Welcome to AP Chemistry 2021-2022 Mrs. Scott

The Course:

AP Chemistry is a two-semester college level course. It is a time-consuming and challenging, yet extremely rewarding course! It moves at a fast pace and will require a large amount of independent study outside of the class. Your study skills will improve and you will learn to do college level work. To have success on the AP exam, students will need to spend on average five to ten additional hours per week outside of class working on AP chemistry. This time will be spent on homework assignments, pre-labs, lab reports, problem sets, etc. There will be times that students will be able to complete things during class if they use their time efficiently. These statements are not meant to discourage, but to point out and state the truth to avoid any misconceptions about the high expectations for this course. As your teacher, I will do my very best to provide a college level course/experience which not only prepares you for the AP exam, but provides a solid foundation in chemistry. It is also intended for it to be fun! You are fortunate to be able to take this type of college level course in the high school setting as part of a small class.

Summer Assignment:

1. **Read the Data Analysis Power Point.** It has information that you will need throughout the course.
2. **Do the worksheets below.**

   This will be graded as homework assignment and for correctness. It is due on the FIRST day of class. This is an AP class and all work must be completed independently. You are on the **honor system**. The material on these pages is NOT new, you learned them last year. But they are skills you will need that I won't be teaching again. You can use your notes from Honors Chemistry to help you or the AP text book.

<u>This form must be signed and returned with Summer Assignment:</u>

I, ___________________________________, worked on this assignment by myself. (student signature)

I know that everything that I take credit for in this class is a reflection of both myself and my character. I promise to take full responsibility for all my actions and strive to give my best at all times.

For the fall, similar to Honors Chemistry, you will be given a worksheet packet along with a power point for each chapter/unit. I would recommend a binder for this class. I am really excited to work with you all again this fall!!!

Monatomic Cations	**Monatomic Anions**	**Polyatomic Cations**	**Polyatomic Anions**
Group 1 (including H) H^{+1}, hydrogen Li^{+1}, lithium Na^{+1}, sodium K^{+1}, potassium Cs^{+1}, cesium Group 2 Be^{+2}, beryllium Mg^{+2}, magnesium Ca^{+2}, calcium Sr^{+2}, strontium Ba^{+2}, barium Group 13 Al^{+3}, aluminum Transition and Heavier Metals Cr^{+2}, chromium (II) Cr^{+3}, chromium (III) Mn^{+2}, manganese (II) Mn^{+4}, manganese (IV) Mn^{+7}, manganese (VII) Cu^{+1}, copper (I) Cu^{+2}, copper (II) Fe^{+2}, iron (II) Fe^{+3}, iron (III) Pb^{+2}, lead (II) Pb^{+4}, lead (IV) Hg^{+2}, mercury (II) Ni^{+2}, nickel (II) Ni^{+3}, nickel (III) Sn^{+2}, tin (II) Sn^{+4}, tin (IV) Ag^{+1}, silver Zn^{+2}, zinc	Group 17 and H H^{-1}, hydride F^{-1}, fluoride Cl^{-1}, chloride Br^{-1}, bromide I^{-1}, iodide Group 16 O^{-2}, oxide S^{-2}, sulfide Group 15 N^{-3}, nitride P^{-3}, phosphide	Ammonium, NH_4^{+1} Mercury (I), Hg_2^{+2}	Acetate, $C_2H_3O_2^{-1}$ Bicarbonate (hydrogen carbonate), HCO_3^{-1} Carbonate, CO_3^{-2} Perchlorate, ClO_4^{-1} Chlorate, ClO_3^{-1} Chlorite, ClO_2^{-1} Hypochlorite, ClO^{-1} Permanganate, MnO_4^{-1} Cyanide, CN^{-1} Hydroxide, OH^{-1} Peroxide, O_2^{-2} Nitrate, NO_3^{-1} Nitrite, NO_2^{-1} Chromate, CrO_4^{-2} Dichromate, $Cr_2O_7^{-2}$ Sulfate, SO_4^{-2} Sulfite, SO_3^{-2} Phosphate, PO_4^{-3} Phosphite, PO_3^{-3}

***Note: Transition metals are named with Roman numerals to indicate their oxidation state (charge) if they have multiple oxidation states. Silver and zinc are the only transition metals on this list that have a single oxidation state and therefore are not named with roman numerals. As long as you know which transition metals need Roman numerals, individual charges of these metals do not need to be memorized.

