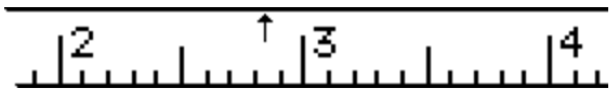
Basic Skills

Significant Figures

When taking measurements, we can only measure to a certain precision.

Ex. Using a ruler, you can measure something to be 4.5 cm. Saying you measured something that is 4.5368551 cm when using a ruler is impossible.

Rule: You can only measure to a certainty of _____ of the smallest increment. Every measurement will also have a degree of error (often follows the same rule of 10%)



- Smallest increment is 1 mm. Can measure up to .01 mm
    - The measurement is for sure greater than ____ but less than ____
    - For sure greater than _____ but less than _____
        - These first two numbers are 100% accurate
    - The last digit is the one that is _____ and is therefore the least accurate. This however, does not make it insignificant
    - Divide the segment between 0.8 and 0.9 into _____ segments and estimate the last digit.
        - Let's say it is 2.8____
        - The uncertainty of this value is 10% of the smallest division
        - We would write it as _____

The rules for sig figs are:

- Any _____ number is significant
    - 25.5 → three sig figs
- Zeros at the beginning of a measurement are never significant
    - 0.027 → two sig figs
- Zeros that are _____ between significant digits are significant
    - 2.07 → three sig figs
- Zeros at the end of a number are only significant if there is a _____ place
    - 200 → minimum 1 sig fig
        - 2×10^2 → 1 sig fig (most likely)
        - 2.0×10^2 → 2 sig figs
    - 200.0 → four sig figs
- Whole numbers have unlimited amount of significant figures

Trick: When dealing with zeros, change the number into scientific notation.

Basic Skills

Adding and Subtracting Significant Figures

The sum or difference cannot be more precise than the _____ precise measurement.

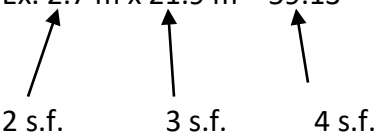
Ex. 2.711 + 3.2 = 5.911 = 5.9

2.711 is precise to the thousandth decimal place while 3.2 is precise to the tenth, therefore our answer must be no more precise than the _____ decimal place.

Multiplying and Dividing Significant Figures

The product or quotient must have the same number of sig figs as did the measurement that had the _____ number of sig figs.

Ex. 2.7 m x 21.9 m = 59.13



2 s.f. 3 s.f. 4 s.f.

Our answer can only have 2 sig figs because that is the fewest amount of measurements given.

Therefore the correct answer is 59 m^2

Multi-step Problems:

- When performing calculations with intermediate answers, keep at least one more sig fig than the final answer.
- In other words, only change your FINAL answer according the appropriate number of significant figures.

Worksheet 1.3 – Significant Figures

1) Counting sig figs: write down the number of sig figs each piece of data has:

   a) 0.0021 m

   b) 200,000 m^3

   c) 21.200 s

   d) 410 kg

   e) 0.0002 s

   f) 91.0001 m^2

2) Multiplication with sig figs:

   a) 92.45 m · 1.01 m =

   b) 0.0024 N · 4.24 s =

   c) 4000 kg · 2.001 m/s

   e) 0.00698 m^2 · 100 cm =

   f) 2001 kg · 12.6 m/s =

   g) 610 N · 4002 s =

3) Division with sig figs:

   a) 12 m ÷ 31.2 s =

   b) 69.4 kg ÷ 38.888 s =

   c) 0.012 m^2 ÷ 0.0002 s =

   d) 1800 kg ÷ 410 s =

   e) 0.102 m ÷ 100 ms =

   f) 1001 m^3 ÷ 40 ks =

4) Addition and subtraction with sig figs:

   a) 14 m + 12.2 m =

   b) 0.012 kg + 1.0046 kg – 0.0064 kg =

   c) 12.46 kg + 9.82 kg – 6.666 kg =

   d) 69.45 s + 19.3 s =

   e) 200.1 m – 128.28 m =

5) Chain calcs with sig figs: round off to the appropriate number of sig figs **at the end!**

   a) (0.045 m · 9.92 kg) ÷ 16.86 s =

   b) (9000 m · 4.01 m) · 1.002 m =

   c) (0.21 m · 6.23 s) · 1.002 m =

   d) (18.01 m · 0.41 m) ÷ (14.62 kg · 12 s) =

Unit 1: Basic Skills

Lesson 1 – Measurement and Scientific Notation

- Measurements in physics are carried out in _____ units; aka, the _____
- The size of the measurements can be expressed using _____. (ex. km vs. m)

Measurement	Unit	Symbol
Length		
Mass		
Time		
Speed		
Acceleration		
Force		
Energy		

Prefix	Symbol	Factor

Converting Units:

Long way:

Short Way:

Single Step:

1: Find the _____

2: Find the _____ of each prefix.

