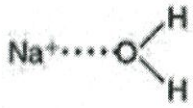
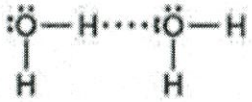
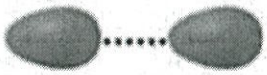
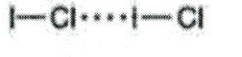
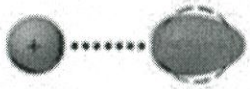
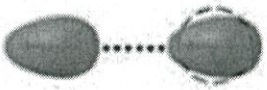
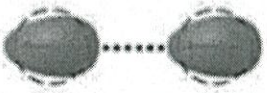
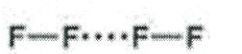
Name: _____

AP Chemistry Summer Assignment

Welcome to AP Chemistry! To ensure the best start for everyone next fall, we have prepared a summer assignment that reviews basic chemistry concepts. To be successful in AP chemistry, you must remember many concepts from regents' chemistry. Unfortunately, we do not have time in the fall to review all the concepts, which is why this summer assignment is important to your success in this course. Please have the summer assignment completed for the first day of school. Index cards are a great way to help you memorize the intermolecular forces, polyatomic ions, and solubility rules.

Memorize the following Intermolecular Forces

Intermolecular

Force	Model	Energy (kJ/mol)	Example
Ion-dipole		40–600	
H bond		10–40	
Dipole-dipole		5–25	
Ion–induced dipole		3–15	
Dipole–induced dipole		2–10	
Dispersion (London)		0.05–40	

Memorize the polyatomic ions

+1 CHARGE		-1 CHARGE		-2 CHARGE		-3 CHARGE	
ion	**name**	**ion**	**name**	**ion**	**name**	**ion**	**name**
NH_4^+	ammonium	$H_2PO_4^-$	dihydrogen phosphate	HPO_4^{2-}	hydrogen phosphate	PO_4^{3-}	phosphate
H_3O^+	hydronium	HCO_3^-	hydrogen carbonate	CO_3^{2-}	carbonate	AsO_4^{3-}	arsenate
Hg_2^{2+}	Mercury I	HSO_3^-	hydrogen sulfite	SO_3^{2-}	sulfite		
		HSO_4^-	hydrogen sulfate	SO_4^{2-}	sulfate		
		NO_2^-	nitrite	$S_2O_3^{2-}$	thiosulfate		
		NO_3^-	nitrate	SiO_3^{2-}	silicate		
		OH^-	hydroxide	$C_2O_4^{2-}$	oxalate		
		CH_3COO^-	acetate	CrO_4^{2-}	chromate		
		CN^-	cyanide	$Cr_2O_7^{2-}$	dichromate		
		CNO^-	cyanate	MoO_4^{2-}	molybdate		
		CNS^-	thiocyanate	O_2^{2-}	peroxide		
		O_2^-	superoxide				
		MnO_4^-	permanganate				
		ClO^-	hypochlorite				
		ClO_2^-	chlorite				
		ClO_3^-	chlorate				
		ClO_4^-	perchlorate				
		BrO_3^-	bromate				
		IO_3^-	iodate				

Memorize the solubility rules.

Table F
Solubility Guidelines for Aqueous Solutions

Ions That Form *Soluble* Compounds	**Exceptions**
Group 1 ions (Li^+, Na^+, etc.)	
ammonium (NH_4^+)	
nitrate (NO_3^-)	
acetate ($C_2H_3O_2^-$ or CH_3COO^-)	
hydrogen carbonate (HCO_3^-)	
chlorate (ClO_3^-)	
halides (Cl^-, Br^-, I^-)	when combined with Ag^+, Pb^{2+}, or Hg_2^{2+}
sulfates (SO_4^{2-})	when combined with Ag^+, Ca^{2+}, Sr^{2+}, Ba^{2+}, or Pb^{2+}

Ions That Form *Insoluble* Compounds*	**Exceptions**
carbonate (CO_3^{2-})	when combined with Group 1 ions or ammonium (NH_4^+)
chromate (CrO_4^{2-})	when combined with Group 1 ions, Ca^{2+}, Mg^{2+}, or ammonium (NH_4^+)
phosphate (PO_4^{3-})	when combined with Group 1 ions or ammonium (NH_4^+)
sulfide (S^{2-})	when combined with Group 1 ions or ammonium (NH_4^+)
hydroxide (OH^-)	when combined with Group 1 ions, Ca^{2+}, Ba^{2+}, Sr^{2+}, or ammonium (NH_4^+)

*compounds having very low solubility in H_2O

Complete the following worksheets. If you are struggling, YouTube is a great resource. I recommend watching Jermery Krug's AP Chemistry Unit 0 videos.