INFORMATION IN THE TABLE BELOW AND IN THE TABLES ON PAGES 3-5 MAY BE USEFUL IN ANSWERING THE QUESTIONS IN THIS SECTION OF THE EXAMINATION.

DO NOT DETACH FROM BOOK.

PERIODIC TABLE OF THE ELEMENTS

1 **H** 1.0079																	2 **He** 4.0026
3 **Li** 6.941	4 **Be** 9.012											5 **B** 10.811	6 **C** 12.011	7 **N** 14.007	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.179
11 **Na** 22.99	12 **Mg** 24.30											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.974	16 **S** 32.06	17 **Cl** 35.453	18 **Ar** 39.948
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.90	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.938	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.39	31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.75	52 **Te** 127.60	53 **I** 126.91	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba** 137.33	57 ***La** 138.91	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.85	75 **Re** 186.21	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.2	83 **Bi** 208.98	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** 226.02	89 **†Ac** 227.03	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (262)	108 **Hs** (265)	109 **Mt** (266)	110 **§** (269)	111 **§** (272)	112 **§** (277)	§Not yet named					

*Lanthanide Series	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 151.97	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.04	71 **Lu** 174.97
†Actinide Series	90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np** 237.05	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)

Metric Conversions

Unit	Symbol	*Equivalent Expressions*	
mega	**M**	**1 Mg** = 1,000,000 g = 10^6 g	**1 Mg** = 1,000,000 g = 10^6 g
kilo	**k**	**1 kg** = 1,000 g = 10^3 g	**1 kg** = 1,000 g = 10^3 g
hecta	**h**	**1 hg** = 100 g = 10^2 g	**1 hg** = 100 g = 10^2 g
deca	**da**	**1 dag** = 10 g = 10^1 g	**1 dag** = 10 g = 10^1 g
o		1g = 10^0g	1g = 10^0g
deci	**d**	**1 g** = 10 dg = 10^1 dg	**1 dg** = 0.1 g = 10^{-1} g
centi	**c**	**1 g** = 100 cg = 10^2 cg	**1 cg** = 0.01 g = 10^{-2} g
milli	**m**	**1 g** = 1,000 mg = 10^3 mg	**1 mg** = 0.001 g = 10^{-3} g
micro	µ	**1 g** = 1,000,000 µg = 10^6 µg	**1 µg** = 0.000001 g = 10^{-6} g
nano	**n**	**1 g** = 1,000,000,000 ng = 10^9 ng	**1 ng** = 0.000000001 g = 10^{-9} g
pico	**p**	**1 g** = 1,000,000,000,000 pg = 10^{12} pg	**1 pg** = 0.000000000001 g = 10^{-12} g

* Any quantity can be substituted for g; ie. 1 L = 1000 mL just as 1 g = 1000 mg

A helpful pnemonic for memorizing prefixes (you need to know these):

Many kids have dropped over dead converting metric measurements in problems.

Advanced Placement Chemistry Review Assignment

Topic 1: Significant Figures & Scientific Notation

1. Count the number of significant figures in the following measurements.

   a. 2.71 g _____ b. 0.00047 kg ______ c. 7.0×10^5 m _______ d. 1,030 L _____

   e. 150 pencils __________ f. 37500 µg ______ g. 0.1010 cm ______

2. Express each of the following in proper scientific notation (Pay attention to sig figs and units).

   a. 0.000125 m _________________ b. 155.0 mL ______________________

   c. 123,030,000 ng _________________ d. 481.9×10^{-9} cm _________________

3. Calculate the correct answer with proper units and significant figures for each of the following:

   a. 12 g + 0.677 g + 86.33 g = ______________________

   b. (355.78 g) / (0.056 g) = _______________________

   c. 97.34 mL – 34.1 mL = _______________________

   d. 14.68 x 5 = _______________________

4. Perform the following calculations with scientific notation and report your answer with the correct number of significant figures.

   a. $0.14 \times (6.02 \times 10^{23}) =$ __________________________

   b. $\frac{(9.875 \times 10^4) - (9.795 \times 10^4)}{9.875 \times 10^4} \times 100\ \% =$ ___________________ (assume 100 is exact)

   c. $\frac{(3.8 \times 10^{-12} \times 4.0 \times 10^{-13})}{(4 \times 10^{12} \times 6.3 \times 10^{13})} =$ ______________________

Topic 2: Dimensional Analysis

Show work using dimensional analysis. No work = no credit even if answer is correct. Follow significant figures and rounding rules unless the number of significant figures is specified. Include units where appropriate.

