1. HCl = 3.0 – 2.1 = 0.9: dipole-dipole, London.
   H_2O = 3.5 – 2.1 = 1.4: hydrogen bonding (H with N, O, or F), London.
   NaCl = 3.0 – 0.9 = 2.1: ionic, London.
   CH_4 = 2.5 – 2.1 = 0.4: London only.
2. a) Solubility is a balance between attractive forces and the speed of molecules. Oil doesn't mix with water because the speed of the oil molecules is not sufficient to break through the attractive forces of the water. Water offers less resistance to molecules of HCl since water has a greater attraction for HCl than it has for oil. Thus, the speed of the HCl molecules is sufficient to break through the attractive forces of the water molecules.

2. b) More solid particles are suspended by warmer water because water molecules move faster at higher temperatures. Unlike solids, dissolved gases can leave the surface of a liquid. The higher the temperature, the faster the gas (and liquid) molecules are traveling. This gives a larger percentage of the gas molecules the speed they need to escape the surface of the liquid (thus, gases have a lower solubility at higher temperatures).
3. 12 % V/V = 12 mL/100 mL, 12 L/100 L, etc.
   250 mL wine x 12 mL alcohol/100 mL wine = 30 mL alcohol

4. 8 ppm = 8 mg/kg, 8 μg/g, etc. For aqueous solutions, 1 kg = 1 L, thus 8 ppm = 8 mg/L
   0.300 L x 8.0 mg/L = 2.4 mg
5. g/mol KCl = 39.10 + 35.45 = 74.55 g/mol
   # mol = 15 g x 1 mol / 74.55 g = 0.2<u>0</u>12 mol
   mol/L = 0.2<u>0</u>12 mol / 0.800 L = 0.25 mol/L
6. M=mol/L, mol = L x mol/L
   # mol = (0.100 L)(3.00 mol/L) = 0.300 mol
   g/mol NaOH = 40.00 g/mol (22.99+16+1.01)
   # g = 0.300 mol x 40.00 g/mol = 12.0 g

or

g NaOH =

$$0.100\ \cancel{L} \times \frac{3.00\ \cancel{\text{mol NaOH}}}{1\ \cancel{L}} \times \frac{40.0\ \text{g NaOH}}{1\ \cancel{\text{mol NaOH}}} = 12.0\ \text{g}$$

7. $M_1V_1=M_2V_2$, (18.0 M)(V_1)=(3.00 M)(1.00 L)
   V_1 = 0.167 L = 167 mL
8. Calculate (total # mol) / (total # L)
   # mol =(3.0 L)(0.30 mol/L)+(1.0 L)(1.5 mol/L)
   = 0.90 mol + 1.5 mol = 2.4 mol
   # mol/L = 2.4 mol / 4.0 L = 0.60 mol/L
9. $NaNO_3$(aq) + $CuCl_2$(aq) $\rightarrow$ NR
   Ionic: Na^+(aq) + NO_3^-(aq)+ Cu^{2+}(aq)+ 2Cl^-(aq)$\rightarrow$ NR
   Net ionic: NR

$3K_2CO_3$(aq) + $2Al(NO_3)_3$(aq) $\rightarrow$ $Al_2(CO_3)_3$(s) + $6KNO_3$(aq)
Ionic: $6K^+$(aq) +$3CO_3^{2-}$(aq) +$2Al^{3+}$(aq) +$6NO_3^-$(aq)
$\rightarrow$ $Al_2(CO_3)_3$(s) + $6K^+$(aq) + $6NO_3^-$(aq)
Net ionic: $3CO_3^{2-}$(aq) +$2Al^{3+}$(aq) $\rightarrow$ $Al_2(CO_3)_3$(s)

10. c) $Zn(C_2H_3O_2)_2$ and d) LiOH are soluble.
11. a) 57 g – 47 g = 10 g $KClO_3$
    b) 0.38 x (85 g – 60 g) = 9.5 g
12. 1) Collection: collect water and remove large particles with screens; 2) Coagulation, floc-culation, sedimentation: coagulate and remove small particles; 3) Filtration: remove smallest particles (including bacteria); 4) dis-infection: kill microorganisms via chlorine, ozone, or UV light; 5) Aeration: air or other chemicals are mixed with water to reduce taste and colour problems; 6) Softening: precipitating Mg^{2+} and Ca^{2+}; 7) Fluoridation: fluoride added to combat tooth decay…

12. 8) Post-chlorination: another round of chlorination, and the pH of water is made basic so that metal pipes do not corrode;
    9) Ammoniation: adding ammonia so that chlorine will stay dissolved in water longer.
13. 2NaCl(aq) + $Pb(NO_3)_2$(aq) $\rightarrow$ $2NaNO_3$(aq) + $PbCl_2$(s)

L NaCl=

$$0.0500\ \cancel{L\ Pb(NO_3)_2} \times \frac{0.350\ \cancel{mol\ Pb(NO_3)_2}}{\cancel{L\ Pb(NO_3)_2}} \times \frac{2\ \cancel{mol\ NaCl}}{1\ \cancel{mol\ Pb(NO_3)_2}} \times \frac{L\ NaCl}{1.50\ \cancel{mol\ NaCl}} = 0.0233\ L = 23.3\ mL$$

14. 6KOH(aq)+$Al_2(SO_4)_3$(aq)$\rightarrow$2$Al(OH)_3$(s)+$3K_2SO_4$(aq)

g $Al(OH)_3$=

$$\frac{1.40}{\cancel{L\ KOH}} \times \frac{0.500\ \cancel{mol\ KOH}}{\cancel{L\ KOH}} \times \frac{2\ \cancel{mol\ Al(OH)_3}}{6\ \cancel{mol\ KOH}} \times \frac{78.01\ g\ Al(OH)_3}{1\ \cancel{mol\ Al(OH)_3}} = 18.2\ g$$

15. $HC_2H_3O_2$ will be the weakest since it does not dissociate/ionize 100%.
16. Phenolphthalein - pink (base), cloudy (acid)
    Bromothymol - blue (base), yellow (acid)
    Litmus - blue (base), red (acid)
    Also: bases are slippery and bitter, acids are sour and react with baking soda and Mg.
17. pH = -log[H^+(aq)] = -log[3.9×10^{-5}] = 4.41
    [H^+(aq)] = 10^{-pH} = $10^{-9.57}$ = 2.7 x 10^{-10} mol/L
18. Arrhenius: acids ionize to form H_3O^+ (hydronium) in water, bases dissociate to form OH^- (hydroxide) in water.
    Bronsted-Lowry: acids are H^+ (proton) donors, bases are H^+ acceptors.

19.

NH_3(aq) + H_2O(aq) $\rightarrow$ NH_4^+(aq) + OH^-(aq)
base   acid   conjugate acid   conjugate base

conjugate acid-base pairs

20. #H x M_A x V_A = #OH x M_B x V_B
    (3)(3.1 M)(V_A) = (2)(0.30 M)(0.250 L)
    V_A = (2)(0.30 M)(0.250 L) / (3)(3.1 M)
    = 0.01<u>6</u>13 L = 16 mL

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