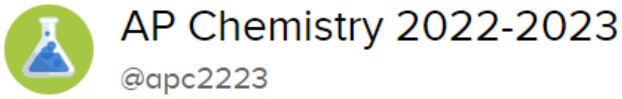
AP Chemistry 2022-2023

Summer Assignment

Welcome to AP Chemistry!

Please sign up for AP Chemistry Remind now! Many updates, solutions to problems and other information will be shared through Remind. If you would like the information for Remind through email let me know.



If you have chosen this course and been approved for the course by your Honors Chemistry teacher, you should have a strong background in chemistry from Honors Chemistry I.

Advanced Placement Chemistry is a college level course covering topics including electrochemistry, equilibrium, kinetics and thermochemistry. Rather than memorizing how to do a particular type of problem, you must really understand the chemistry and be able to apply it to different situations. Because of the amount of material we must cover before the AP exams in May students will complete some of the work outside of class. Homework will include practice problems, sample AP questions and reading assignments from the textbook.

But with hard work you will not only be successful in the AP Chemistry exam and coursework but also be prepared for college level coursework.

Like most AP classes, AP Chemistry comes with a summer assignment. You will need time to complete the different parts of this assignment and review content before school starts. **There will be a quiz on the summer content the first day of school.** So it is important to schedule your work during the summer. Some topic pages include a video to help you review content.

Materials-
1-1.5 inch ring binder
Divider tabs
Scientific calculator
Lab manual (provided)

Contact Ms. Pierce

Email me at cheryl.pierce@polk-fl.net if you have questions about the assignment or course during the summer months.

AP Chemistry Summer Work 2022

Unit 1.1 - Molar Mass Calculations

1. Use the AP periodic table to calculate the molar mass to 2 decimal places for the following compounds. Include units (g/mol).

(a) $C_{12}H_{22}O_{11}$

(b) $Cr_4(P_2O_7)_3$.

(c) $RbOH \cdot 2H_2O$.

(d) $KAl(SO_4)_2 \cdot 12H_2O$.

2. Use the molar mass for the compound or Avogadro's number to solve the problems below. You must show the bracket set up for each. Include units.

Avogadro's #: 1 mole = 6.02×10^{23} molecules
1 mole = 6.02×10^{23} atoms

(a) What is the mass in grams of 0.172 moles of $NaHCO_3$?

(b) How many moles of $CdBr_2$ are in a 39.25 gram sample of $CdBr_2$?

(c) How many grams of aluminum are in 0.58 moles of $Al_2O_3 \cdot 2H_2O$?

(d) How many atoms of cobalt are in a 0.39 mole sample of $Co(C_2H_3O_2)_3$?

(e) What is the mass in milligrams of chlorine in 3.9×10^{19} molecules of Cl_2?

(f) Calculate the number of H_2O_2 molecules present in a 38.977 g sample of the compound.

Unit 1.2 Mass Spectroscopy - calculate average atomic mass for an element from either data or graph

Watch the video from the 2 minute mark: **https://youtu.be/mBT73Pesiog**

Example: A sample of hydrogen contains three isotopes: hydrogen-1, hydrogen-2 and hydrogen-3. When the hydrogen sample is analyzed using a mass spectrometer the following data is obtained:

Isotope Mass	Percent
H-1	99%
H-2	0.80%
H-3	0.20%

Atomic Mass = (mass 1)(%/100) + (mass 2)(%/100) + (mass 3)(%/100) …

Atomic Mass = 1(0.99) + 2(0.0080) + 3(0.0020) = **1.012**

1. Calculate the average atomic mass of magnesium using the following data for three magnesium isotopes.

Isotope Mass	Percent
23.985	78.70%
24.986 0.	10.13%
25.983	11.17%

Atomic Mass =

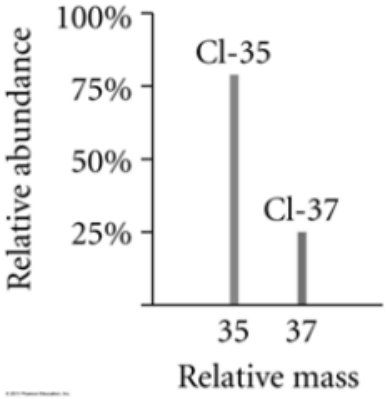
2.

