Unit Test Review: Solutions and Acids/Bases

Name: Key Period: 2 3

1. Define the following terms:
   a. Solute - substance that gets dissolved, present in smaller amounts
   b. Solvent - substance that does the dissolving, present in larger amounts
   c. Saturated - solution that has dissolved the maximum amount of solute at a specific temperature
   d. Unsaturated - solution that has dissolved less than the maximum amount of solute at a specific temperature
   e. Super saturated - a solution that has dissolved more than the maximum amount of solute at a specific temperature
   f. Concentrated - a lot of solute is dissolved in solution
   g. Dilute - a small amount of solute is dissolved in solution
   h. Colligative property - property that is only dependent on the concentration of the solution
   i. Freezing point depression - the freezing point of a solution is lower than that of the pure solvent
   j. Boiling point elevation - the boiling point of a solution is higher than that of the pure solvent

2. What are 3 factors that can speed up how fast a solute dissolves in a solvent and why?

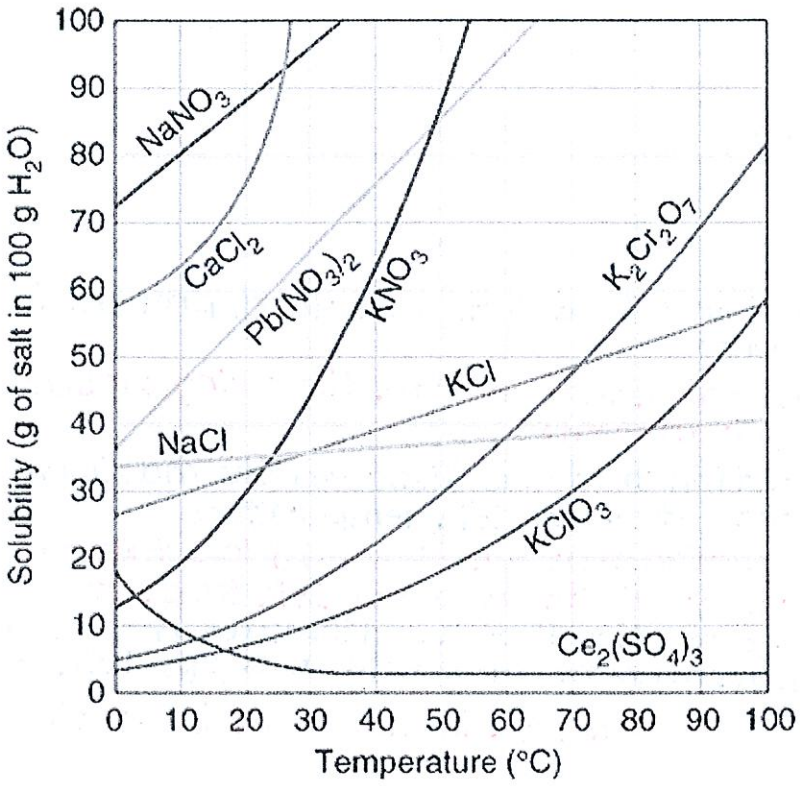
1) Increasing Surface Area - more solute is in contact with the solvent

2) Agitation (stirring) - brings solute & solvent into contact more often

3) Solids & Liquids
Increase Temperature - makes molecules move around faster so they are in contact more often

Gases
Decrease Temperature - gas won't escape from the liquid, & will stay dissolved

3.



a. In order to make a saturated solution of potassium chlorate at 70°C, how much potassium chlorate should be dissolved in 100 g of water?

30 g

b. How many grams of NaCl should be dissolved in 500g of water in order to make a saturated solution at 90°C?

$\frac{40\ g}{100\ g\ H_2O} \Rightarrow \frac{200\ g}{500\ g\ H_2O}$

c. Which is more concentrated: a saturated solutions of sodium nitrate at 20°C or a super saturated solution of calcium chloride holding 83g of calcium chloride dissolved in 100g of water at 20°C?

$NaNO_3 \sim 89\ g$ $NaNO_3$ is more concentrated

$CaCl_2 \sim 83g$

4. Can a solution be dilute and saturated at the same time? Explain.

Yes, dilute means only a small amount of solute has dissolved and saturated means that the maximum amount of solute has dissolved. For example, at 60°C, only ~3 g $Ce_2(SO_4)_3$ is dissolved in 100g H_2O to make a saturated solution. It is also dilute because it is such a small amount of $Ce_2(SO_4)_3$.

To convert g to moles, $\left(\frac{1\,mol}{molar\ mass}\right)$

moles of solute

5. Use the equation for molarity to solve these problems: **M = n/V**

   a. What is the molarity of a solution made by dissolving 130.0g of $Cu(NO_3)_2$ in enough water to make a 2.32L solution?