5. How many hours are in a week? Report your answer to three significant figures.

6. Find the number of centimeters in 1.00×10^2 yards. (1 yd = 3 ft, 1 ft = 12 in, 2.54 cm = 1 in)

7. If Jules Verne expressed the title of his famous book, <u>Twenty Thousand Leagues under the Sea</u> in basic SI units, what would the title be? Round your answer to three significant figures.
   (1 league = 3.45 mi, 1 mi = 1609 m)

8. How many μL are present in 250 mL of H_2O?

9. Wavelengths are often represented in nm. What is the diameter of a helium (He) atom in nm if it is equivalent to $1.0x10^{-13}$ km?

10. The area of a rectangular room has a length of 10.5 m and a width of 4.50 m. What is this area in m^2? In cm^2?

11. The acceleration of a sphere is determined to be 9.52 m/s^2. What is the acceleration in km/min^2?

<u>Topic 3: Density and Temperature</u>

Show all work. No work = no credit even if answer is correct. Follow significant figures and rounding rules. Include units where appropriate.

12. A rectangular block has dimensions of 2.9 cm x 3.5 cm x 10.0 cm. The mass of the block is 615.0 grams. What are the volume and the density of the block?

13. The density of pure silver is 10.5 g/mL at 20°C. If 5.25 grams of pure silver pellets are added to a graduated cylinder containing 11.2 mL of water, to what volume will the water in the cylinder rise?

14. You can figure out whether a substance floats or sinks if you know its density and the density of the liquid. In which of the liquids listed below will high-density polyethylene, HDPE, float? HDPE, a common plastic, has a density of 0.97 g/cm^3. It does not dissolve in any of the following liquids.

Substance	Density (g/cm^3)
ethylene glycol	1.1088
water	0.9997
ethanol	0.7893
methanol	0.7914
acetic acid	1.0492
glycerol	1.2613

15. Mercury is found as a liquid at room temperature. If it has a boiling point of 630. K, what is this boiling point in degrees Celsius?

Topic 4: Precision and Accuracy

16. The density of ethanol was determined experimentally at 25°C in a series of trials to be 0.608 g/mL, 0.705 g/mL, and 0.689 g/mL. The accepted density of ethanol is reported to be 0.789 g/mL.
    a. Are the experimental densities precise? Why/Why not?

    b. Calculate % error for this experiment. Use the average experimental density in your calculation and report your answer to 0.1%. Show your work.

    c. Are the experimental densities accurate? Why/Why not?

Topic 5: Properties and Changes

17. Categorize each of the following as an element, a compound, or a mixture:
    a. carbonated water ______________
    b. tungsten ______________
    c. aspirin (acetylsalicylic acid) ______________
    d. air ______________
    e. lye (sodium hydroxide) ______________
    f. fluorine ______________

18. Iron pyrite, also known as fool's gold, has a shiny golden metallic appearance. Crystals are often in the form of perfect cubes. A cube of iron pyrite measuring 0.40 cm on each side has a mass of 0.064 g.

    a. Which of these observations are qualitative and which are quantitative?

    b. Which of these observations are extensive (dependent on the amount of substance present) and which are intensive (independent of the amount of substance present)?