3: Use the _____ _____!

Multi-Step:

Ex.

1) Convert 165 mm to m

2) Convert 380 cg to mg

3) Convert 24 ML to mL

4) Convert 24 m/s to km/h

When converting between m/s and km/h remember the magic number:

Scientific Notation:

Ex:

32 000 000 →

0.00000436 →

- Move the decimal point until only...

- The # of spaces moved is the...

- Move left and the exponent is _____

-Move right and the exponent is _____

1. Write the following numbers in scientific notation:

a) 5,500,000,000

b) 780

c) 0.091

d) 0.000003004

2. Write the following numbers in regular notation:

a) 5.5×10^{-4}

b) 7.1×10^{6}

c) 1.0×10^{3}

3. Compute the following:

a) $10^{3} \times 10^{5}$

b) $4 \times 10^{-3} \times 5 \times 10^{-5}$

c) $10^{-3} \times 10^{5}$

d) $(8.0 \times 10^{5})(1.2 \times 10^{8})$

e) $10^{3} \div 10^{5}$

f) $(2.3 \times 10^{-3}) \div (1.0 \times 10^{-5})$

g) $10^{-3} \div 10^{5}$

h) $(3 \times 10^{8})^{2}$

Unit 1: Introduction

2 - Algebra

- Often in physics, you will be given a formula. You need to be able to manipulate these formulae.

Ex:

1. Solve for "a" → F = ma

2. Solve for "t" → v = d/t

3. Solve for "c" → $E = mc^2$

4. Solve for "d" → $v^2 = u^2 + 2ad$

- Once you can manipulate formulae, you can plug in numbers.

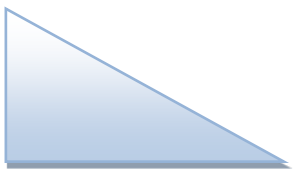
Ex:

1. Solve for "d" given that v = d/t
   - v = 36 m/s and t = 8.0 s

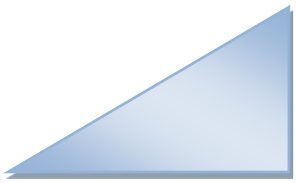
2. Solve for "m" given that F = ma
   - F = 150 N and a = 2.50 m/s^2

Trigonometry

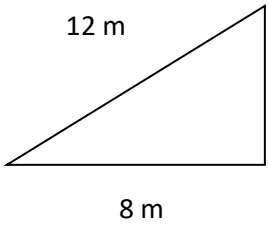
- **Pythagorean Theorem**



Trig Ratios



Ex. Solve the Triangle



Worksheet 1.3: Trigonometry

Draw Diagrams. *Show work. Round off all answers to one decimal place.*

1. The angle of elevation of the summit from the bottom of the lift at Snow Bowl is 33˚. If a skier rides 1000 m on this lift to the summit, what is the vertical distance between the bottom of the lift and the summit?

2. The angle of depression (below the horizontal) of an aircraft carrier from an approaching airplane is 52.2˚. If the plane is 700 m above level of the deck of the carrier, how far away is the plane from the carrier?

3. The navigator on a bomber finds that the angle of depression of a target 4.00 km away is 11.4˚. At what altitude is the plane flying?

4. Billy's kite has a string 40 m long and is flying 27 m above his eye level. Find the angle of elevation of the kite.

5. At an airport, cars drive down a ramp 96 m long to reach the lower level baggage-claim area 13 m below the main level. What angle does the ramp make with the ground at the lower level?

   .

6. A pendulum 40 cm long is moved 30˚ from the vertical. How high is the lower end of the pendulum lifted?

Bonus: The angle of depression of the top of Billings Building from the roof of the Wolcott Building (in the same vertical plane) is 33.10˚, and from the 15^{th} floor it is 21.50˚. If the distance between the roof and the 15^{th} floor is 101 m, how far apart are the buildings?

