

FORMULA SHEET (tear off)

1A																	8A																
1 H 1.01	2A										3A					4A	5A	6A	7A	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 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	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 65.41	31 Ga 69.72	32 Ge 72.64	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	[98]	43 Tc [98]	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3															
55 Cs 132.9	56 Ba 137.3	71 Lu 175.0	72 Hf 178.5	73 Ta 181.0	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po [209]	85 At [210]	86 Rn [222]																
87 Fr [223]	88 Ra [226]	103 Lr [262]	104 Rf [261]	105 Db [262]	106 Sg [266]																												
										57 La 138.9	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm [145]	62 Sm 150.4	63 Eu 152.0	64 Gd 157.2	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0										
										89 Ac [227]	90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np [237]	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]										

$$N_A = 6.022 \times 10^{23}$$

$$1 \text{ amu} = 1.661 \times 10^{-27} \text{ kg}$$

$$1 \text{ atm} = 760 \text{ torr} = 760 \text{ mm Hg}$$

$$R = 0.08206 \text{ L}\cdot\text{atm/mol}\cdot\text{K}$$

$$R = 8.314 \text{ J/mol}\cdot\text{K}$$

$$^\circ\text{C} = (5/9)(^\circ\text{F} - 32)$$

$$^\circ\text{C} = \text{K} - 273.15$$

$$1 \text{ atm} = 1.013 \text{ bar}$$

$$1 \text{ L}\cdot\text{atm} = 101.3 \text{ J}$$

$$1 \text{ J} = 1 \text{ kg}\cdot\text{m}^2/\text{s}^2$$

$$^\circ\text{F} = (9/5)(^\circ\text{C}) + 32$$

$$\text{K} = ^\circ\text{C} + 273.15$$

$$pV = nRT$$

$$p_A = X_A p_A^\circ$$

$$\Delta T_b = K_b m_B$$

$$[B] = k p_B$$

$$\Delta T_f = K_f m_B$$

$$\Delta p_A = X_B p_A^\circ$$

$$\Pi = [B]RT$$

$$K_p = K_c (RT)^{\Delta n}$$

$$H = E + pV$$

$$\Delta G_{\text{rxn}} = \Delta G^\circ_{\text{rxn}} + RT \ln Q$$

$$G = H - TS$$

$$\ln K = -\Delta G^\circ_{\text{rxn}}/RT$$

$$\text{If } ax^2 + bx + c = 0, \text{ then } x = \left(\frac{-b \pm [b^2 - 4ac]^{1/2}}{2a} \right)$$

$$K_a \cdot K_b = K_w = 1.0 \times 10^{-14} \text{ (at } T = 25^\circ\text{C)}$$

**GENERAL CHEMISTRY 2
SECOND HOUR EXAM (Sample)**

Name _____

Panthersoft ID _____

Signature _____

Part 1 _____ (24 points)

Part 2 _____ (50 points)

Part 3 _____ (26 points)

TOTAL _____ (100 points)

j

Do all of the following problems. Show your work.

Part 1. Multiple choice. Circle the letter corresponding to the correct answer. There is one and only one correct answer per problem. [4 points each]

1) The numerical value for the equilibrium constant for the reaction $A_2(g) + 2 B(g) \rightleftharpoons 2 AB(g)$ is $K_C = 25$. The numerical value for the equilibrium constant for the reaction $AB(g) \rightleftharpoons \frac{1}{2} A_2(g) + B(g)$, measured at the same temperature, is

- a) $K_C = 0.040$
- b) $K_C = 0.20$
- c) $K_C = 5.0$
- d) $K_C = 25$.
- e) Cannot tell from the information given

2) Consider the following chemical reaction.



A system containing PCl_3 , PCl_5 , and Cl_2 at a fixed temperature is initially at equilibrium. Which of the following changes will lead to an increase in the number of moles of PCl_3 in the system?