19. Identify the following as a physical property, physical change, chemical property, or chemical change:

    a. Ethanol has a density of 0.697 g/mL. ________________

    b. The solution turns blue upon mixing water and food coloring. ________________

    c. Wood burns in an oven. ________________

    d. Methyl alcohol is highly flammable. ________________

    e. Ice melts in a beaker. ________________

    f. Methyl ethanoate smells like apples. ________________

    g. Iron rusts on a car. ________________

    h. Alkali metals react strongly in hydrochloric acid. ________________

<u>Topic 6: Atom Structure & History</u>

20. How many protons and neutrons are contained in the nucleus of each of the following atoms? How many electrons are present in each of these neutral atoms?

    a. ${}^{13}_{6}C$ ____ protons ____ neutrons ____ electrons

    b. ${}^{208}_{82}Pb$ ____ protons ____ neutrons ____ electrons

21. Complete the following table:

Name	Mass #	Atomic #	# of Protons	# of Neutrons	# of Electrons	Symbol
Gallium-70					31	
						${}^{31}_{15}P^{-3}$
Strontium-80					36	
						${}^{55}_{25}Mn^{+2}$

22. The natural abundance for boron isotopes is 19.9% boron-10 (exact mass 10.013 amu) and 80.1% boron-11 (exact mass 11.009 amu). Calculate the average atomic mass of boron using the exact masses instead of mass numbers in your calculations. Show your work. Follow significant figures and rounding rules. Include appropriate units.

23. Europium has two stable isotopes, ^{151}Eu and ^{153}Eu, with masses of 150.9197 u and 152.9212 u, respectively. Calculate the percent abundances of these isotopes of europium to 0.1%. Hint: The percent abundances of these two isotopes must add to 100%. Show your work. Follow significant figures and rounding rules. Include appropriate units.

24. Identify the scientist(s) noted for the following events in atomic history.
   a. identified the electron; noted for the plum pudding model ________________
   b. noted for the first atomic theory of the atom; solid sphere model ______________
   c. developed the planetary model; electrons in fixed orbits _______________
   d. developed the quantum mechanical model; electrons are localized to orbitals ____
   e. identified the proton and the nucleus; nuclear model _________________
   f. determined the charge of an electron __________________
   g. described wave theory _________________
   h. known for the uncertainty principle _________________
   i. developed quantum numbers _________________

25. Identify the model of the atom described in the following statements.
   a. currently accepted model ______________________
   b. model that first included a subatomic particle _____________________
   c. model developed using the gold foil experiment ______________________
   d. original model of the atom; atom was thought to be "indivisible" ___________________
   e. model that only showed the movement of hydrogen's electron accurately; involved "quantums" ________________________

Topic 7: Periodic Table Structure

Identify by name the group or section of the periodic table noted for the following features.

26. a. group containing the most reactive nonmetals; all are diatomics; form -1 ions _______________
   b. group containing metals that only form +2 ions ________________________________
   c. set of metals that often form colored ions in solution; the majority have multiple charges as ions ____________________________
   d. group containing the most reactive metals; form +1 ions _______________________
   e. group containing least reactive elements on periodic table, typically inert __________________

27. These elements start with the letter B: B, Ba, Bk, Bi, and Br. Identify which of these elements match the following descriptions. You may use elements once, more than once, or not at all.
   a. Which are metals? ______________________
   b. Which are liquids? ______________________
   c. Which are actinides? ______________________
   d. Which are main block elements? ______________________

Topic 8: Compound Nomenclature

28. Name or give the formula for the following compounds. All ions included in the summer letter are required to be memorized by name and by formula.

	Name	Formula
a.	lithium fluoride	______________
b.	______________________________	K_2O
c.	calcium phosphate	______________
d.	______________________________	$MnCl_2$
e.	silver sulfide	______________
f.	______________________________	Cu_2O
g.	aluminum sulfate	______________
h.	______________________________	$ZnCO_3$
i.	chromium (III) phosphide	______________
j.	______________________________	SO_3
k.	lead (IV) hydroxide	______________
l.	______________________________	N_2O_5
m.	ammonium sulfite	______________
n.	______________________________	$BaCr_2O_7$
o.	sodium peroxide	______________
p.	______________________________	NH_3 (use common names; see ppt/videos if necessary)
q.	nickel (II) hypochlorite	______________
r.	______________________________	$Fe(CN)_3$
s.	rubidium chromate	______________
t.	______________________________	$Mg_3(PO_4)_2$

Topic 9: Equations

29. Balance the following equations using the lowest whole-number coefficients.

a. __Fe + __P_4 → __Fe_3P_2

b. __Ca + __H_2O → __$Ca(OH)_2$ + __H_2

c. __$Ba(OH)_2$ + __H_3PO_4 → __$Ba_3(PO_4)_2$ + __H_2O

d. __$(NH_4)_2CO_3$ + __$Al(ClO_3)_3$ → __$Al_2(CO_3)_3$ + __NH_4ClO_3

30. Write balanced chemical equations for the following word equations. Use the lowest possible whole-number coefficients to balance the equations.