Basic Skills

Solving Equations

Evaluate the following using the information given. Try algebraically solving for the unknown first.

1. $v_f = v_i + at$ (find a, if $v_i = 2, v_f = 16, t = 2$)

2. $F = \frac{mv^2}{r}$ (find r, if $F = 10, m = 5, v = 4$)

3. $T = 2\pi\sqrt{\frac{m}{k}}$ (find m, if $T = 3, k = 50$)

4. $\frac{{P_1}^2}{{d_1}^3} = \frac{{P_2}^2}{{d_2}^3}$ (find $d_2, if\ P_1 = 10, P_2 = 8, d_1 = 2$)

5. $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$ (find $d_o, if\ d_i = 20, f = 12$)

6. $d = v_o t + {}^1\!/_2\, at^2$ (find t, if $v_i = 0, d = 125, a = 10$)

Solve the following word problems using the information and steps (I, II, III) provided.

7. If an airplane travels at 120 m/s (v), how long would it take (t) for the plane to travel a distance (d) of 300 m?

I. List givens

v =
d =
t =

Concept Equation: $v = \frac{d}{t}$

II. Derive Equation (solve for t)

II. Substitute the given values (I) into your derived equation (II) and solve.

Basic Skills

8. A toy car accelerates from an initial velocity (v_i) of 5 m/s, to a final velocity (v_f) of 17 m/s, in 6 seconds (t). Find the acceleration of the car.

Concept Equation: $v_f = v_i + at$

<u>Worksheet 1.2 Algebra</u>

1. Solve each formula for the variable indicated.

a) A = lw, "w"

b) A = $^1/_2$ bh, "h"

c) g = a + w, "a"

d) P = s – e, "s"

e) v = u + at, "u"

f) W = R + Ht, "t"

2. Solve for the variable indicated.

a) d = vt + ½at^2 , solve for "a"

b) $C = \frac{nE}{nr + R}$, solve for "E"

c) $F = \frac{mn}{d^2}$ solve for "n"

3. The formula for the circumference of a circle is C = πd, where π = 3.14.
   a) Solve the formula for d.
   b) Canada's largest tree is a Douglas fir on Vancouver Island. Its circumference is 12.54 m. Use the formula for find the diameter of Canada's largest tree.

4. Density can be calculated by the formula D = m/V, where D = density, m = mass and V = volume.
   Find the mass of:
   a)55.2 cm^3 of aluminum (d_{Al} = 2.70 g/cm^3)

   b) 82.3 cm^3 of mercury (d_{Hg} = 11.4 g/cm^3).

5. The temperature below the Earth's surface, T, in degrees Celsius, is given by the formula: T=10d + 20, where d is the depth in kilometers.
   a) The deepest hole in the Earth is a test-drilling hole in Russia. At the bottom of the hole the temperature is expected to reach 170'C. Estimate the depth of the drilling.

   b) Estimate the depth of a mine in which the temperature is 420˚C.

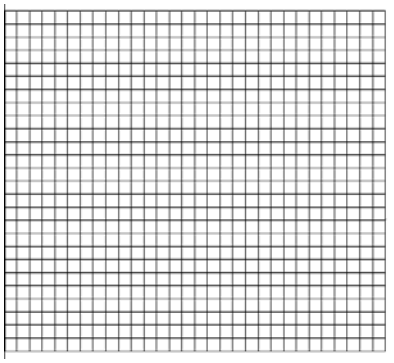
Unit 1: Introduction

4 – Graphing

Graphing Rules

- Label the axis
  - _____ variable on the x-axis
  - _____ variable on the y-axis
- Give the graph an _____ _____.
- Scale each axis
  - Use…
  - Choose a scale that is…
  -
- Plot the points and draw a _____ _____ _____.

