

FORMULA SHEET (tear off)

1A																8A															
1 H 1.01	2A																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	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]

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

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

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

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

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

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

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

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

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

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

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

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

$$pV = nRT$$

$$p_A = X_A p_A^\circ$$

$$\Delta T_b = K_b m_B$$

$$H = U + pV$$

$$[B] = k p_B$$

$$\Delta T_f = K_f m_B$$

$$G = H - TS$$

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

$$\Pi = M_B RT$$

**GENERAL CHEMISTRY 2
FIRST HOUR EXAM
FEBRUARY 11, 2022**

Name _____

Panthersoft ID _____

Signature _____

Part 1 _____ (20 points)

Part 2 _____ (43 points)

Part 3 _____ (37 points)

TOTAL _____ (100 points)

Unless otherwise stated, you may assume $T = 25.0\text{ }^{\circ}\text{C}$ in all of the problems below.

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) A solution is formed by dissolving 4.78 g of methyl alcohol (CH_3OH , MW = 32.04 g/mol) and 28.53 g of water (H_2O , MW = 18.02 g/mol) in 485.1 g of ethyl alcohol ($\text{C}_2\text{H}_5\text{OH}$, MW = 46.07 g/mol). Which of the following is the solvent in the above solution?

- a) methyl alcohol
- b) ethyl alcohol
- c) water
- d) Both a and b
- e) Both a and c

2) The value for the constant k in Henry's Law ($[\text{B}] = k p_{\text{B}}$) depends on which of the following?

- a) The identity of the solute
- b) The identity of the solvent
- c) Temperature
- d) Both a and b
- e) Both a and b and c

3) Which of the following is not a colligative property?

- a) Boiling point elevation
- b) Freezing point depression
- c) Raoult's Law
- d) Vapor pressure lowering
- e) Osmotic pressure

4) For a process to occur spontaneously which of the following must be true?

- a) $\Delta S_{\text{syst}} > 0$
- b) $\Delta S_{\text{surr}} > 0$
- c) $\Delta S_{\text{univ}} > 0$
- d) Both a and b
- e) Both a and b and c

5) For which of the following pure chemical substance is $S^\circ = 0.0 \text{ J/mol}\cdot\text{K}$ at $T = 25.^\circ\text{C}$?

- a) Aluminum ($\text{Al}(\text{s})$)
- b) Nitrogen ($\text{N}_2(\text{g})$)
- c) Sulfur dioxide ($\text{SO}_2(\text{g})$)
- d) Both a and b
- e) None of the above

Part 2. Short answer.

1) Define the following term: heterogeneous mixture [5 points]

2) A solution is formed by dissolving 0.0126 g of a nonvolatile and nonionizing solute in water (H_2O , MW = 18.02 g/mol). The final volume of the solution is $V = 20.00$ mL. The osmotic pressure of the solution (relative to pure water) is $\Pi = 83$. torr at $T = 35$. °C. What is the molecular weight of the solute? [12 points]

3) Give the correctly balanced formation reaction for gold III hydroxide ($\text{Au}(\text{OH})_3(\text{s})$). [5 points]

4) The molality of a solution of acetone (CH_3COCH_3 , MW = 58.08 g/mol) in n-hexane (C_6H_{14} , MW = 86.18 g/mol) is $m = 2.317$ mol/kg. What is the percent by mass acetone in the solution? [9 points]

5) For each of the following provide the missing information by filling in the blank. Include correct units. You may assume $T = 25.^\circ\text{C}$. [6 points each]

a) $\Delta S_{\text{univ}} = 34.7 \text{ J/mol}\cdot\text{K}$ $\Delta S_{\text{sys}} = 41.5 \text{ J/mol}\cdot\text{K}$

$$\Delta S_{\text{surr}} = \underline{\hspace{10em}}$$

b) $\Delta S^\circ_{\text{rxn}} = -144.6 \text{ J/mol}\cdot\text{K}$ $\Delta G^\circ_{\text{rxn}} = 152.8 \text{ kJ/mol}$

$$\Delta H^\circ_{\text{rxn}} = \underline{\hspace{10em}}$$

1) At $T = 20. \text{ }^\circ\text{C}$, n-pentane (C_5H_{12} , $\text{MW} = 72.15 \text{ g/mol}$) and n-hexane (C_6H_{14} , $\text{MW} = 86.18 \text{ g/mol}$) form an ideal solution. The vapor pressures for the pure liquids at this temperature are $p_p^\circ = 372.8 \text{ torr}$ for n-pentane and $p_h^\circ = 107.0 \text{ torr}$ for n-hexane.

a) Which pure liquid has the higher value for S° at $T = 20. \text{ }^\circ\text{C}$, n-pentane or n-hexane? Give a brief justification for your answer. [5 points]

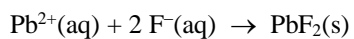
b) Do n-pentane and n-hexane obey Raoult's law in the above solution (yes/no and a brief justification for your answer)? [5 points]

c) The partial pressure of n-pentane above a solution of n-pentane and n-hexane at $T = 20. \text{ }^\circ\text{C}$ is $p_p = 156. \text{ torr}$. What is the partial pressure of n-hexane above the solution? [12 points]

The data below is given at $T = 25.0\text{ }^{\circ}\text{C}$, and may be of use in doing the following problem.

substance	ΔH°_f (kJ/mol)	ΔG°_f (kJ/mol)	S° (J/mol \cdot K)
$\text{F}^{-}(\text{aq})$	- 332.6	- 278.8	- 13.8
$\text{Pb}^{2+}(\text{aq})$	- 1.7	- 24.4	10.5
$\text{PbF}_2(\text{s})$	- 664.0	- 617.1	110.5

2) Pb^{2+} ion can be removed from aqueous solution by reaction with fluoride ion. The balanced reaction is



a) What are $\Delta S^{\circ}_{\text{rxn}}$ and $\Delta G^{\circ}_{\text{rxn}}$ for the above reaction (including units)? [10 points]

b) Is the above reaction spontaneous for standard conditions and $T = 25.0\text{ }^{\circ}\text{C}$? (yes or no, and a brief justification for your answer). [5 points]