Post Assessment - AP Chem

Naming

Gen stoich + Limiting Reagent Problems

A/B Eqm

Le' Chatlier's Princ.

- Determining direction of shift based on changing conc, changing temp, or changing pressure due to ↑ or ↓ volume.

Balancing Net Ionic Eqns

- Make sure charges balance as well

Gen. concept of Entropy

Converting °C to K and vice versa

Gases

- Partial pressures
- PV=nRT

Isotope recognition

e^- Config.

- maximum # of orbitals/electrons

Bonding

- H- bonding: when H is directly bonded to N, O, or F it can H-bond w/ those elements in nearby molec.

Periodic Trends

- Ionization energy

Gen. Trends about Cations/Anions

Cations → positive, lose e^-, smaller than parent atom
common among metals

Anions → negative, gain e^-, larger than parent atom,
common among nonmetals

Rate Rxns

$Rate = k[A]^m[B]^n$

order is determined by m+n

If rate is 1st order:

$\ln[A] = -kt + \ln[A_0]$

the graph of $\ln[A]$ vs. time will be a straight lir

Definition + able to identify different types of A/B.

Determining ox. #s

H tends to be +1
O tends to be -2

LEO says GER
↓ ↘
loses e^- = oxidation gains e^- = reduction

Hybridization : sp, sp^2, sp^3
↙ ↓ ↘
2 ~~electron~~ domains 3 e^- domains 4 e^- domains

- Remember that "normal" boiling or melting pt is at standard pressure : 1atm, 101.3 kPa, 760mmHg, etc.
- Remember alkali metals react violently w/ H_2O
- Combustion Rxn : Hydrocarbon + $O_2 \rightarrow CO_2 + H_2O$
  BUT CO can also be produced as well
- $Molarity = \frac{\text{mol solute}}{\text{L soln}}$

AP Chemistry – Post Assessment Review

Naming Compounds

For each of the following compounds, FIRST determine whether the compound is ionic, covalent, or an acid, THEN name it appropriately.

1.	CO_2	C	carbon dioxide
2.	Al_2S_3	I	aluminum sulfide
3.	$Mn_3(PO_4)_2$	I	manganese (II) phosphate
4.	HCl	A	hydrochloric acid
5.	$HClO_3$	A	chloric acid
6.	Si_2F_6	I	disilicon hexafluoride

For each of the following compounds, FIRST determine whether the compound is ionic, covalent, or an acid, THEN write the correct formula.

7.	Magnesium bromide	I	$MgBr_2$
8.	Diphoshorous pentoxide	C	P_2O_5
9.	Lead(II) phosphate	I	$Pb_3(PO_4)_2$
10.	Sulfurous acid	A	H_2SO_3
11.	Nitrous acid	A	HNO_2
12.	Hydrosulfuric acid	A	H_2S

General Stoichiometry and Limiting Reagent Problems

Given the following reaction:

a) How many grams of zinc are required to react with 5.23 moles of hydrochloric acid (HCl)?

$$\underset{?g}{\_\_}\ Zn + \underset{5.23\,mol}{\underline{2}}\ HCl \rightarrow \_\_\ ZnCl_2 + \_\_\ H_2$$

$$5.23\,mol\ HCl \left|\frac{1\,mol}{2\,mol}\right|\frac{65.38\,g}{1\,mol\ Zn} = 171\,g\ Zn$$

b) Using the reaction above, how many liters of hydrogen gas will be produced by 2.78 g of zinc and 5.86 g of HCl assuming STP?

$$2.78\,g\ Zn \left|\frac{1\,mol\ Zn}{65.38\,g}\right|\frac{1\,mol\ H_2}{1\,mol\ Zn}\left|\frac{22.4\,L}{1\,mol\ H_2}\right| = \boxed{.952\,L\ H_2}$$

$$5.86\,g\ HCl \left|\frac{1\,mol\ HCl}{36.46\,g}\right|\frac{1\,mol\ H_2}{2\,mol\ HCl}\left|\frac{22.4\,L}{1\,mol\ H_2}\right| = 1.80\,L\ H_2$$

A/B Equilibrium and Identifying different types of acids and bases

49. Each of the following can act as both a Brönsted acid and a Brönsted base EXCEPT

(A) HCO_3^-

(C) NH_4^+

(E) HS^-

(B) $H_2PO_4^-$

(D) H_2O

55. $H_2PO_4^- + HBO_3^{2-} \leftrightarrow HPO_4^{2-} + H_2BO_3^-$

The equilibrium constant for the reaction represented by the equation above is greater than 1.0. Which of the following gives the correct relative strengths of the acids and bases in the reaction?