Direct Relationship



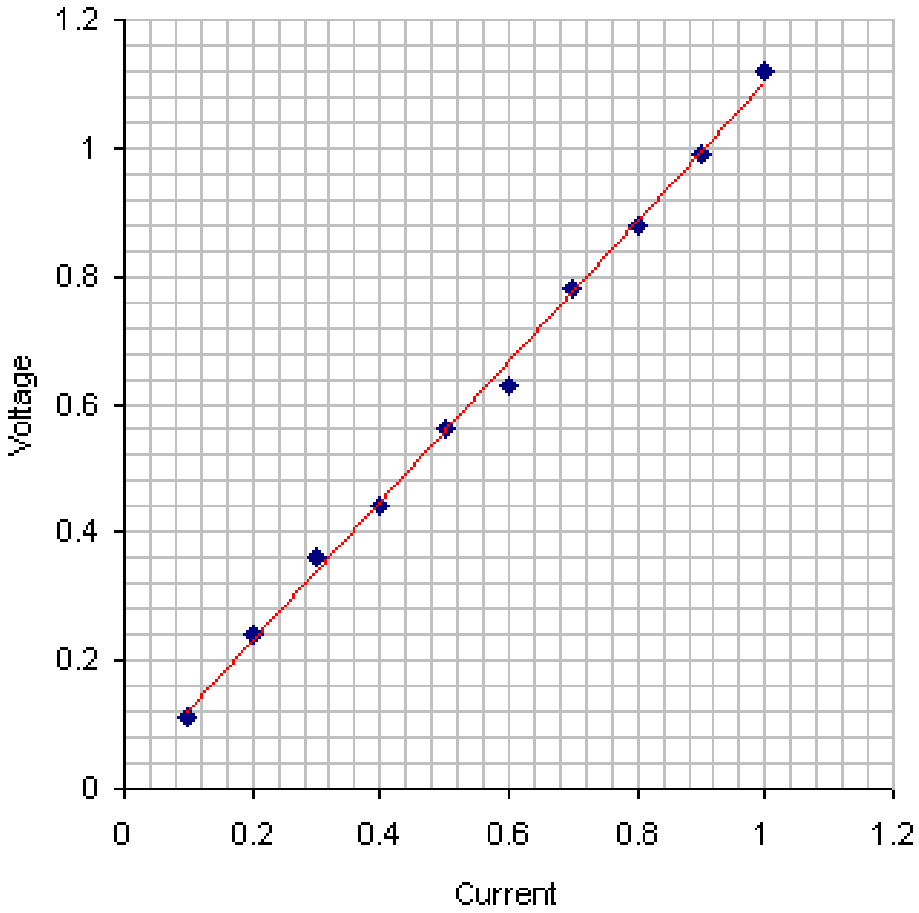
Finding Slope

To find the slope of a straight line:

- Choose…
- Choose them as…
- Use only…

Remember the equation of a line is:

Determine the slope and y-intercept of the graph shown and write the equation describing this line.



Graphs of Wrath

Mr. Trask was interested in seeing the relationship between the variables velocity and time. He took three suped-up Hot Wheels cars and ran them through an extensive timing circuit. Here are three sets of data recorded in Mr. Trask's secret laboratory lair:

Car 1		Car 2		Car 3	
Time (s)	Velocity (m/s)	Time (s)	Velocity (m/s)	Time (s)	Velocity (m/s)
0	0	0	0	0	0
5	6	5	10	5	3
10	12	10	17	10	7
15	16	15	25	15	11
20	23	20	33	20	14
25	30	25	42	25	19
30	34	30	51	30	22
35	40	35	67	35	25
40	46	40	73	40	30
45	55	45	81	45	34
50	62	50	89	50	39

Your challenge as Mr. Trask's assistant/lackey is to provide a beautiful graph of all three sets of data on only ONE piece of graph paper (Mr. T's lab is a bit budget). Follow the steps like we did in our notes and you will be fine. You MUST have all data fit on your graphs, so you will have to make some tough decisions about your variable range on the axes. Also, use as much space as possible.
Mr. Trask will be looking to make sure your graph is readable and all your labeling and calculations are on the graph as well.

Questions (show all work **on your graph paper**):

1) Find:
   Slope of the line for car 1
   Slope of the line for car 2
   Slope of the line for car 3

2) a. Write an equation for the line for car 1.
   b. Use this equation to predict how fast car 1 will be traveling at t = 90 s.

Discussion:

1) Pretend car 2 has some really bad tires, which heat up and get sticky the longer the vehicle moves. As the tires get stickier, the car's acceleration decreases. What would you predict the graph of car 2 would look like?
Sketch a graph.

2) Pretend that at t = 55s the driver of car 3 sees an adorable marmot in the road and jams on the brakes, suddenly stopping. What would you predict the graph of car 3 would look like?
Sketch a graph.