Significant Digits

Round the following numbers to three significant digits.

a) 0.04500 =_____

b) 0.0288714 = _____

c) 1.0 = _____

d) 2,988,300 = _____

e) 0.999 = _____

f) 96,485 = _____

Conversions with S.I Prefixes

Make the following conversions to the correct number of significant digits.

a) 940 mL to _____L

b) 0.0038 L to _____ mL

c) 25mL to _____ L

d) 5.75 mL to _____ L

e) 0.48 L to _____ mL

f) 0.0034 m to _____ nm

g) 728 nm to _____ m

h) 210 nm to _____ m

i) 0.000048 m to _____ nm

Percent Error and Percent Yield.

$$\textbf{\textit{Percent Error}}\ \% = \frac{\textit{Measured} - \textit{Accepted}}{\textit{Accepted}} \times 100 \qquad \textbf{\textit{Percent Yield}}\ \% = \frac{\textit{Actual}}{\textit{Theoritical}} \times 100$$

a) A student calculates the density of an aluminum block to be 2.64 g/cm^3. The accepted value is 2.70 g/cm^3. Perform a quantitative analysis. (Percent Error)

b) The density of mercury metal is 13.6 g/mL. The student experimentally measured the mass of a 5.40 mL piece of metal to have a mass of 76.5 grams. Using the density formula, determine the student's percent error for the mass of the meta.

c) The student determines the theoretical yield of salt produced from the decomposition of baking soda to be 3.20 grams. After running the experiment, the mass of salt produced was 3.10 grams. Calculate the student's percent yield.

Gram Formula Mass and Mole Calculations.

Calculate the following gram formula masses using the AP Periodic Table. Do not round off.

a) H_2O _____

b) CO_2 _____

c) NaCl _____

d) $Al_2(SO_4)_3$ _____

Using the gfms from above, perform the following calculations.

a) How many moles of water are in 100.0 grams of water.

b) How many grams are in 5.00×10^3 moles of carbon dioxide.

c) How many moles of sodium chloride are in 25.0 grams of sodium chloride?

d) How many moles of aluminum atoms are in 500.0 grams of aluminum sulfate?

Stoichiometry

Balance the following equation below. Once balanced, use the chemical equation to answer questions a)-d). Answer all questions to the correct number of significant digits.

$$\_\_\_\_\_ KClO_3 \rightarrow \_\_\_\_\_ KCl + \_\_\_\_\_ O_2$$

a) Determine the moles of oxygen gas produced if 0.250 mol of potassium chlorate undergoes complete decomposition.

b) Calculate the mass of potassium chlorate that would need to produce 0.500 mol of potassium chloride.

c) If 245.1 g of potassium chlorate decomposes completely, find the mass in grams of oxygen gas that would be produced.

d) How many grams of potassium chloride are produced when 450.0 grams of potassium chlorate are decomposed?

e) Calculate the moles of oxygen atoms found in 45.0 g of water.

f) If 45.0 g of water are decomposed, how many moles of hydrogen gas are produced?

g) Determine the number of moles of magnesium is found in 171.07 grams of magnesium phosphate?

Balance the following combustion reaction. Once balanced, use the chemical equation to answer questions h)-i). Answer all questions to the correct number of significant digits.

$$\_\_\_\_\_C_6H_{12} + \_\_\_\_\_O_2 \rightarrow \_\_\_\_\_H_2O + \_\_\_\_\_CO_2$$

h) How many moles of oxygen gas are needed to make 5.00 kg of carbon dioxide?

i) How many g of C_6H_{12} are needed to make 150.0 moles of water?

Concentration

Answer the following questions to the correct number of significant digits.

a) Calculate the molarity of a solution that is made by dissolving 14.61 g of sodium chloride in 150.0 mL of water.

b) Determine the concentration in mol/L of $K^+(aq)$ when 178.5 g of KBr(s) is dissolved in 500.0 mL of water.

c) Determine the molarity of lithium ions if 95.0 grams of lithium sulfide are dissolved in 500.0 mL of water.

d) A sample of seawater contains 8.50 g of sodium chloride per liter of solution. How many grams of sodium chloride would be in 15.0 mL of this solution?