	Acids	Bases
(A)	$H_2PO_4^- > H_2BO_3^-$	$HBO_3^{2-} > HPO_4^{2-}$
(B)	$H_2BO_3^- > H_2PO_4^-$	$HBO_3^{2-} > HPO_4^{2-}$
(C)	$H_2PO_4^- > H_2BO_3^-$	$HPO_4^{2-} > HBO_3^{2-}$
(D)	$H_2BO_3^- > H_2PO_4^-$	$HPO_4^{2-} > HBO_3^{2-}$
(E)	$H_2PO_4^- = H_2BO_3^-$	$HPO_4^{2-} = HBO_3^{2-}$

favors prod. $K_a > 1$

$H_2PO_4^- > H_2BO_3^-$

$HBO_3^{2-} > HPO_4^{2-}$

56. A 0.20–molar solution of a weak monoprotic acid, HA, has a pH of 3.00. The ionization constant of this acid is

(A) 5.0×10^{-7}

(B) 2.0×10^{-7}

(C) 5.0×10^{-6}

(D) 5.0×10^{-3}

(E) 2.0×10^{-3}

$pH = 3.00 = -\log [H^+]$

$[H^+] = 10^{-3}$

$K_a = \frac{(10^{-3})^2}{.2} =$

Le' Chatlier's Principle

71. Which of the following reactions does NOT proceed significantly to the right in aqueous solutions?

(A) $H_3O^+ + OH^- \rightarrow 2\,H_2O$ equil

(B) $HCN + OH^- \rightarrow H_2O + CN^-$ some

(C) $Cu(H_2O)_4^{2+} + 4\,NH_3 \rightarrow Cu(NH_3)_4^{2+} + 4\,H_2O$

(D) $H_2SO_4 + H_2O \rightarrow H_3O^+ + HSO_4^-$

(E) $H_2O + HSO_4^- \rightarrow H_2SO_4 + OH^-$

← St. acid

Balancing Net Ionic Equations – Balance the following net ionic equations (be sure to pay attention to charges!)

2 $Fe^{3+}(aq)$ + 3 $Mg(s)$ → 3 $Mg^{2+}(aq)$ + 2 $Fe(s)$

2 $PO_4^{3-}(aq)$ + 3 $Zn^{2+}(aq)$ → ___ $Zn_3(PO_4)_2(s)$

___ $Zr(OH)_4(s)$ + 4 $H^+(aq)$ → ___ $Zr^{4+}(aq)$ + 4 $H_2O(l)$

Entropy

35. For which of the following processes would ΔS have a negative value?

I. $2\ Fe_2O_3(s) \rightarrow 4\ Fe(s) + 3\ O_2(g)$ 2 → 7 less disorder

II. $Mg^{2+} + 2\ OH^- \rightarrow Mg(OH)_2(s)$ aq → s ↓ more order

III. $H_2(g) + C_2H_4(g) \rightarrow C_2H_6(g)$ 2 → 1 ↓

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

22. Of the following reactions, which involves the largest decrease in entropy?

(A) $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$ 0 → 1 ↑
(B) $2\ CO(g) + O_2(g) \rightarrow 2\ CO_2(g)$ 3 → 2 ↓
(C) $Pb(NO_3)_2(s) + 2\ KI(s) \rightarrow PbI_2(s) + 2\ KNO_3(s)$ same
(D) $C_3H_8(g) + 5\ O_2(g) \rightarrow 3\ CO_2(g) + 4\ H_2O(g)$ 6 → 7 ↑
(E) $4\ La(s) + 3\ O_2(g) \rightarrow 2\ La_2O_3(s)$ 3 → 0 ↓

↑ entropy =
↓ entropy =

Converting $^oC \rightarrow K$ and vice versa

Remember 0°C = 273 K and a change of 1°C = 1 K so to go from °C → K you add 273 and to go from K → °C, you subtract 273.

Gases

16. A gaseous mixture containing 7.0 moles of nitrogen, 2.5 moles of oxygen, and 0.50 mole of helium exerts a total pressure of 0.90 atmosphere. What is the partial pressure of the nitrogen?

(A) 0.13 atm
(B) 0.27 atm
(C) 0.63 atm
(D) 0.90 atm
(E) 6.3 atm

$\frac{7\ mol}{2.5+.5+7} = \frac{?\ atm}{.9\ atm}$

$$NH_4NO_{3(s)} \rightarrow N_2O_{(g)} + 2\ H_2O_{(g)}$$

60. A 0.03 mol sample of $NH_4NO_{3(s)}$ is placed in a 1 L evacuated flask, which is then sealed and heated. The $NH_4NO_{3(s)}$ decomposes completely according to the balanced equation above. The total pressure in the flask measured at 400 K is closest to which of the following? (The value of the gas constant, R, is 0.082 L atm mol^{-1} K^{-1}.)

(A) 3 atm
(B) 1 atm
(C) 0.5 atm
(D) 0.1 atm
(E) 0.03 atm

$PV = nRT$

$P = \frac{nRT}{V} = \frac{(.03mol)(.0821)(400)}{1L}$

20. A flask contains 0.25 mole of $SO_{2(g)}$, 0.50 mole of $CH_{4(g)}$, and 0.50 mole of $O_{2(g)}$. The total pressure of the gases in the flask is 800 mm Hg. What is the partial pressure of the $SO_{2(g)}$ in the flask?