a. Aqueous solutions of ammonium sulfate and barium nitrate form a precipitate of barium sulfate and aqueous ammonium nitrate.

b. Elemental magnesium and oxygen gas combine to form solid magnesium oxide.

c. Chlorine gas and aqueous potassium bromide react to form bromine liquid and aqueous potassium chloride.

d. Solid copper (II) carbonate decomposes to form crystals of copper (II) oxide and carbon dioxide gas.

e. Sulfuric acid is neutralized by lithium hydroxide to form water and aqueous lithium sulfate.

f. Liquid benzene, C_6H_6, undergoes combustion in oxygen gas, making carbon dioxide gas and steam.

<u>Topic 10: Mole Conversions & Stoichiometry</u>

Show your work. No work = no credit. Follow significant figures and rounding rules. Include appropriate units.

31. a. Calculate the number of moles in 500. atoms of iron (Fe).

b. What is the molar mass of lead (IV) carbonate, $Pb(CO_3)_2$?

c. How many formula units are present in 87.2 grams of lead (IV) carbonate?

d. What percentage of oxygen is found in lead (IV) carbonate? Round your answer to 0.1%.

32. The reusable booster rockets of the U.S. space shuttle employed a mixture of aluminum and ammonium perchlorate for fuel. A possible reaction for this is:

__Al(s) + __ NH_4ClO_4(s) → __ Al_2O_3(s) + __ $AlCl_3$(s) + _ NO(g) + __H_2O(g)

a. Balance the above reaction using the lowest possible whole-number coefficients.

b. If 4.00 g of aluminum reacted completely, how many grams of aluminum oxide would be made?

c. If 4.18 g of aluminum chloride was produced, how many moles of ammonium perchlorate would be consumed?

d. How many molecules of nitrogen monoxide would form if 6.3×10^{25} formula units of aluminum oxide were also produced?

33. The decomposition of ammonia is shown in the following equation: $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$.

a. 42.0 g of nitrogen has what volume in liters at STP?

b. 150 L of NH_3 undergoes decomposition to form how many liters of hydrogen gas at STP?

c. How many liters of ammonia were decomposed at STP if 3.0×10^{23} nitrogen molecules were made?

Data Analysis

This goes over some basic information you need in order to analyze date in a lab or in a problem

Significant figures

3.7 cm + 4.6083 cm = 8.3 cm The result is written with one decimal place because the number 3.7 has only one significant digit to the right of the decimal.

48.3506 m – 6.28 m = 42.10 m The result is written with two decimal places because the number 6.28 has only two significant digits to the right of the decimal.

(8 km – 4.2 km) + 1.94 km = 6 km The result is written with zero decimal places because the number 8 has zero significant digits to the right of the decimal

5.246 in. × 2.30 in. = 12.1 in. The result is written with three significant digits because 2.30 has three significant digits.

0.038 cm ÷ 5.273 cm = 0.0072 cm The result is written with two significant digits because 0.038 has two significant digits.

76.34 m × 2.8 m = 2.1×102 m The result is written with two significant digits because 2.8 has two significant digits. [Note that scientific notation had to be used because writing the result as 210 would have an unclear number of significant digits.

Calculations Using Percentages

Percent Change

$$\% \text{ change} = \frac{\text{Final value} - \text{Initial Value}}{\text{Initial Value}} \times 100$$

If the mass of a dialysis bag at the beginning of the experiment was 12.2 g and at the end of the experiment it was 16.7 g, the percent change is

% change = (16.7 -12.2) / 12.2   x 100

= 36.9%

% change can be negative or positive

Percent Error

$$\% error = \frac{|\text{experimental value} - \text{theoretical value}|}{\text{theoretical value}} \times 100$$