- a) Addition of 0.100 moles of Cl_2 into the system
- b) Addition of 0.100 moles of PCl_5 into the system
- c) Decreasing the volume of the system by 2.00 L
- d) Both a and c
- e) Both b and c

3) A Bronsted base is

- a) a proton acceptor
- b) a proton donor
- c) an electron pair acceptor
- d) an electron pair donor
- e) any ionic compound that will dissolve in water

4) Ammonium perchlorate (NH_4ClO_4) is a soluble salt formed by the reaction of a strong acid with a weak base. The pH of a 0.100 M solution of ammonium perchlorate, measured at $T = 25$. °C, is expected to be

- a) exactly equal to 7.0
- b) approximately equal to 7.0
- c) significantly larger than 7.0
- d) significantly smaller than 7.0
- e) undefined, because the concept of pH does not apply to solutions of salts

5) Hypoiodous acid (HOI) is a weak acid, with $K_a = 3.5 \times 10^{-8}$ (at $T = 25$. °C). OI^- ion is

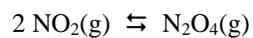
- a) a weak acid
- b) a strong acid
- c) a weak base
- d) a strong base
- e) None of the above, as ions have no acid or base properties

6) Which of the following is the strongest oxyacid?

- a) HIO_2
- b) HIO_3
- c) $HBrO$
- d) $HBrO_2$
- e) $HBrO_3$

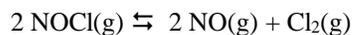
Part 2. Short answer.

1) The free energy change for the reaction



is $\Delta G^\circ_{\text{rxn}} = -5.3 \text{ kJ/mol}$ at $T = 25.^\circ\text{C}$. Based on this information, find the numerical value for K , the equilibrium constant, for this reaction. [8 points]

2) A system containing the gases Cl_2 , NO , and NOCl will achieve equilibrium. The process that takes place is



At $T = 500. \text{ K}$, the partial pressures of gas present at equilibrium are $p(\text{Cl}_2) = 0.608 \text{ atm}$, $p(\text{NO}) = 0.240 \text{ atm}$, and $p(\text{NOCl}) = 1.36 \text{ atm}$.

a) What is the numerical value for K_p for the above reaction at $T = 500. \text{ K}$? [5 points]

b) What is the numerical value for K_C for the above reaction at $T = 500. \text{ K}$? [5 points]

3) The pH of an aqueous solution is $\text{pH} = 8.82$ at $T = 25\text{ }^\circ\text{C}$. Find $[\text{H}_3\text{O}^+]$, $[\text{OH}^-]$, and the pOH for the solution. [8 points]

4) Answer each of the following questions by filling in the blank. [4 points each]

a) The conjugate base of HCO_3^- . _____

b) The value for K_b for NO_2^- , at $T = 25\text{ }^\circ\text{C}$
(Note $K_a = 4.5 \times 10^{-4}$ for HNO_2 at $T = 25\text{ }^\circ\text{C}$) _____

c) The pH of pure water at $T = 50\text{ }^\circ\text{C}$. _____
(Note $K_w = 5.5 \times 10^{-14}$ at $T = 50\text{ }^\circ\text{C}$)

5) For each of the following questions circle the correct answer. There is one and only one correct answer per question. [4 points each]

The weakest acid

HI HBr HCl HF

A strong soluble base

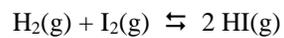
AgOH Cu(OH)₂ Ba(OH)₂ Fe(OH)₃

An example of a polyprotic acid

HBr HF HNO₂ H₂SO₄

Part 3. Problems.

1) The numerical value for the equilibrium constant for the reaction



is $K_C = 57.0$ at $T = 700. \text{ K}$.

The initial concentration of H_2 and I_2 in a system at $T = 700. \text{ K}$ are $[\text{H}_2] = 0.2000 \text{ mol/L}$ and $[\text{I}_2] = 0.1000 \text{ mol/L}$. No HI is initially present in the system. What are the concentrations of H_2 , I_2 , and HI that are present when the system reaches equilibrium? [16 points]

2) A chemist prepares 500.0 mL of a 0.0200 M aqueous solution of hypochlorous acid (HOCl , $K_a = 3.5 \times 10^{-8}$). What is the pH of the above solution? [10 points]