

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:
$$\text{NaNH}_2(\text{s}) + \text{CH}_3\text{OH}(\text{l}) \rightarrow \text{NH}_3(\text{methanol}) + \text{NaOCH}_3(\text{methanol})$$

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, $\text{H}_2\text{O}(\text{g})$, 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? ($K_a = 1.8 \times 10^{-5}$).

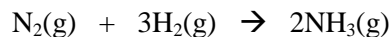
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8. What is the molar concentration of hydroxide ion in a 0.100 M solution of barium hydroxide, Ba(OH)₂?

9. The total pressure of a gas mixture of 35% helium (He) and 65% nitrogen (N₂) is 900 mm Hg. What is the partial pressure of helium?

10. Consider the following reaction:



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 (O₂) 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, $\text{CH}_3\text{CH}_2\text{OH}$. |
| b. ___ Ion-dipole attraction | 2. $\text{NaCl}(\text{aq})$ |
| 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:

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

Abbreviated table of acids in order of decreasing acid strength:

ACID	CONJUGATE BASE
HCl	Cl ⁻
H ₃ O ⁺	H ₂ O
H ₃ PO ₄	H ₂ PO ₄ ⁻
HNO ₂	NO ₂ ⁻
HF	F ⁻
CH ₃ COOH (HOAc)	OAc ⁻
H ₂ CO ₃	
NH ₄ ⁺	
HCN	
H ₂ O	OH ⁻
NH ₃	NH ₂ ⁻

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

$$K_a K_b = K_w; \quad \text{pK}_a + \text{pK}_b = 14$$

Ideal gas law, $PV = nRT$

$$R = 0.0821 \text{ L-atm per mol-K or } 62.4 \text{ L-mmHg per mol-K}$$

$$K = \text{deg C} + 273$$

$$760 \text{ mmHg} = 760 \text{ torr} = 1.000 \text{ atm} = 14.7 \text{ psi}$$