Calculate the percent error of a titration of 3.0% hydrogen peroxide (H2O2) with potassium permanganate (KMnO4).   If we performed this investigation and calculated the concentration of in our sample to be 2.74%, our calculation would be:

$$\% error = \frac{|2.74 - 3.0|}{3.0} \times 100$$

$$= \frac{0.26}{3.0} \times 100$$

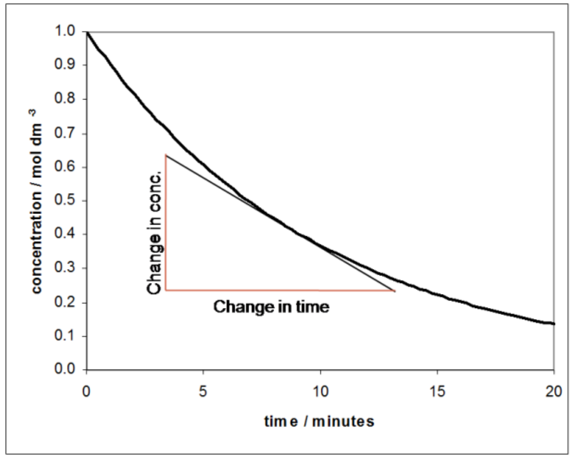
$$= 8.67\%$$

This means that our titration yielded data that was in error by 8.67% relative to what was expected.

Rate Calculations

You may occasionally have to determine a rate of change when you are processing data from an experiment.

$$\frac{\Delta Y}{\Delta t} = \frac{\text{the change in the dependent variable}}{\text{the change in time}}$$



where Δ Y represents the change on the y-axis and Δ t represents the change on the x-axis. Whenever you are graphing and time is a variable, it is always the independent variable and on the x-axis

Suppose you were doing an AP Physics lab and wanted to calculate the magnitude of the average velocity (speed) of an object. You would do this by calculating the displacement traveled during a particular period of time. So, if you pushed a toy car across the floor and it traveled in a straight line from 1.0 meter to 4.0 meters in 8 seconds, you would calculate the speed as follows:

$$\text{average velocity} = \frac{\text{displacement}}{\text{time}} = \frac{(4.0-1.0)\text{meters}}{(8-0)\text{seconds}} = \frac{3.0\text{meters}}{8\text{seconds}} = 0.375\text{meters/sec}$$

Suppose you are doing an AP Chemistry lab and needed to calculate the rate of the decompostion of NO_2 from 60 to 120 seconds:

$$NO_2(g) \rightarrow 2NO(g) + O_2(g)$$

Time (seconds)	$[NO_2]$	$[NO]$	$[O_2]$
0	0.0150	0	0
60	0.0085	0.0027	0.0018
120	0.0071	0.0041	0.0024

$$Rate = \frac{\Delta A}{\Delta t} = \frac{\Delta[NO_2]}{\Delta t}$$

$$Rate = \frac{0.0071\,M - 0.0085\,M}{120\,sec - 60\,sec}$$

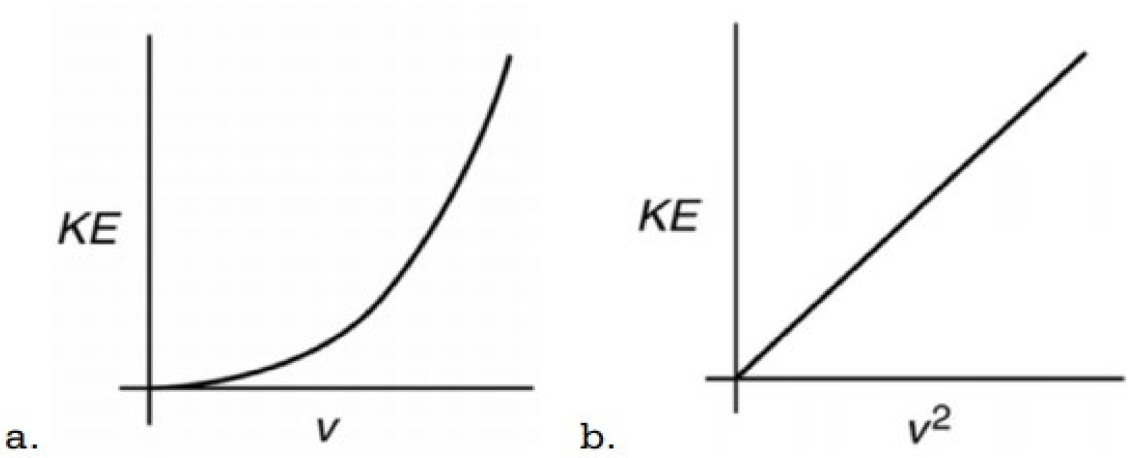
$$Rate = \frac{-0.0014\,M}{60\,sec} = -2.33\times10^{-5}\,M/sec$$

The reason the concentration goes down is because the NO_2 is being turned into the products, so its amount will go down over time. The amount of the products will go up as time goes on.

