Dry Lab & Review **Name** Key

General Chemistry II "Dry Lab" & Review 6/27/13 Dr. Hahn

Part II Short Answer:

Exam I

1. Convert 250 millimeters to units of kilometers. Fill in the parenthesis to do this.

250 millimeters x (1 / (1000)) m x (1 / (1000)) Kilo meters = (2.5×10^{-4}) Kilo meters

2. In the periodic table:

a. What is the elemental symbol for oxygen ? O

b. How much does one mole of Zn weigh ? 65.39 grams

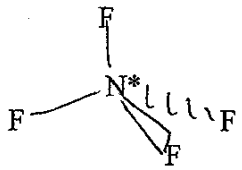
c. An element symbol for an element which is a Transition Metal is Sc—Zn / La—Hg (any element within this area)

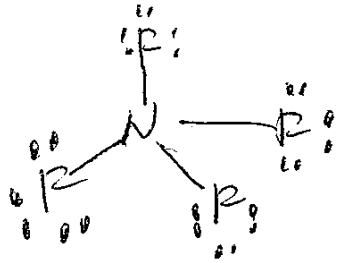
d. What **group** is the element Se in ? VI A

e. What **period** is element Si in ? 3

f. For the element P, the group number is V A and the charge for the ionic form of P is 5-8 = -3 (show formula if applicable)

4 Complete the Lewis Dot structure for the NF_4^- below. Make a molecular model of the molecule using your model set. Use black for the nitrogen and white for the fluorine.





a. How many electron pairs is around the atom with the * ? 4

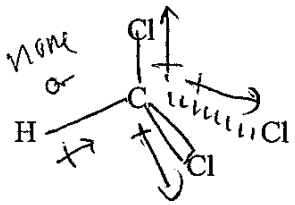
b. How many lone pairs is around the atoms with the * ? 0

c. The VSEPRT geometry of electron pairs is tetrahedral

c. The VSEPRT geometry of the molecule is tetrahedral

Exam II

1. Intermolecular forces question:



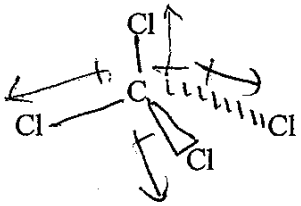
make a molecular model for this molecule

use black for the carbon, white for the hydrogen and blue for the chlorine

(a) For the molecule shown, draw a dipole moment arrow for each bond in the molecule. (The dipole moment arrow should look like (⟶)

(b) The dipole moment for the molecule as a whole is [(zero) or (not zero)] (circle one)

(c) The intermolecular force for this molecule is [(London force) or (dipole-dipole) or (hydrogen bonding)] (circle one)



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(b) The dipole moment for the molecule as a whole is [(zero) or (not zero)] (circle one)

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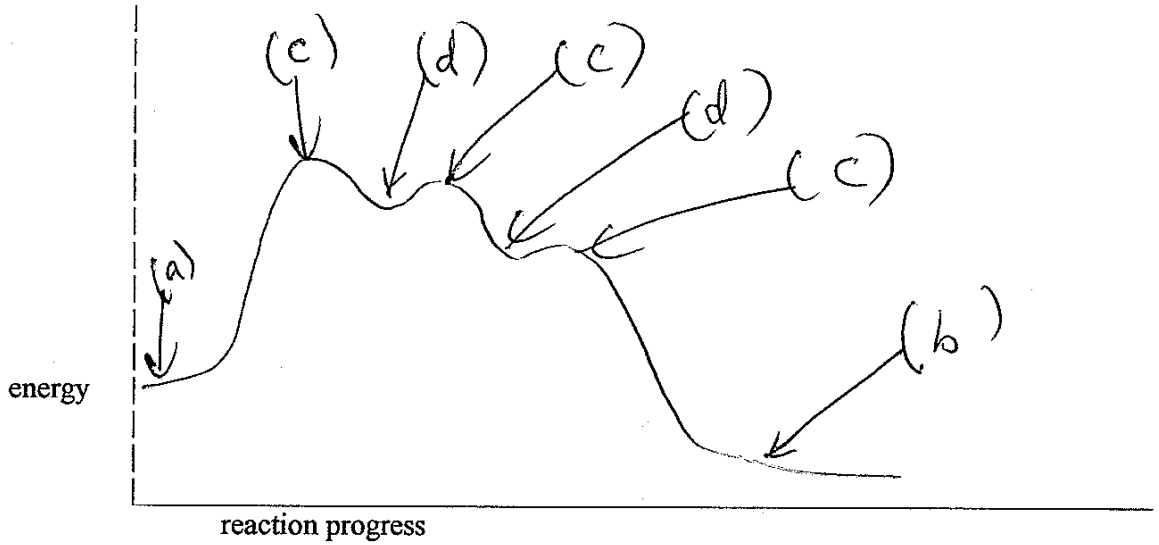
2. For a reaction illustrated below, label (a) reactant (b) product (c) transition state (d) intermediate by filling in the blank with the appropriate letters. You may use each letter one time, many times or not at all.