Lithium Isotopes

Isotope	Atomic Mass (u)	Natural Abundance (%)
Li-6	6.02	7.5
Li-7	7.02	92.5

Calculate the average atomic mass for lithium.

3.



Calculate the average atomic mass for Cl using the graph.

Unit 1.3-Percent composition of element in a compound

https://youtu.be/Snnt0CpkWSM

Example:
% Composition of C in CO_2 =12.01 /44.01 x 100 = 27.29%

1. What is the percent composition of carbon in soap, $C_{17}H_{35}COONa$?

2. _____ A compound has the following percentage composition: 40.0% carbon, 6.72% hydrogen, 53.28% oxygen. How many moles of hydrogen are present in 100 g of the compound described above?
(a) 3.33 mol (b) 6.66 mol (c) 1.07 mol (d) 6.72 mol

3. A strip of pure copper, mass 7.546 g, is heated with oxygen to form a compound of copper and oxygen, mass 9.433 g. What is the percent composition of the compound?

4. What is the percent composition of carbon in soap, $C_{17}H_{35}COONa$?

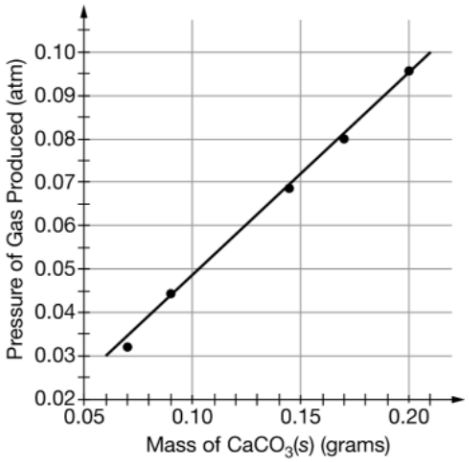
5. Calcium dihydrogen phosphate is an important fertilizer. What is the percent phosphorus in $Ca(H_2PO_4)_2$?

Unit 1.4-Composition of Mixtures

1. A mixture of gases contains 23.5 g CO_2, 16.28 g H_2O vapor and 3.5 g H_2. Calculate the percent H_2 in the mixture.

2. A sample of carbonate rock contains $CaCO_3$ (100.9 g/mol) and another metal carbonate (XCO_3). If the sample was found to be 52% oxygen, which metal carbonate is likely to be the other component of the rock: $MgCO_3$ (84.31 g/mol) or $SrCO_3$ (147.63 g/mol)? Justify your answers with a calculation.

3. An experiment is performed to measure the percent by mass of $CaCO_{3(s)}$ in eggshells. The $CaCO_{3(s)}$ is reacted with aqueous HCl in a sealed container.



Mass of eggshell sample	0.200 g
Pressure prior to reaction	0.800 atm
Pressure at completion of reaction	0.870 atm

The percent by mass of $CaCO_{3(s)}$ in the eggshell sample is closest to:

(a) 30% (b) 45% (c) 60% (d) 75%

4.

1	2	3	4
Total mass of sample (g)	Mass of C in sample (g)	Mass of Mg in sample (g)	Mass of Ca in sample (g)
98.5	12.0	2.4	36.1

A sample of carbonate rock is a mixture of $CaCO_3$ and $MgCO_3$. The rock is analyzed in a laboratory, and the results are recorded in the table above. What is the mole ratio of Ca to Mg in the rock?

Unit 1.5-Atomic Particles & Electron Configuration

Questions 1-3

(A) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$ (B) $1s^2 2s^2 2p^6 3s^2 3p^4$ (C) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$

(D) $1s^2 2s^2 2p^6 3s^2 3p^5$ (E) $1s^2 2s^2 2p^6$

_____1. The electron configuration of a nitride (N^{-3}) ion.

_____ 2. The electron configuration of an atom with two unpaired electrons.

_____ 3. The electron configuration of a Zn^{+2} ion.

_____ 4. Which of the following lists includes only species that are isoelectric (same electron configuration) with one another?

