Key

Acids/Bases

1. Define the following terms.

   a. Arrhenius acid - a substance that releases H^+ ions in solution

   b. Arrhenius base - a substance that releases OH^- ions in solution

   c. Brønsted-Lowry acid - a substance that donates H^+ ions in solution

   d. Brønsted-Lowry base - a substance that accepts H^+ ions in solution

   e. Conjugate acid - substance that the base becomes after accepting a H^+ ion

   f. Conjugate base - substance that is left over after an acid donates a H^+ ion

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

   h. pH - potential of hydrogen

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

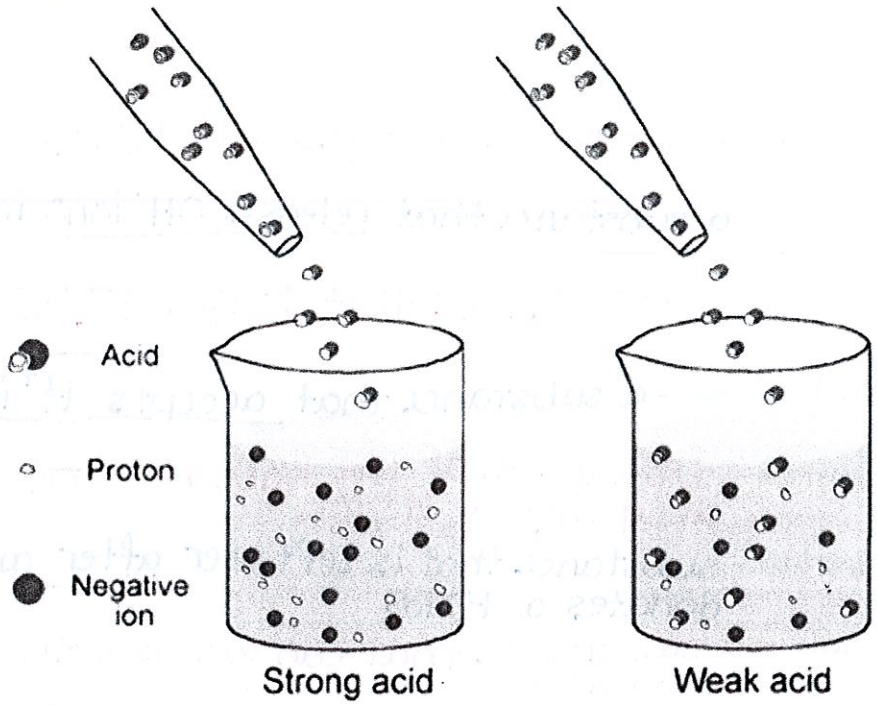
   a. $HSO_4^{1-} + NH_3 \rightarrow SO_4^{2-} + NH_4^{1+}$
   A B CB CA

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

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

   d. $F^- + H_2SO_4 \rightarrow HF + HSO_4^-$
   B A CA CB

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



a. What makes an acid or base strong?
it ionizes 100% Ex) $HNO_3 \rightarrow H^+ + NO_3^-$ (0% / 100%)

b. What makes an acid or base weak?
it ionizes 10% or less Ex) $HF \rightarrow H^+ + F^-$ (90% / 10%)

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, $Ca(OH)_2$, $Ba(OH)_2$, & $Sr(OH)_2$

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

Acids

(1) taste sour
(2) react w/metals to give off H_2 gas.
(3) react w/bases to produce a salt & water
(4) turn blue litmus paper red
(5) are electrolytes

Bases

(1) taste bitter
(2) are electrolytes
(3) react w/acids to produce a salt & water
(4) turn red litmus paper blue

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

(A) $pH = -\log[H^+]$ (B) $pOH = -\log[OH^-]$ (C) $pH + pOH = 14.0$

(D) $[H^+] = 10^{-pH}$ (E) $[OH^-] = 10^{-pOH}$ (F) $[H^+] \times [OH^-] = 1.00 \times 10^{-14}$

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

has H^+, not OH^- use equation C

(C) $pH + pOH = 14.0$

$5.45 + pOH = 14.0$

$pOH = 8.55 = \boxed{8.6}$

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

has H^+ use equation A

(A) $pH = -\log(6.56 \times 10^{-7})$

$\boxed{pH = 6.18}$

c. Determine the pOH of a solution of HNO_3 with a concentration of 7.67×10^{-11} M.