3. For the following reaction mechanism and the overall reaction, give the expression for the rate law. You do not need to have the expression in only reagents given in the overall reaction. Assume all reactions including the overall reactions are irreversible. I am using letters A,B,C,... etc. to represent some molecule in the reaction mechanism and overall reaction.

$2\,A + 3\,B \xrightarrow{k_1} 2\,D$ elementary reaction mechanism step (1) fast

$2\,D + 2\,E \xrightarrow{k_2} F + 2\,G$ elementary reaction mechanism step (2) slow

$2\,A + 3\,B + 2\,E \rightarrow F + 2\,G$ overall reaction

slow → determines rate

Rate = $k_2[D]^2[E]^2$

4. For the overall reaction given, show the rate expression using $\Delta [O_2(g)]$ and change in time.

$2\,O_3(g) \rightarrow 3\,O_2(g)$ $+ \frac{1}{3}\frac{\Delta[O_2(g)]}{\Delta t}$

reactant (−) product (+)

Exam III

2 For a weak acid CH_3COOH the initial concentration of the CH_3COOH is 0.500 M. The equilibrium equation is shown below and an ICE table has been started.

$CH_3COOH\ (aq) + H_2O\ (l) \rightarrow H_3O^+\ (aq) + CH_3COO^-\ (aq)$

a. complete the following ICE table using the variable x = change in $[H_3O^+]$

	$[CH_3COOH]$	$[H_3O^+]$	$[CH_3COO^-]$
initial	0.500	0	0
change	$-x$	$+x$	$+x$
equilibrium	$0.500 - x$	x	x

b. What is the K_a expression ?

$$K_a = \frac{[H_3O^+][CH_3COO^-]}{[CH_3COOH]}$$

c. What is the Ka expression with the equilibrium values input into the equation ?

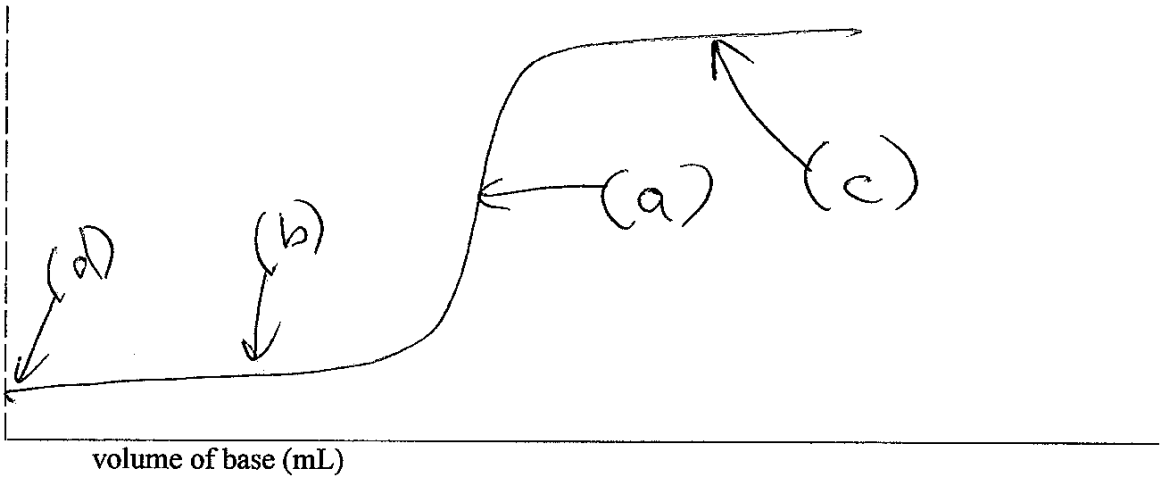
$$Ka = \frac{(x)(x)}{(0.500 - x)}$$

d. What is the Ka expression with the simplifying assumption ? $x << 0.500$

$$Ka = \frac{(x)(x)}{(0.500)}$$

4 In the following titration graph for a strong acid to which is added a strong base, match the letter with the appropriate parenthesis. The equations below are absolutely correct except for you not knowing which of the equations goes with which part of the graph until you fill in the parenthesis with the correct letter.