I. Ca^{+1}, Na^{+1}, Al^{+1} II. Ca^{+2}, Ar, K^{+1} III. S^{-2}, Cl^{-1}, P^{-3}

(A) I only (B) II only (C) III only (D) II and III only (E) I, II and III

5. Give the electron configuration for the following atoms:

a. Mg b. Rb

c. I d. Ba

e. As f. Kr

6. Give the electron configuration for the following ions:

a. Mg^{+2} b. Rb^{+1}

c. I^{-1} d. Sr^{+2}

7. Draw the orbital notation (arrows) for the following elements:

a. I b. Ca

c. Ag d. As

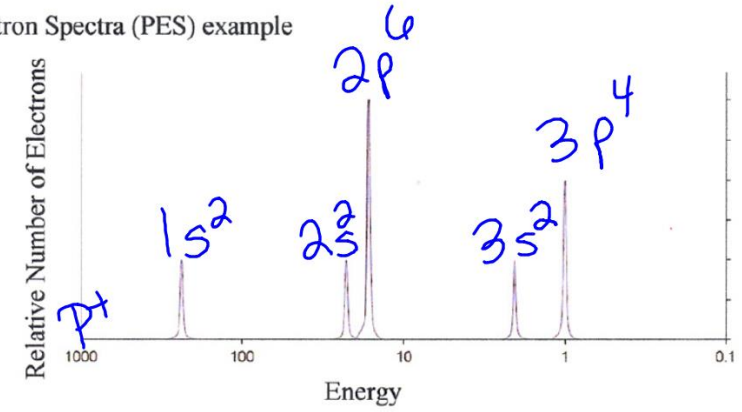
8. Draw the electron dot diagram for:

a. Mg b. Se d. Sr e. C

Unit 1.6-PhotoElectron Spectra (PES) Graphs & electron configuration

https://www.youtube.com/watch?v=gyKD6QULa0A

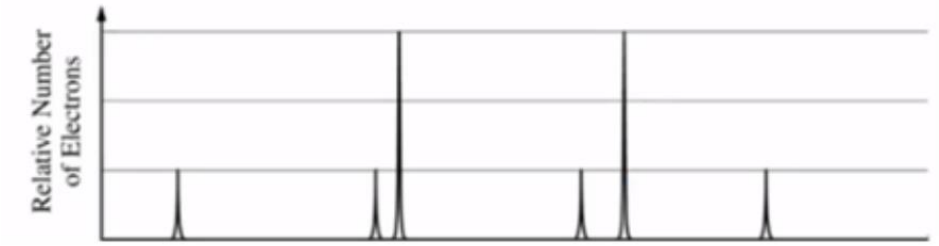
Photo Electron Spectra (PES) example



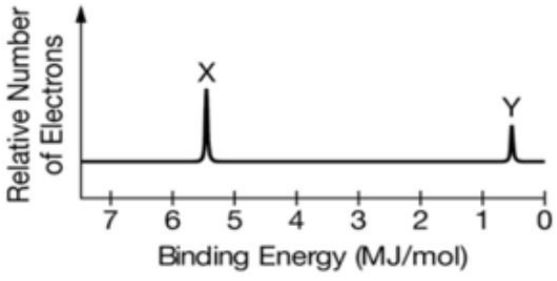
Answer the following questions about the PES graph above.

1. Electrons in which orbital require the most energy to remove?
2. Why are the peaks for 1s, 2s and 3s the same height?
3. Why is the 2p peak higher than the 2s peak in the graph?
4. Identify the element identified by the PES graph?

5. Identify the element represented in the PES graph below.



6. The PES graph of an element is given below.



_____ Which labelled peak corresponds to the 1s electron and why?

(a) Peak X, because 1s electrons are easier to remove from the atom.

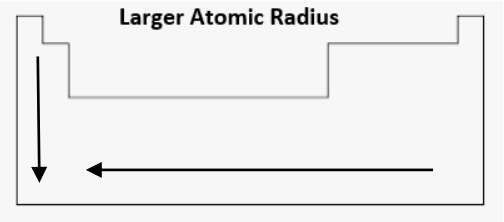
(b) Peak X, because 1s electrons have the strongest attractions to the nucleus.

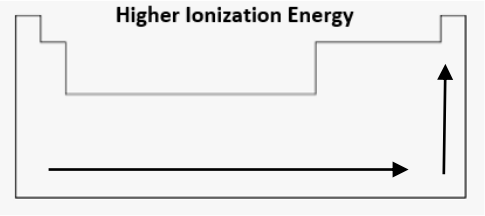
(c) Peak Y, because electrons in the 1s sublevel are the farthest from the nucleus.