Linear Relationships and Curve Fitting

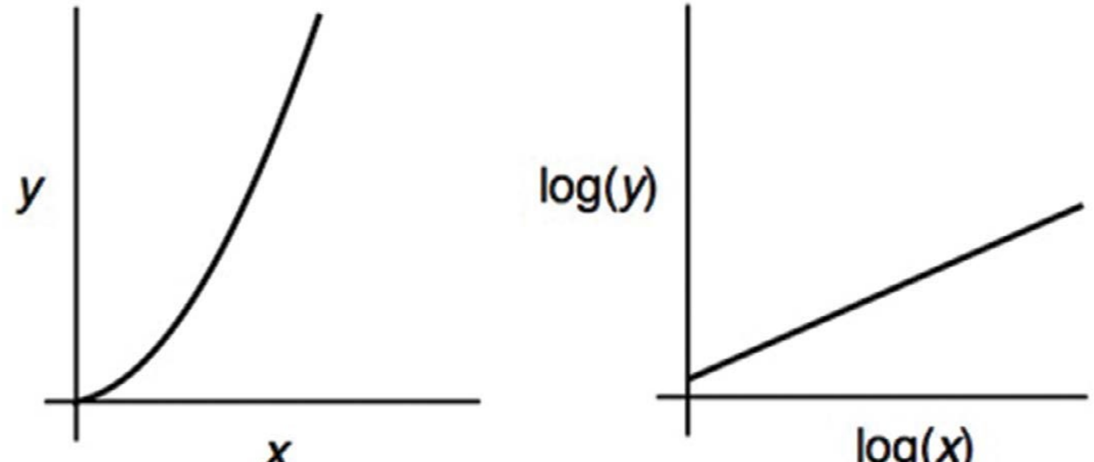
Graphing Data as a Straight Line

- You can represent data as a straight line on a graph as long as you can identify its slope (m) and its y-intercept (b) in a linear equation: y = mx + b
- Even if the data you measure do not have an apparent linear relationship, you may be able to represent the data as a straight line by revising the form of the variables in your graph.