(a) $[H^+] = 1.0 \times 10^{-7}$
(b) $[H^+]$ = (# moles acid - # moles base) / {(mL volume acid + mL volume base) x (1 Liter /1000 mL)}
(c) $[OH^-]$ = (# moles base - # moles acid)/ {(mL volume acid + mL volume base) x (1 Liter/1000 mL) }
(d) $[H^+]$ = concentration of the strong acid



5. What is the solubility (S) ? Towards answering this question complete only the following. Fill in the ICE table below by putting in (a) the variable, S or a (b) a number or (c) a combination of a number and the variable, S or (d) the words "no value in this box". **Do not continue on to actually answer the actual value of S. (If you do, you will run out of time.)**

$Al(OH)_3$ (s) $\rightleftarrows$ Al^{+3} (aq) + 3 OH^- (aq)

K_{sp} = $[Al^{+3}][OH^-]^3$ give the expression for the Ksp

	$Al(OH)_3$ (s)	Al^{+3} (aq)	OH^- (aq)
initial	—	0	0
change	—	+s	+3s
equilibrium	—	s	3s

Part III. Long Answer

1. For the following reaction write out the expression for the enthalpy, free energy and entropy. You obviously cannot complete this question because I have not provided the values for the enthalpy, free energy and entropy of formation for any of the reagents.

useful equation:

$\{\Delta H^\circ_{RXN} = \Sigma\, n_{product}\, \Delta H^\circ_f(\text{product}) - \Sigma\, n_{reactant}\, \Delta H^\circ_f(\text{reactant})\}$

$\{\Delta G^\circ_{RXN} = \Sigma\, n_{product}\, \Delta G^\circ_f(\text{product}) - \Sigma\, n_{reactant}\, \Delta G^\circ_f(\text{reactant})\}$

$\{\Delta S^\circ_{RXN} = \Sigma\, n_{product}\, S^\circ_f(\text{product}) - \Sigma\, n_{reactant}\, S^\circ_f(\text{reactant})\}$

$2\ SO_2(g) + O_2(g) \rightarrow 2\ SO_3(g)$

$$\Delta H^\circ_{RXN} = \underset{mol}{2}\,\Delta H_f^\circ[SO_3(g)] - \left\{\underset{mol}{2}\,\Delta H_f^\circ[SO_2(g)] + \underset{1\ mol}{}\,\Delta H_f^\circ[O_2(g)]\right\}$$

$\Delta H_f^\circ[O_2(g)] \rightarrow$ zero

$$\Delta G^\circ_{RXN} = \underset{mol}{2}\,\Delta G_f^\circ[SO_3(g)] - \left\{\underset{mol}{2}\,\Delta G_f^\circ[SO_2(g)] + \underset{mol}{1}\,\Delta G_f^\circ[O_2(g)]\right\}$$

$\Delta G_f^\circ[O_2(g)] \rightarrow$ zero

$$\Delta S^\circ_{RXN} = \underset{mol}{2}\,S_f^\circ[SO_3(g)] - \left\{\underset{mol}{2}\,S_f^\circ[SO_2(g)] + \underset{mol}{1}\,S_f^\circ[O_2(g)]\right\}$$

3 You have 65.2 grams of Li Br (molar mass = 86.84 g/mol) and dissolve it in 450.0 mL of water which results in a 480.4 mL of total solution (density of pure water = 1.00 g / mL). (I made up these numbers so these numbers do not fit experimental data.) What is the molarity (M) of the solution ? (show work)

$$\text{molarity} = \frac{\#\text{ moles solute}}{\text{liter solution}}$$

$$\#\text{ moles solute} = 65.2\ \text{g LiBr} \times \frac{1\ \text{mol LiBr}}{86.84\ \text{g LiBr}} = 0.759$$

$$\#\text{ liter solution} = 480.4\ \text{mL} \times \frac{1\ \text{L}}{1000\ \text{mL}} = 0.4804\ \text{L}$$

$$M = \frac{0.759\ \text{mol}}{0.4804\ \text{liter}} = 1.58\ M$$

2. **Titration of a strong acid to which you add a strong base: (This is a before equivalence point problem)**: For 30 mL of H Br of concentration 0.150 M and a KOH concentration of 0.200 M, what is the $[H_3O^+]$ concentration after the addition of 10 mL of the K OH ?