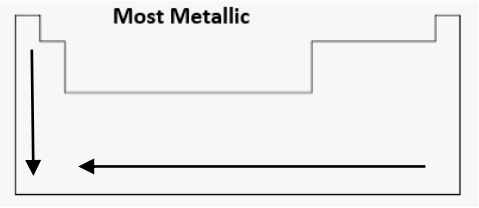
(d) Peak Y, because there are fewer electrons in an s sublevel than in a p sublevel.

Unit 1.7-Periodic Trends-Atomic Radius, Ionization Energy, Nuclear Charge & Electron Affinity

https://www.youtube.com/watch?v=hePb00CqvP0







1. Consider these elements:

Al Si P S

(a) which is the most metallic?

(b) least metallic?

(c) highest ionization energy?

(d) largest atomic radius?

(e) which are nonmetals?

(f) which lose e^- to reach an octet?

(g) which would form anions?

(h) which would form cations?

2. Consider these elements:

Mg Ca Sr Ba

(a) name given to this group of elements?

(b) would ions be cations or anions?

(c) which are nonmetals?

(d) list from small to large atom

(e) gain or lose electrons to form ion?

(f) ion larger or smaller than atom?

3. Name the element found in:

(a) Group 1, period 4

(b) Group 13, period 3

(c) Group 16, period 3

(d) Group 2, period 6

4. Name the element group found:

(a) in Groups 3-12

(b) in the "d" block

(c) in Group 18

(d) along the zig zag line

5. Which is larger and why?

Ca vs K

Which is larger and why?

Ca vs Ca^{+2}

Unit 1.8-Ions & Ionic Compounds

1. Give the ion formula and charge for the following ions:

(a) Ba (b) I (c) Al (d) N (e) Fr (f) S

(g) chromium III (h) tin IV (i) Zn (j) Ag (k) iron III

(l) ammonium (m) sulfite (n) carbonate (o) dichromate

2. Give the formula for the compounds formed between:

a. Ba and O

b. K and SO_3

c. Cr^{+3} and O

d. Zn and ClO_3

3. Name the following:

a. $AlCl_3$

b. Na_2CO_3

c. CuO

d. $KMnO_4$

4. Give the correct formula for the following compounds:

a. potassium iodide

b. iron II sulfide

c. ammonium phosphate

d. chromium III hydroxide

5. Give the short electron configuration for:

a. Cl^{-1}

b. Ba^{+2}

c. Se^{-2}

d. N^{-3}

e. Fe^{+2}

f. Cu^{+1}

g. Sr^{+2}

h. S^{-2}

PERIODIC TABLE OF THE ELEMENTS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 **H** 1.008																	2 **He** 4.00
3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.30											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.87	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.38	31 **Ga** 69.72	32 **Ge** 72.63	33 **As** 74.92	34 **Se** 78.97	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** 95.95	43 **Tc**	44 **Ru** 101.07	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** 121.76	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba** 137.33	57-71 *	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.84	75 **Re** 186.21	76 **Os** 190.23	77 **Ir** 192.22	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**	85 **At**	86 **Rn**
87 **Fr**	88 **Ra**	89-103 †	104 **Rf**	105 **Db**	106 **Sg**	107 **Bh**	108 **Hs**	109 **Mt**	110 **Ds**	111 **Rg**	112 **Cn**	113 **Nh**	114 **Fl**	115 **Mc**	116 **Lv**	117 **Ts**	118 **Og**

*Lanthanoids	57 **La** 138.91	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm**	62 **Sm** 150.36	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** 173.05	71 **Lu** 174.97
†Actinoids	89 **Ac**	90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np**	94 **Pu**	95 **Am**	96 **Cm**	97 **Bk**	98 **Cf**	99 **Es**	100 **Fm**	101 **Md**	102 **No**	103 **Lr**

AP® CHEMISTRY EQUATIONS AND CONSTANTS

Throughout the exam the following symbols have the definitions specified unless otherwise noted.

