Chemistry 30A **Midterm #3A** **Laney College**
Dr Schaleger **Spring 2015**

Secret word_____ **Name_____**

1. What is the pH of 0.010 M KOH?

2. Carbon dioxide is a weak Lewis acid. Write the chemical equations that explain how CO_2 manages to generate H^+ ions when dissolved in water.

3. Sodium amide, $NaNH_2$, reacts with methanol, CH_3OH, in a Brønsted acid-base reaction as follows:
   $NaNH_2(s) + CH_3OH(l) \rightarrow NH_3(methanol) + NaOCH_3(methanol)$
   Circle the stronger base.

4. Which solution will generate more osmotic pressure versus water: ____0.10 M sodium sulfate (Na_2SO_4) or _____0.10 M sodium phosphate (Na_3PO_4)? Check one.

5. What is the conjugate base of hydrogen phosphate ion, HPO_4^{2-}?

6. A sealed vessel of steam, $H_2O(g)$, at 120 deg C and 1.00 atm pressure is heated to 240 deg C at constant volume. What is the final pressure of the steam?

7. What is the pH of an acetate buffer which is 0.100 M in sodium acetate and 0.250 M in acetic acid? ($Ka = 1.8 \times 10^{-5}$).

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8. What is the molar concentration of hydroxide ion in a 0.100 M solution of barium hydroxide, $Ba(OH)_2$?

9. The total pressure of a gas mixture of 35% helium (He) and 65% nitrogen (N_2) is 900 mm Hg. What is the partial pressure of helium?

10. Consider the following reaction:

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

If 6.2 L of nitrogen are reacted to form ammonia at STP, how many liters of hydrogen will be required to consume all of the nitrogen?

11. How many grams of oxygen (O_2) are contained in a 25.0 L sample at 5.20 atm and 27 deg C?

12. Consider the melting (fusion) of sulfur: S(s) = S(l). Provide the signs (plus (+), minus (-) or zero (0)) for the free energy _____; heat of fusion _____; and entropy of fusion _____.

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13. Nitrous acid, HNO_2, is a weak acid. Write the expression for the acid dissociation constant, K_a, for its dissociation in water.

14. (10 pts). Calcium carbonate ($CaCO_3$) is slightly soluble in water. Its solubility is 0.0153 grams per liter at 25 deg C. What is the molar concentration of $CaCO_3$ in water at 25 deg C?

15. Fill in the blank.The boiling point of any liquid is the temperature at which the _____ of the liquid is equal to the external pressure.

16. Match the type of inter-particle attractive force with the appropriate solvent mixture or solute-solvent pair by placing its number in the space provided.

a.___ London dispersion	1. 50-50 water and ethyl alcohol, CH_3CH_2OH.
b.___ Ion-dipole attraction	2. NaCl(aq)
c. ___Dipole-dipole attraction	3. Olive oil dissolved in hexane (C_6H_{14})
d.___Hydrogen bonding	4. HCN dissolved in chloroform (CH_3Cl)

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Useful information:

Henderson-Hasselbalch equation:

$$pH = pKa + \log\frac{[A-]}{[HA]} \quad \text{or} \quad pH = pKa - \log\frac{[HA]}{[A-]}$$

Abbreviated table of acids in order of decreasing acid strength:

ACID	CONJUGATE BASE
HCl	Cl^-
H_3O^+	H_2O
H_3PO_4	$H_2PO_4^-$
HNO_2	NO_2^-
HF	F^-
CH_3COOH (HOAc)	OAc^-
H_2CO_3	
NH_4^+	
HCN	
H_2O	OH^-
NH_3	NH_2^-

$K_w = 10^{-14}$; $pH + pOH = 14$

$K_a K_b = K_w$; $pK_a + pK_b = 14$

Ideal gas law, $PV = nRT$

R = 0.0821 L-atm per mol-K or 62.4 L-mmHg per mol-K

K = deg C + 273

760 mmHg = 760 torr = 1.000 atm = 14.7 psi