has H^+, not OH^- use equations A & C

(A) $pH = -\log(7.67 \times 10^{-11})$

$pH = 10.1$

(C) $pH + pOH = 14.0$

$10.1 + pOH = 14.0 \rightarrow \boxed{pOH = 3.9}$

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

has OH^-, not H^+ use equations B & C

(B) $pOH = -\log(8.78 \times 10^{-6})$

$pOH = 5.06$

(C) $pH + pOH = 14.0$

$pH + 5.06 = 14.0 \rightarrow \boxed{pH = 8.9}$

e. Calculate the $[H^+]$ of a solution of HI with a pH = 4.56.

has H^+ use equation D

(D) $[H^+] = 10^{-4.56}$

$\boxed{[H^+] = 2.75 \times 10^{-5}\ M}$

f. Calculate the $[OH^-]$ of a solution of $Ca(OH)_2$ with a pOH = 11.1.

has OH^- use equation E

(E) $[OH^-] = 10^{-11.1}$

$[OH^-] = (7.94 \times 10^{-12}\ M) \times 2 = \boxed{1.59 \times 10^{-11}\ M}$

g. Calculate the $[H^+]$ of a solution of NaOH with a pOH = 7.77.

has OH^-, not H^+ use equations C & D

(C) $pH + pOH = 14.0$

$pH + 7.77 = 14.0$

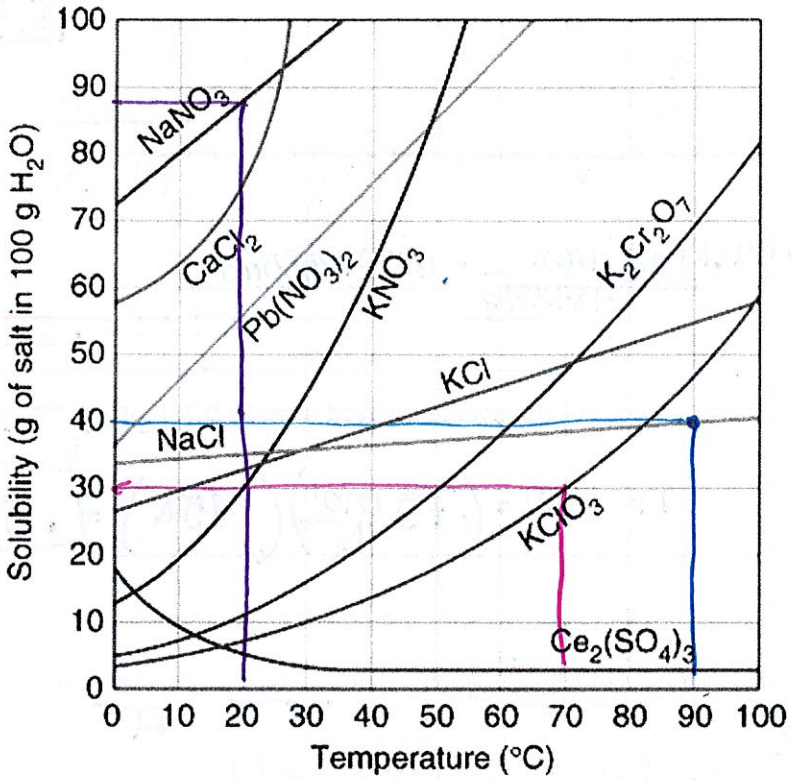
$pH = 6.2$

(D) $[H^+] = 10^{-6.2}$

$\boxed{[H^+] = 6.3 \times 10^{-7}\ M}$

Solutions

1.



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?

$\frac{40\text{g NaCl}}{100\text{g } H_2O}$ so $\frac{5(40\text{g})\text{ NaCl}}{500\text{g } H_2O} = \frac{200\text{g NaCl}}{500\text{g } H_2O}$

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?

~89g $NaNO_3$ or 83g $CaCl_2$

Concentrated - which has more solute dissolved

The answer is $NaNO_3$.