$n = 130.0g\ Cu(NO_3)_2 \left(\frac{1mol}{187.57g}\right) = .6931mol$

$V = 2.32L$

$M = \frac{.6931mol}{2.32L}$

$M = .299M$

   b. How many moles of $CrCl_3$ were dissolved to make 0.75L of a 0.75M solution?

$n = M \cdot V = .75M \cdot .75L = .56mol$

   c. What is the mass of $MgSO_4$ used to create 101mL of a 1.11M solution?

$n = M \cdot V = 1.11M \cdot .101L = .112mol$

$.112mol\ MgSO_4 \left(\frac{120.38g}{1mol}\right) = 13.5g$

6. Use the equation for molality to solve these problems: **m = n/kg**

   a. What is the molality of a solution made by dissolving 25.0g of Na_2S in 1.45kg of water?

$n = 25.0g\ Na_2S \left(\frac{1mol}{78.05g}\right) = .320mol$

$m = \frac{.320mol}{1.45kg}$

$m = .221m$

   b. How many moles of HF were dissolved in 1500g of water to make a 0.88m solution?

$n = m \cdot kg = .88m \cdot 1.500kg = 1.32mol$

   c. What mass of CO_2 was dissolved in 1220g of water to make a 1.25m solution?

$n = m \cdot kg = 1.25m \cdot 1.220kg = 1.53mol$

$1.53mol\ CO_2 \left(\frac{44.01g}{1mol}\right) = 67.3g$

Acids/Bases

1. Define the following terms.

   a. Arrhenius acid - release H^+ ions in solution

   b. Arrhenius base - release OH^- ions in solution

   c. Brønsted-Lowry acid - donate H^+ ions

   d. Brønsted-Lowry base - accept H^+ ions

   e. Conjugate acid - what the base becomes after getting an H^{+1}

   f. Conjugate base - what the acid becomes after losing H^{+1}

   g. Amphoteric - can act as an acid or a base

   h. pH - power (potential) of Hydrogen

2. Identify the Brønsted-Lowry acid, Brønsted-Lowry base, conjugate acid, and conjugate base in the reactions below:

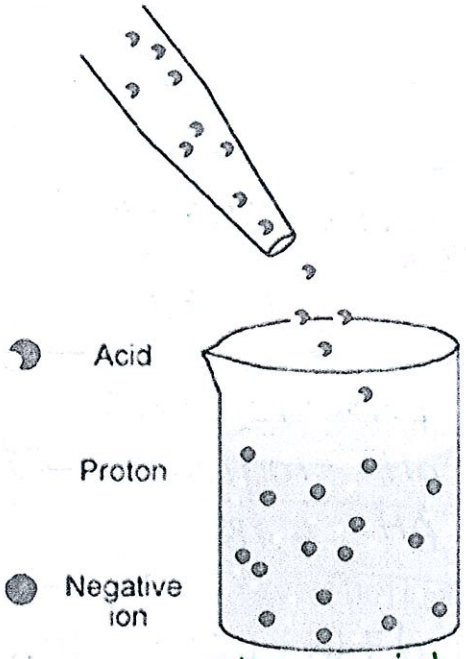
   a. $HSO_4^{1-} + NH_3 \rightarrow SO_4^{2-} + NH_4^{1+}$
   Acid Base CB CA

   b. $H_2O + NO_3^{1-} \rightarrow OH^- + HNO_3$
   Acid Base CB CA

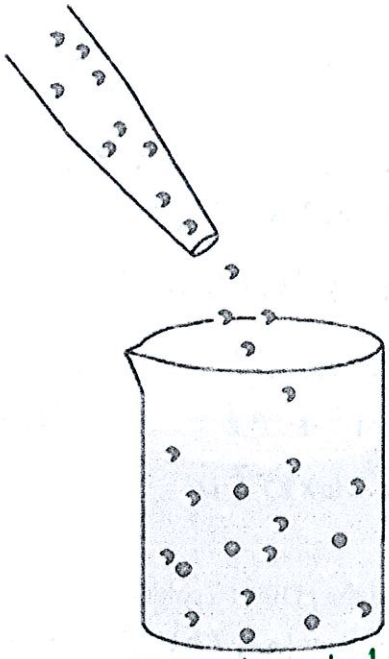
   c. $H_2O + HCO_3^{1-} \rightarrow H_3O^{1+} + CO_3^{2-}$
   Base Acid CA CB

   d. $F^- + H_2SO_4 \rightarrow HF + HSO_4^-$
   Base Acid CA CB

3. Label the beaker in the picture that represents a strong acid. Label the beaker that represents a weak acid.



strong acid
all broken apart



weak acid
barely any are broken apart

a. What makes an acid or base strong?
100% ionization

b. What makes an acid or base weak?
< 10% ionization

c. List 7 strong acids.
HCl, HBr, HI, HNO_3, $HClO_3$, $HClO_4$, H_2SO_4

d. List 8 strong bases.
$LiOH$, $NaOH$, KOH, $RbOH$, $CsOH$, $Ca(OH)_2$, $Sr(OH)_2$, $Ba(OH)_2$