$$[H_3O^+] = \frac{\#\text{ moles acid} - \#\text{ moles base}}{\left\{\left(\text{ml acid} + \text{ml base}\right) \times \frac{1\,l}{1000\,\text{ml}}\right\}}$$

$$\#\text{ moles acid} = 30\,\text{ml HBr soln} \times \frac{0.150\,\text{mol HBr}}{1000\,\text{ml HBr}} = 4.5 \times 10^{-3}$$

$$\#\text{ moles base} = 10\,\text{ml KOH} \times \frac{0.200\,\text{mol KOH}}{1000\,\text{ml KOH}} = 2.0 \times 10^{-3}$$

$$\text{Volume total} = 30\,\text{ml acid} + 10\,\text{ml base} = 40\,\text{ml total}$$

$$[H_3O^+] = \frac{4.5 \times 10^{-3} - 2.0 \times 10^{-3}}{\left(40\,\text{ml} \times \frac{1\,l}{1000\,\text{ml}}\right)} = \frac{2.5 \times 10^{-3}}{0.040\,l}$$

$$[H_3O^+] = 0.0625$$

After Exam III

1. ($\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$) The ΔH° of a reaction is 473.2 kJ, and the ΔS° is – 203.4 J/K. At a temperature of 298 K, what is the ΔG°

$-203.4\frac{J}{K} \times \frac{1\,kJ}{1000\,J} = -0.2034\frac{kJ}{K}$

$\Delta G^\circ = (473.2\,kJ) - (298\,K)\left(-0.2034\frac{kJ}{K}\right)$

$\Delta G^\circ = 533.8\,kJ$

2. For the reaction above, what is the equilibrium constant ? ($\Delta G^\circ_{rxn} = -RT \ln K$) (R=8.134 J/mol K) (set up but do not try to come up with the final number)

$\Delta G^\circ = -RT \ln K \qquad \ln K = \frac{(533.8\,kJ)(298\,K)}{\left(8.134\frac{J}{mol\,K}\right)(298\,K)}$

$\frac{-\Delta G^\circ}{RT} = \ln K$

$K = 6516$

3. Give the electron configuration of Copper (Cu) using the notation $1s^2, 2s^2, \ldots$.

$[Ar]\,4s^2, 3d^9 \xrightarrow{\text{better}} [Ar]\,4s^1, 3d^{10}$

4. Ca $[Pt(NH_3)_2Cl_4]$

What are the ligands ? NH_3 & Cl

What is the transition metal ? Pt

What is the coordination complex ? $Pt(NH_3)_2Cl_4^{-2}$

What is the coordination compound ? $Ca[Pt(NH_3)_2Cl_4]$

What is the coordination number ? 6

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250 millimeters x (_____) m x (_____) Kilo meters = (_____) Kilo meters
( )mm ( ) m

2. In the periodic table:

a. What is the elemental symbol for oxygen ? _____

b. How much does one mole of Zn weigh ? _____ grams

c. An element symbol for an element which is a Transition Metal is _____

d. What **group** is the element Se in ? _____

e. What **period** is element Si in ? _____

f. For the element P, the group number is _____ and the charge for the ionic form of P is _____ (show formula if applicable)

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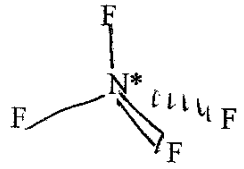

a. How many electron pairs is around the atom with the * ? _____

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c. The VSEPRT geometry of the molecule is _____

Exam II

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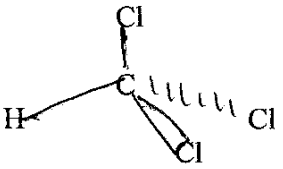

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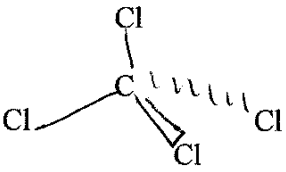