(A) 800 mm Hg
(B) 600 mm Hg
(C) 250 mm Hg
(D) 200 mm Hg
(E) 160 mm Hg

$\frac{.25}{1.25} = \frac{?\ mmHg}{800\ mmHg}$

Isotopes

Isotopes: isotopes are a given atom of an element that have a different number of neutrons and therefore a different mass.

1. If E is the symbol for an element, which two of the following symbols represent isotopes of the same element?

1. $^{20}_{10}E$ 2. $^{20}_{11}E$ 3. $^{21}_{9}E$ 4. $^{21}_{10}E$

a. 1 and 2
b. 3 and 4
c. 1 and 4
d. 2 and 3

e- configuration

22. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$

Atoms of an element, X, have the electronic configuration shown above. The compound most likely formed with magnesium, Mg, is

(A) MgX

(B) Mg_2X

(C) MgX_2

(D) MgX_3

(E) Mg_3X_2

$Mg^{2+}\ X^{3-}$

58. Which of the following represents the ground state electron configuration for the Mn^{3+} ion? (Atomic number Mn = 25)

(A) $1s^2\ 2s^2 2p^6\ 3s^2 3p^6 3d^4$

(B) $1s^2\ 2s^2 2p^6\ 3s^2 3p^6 3d^5\ 4s^2$

(C) $1s^2\ 2s^2 2p^6\ 3s^2 3p^6 3d^2\ 4s^2$

(D) $1s^2\ 2s^2 2p^6\ 3s^2 3p^6 3d^8\ 4s^2$

(E) $1s^2\ 2s^2 2p^6\ 3s^2 3p^6 3d^3\ 4s^1$

$1s^2 2s^2 2p^6 3s^2 3p^6 3d^4$

Bonding

1. What is the most electronegative element?

(A) O

(B) La

(C) Rb

(D) Mg

(E) N

2. Which of the following substances exhibits significant hydrogen bonding in the liquid state?

a. CH_2F_2

b. N_2H_4

c. CH_3OCH_3

d. C_2H_4

e. C_2H_2

14. Is used to explain the fact that the carbon-to-carbon bonds in benzene, C_6H_6, are identical

(A) hydrogen bonding

(B) hybridization

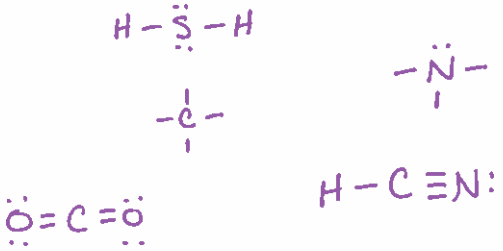
(C) ionic bonding

(D) resonance

(E) van der Waals forces (London dispersion forces)

62. The Lewis structure for which of the following molecules would have two unshared pairs of electrons on the central atom?

(A) H_2S
(B) NH_3
(C) CH_4
(D) HCN
(E) CO_2



Questions 11–14

(A) hydrogen bonding
(B) hybridization
(C) ionic bonding
(D) resonance
(E) van der Waals forces (London dispersion forces)

11. Is used to explain why iodine molecules are held together in the solid state E
12. Is used to explain why the boiling point of HF is greater than the boiling point of HBr A
13. Is used to explain the fact that the four bonds in methane are equivalent B
14. Is used to explain the fact that the carbon-to-carbon bonds in benzene, C_6H_6, are identical D

Periodic Trends

Ionization Energies for element *X* (kJ mol^{-1})				
First	Second	Third	Fourth	Fifth
580	1,815	2,740	11,600	14,800

37. The ionization energies for element *X* are listed in the table above. On the basis of the data, element *X* is most likely to be
(A) Na
(B) Mg
(C) Al
(D) Si
(E) P

50. In the periodic table, as the atomic number increases from 11 to 17, what happens to the atomic radius?
(A) It remains constant.
(B) It increases only.
(C) It increases, then decreases.
(D) It decreases only.
(E) It decreases, then increases.

Rate and Kinetics

3. Rate = k[X]
For the reaction whose rate law is given above, a plot of which of the following is a straight line?
a. [X] versus time
b. log [X] versus time
c. 1/[x] versus time
d. [X] versus 1/time
e. log[X] versus 1/time

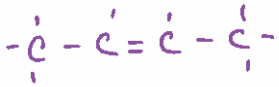
Determining Oxidation Numbers

+1 +1 -2 0 +1 +7 -2

4. $2\ HClO + 3\ O_2 \rightarrow 2\ HClO_4$
As the reaction represented above proceeds to the right, the oxidation number of chlorine changes from
a. -1 to +3
b. -1 to +5
c. +1 to +5
d. +1 to +7
e. +3 to +7

Hybridization

5. Types of hybridization exhibited by carbon atoms in a molecule of butene, $CH_3CHCHCH_3$, include which of the following?
I. sp
II. sp^2
III. sp^3
a. I only
b. II only
c. I and II only
d. II and III only
e. I, II, and III



sp^3 sp^2