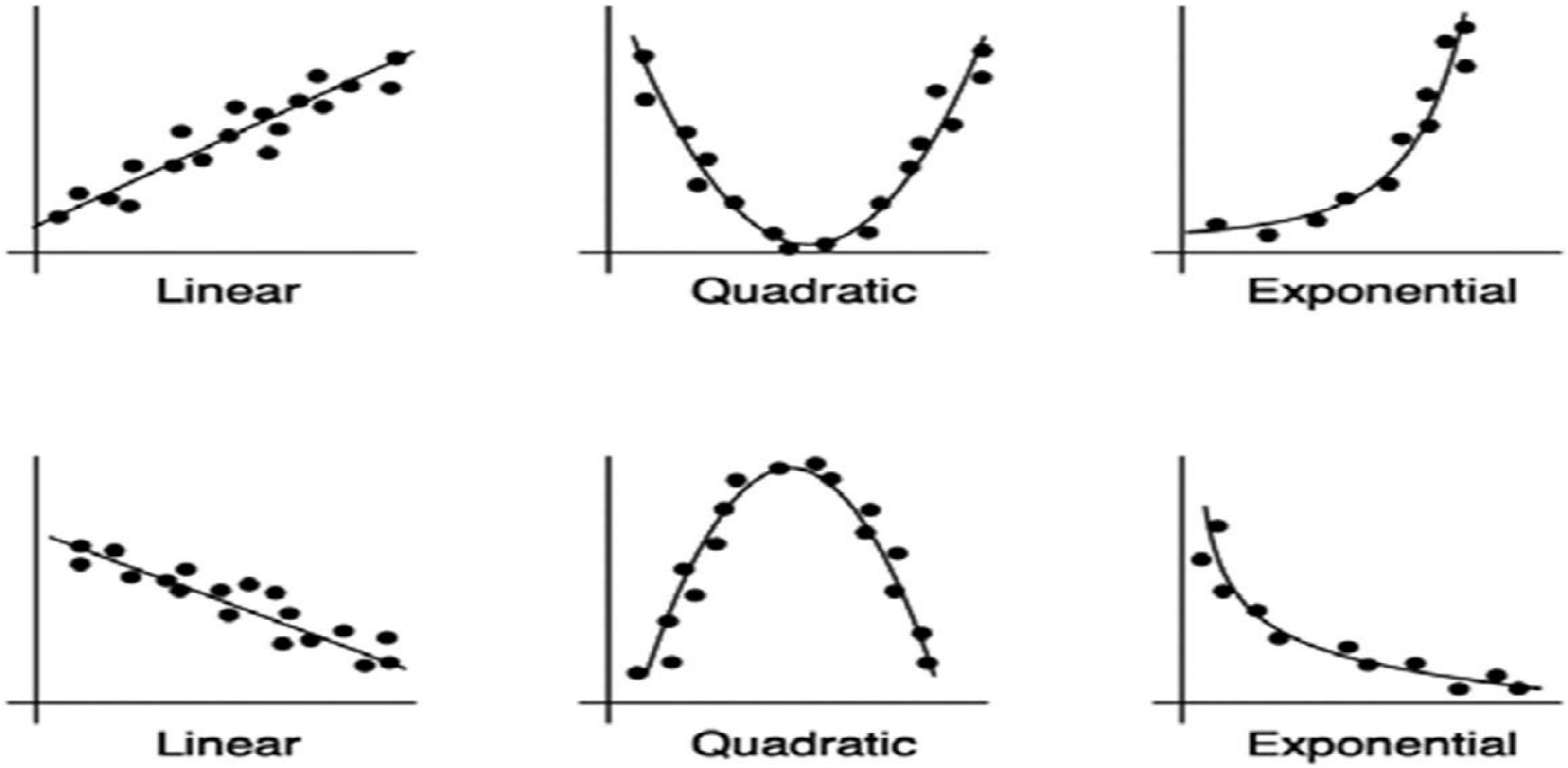
Kinetic Energy (KE)= $1/2mv^2$, so it makes sense that since KE is proportional to v^2, that would give a straight line.

Similarly, for an equation with a power of *x*, taking the log of both sides of results in . If you plot log(*y*) versus log(*x*), the data will approximate a line with y-intercept log(*a*) and slope *n.*



Curve Fitting

A useful way to analyze data is to determine whether it corresponds to a certain mathematical model. A mathematical relationship or function will allow you to make a prediction if you know the function and an initial condition. The first step is to plot the points and see if t hey follow a recognizable trend, such as a linear, quadratic, or exponential function.



Accuracy, Precision, and Experimental Error

Accuracy

- how close a measurement is to a known or accepted value.
- For example, suppose the mass of a sample is known to be 5.85 g. A measurement of 5.81 g would be more accurate than a measurement of 6.05 g because 5.81 g is closer to actual value of the measurement.

Precision

- how close several measurements are to each other. The closer measured values are to each other, the higher their precision.

Measurements can be precise even if they are not accurate. Consider a sample with a known mass of 5.85 g. Suppose several students each measure the sample's mass, and all of the measurements are close to 8.5 g. The measurements are precise because they are close to each other, but none of the measurements are accurate because they are all far from the known mass of the sample.

Types of Errors

Systemic Errors

Errors that occur every time you make a certain measurement.

They result in measurements that can be inaccurate or incorrect by making measurements that are consistently either higher or lower than they would be if there were no systematic errors.

Examples include errors due to the calibration of instruments and errors due to faulty procedures or assumptions; for example, using a balance that is not correctly calibrated.

Random Errors

Errors that cannot be predicted.

This includes errors of judgment in reading a meter or a scale and errors due to fluctuating experimental conditions.

If the random errors in an experiment are small, the experiment is said to be precise.

For example, when having numerous groups of students making temperature measurements of a classroom at the same time, they will have random variations due to local variation and instrument fluctuation.