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Name: Key
Blk:____Date:_____

Chemistry 11
Solution Chemistry Review

1. **Define** the following terms:

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solution
solute
solvent
saturated
unsaturated
solvation
polar
non-polar
ionic compound
molecular compound
Vander Waals Forces
dipole-dipole force
H bond
london force
AMPHIPROTIC
Bronsted-Lowry acid
Bronsted-Lowry base
Arrhenius acid
Arrhenius base

2. Indicate whether the following molecules are **polar** or **non-polar**

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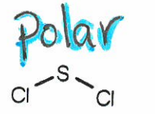
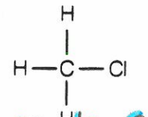
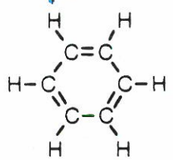


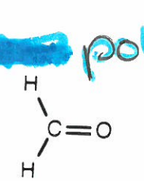
Polar



polar

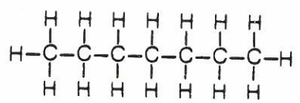


non-polar



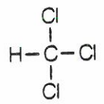
polar

non-polar

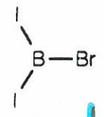


non-polar

polar



polar



polar

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3. List the most important **INTRA-MOLECULAR FORCE** that exists between:

INTER Molecular or

a. 2 atoms of He in He (g) — London forces
b. 2 molecules of $CH_3CH_3NH_2$ in $CH_3CH_3NH_2$ — H-bond
c. 2 molecules of CCl_4 (symmetric) in CCl_4 — London forces
d. The atom Na and the atom Cl in NaCl (s) — ionic bond
e. 2 molecules of CH_3F in CH_3F (l) — H-bond

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4. Explain why **WATER** is the universal SOLVENT:

Water is the universal solvent because it is a polar molecule but it can also dissolve non-polar molecules. Water is abundant, cheap, not harmful and non-toxic.

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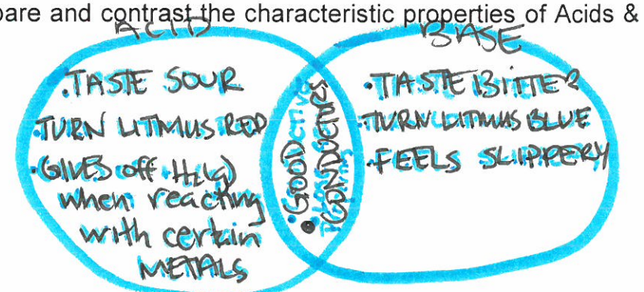
5. Compare and contrast the characteristic properties of Acids & Bases



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6. Write the **dissociation** and **ionization** equations the result when the following compounds are dissolved in water:

a. NaBr $\longrightarrow$ $Na^+(aq) + Br^-(aq)$ [DISSOCIATION]
b. HNO_3 $\longrightarrow$ $H^+(aq) + NO_3^-(aq)$ [IONIZATION]
c. $AlBr_3$ $\longrightarrow$ $Al^{3+}(aq) + 3Br^-(aq)$ [DISSOCIATION]
d. $(NH_4)_2SO_4$ $\longrightarrow$ $2NH_4^+(aq) + SO_4^{2-}(aq)$ [DISSOCIATION]
e. $Ba(OH)_2$ $\longrightarrow$ $Ba^{2+}(aq) + 2OH^-(aq)$ [DISSOCIATION]
f. $Cr_2(SO_4)_3$ $\longrightarrow$ $2Cr^{3+}(aq) + 3SO_4^{2-}(aq)$ [DISSOCIATION]
g. H_3PO_4 $\longrightarrow$ $3H^+(aq) + PO_4^{3-}(aq)$ [IONIZATION]

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7. Write the dissociation equation for each of the following solutions, then calculate the concentration of each ION in the solution:

a. 0.18 M $Hg(NO_3)_2$ $\longrightarrow$ $Hg^{2+}(aq) + 2NO_3^-(aq)$

1/2 0.18 M Hg^{2+} ; 0.36 M NO_3^-

b. 0.35 M $(NH_4)_2SO_4$ $\longrightarrow$ $2NH_4^+(aq) + SO_4^{2-}(aq)$

1/2 0.70 M NH_4^+ ; 0.35 M SO_4^{2-}

c. 0.070 M $Fe(ClO_4)_3$ $\longrightarrow$ $Fe^{3+}(aq) + 3ClO_4^-(aq)$

1/2 0.070 M Fe^{3+} ; 0.21 M ClO_4^-

8. Calculate the final concentration of <u>each ion</u> when the following solutions are mixed

a. 125 mL of 0.20 M $MgCl_2$ mixed with 375 mL of 0.40 M KCl

$MgCl_2 \rightarrow Mg^{2+} + 2Cl^-$

$KCl \rightarrow K^+ + Cl^-$

$\frac{0.20M \times 0.125L}{0.500L} = 0.050M\ Mg^{2+}$

$\frac{0.40M \times 0.375L}{0.500L} = 0.30\ M\ K^+$

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2x $\frac{0.20M \times 0.125L}{0.500L} = 0.10M\ Cl^-$