L, mL	=	liter(s), milliliter(s)	mm Hg	=	millimeters of mercury
g	=	gram(s)	J, kJ	=	joule(s), kilojoule(s)
nm	=	nanometer(s)	V	=	volt(s)
atm	=	atmosphere(s)	mol	=	mole(s)

ATOMIC STRUCTURE

$E = h\nu$

$c = \lambda\nu$

E = energy
ν = frequency
λ = wavelength

Planck's constant, $h = 6.626 \times 10^{-34}$ J s
Speed of light, $c = 2.998 \times 10^{8}$ m s^{-1}
Avogadro's number = 6.022×10^{23} mol^{-1}
Electron charge, $e = -1.602 \times 10^{-19}$ coulomb

EQUILIBRIUM

$K_c = \dfrac{[C]^c[D]^d}{[A]^a[B]^b}$, where $a\,A + b\,B \rightleftarrows c\,C + d\,D$

$K_p = \dfrac{(P_C)^c(P_D)^d}{(P_A)^a(P_B)^b}$

$K_a = \dfrac{[H^+][A^-]}{[HA]}$

$K_b = \dfrac{[OH^-][HB^+]}{[B]}$

$K_w = [H^+][OH^-] = 1.0 \times 10^{-14}$ at 25°C

$= K_a \times K_b$

$pH = -\log[H^+]$, $pOH = -\log[OH^-]$

$14 = pH + pOH$

$pH = pK_a + \log\dfrac{[A^-]}{[HA]}$

$pK_a = -\log K_a$, $pK_b = -\log K_b$

Equilibrium Constants

K_c (molar concentrations)
K_p (gas pressures)
K_a (weak acid)
K_b (weak base)
K_w (water)

KINETICS

$[A]_t - [A]_0 = -kt$

$\ln[A]_t - \ln[A]_0 = -kt$

$\dfrac{1}{[A]_t} - \dfrac{1}{[A]_0} = kt$

$t_{1/2} = \dfrac{0.693}{k}$

k = rate constant
t = time
$t_{1/2}$ = half-life

GASES, LIQUIDS, AND SOLUTIONS

$$PV = nRT$$

$$P_A = P_{\text{total}} \times X_A, \text{ where } X_A = \frac{\text{moles A}}{\text{total moles}}$$

$$P_{total} = P_A + P_B + P_C + \ldots$$

$$n = \frac{m}{\boldsymbol{M}}$$

$$\text{K} = {}^\circ\text{C} + 273$$

$$D = \frac{m}{V}$$

$$KE_{\text{molecule}} = \frac{1}{2}mv^2$$

Molarity, M = moles of solute per liter of solution

$$A = \varepsilon bc$$

P = pressure
V = volume
T = temperature
n = number of moles
m = mass
$\boldsymbol{M}$ = molar mass
D = density
KE = kinetic energy
v = velocity
A = absorbance
ε = molar absorptivity
b = path length
c = concentration

Gas constant, R = 8.314 J $\text{mol}^{-1}\text{K}^{-1}$
= 0.08206 L atm $\text{mol}^{-1}\text{K}^{-1}$
= 62.36 L torr $\text{mol}^{-1}\text{K}^{-1}$

1 atm = 760 mm Hg = 760 torr

STP = 273.15 K and 1.0 atm

Ideal gas at STP = 22.4 L mol^{-1}

THERMODYNAMICS/ELECTROCHEMISTRY

$$q = mc\Delta T$$

$$\Delta S^\circ = \sum S^\circ \text{ products} - \sum S^\circ \text{ reactants}$$

$$\Delta H^\circ = \sum \Delta H_f^\circ \text{ products} - \sum \Delta H_f^\circ \text{ reactants}$$

$$\Delta G^\circ = \sum \Delta G_f^\circ \text{ products} - \sum \Delta G_f^\circ \text{ reactants}$$

$$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$$
$$= -RT \ln K$$
$$= -nF E^\circ$$

$$I = \frac{q}{t}$$

$$E_{cell} = E^\circ_{cell} - \frac{RT}{nF} \ln Q$$

q = heat
m = mass
c = specific heat capacity
T = temperature
S° = standard entropy
H° = standard enthalpy
G° = standard Gibbs free energy
n = number of moles
E° = standard reduction potential
I = current (amperes)
q = charge (coulombs)
t = time (seconds)
Q = reaction quotient

Faraday's constant, F = 96,485 coulombs per mole of electrons

$$1 \text{ volt} = \frac{1 \text{ joule}}{1 \text{ coulomb}}$$