4. List 4 properties of an acid. List 4 properties of a base.

Acid
- taste sour
- electrolytes
- turn blue litmus red
- react w/metals to form $H_2(g)$
- react w/ basis to form a salt & water

Base
- taste bitter
- electrolytes
- turns red litmus blue
- react w/acids to form a salt and water

5. Use the pH equations below to answer these questions.

$pH = -\log[H^+]$ $\quad pOH = -\log[OH^-]$ $\quad pH + pOH = 14.00$

$[H^+] = 10^{-pH}$ $\quad [OH^-] = 10^{-pOH}$ $\quad [H^+] \times [OH^-] = 1.00 \times 10^{-14}\ M^2$

a. Find the pOH of a solution of HNO_3 with a pH of 5.45.

$HNO_3 \rightarrow H^+ + NO_3^-$

Use $pH + pOH = 14.00$

$5.45 + pOH = 14.00$

$-5.45 \quad -5.45$

0

$pOH = 8.55$

b. Calculate the pH of a solution of HCl with a concentration of 6.56×10^{-7} M.

$HCl \rightarrow H^+ + Cl^-$

$6.56 \times 10^{-7}\ M \quad 6.56 \times 10^{-7}\ M$

Use $pH = -\log[H^+]$

$pH = -\log[6.56 \times 10^{-7}]$

$pH = 6.18$

c. Determine the pOH of a solution of HNO_3 with a $[OH^-]$ of 7.67×10^{-11} M.

Use $pOH = -\log[OH^-] = -\log[7.67 \times 10^{-11}] = 10.1$

d. Find the pH of a solution of RbOH with a concentration of 8.78×10^{-6} M.

$RbOH \rightarrow Rb^{+1} + OH^-$

$8.78 \times 10^{-5}\ M \quad 8.78 \times 10^{-5}\ M$

1) Use $pOH = -\log[OH^-]$

$pOH = -\log[8.78 \times 10^{-6}] = 5.06$

2) Use $pH + pOH = 14.00$

$pH + 5.06 = 14.00 \Rightarrow pH = 8.94$

e. Calculate the $[H^+]$ of an $HClO_3$ solution with a pH of 2.32.

$HClO_3 \rightarrow H^+ + ClO_3^-$

Use $[H^+] = 10^{-pH}$

$= 10^{-2.32} = 4.79 \times 10^{-3}\ M$

f. Calculate the $[OH^-]$ of a solution of HI with a $[H^+]$ of 9.89×10^{-4} M.

Use $[H^+] \times [OH^-] = 1.00 \times 10^{-14}\ M^2$

$\frac{[9.89 \times 10^{-4}\ M] \times [OH^-]}{9.89 \times 10^{-4}\ M} = \frac{1.00 \times 10^{-14}\ M^2}{9.89 \times 10^{-4}\ M} \Rightarrow [OH^-] = 1.01 \times 10^{-11}\ M$

g. Calculate the $[H^+]$ of a solution of KOH with a pOH of 3.43.

1) Use $pH + pOH = 14.00$

$pH + 3.43 = 14.00$

$pH = 10.57$

2) Use $[H^+] = 10^{-pH}$

$[H^+] = 10^{-10.57}$

$[H^+] = 2.69 \times 10^{-11}\ M$

6. Use the neutralization equation to answer these questions.

$$M_AV_A = M_BV_B$$

a. What is the concentration of .900L HCl (MA, VA) needed to neutralize 1.21 L of .0750 M LiOH (VB, MB)?

MA = ?
VA = .900L
MB = .0750M
VB = 1.21L

$$\frac{M_A(.900L)}{.900L} = \frac{(.0750\,M)(1.21L)}{.900L}$$

$$M_A = .101M$$

b. What is the volume, in L, of 1.40×10^{-4} M $HClO_3$ (VA, MA) needed to neutralize 125 mL (VB) of 1.10×10^{-4} M $Ca(OH)_2$? (MB)

$M_A = 1.40 \times 10^{-4}\,M$
$V_A = ?$
$M_B = 2 \times (1.10 \times 10^{-4}\,M) = 2.20 \times 10^{-4}\,M$
$V_B = 125mL = .125L$

$$\frac{(1.40 \times 10^{-4}\,M)V_B}{1.40 \times 10^{-4}M} = \frac{(2.20 \times 10^{-4}\,M)(.125V)}{1.40 \times 10^{-4}M}$$

$$V_B = .250L$$