Chem 1121
Spring 2012
Exam 4A

Name: KEY

Show all work to receive credit. You must use the factor-label (conversion-factor) method for all conversions. Be sure to show all units and write your answers using the correct number of significant figures or decimal places.

Q1. [5 pts.] Predict whether the following compounds will be **soluble** or **insoluble** in water:

a) Li_3PO_4 SOLUBLE
b) $CaSO_4$ SOLUBLE
c) $Fe(NO_3)_2$ SOLUBLE
d) $(NH_4)_2CO_3$ SOLUBLE
e) $Mg(OH)_2$ INSOLUBLE

~ Li^+ compounds are always soluble
~ SO_4^{2-} " " unless cation is Ba^{2+}, Hg_2^{2+}, or Pb^{2+}
~ NO_3^- " "
~ NH_4^+ " "
~ If it's not on the chart of soluble compounds, then it is assumed to be insoluble!

Q2. [20 pts.] Write the *balanced* molecular, full-ionic, and net-ionic equation for the reaction between aqueous sodium carbonate and aqueous calcium nitrate:
Be sure to include state symbols and charges (where necessary).

Molecular: $\_Na_2CO_3(aq) + \_Ca(NO_3)_2(aq) \longrightarrow 2NaNO_3(aq) + CaCO_3(s)$

Full-Ionic: $2Na^+(aq) + CO_3^{2-}(aq) + Ca^{2+}(aq) + 2NO_3^-(aq) \longrightarrow 2Na^+(aq) + 2NO_3^-(aq) + CaCO_3(s)$

Net-Ionic: $Ca^{2+}(aq) + CO_3^{2-}(aq) \longrightarrow CaCO_3(s)$

Q3. [3 pts.] What is meant by a *saturated* solution?

The maximum amount of solute possible has been dissolved in a given amount of solvent.

Q4. [5 pts.] Write the conversion factor corresponding to a 3.5 %(w/v) solution of $MgCl_2(aq)$.

$$\frac{3.5\text{ g } MgCl_2}{100\text{ mL solution}}$$

Q5. [5 pts.] How many moles of HCl are present in 125 mL of a 4.50 M HCl(aq) solution?
You must use the conversion-factor/factor-label method to receive credit.

$$125\text{ mL} \left| \frac{1\text{ L}}{1000\text{ mL}} \right| \frac{4.50\text{ mol HCl}}{1\text{ L}} = 0.563\text{ mol HCl} \quad (3\text{ s.f.})$$

Q6. [5 pts.] What is the molar concentration of a solution made by dissolving 82.4 g of NaBr in water, so that the total volume is 2.10 L?

NaBr
1 x Na = 22.99
1 x Br = 79.90
102.89

$$82.4\text{ g NaBr} \left| \frac{1\text{ mol NaBr}}{102.89\text{ g NaBr}} \right. = 0.800855\text{ mol NaBr (3sf)}$$

$$[NaBr] = \frac{0.8009\text{ mol}}{2.10\text{ L}} = 0.381 \frac{\text{mol}}{\text{L}} \text{ OR } M$$

Q7. [5 pts.] What is the *osmolarity* of 2.1 M $CaCl_2(aq)$? Show all work to receive credit.

$CaCl_2(aq) \longrightarrow Ca^{2+}(aq) + 2Cl^-(aq)$

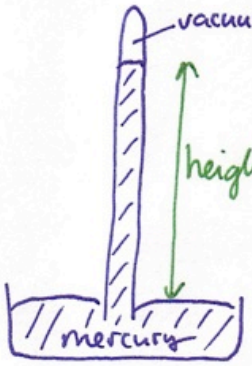
$2.1M \longrightarrow 2.1M + 4.2M$

tot. conc = 6.3 M

↑ osmolarity

Q8. [10 pts.] What is a Toricelli barometer? Explain how it can be used to measure atmospheric pressure.

A Toricelli barometer is a device used to measure atmospheric pressure.



height of mercury column in mm is equal to atmospheric pressure in terms of mmHg or torr.

Q9. [10 pts.] 122 mL of helium gas with a pressure of 433 torr is squeezed until its volume changes to 31.2 mL. What will its pressure be? Assume the temperature of the gas does not change.

$$P_1V_1 = P_2V_2 \Rightarrow P_2 = \frac{P_1V_1}{V_2} = \frac{433\ \text{torr} \times 122\ \text{mL}}{31.2\ \text{mL}} = 1690\ \text{torr} \quad (3\text{s.f.})$$

Q10. [10 pts.] 122 mL of helium gas is cooled from 34 °C to –178 °C. What will its volume become? Assume the pressure of the gas does not change.

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \Rightarrow V_2 = \frac{V_1 \times T_2}{T_1} = \frac{122\ \text{mL} \times 95\ \text{K}}{307\ \text{K}} = 38\ \text{mL} \quad (2\text{s.f.})$$

$T_1 = 34 + 273 = 307\ \text{K}$

$T_2 = -178 + 273 = 95\ \text{K}$

Q11. [8 pts.] A mixture of helium gas, nitrogen gas, and oxygen has has a total pressure of 813 mmHg. If the partial pressure of helium is 121 mmHg, and the partial pressure of nitrogen is 319 mmHg, then what is the partial pressure of oxygen? Also, what percent of the mixture is helium?

$P_{TOT} = P_{He} + P_{N_2} + P_{O_2} \Rightarrow P_{O_2} = P_{TOT} - P_{He} - P_{N_2} = 813\,mmHg - 121\,mmHg - 319\,mmHg = 373\,mmHg$

$P_{He} = x_{He} \times P_{TOT}$

$\Rightarrow x_{He} = \frac{P_{He}}{P_{TOT}} = \frac{121\,mmHg}{813\,mmHg} = 0.1488 = \boxed{14.9\%}$

Q12. [6 pts.] What is Gay Lussac's law?

$P \propto T$ or $\frac{P_1}{T_1} = \frac{P_2}{T_2}$

Q13. [8 pts.] Give two examples of colligative properties. What do colligative properties depend upon, and what makes them different from many other properties?

(1) Boiling Point Elevation

(2) Freezing Point Depression

Colligative properties only depend on solute concentration, not identity!

BONUS Question:

What is meant by the term: "hypotonic solution"?

lower concentration of solute (than the other solution)