Nomenclature

Provide names for the following ionic compounds.

a) AlF_3 _____

b) $Fe(OH)_2$ _____

c) $Cu(NO_3)_2$ _____

d) Li_3PO_4 _____

e) Cr_2O_3 _____

f) $ZnSO_4$ _____

g) AgI _____

Write the chemical formulas for the following ionic compounds.

a) Ammonium chloride _____

b) Lead (IV) sulfide _____

c) Sodium peroxide _____

d) Iron (III) carbonate _____

e) Silver chloride _____

f) Zinc oxide _____

g) Sodium perchlorate _____

Write the name or chemical formula for each of the following molecules.

a) Hydrogen gas _____

b) Dinitrogen tetroxide _____

c) Carbon monoxide _____

d) SF_6 _____

e) Oxygen gas _____

f) Ammonia _____

g) CO_2 _____

Constructing Lewis Structures

Chemical Formula	Lewis Structure	Shape
F_2		
O_2		
N_2		
H_2O		
NH_3		
CH_4		
CO_2		

AP® CHEMISTRY EQUATIONS AND CONSTANTS, EFFECTIVE 2025

UNIT SYMBOLS	
gram,	g
mole,	mol
liter,	L
meter,	m
second,	s
hertz,	Hz
atmosphere,	atm
millimeter of mercury,	mm Hg
degree Celsius,	°C
Kelvin,	K
joule,	J
volt,	V
coulomb,	C
ampere,	A

UNIT CONVERSIONS
1 hertz = 1 s^{-1}
1 atm = 760 mm Hg = 760 torr
K = °C + 273.15
1 volt = $\frac{1 \text{ joule}}{1 \text{ coulomb}}$
1 ampere = $\frac{1 \text{ coulomb}}{1 \text{ second}}$

METRIC PREFIXES		
Factor	Prefix	Symbol
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p

ATOMIC STRUCTURE

$$E = h\nu$$

$$c = \lambda\nu$$

$$F_{coulombic} \propto \frac{q_1 q_2}{r^2}$$

E = energy
ν = frequency
λ = wavelength
F = force
q = charge
r = separation

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}

GASES, LIQUIDS, AND SOLUTIONS

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$PV = nRT$$

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

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

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

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

$$KE = \frac{1}{2} m v^2$$

$$M = \frac{n_{solute}}{L_{solution}}$$

$$A = \varepsilon b c$$

P = pressure
V = volume
T = temperature
n = number of moles
X = mole fraction
m = mass
M = molar mass
D = density
KE = kinetic energy
v = velocity
M = molarity
A = absorbance
ε = molar absorptivity
b = path length
c = concentration

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

STP = 273.15 K and 1.0 atm

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

KINETICS

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

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

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

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

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

EQUILIBRIUM

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

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

$$K_w = [H_3O^+][OH^-] = 1.0 \times 10^{-14} \text{ at } 25°C$$

$$pK_w = 14 = pH + pOH \text{ at } 25°C$$

$$pH = -\log[H_3O^+], \qquad pOH = -\log[OH^-]$$

$$K_a = \frac{[H_3O^+][A^-]}{[HA]}, \qquad K_b = \frac{[OH^-][HB^+]}{[B]}$$

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

$$K_w = K_a \times K_b, \qquad pK_w = pK_a + pK_b$$

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

Equilibrium Constants

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

THERMODYNAMICS/ELECTROCHEMISTRY

$$q = mc\Delta T$$

$$\Delta H^\circ_{reaction} = \sum \Delta H^\circ_{f\ products} - \sum \Delta H^\circ_{f\ reactants}$$

$$\Delta S^\circ_{reaction} = \sum S^\circ_{products} - \sum S^\circ_{reactants}$$

$$\Delta G^\circ_{reaction} = \sum \Delta G^\circ_{f\ products} - \sum \Delta G^\circ_{f\ reactants}$$

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

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

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

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

Faraday's constant, F = 96,485 coulombs / 1 mol e^-

PERIODIC TABLE OF THE ELEMENTS

1												13	14	15	16	17	18
1 **H** 1.008	2																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	3	4	5	6	7	8	9	10	11	12	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**