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

Yes, dilute means only a small amount of solute has dissolved. Saturated means the maximum amount of solute has dissolved.

Molar Mass - $Cu(NO_3)_2$

1 Cu × 63.55g = 63.55g
2 N × 14.01g = 28.02g
6 O × 16.00g = 96.00g / 187.57g

3. 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?

M = ?

$n = 130.0g\ Cu(NO_3)_2 \left| \frac{1mol}{187.57g} \right. = .693074585mol$

V = 2.32L

$M = \frac{n}{V}$

$M = \frac{.693074585mol}{2.32L}$

$M = .299\ mol/L$

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

M = .75 mol/L
n = ?
V = .75L

$n = M \cdot V = \left(.75\ \frac{mol}{L}\right)(.75L) = .56mol$

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

M = 1.11 mol/L
n = ?
V = 101mL = .101L

$n = M \cdot V = \left(1.11\ \frac{mol}{L}\right)(.101L)$

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

MM - $MgSO_4$

1 Mg × 24.31g = 24.31g
1 S × 32.07g = 32.07g
4 O × 16.00g = 64.00g
120.38g

4. Use the equation for dilutions to solve these problems: **$M_1V_1 = M_2V_2$**

a. You have 13.00mL of 3.36M solution of sodium hydroxide, you need a concentration of 2.24M. What volume should you dilute the solution to?

$M_1V_1 = M_2V_2$

$(3.36M)(.01300L) = (2.24M)V_2$

$\frac{.04368\ M \cdot L}{2.24M} = \frac{(2.24M)V_2}{2.24M}$

$.0195L = V_2$

b. You have 250L of 12.0 M sulfuric acid. You dilute it to 1.250L. What is the new molarity of your solution?

$M_1V_1 = M_2V_2$

$(12.0M)(.250L) = M_2(1.250L)$

$\frac{3\ M \cdot L}{1.250L} = \frac{M_2(1.250L)}{1.250L}$

$2.40M = M_2$

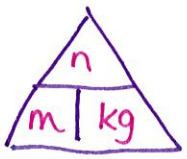
MM of Na_2S

$2 Na \times 22.99g = 45.98g$

$1 S \times 32.07g = 32.07g$

$78.05g$

5. 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?

? m kg

$m = ?$

$n = 25.0g\ Na_2S \left| \frac{1 mol}{78.05g} \right. = .320307495 mol$

$m = \frac{n}{kg} = \frac{.320307495 mol}{1.45 kg}$

$Kg = 1.45 kg$

$m = .221 mol/kg$

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

? n kg m

$m = .88 mol/kg$

$n = ?$

$Kg = 1500g = 1.500 kg$

$n = m \cdot kg$

$n = (.88 \frac{mol}{kg})(1.500 kg) = 1.3 mol$

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

? n kg m

$m = 1.25 mol/kg$

$n = ?$

$Kg = 1220g = 1.22 kg$

$n = m \cdot kg$

$n = (1.25 \frac{mol}{kg})(1.22 kg) = 1.53 mol$

$1.53 mol\ CO_2 \left| \frac{44.01g}{1 mol\ CO_2} \right. = 67.3g\ CO_2$

MM CO_2

$1C \times 12.01g = 12.01g$

$2O \times 16.00g = 32.00g$

$44.01g$

6. What are colligative properties? Name 2.

Properties that are affected by the number of particles in solution rather than what the particles are.

2 colligative properties are boiling point elevation & freezing point depression.

7. What would happen to the freezing point if you add sugar to water? What would happen to the boiling point?

↓ It would lower

↳ It would raise

8. Which solute would have the greatest effect on the boiling point of a solution:

ionic a. $CaCl_2$ $CaCl_2 \rightarrow Ca^{2+} + 2Cl^- = 3$ particles

covalent b. Br_2 $Br_2 = 1$ particle

ionic c. $Al(NO_3)_3$ $Al(NO_3)_3 \rightarrow Al^{3+} + 3NO^- = 4$ particles

The more particles the greater the effect!

9. What would happen to the freezing point if you add sugar to water? What would happen to the boiling point?

10. Which solute would have the greatest effect on the boiling point of a solution:

a. $CaCl_2$

b. Br_2

c. $Al(NO_3)_3$