

Fall 2013 Honors Chemistry Final Review Key

Scientific Method - define

- observation - using 5 senses to notice situations
- hypothesis - testable explanation of observations
- experiment - step by step procedure for testing the hypothesis
- data/analysis - qualitative (descriptions) or quantitative (measurements) information obtained from the experiment. Analysis is any calculations or manipulation of data.
- theory/scientific law - theories explain why specific phenomena occur. Scientific laws explain what is happening.

- a) Initial observation - honeybee populations are crashing.
- b) Hypothesis - The cause of the collapse of honeybee population is believed to be a pathogen (virus, bacteria, or fungus).
- c) Experiment - I would set up 4 healthy, isolated hives. One would be the control, the second would receive a virus, the third would receive a bacteria, & the fourth would receive a fungus. I would monitor each hive's health daily for one week. Also, each hive would have the same type of food, water, weather conditions, etc.
- d) If hypothesis is supported - one of the experimental hives would die out while the other 3 remain healthy
- e) If hypothesis is not supported - all 4 hives would die out or all 4 would remain healthy.

Lab Safety

- a) Wearing loose clothing / hair or dangling jewelry can either knock over containers or become contaminated w/chemicals.
- b) Wearing goggles protects the eyes from spilled chemicals splashing up & broken glassware from entering the eyes.
- c) Wear closed-toe shoes so your feet do not get cut by broken glassware or get chemicals on your skin.
- d) By not eating or drinking in the lab, there is little chance of ingesting dangerous chemicals
- e) Being serious in the lab prevents accidents from happening

Lab Equipment

- 3 a) beaker b) thermometer c) funnels
 d) graduated cylinder e) balance f) Beaker, g) Erlenmeyer
 (from muppets) flask

Scientific Notation

- 4 a) 0.00000678 s ~~~ $6.78 \times 10^{-6}\text{ s}$
 b) 19100000 J ~~~ $1.91 \times 10^7\text{ J}$
 c) 0.000546 g ~~~ $5.46 \times 10^{-4}\text{ g}$
 d) $12110000000^\circ\text{C}$ ~~~ $1.211 \times 10^{10}^\circ\text{C}$
 e) $8.76 \times 10^4\text{ atm}$ ~~~ 87600 atm
 f) $3.42 \times 10^{-4}\text{ mol}$ ~~~ 0.000342 mol

Significant Figures

- 5 a) 100.0 g ~~~ 4 s.figs (trailing zeroes + decimal pt.)
 b) 0.5406040 m ~~~ 7 s.figs (captured + trailing zeroes + decimal pt.)
 c) 0.000005 s ~~~ 1 s.figs. (all zeroes are leading zeroes.)
 d) 0.0034565400 J ~~~ 8 s.figs. (trailing zeroes + decimal pt.)

- 6 a) 100. g
 b) 0.541 m
 c) 0.00000500 s
 d) 0.00346 J

Nuclear Chemistry - define

- nuclear fission - breaking down a radioactive atom into 2 or more smaller pieces + lots of energy
- nuclear fusion - combining of 2 smaller particles into a larger atom + tons of energy

- 7 a) fusion produces elements
 b) fission is used in nuclear reactors
 c) fusion occurs in stars
 d) fusion requires extremely high temperatures

States of matter

- 8 (1) b. liquid
(2) c. gas
(3) a. solid
(4) d. plasma
(5) a. solid
(6) c. gas & d. plasma
(7) b. liquid

9 a) physical
b) chemical
c) physical
d) physical
e) chemical
f) chemical
g) physical
h) chemical

10 a) copper \rightarrow element
b) air \rightarrow homogeneous mix.
c) carbon monoxide \rightarrow compound
d) Lucky Charms - heterogeneous mix.
e) oxygen - element
f) hot coffee - homogeneous mix.

11 a) chemical
b) physical
c) physical
d) chemical
e) physical
f) physical

12) Gallium would be a liquid in your hand at 37.0°C

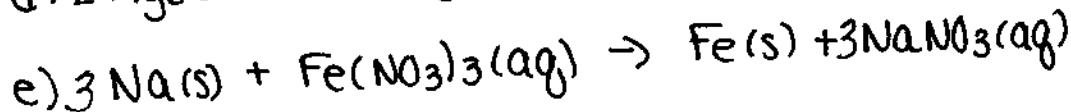
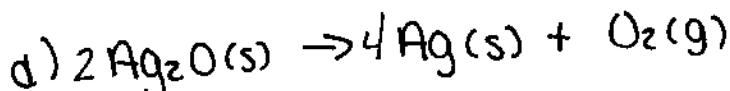
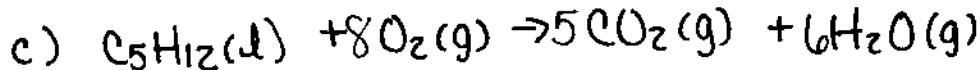
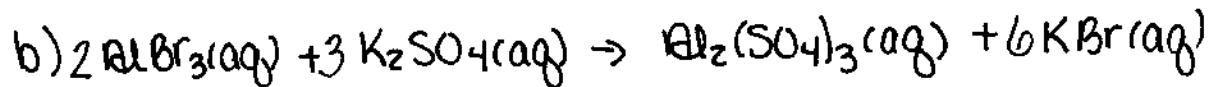
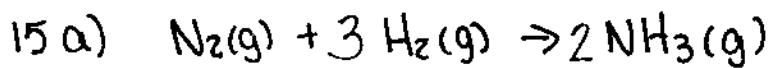
Nomenclature