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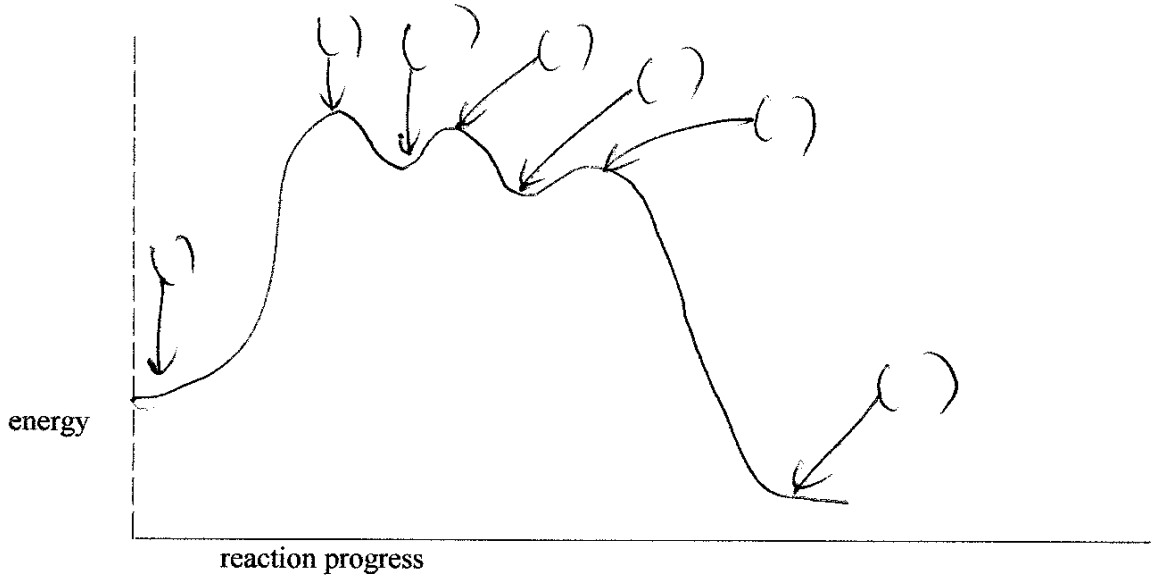

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$2\,A + 3\,B \xrightarrow{k_1} 2\,D$ elementary reaction mechanism step (1) fast

$2\,D + 2\,E \xrightarrow{k_2} F + 2\,G$ elementary reaction mechanism step (2) slow

$2\,A + 3\,B + 2\,E \rightarrow F + 2\,G$ overall reaction

Rate = _____

4. For the overall reaction given, show the rate expression using $\Delta [O_2(g)]$ and change in time.

$2\,O_3(g) \rightarrow 3\,O_2(g)$

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initial			
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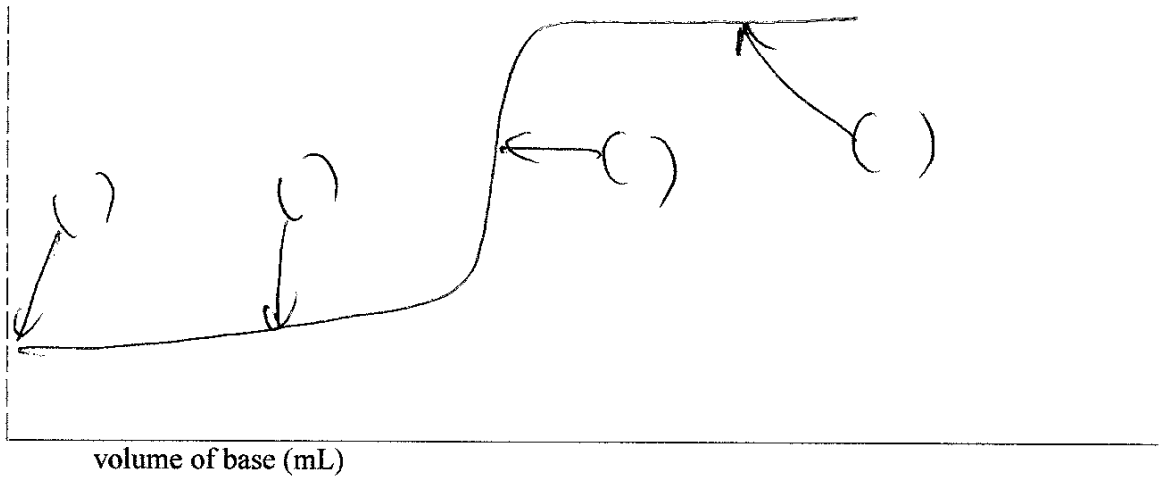

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K_{sp} = _____ give the expression for the Ksp

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initial			
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$\{\Delta S^\circ_{RXN} = \Sigma\, n_{product}\, S^\circ_f(\text{product}) - \Sigma\, n_{reactant}\, S^\circ_f(\text{reactant})\}$

$2\ SO_2(g) + O_2(g) \rightarrow 2\ SO_3(g)$

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4. Ca $[Pt(NH_3)_2Cl_4]$

What are the ligands ? _____

What is the transition metal ? _____

What is the coordination complex ? _____

What is the coordination compound ? _____

What is the coordination number ? _____