

Chemistry 210

Exam 1

Be sure to put your name on each page. This page can be removed from your exam so that you will have a Periodic Table handy throughout the exam, it does not need to be turned in. Show all your work for problems which require any sort of calculation, no credit will be given for answers without work shown. If you have shown a significant amount of work or multiple drawings for a problem, draw a box around what you consider your final answer.

Avogadro's Number = 6.022×10^{23} units/mol

$32.00^\circ\text{F} = 0.000^\circ\text{C} = 273.15\text{K}$

Density of Water = $1.000^{\text{g}}/\text{mL}$

$R = 0.08206 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K} = 8.314 \text{ J}/\text{mol}\cdot\text{K}$

$1\text{atm} = 760\text{torr} = 760\text{mmHg} = 101.325\text{kPa}$

$PV = nRT$

$\Delta T_{\text{fp/bp}} = k_{\text{fp/bp}} \cdot m \cdot i$

For water: $k_{\text{fp}} = -1.86^\circ\text{C}/m$
 $k_{\text{bp}} = 0.512^\circ\text{C}/m$

$P_1 = X_1 P_1^\circ$

$\Pi = MRTi$

$C_1 V_1 = C_2 V_2$

Integrated Rate Laws:

$\ln[A]_t = -kt + \ln[A]_o$

$1/[A]_t = kt + 1/[A]_o$

$[A]_t = -kt + [A]_o$

$k = Ae^{-E_a/RT}$

$\ln(k) = \left(\frac{-E_a}{R} \right) \left(\frac{1}{T} \right) + \ln(A)$

$\ln\left(\frac{k_1}{k_2} \right) = \frac{E_a}{R} \left(\frac{1}{T_2} - \frac{1}{T_1} \right)$

$\text{pH} = \text{pK}_a + \log\left(\frac{[\text{conjugate base}]}{[\text{conjugate acid}]} \right)$

$E_{\text{cell}} = E_{\text{cell}}^\circ - \frac{RT}{nF} \ln Q$

$E_{\text{cell}}^\circ = \frac{RT}{nF} \ln K^\circ$

$K^\circ = e^{(nF/RT) E_{\text{cell}}^\circ}$

$F = 96485 \text{ J}/\text{V}\cdot\text{mol of electrons}$

$\Delta G^\circ = \Delta H^\circ_{\text{system}} - T\Delta S^\circ_{\text{system}}$

$\Delta G^\circ = -nFE_{\text{cell}}^\circ = -RT \ln K^\circ$

$\Delta G = \Delta G^\circ + RT \ln Q$

$F = 96485 \text{ C}/\text{mol electrons}$

$1A = 1 \text{ C} / \text{sec}$

Quadratic formula:

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

1 H 1.0079																	2 He 4.0026				
3 Li 6.941	4 Be 9.0122															5 B 10.811	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180
11 Na 22.990	12 Mg 24.305															13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.066	17 Cl 35.453	18 Ar 39.948
19 K 39.098	20 Ca 40.078	21 Sc 44.956	22 Ti 47.88	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.847	27 Co 58.933	28 Ni 58.69	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.80				
37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.94	43 Tc (98)	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 La 138.91	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 (209)	85 At (210)	86 Rn (222)				
87 Fr (223)	88 Ra 226.03	89 Ac 227.03	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 (269)	111 (272)	112 (277)	114		116							

58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	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 168.94	70 Yb 173.04	71 Lu 174.97
90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (258)	101 Md (258)	102 No (259)	103 Lr (260)

Multiple Choice (6pts each): Circle the letter of the most correct response.

- Rank the 3 states of matter from lowest kinetic energy to highest kinetic energy.
 - Solid, liquid, gas
 - Gas, solid, liquid
 - Liquid, gas, solid
 - Gas, liquid, solid
 - Solid, gas, liquid
- When dissolving a solid in a liquid:
 - Formation of solvent-solute interactions is endothermic
 - The boiling point of the solution will be higher than that of the pure solvent
 - Energy is released (exothermic) by breaking solvent-solvent and solute-solute interactions
 - The enthalpy of solution is always positive
 - The freezing point of the solution will be higher than that of the pure solvent
- Which of the following statements is most correct about colligative properties of an ideal solution?
 - Colligative properties depend upon the number of solute particles, not on the identity of the solute particles.
 - The presence of a solute raises the freezing point of a solution.
 - The presence of a solute lowers the boiling point of a solution.
 - The presence of a solute raises the vapor pressure of a solution.
 - These statements are all correct.
- The volume of a gas:
 - Decreases as the temperature increases
 - Remains constant as the amount of gas is increased
 - Is always a constant
 - Decreases as the pressure increases
 - Increases as the kinetic energy increases
- Under which of the following conditions is a gas *least* “ideal”?
 - Low temperature, low pressure
 - High temperature, low pressure
 - Room temperature, 25°C
 - High temperature, high pressure
 - Low temperature, high pressure
- Which of the following is *not* a correct gas law relationship?
 - $PV = nRT$
 - $n_1T_1 = n_2T_2$
 - $V_1n_1 = V_2n_2$
 - $P_1V_1 = P_2V_2$
 - $P_1 / T_1 = P_2 / T_2$

7. What is the volume of 1.648mols of ideal gas at 34.67°C and 2.81atm pressure? (12pts)
8. You have a 17.38L sample of gas at 41.29°C. What is the volume of this gas if the temperature is decreased to 14.82°C? (12pts)
9. You have prepared a solution by dissolving 21.918g of magnesium bromide in enough water to make 400.0mL of solution. What is the *molarity* of this solution? (12pts)
10. What is the freezing point of a solution made by dissolving 26.734g of nickel(II) nitrate in 200.0g of water? (15pts)
11. Each of the following solids is dissolved in separate beakers containing 500.0mL of water. Rank the solutions from highest freezing point to lowest freezing and explain your answer. (15pts)
- 0.4mols magnesium phosphate
 - 0.5mols calcium nitrate
 - 0.6mols sodium chloride
 - 0.7mols ammonium phosphate

12. How much energy is lost when cooling 750.0g of water from 37.25°C to -11.92°C? { $C_s(\text{ice}) = 2.09 \text{ J/g}\cdot\text{K}$;
 $C_s(\text{water}) = 4.184 \text{ J/g}\cdot\text{K}$; $C_s(\text{steam}) = 2.01 \text{ J/g}\cdot\text{K}$; $\Delta H_{\text{fusion}}(\text{water}) = 6.02 \text{ kJ/mol}$; $\Delta H_{\text{vaporization}}(\text{water}) = 40.7 \text{ kJ/mol}$ }
(25pts)

13. You have reacted 2.83g of aluminum metal with 100.0mL of 3.07M HCl(aq) to produce hydrogen gas and aluminum chloride. How many liters of hydrogen gas can be produced at 38.27°C and 1.085atm? (25pts)