$\frac{0.40M \times 0.375L}{0.500L} = 0.30\ M\ Cl^-$

$0.10 + 0.30 = 0.40\ M\ Cl^-$

b. 4.0 L of 0.25 M $CuSO_4$ mixed with 6.0 L if 0.75 M Na_2SO_4

$CuSO_4 \rightarrow Cu^{2+} + SO_4^{2-}$

$Na_2SO_4 \rightarrow 2Na^+ + SO_4^{2-}$

1/3 $\frac{0.25M \times 4.0L}{10.0L} = 0.10M\ Cu^{2+}$

2x $\frac{0.75 \times 6.0L}{10.0L} = 0.90\ M\ Na^+$

1/12 $\frac{0.25M \times 4.0L}{10.0L} = 0.10M\ SO_4^{2-}$

$\frac{0.75M \times 6.0L}{10.0L} = 0.45\ M + 0.10M$

$0.55\ M\ SO_4^{2-}$

$CrBr_3 \rightarrow Cr^{3+} + 3Br^-$; $CaBr_2 \rightarrow Ca^{2+} + 2Br^-$

c. 300 mL of 0.3 M $CrBr_3$ mixed with 700 mL of 0.1 M $CaBr_2$

$\frac{0.3\,M \times 0.3\,L}{1.0\,L} = 0.09\,M\,Cr^{3+}$ || $\frac{0.1\,M \times 0.7\,L}{1.0\,L} = 0.07\,M\,Ca^{2+}$

1/3 3x $\frac{0.3\,M \times 0.3\,L}{1.0\,L} = 0.27\,M\,Br^-$ → 0.3 M

2x $\frac{0.1\,M \times 0.7\,L}{1.0\,L} = 0.1\,M + 0.3\,M\,Br^-$

0.4 M Br^-

9. What is the concentration of NaOH if 27.0 mL is neutralized by adding 35.0 mL 0f 0.500 M HCl?

$NaOH + HCl \rightarrow NaCl + H_2O$

1/2 $\frac{0.50\,mol\,HCl}{1\,L} \times 0.035\,L = 0.0175\,mol\,NaOH$ $= \frac{0.0175\,mol\,NaOH}{0.0270\,L} =$ 0.648 M NaOH

0.25 M H_2SO_4 unknown [ ] of KOH

10. If 35 mL of 0.25 M H_2SO_4 is titrated with 15.8 mL of 0.0928 M KOH, what is the concentration of the original ~~H_2SO_4~~ KOH?

$H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$

1/2 $\frac{0.25\,mol\,H_2SO_4}{4\,L} \times 0.035\,L = 0.00875\,mol\,H_2SO_4 \times \frac{2\,mol\,KOH}{1\,mol\,H_2SO_4}$

$= \frac{0.0176\,mol\,KOH}{0.0158\,L} =$ 1.1 M KOH

11. If 125 mL of 0.551 M H_3PO_4 is titrated to neutralize 50.0 mL of $Ca(OH)_2$, what is the concentration of $Ca(OH)_2$?

$2H_3PO_4 + 3Ca(OH)_2 \rightarrow Ca_3(PO_4)_2 + 6H_2O$

1/2 $\frac{0.551\,mol \times 0.125\,L}{1\,L} = 0.068875\,mol\,H_3PO_4 \times \frac{3\,mol\,Ca(OH)_2}{2\,mol\,H_3PO_4}$

$= \frac{0.10331\,mol\,Ca(OH)_2}{0.0500\,L} =$ 2.06 M $Ca(OH)_2$

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FLASHBACK QUESTIONS: TITRATIONS!!!!

9. What is the concentration of NaOH if 27.0 mL is neutralized by adding 35.0 mL 0f 0.500 M HCl?

$$NaOH + HCl \longrightarrow NaCl + H_2O$$

$$0.0350\,L \times \frac{0.500\,mol\,HCl}{1\,L} \times \frac{1\,mol\,NaOH}{1\,mol\,HCl} = \frac{0.0175\,mol\,NaOH}{0.0270\,L} = \boxed{0.648\,M\ NaOH}$$

10. If 35 mL ~~of 0.25 M~~ unknown H_2SO_4 is titrated with 15.8 mL of 0.0928 M KOH, what is the concentration of the ~~original~~ unknown H_2SO_4?

$$H_2SO_4 + 2\,KOH \longrightarrow K_2SO_4 + 2H_2O$$

$$0.0158\,L \times \frac{0.0928\,mol\,KOH}{1\,L} \times \frac{1\,mol\,H_2SO_4}{2\,mol\,KOH} = \frac{7.33\times10^{-4}\,mol}{0.035\,L} = \boxed{0.021\,M\ H_2SO_4}$$

11. If 125 mL of 0.551 M H_3PO_4 is titrated to neutralize 50.0 mL of $Ca(OH)_2$, what is the concentration of $Ca(OH)_2$?

$$2\,H_3PO_4 + 3\,Ca(OH)_2 \longrightarrow Ca_3(PO_4)_2 + 6H_2O$$

$$0.125\,L \times \frac{0.551\,mol\,H_3PO_4}{1\,L} \times \frac{3\,mol\,Ca(OH)_2}{2\,mol\,H_3PO_4} = \frac{0.103\,mol\,Ca(OH)_2}{0.0500\,L}$$

$$= \boxed{2.07\,M\ Ca(OH)_2}$$