delta t}$$

Solve for v_f:

$a\Delta t = v_f - v_i$

$v_f = v_i + a\Delta t$

A boat has a 30.0m long cable with anchor attached. If the ship is anchored at an angle of 39°, how deep is the water?



$\sin\theta = \frac{d}{30m}$

$d = 30m \times \sin 39°$

$= 18.9m$