13 a) sodium sulfide - Na_2S
c) gold (III) fluoride - AuF_3
e) carbonic acid - H_2CO_3
g) dihydrogen monoxide - H_2O
i) lead(IV) sulfate - $\text{Pb}(\text{SO}_4)_2$
b) HCl - hydrochloric acid
d) N_2O_5 - dinitrogen pentoxide
f) $\text{Ca}(\text{NO}_3)_2$ - calcium nitrate
h) H_3PO_3 - phosphorous acid
j) $\text{Fe}_2(\text{C}_2\text{O}_4)_3$ - iron (III) oxalate

Chemical Reactions

- Chemical Reactions

14) a) $\text{NaCl(s)} + \text{F}_2\text{(g)} \rightarrow \text{NaF(s)} + \text{Cl}_2\text{(g)}$
b) $\text{KClO}_3\text{(s)} \rightarrow \text{KCl(s)} + \text{O}_2\text{(g)}$
c) $\text{S}_8\text{(s)} + \text{O}_2\text{(g)} \rightarrow \text{SO}_3\text{(s)}$
d) $\text{HCl(aq)} + \text{CaCO}_3\text{(s)} \rightarrow \text{CaCl}_2\text{(aq)} + \text{H}_2\text{O(l)} + \text{CO}_2\text{(g)}$
e) $\text{C}_3\text{H}_8\text{(l)} + \text{O}_2\text{(g)} \rightarrow \text{CO}_2\text{(g)} + \text{H}_2\text{O(g)}$



16) from #14

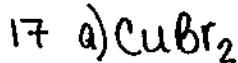
- a) single-replacement
- b) decomposition
- c) synthesis
- d) double-replacement*
- e) combustion

from #15

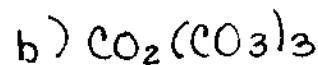
- a) synthesis
- b) double-replacement
- c) combustion
- d) decomposition
- e) single-replacement

*Remember, when H_2CO_3 forms - it automatically breaks down into H_2O and CO_2

Moles



$$\begin{array}{rcl} \text{Cu: } 1 \times 63.55 \text{ g/mol} & = & 63.55 \text{ g/mol} \\ \text{Br: } 2 \times 79.90 \text{ g/mol} & = & 159.80 \text{ g/mol} \\ & \hline & 223.35 \text{ g/mol} \end{array}$$



$$\begin{array}{rcl} \text{C: } 2 \times 12.01 \text{ g/mol} & = & 117.80 \text{ g/mol} \\ \text{O: } 3 \times 16.00 \text{ g/mol} & = & 36.03 \text{ g/mol} \\ & \hline & 297.89 \text{ g/mol} \end{array}$$

$$\% \text{ Cu} = \frac{63.55 \text{ g/mol}}{223.35 \text{ g/mol}} \times 100 = 28.45\%$$

$$\% \text{ C} = \frac{117.80 \text{ g/mol}}{297.89 \text{ g/mol}} \times 100 = 39.56\%$$

$$\% \text{ Br} = \frac{159.80 \text{ g/mol}}{223.35 \text{ g/mol}} \times 100 = 71.55\%$$

$$\% \text{ O} = \frac{36.03 \text{ g/mol}}{297.89 \text{ g/mol}} \times 100 = 12.10\%$$

$$\% \text{ O} = \frac{144.00 \text{ g/mol}}{297.89 \text{ g/mol}} \times 100 = 48.34\%$$

$$18) \frac{34.5 \text{ g H}_2\text{O}}{18.02 \text{ g}} \Big| \frac{1 \text{ mol}}{1 \text{ mol}} = 1.91 \text{ mol H}_2\text{O}$$

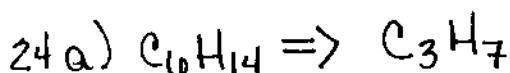
$$19) \frac{456 \text{ mol H}_2\text{O}}{1 \text{ mol}} \Big| \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} = 2.75 \times 10^{23} \text{ molecules H}_2\text{O}$$

$$20) \frac{21.1 \text{ g CaCl}_2}{110.98 \text{ g}} \Big| \frac{1 \text{ mol}}{1 \text{ mol}} = .190 \text{ mol CaCl}_2$$

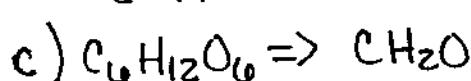
$$21) \frac{6.789 \times 10^{22} \text{ f.units CaCl}_2}{6.02 \times 10^{23} \text{ f.units}} \Big| \frac{1 \text{ mol}}{1 \text{ mol}} = .1128 \text{ mol CaCl}_2$$

$$22) \frac{99.99 \text{ g HNO}_3}{63.02 \text{ g}} \Big| \frac{1 \text{ mol}}{1 \text{ mol}} \Big| \frac{6.02 \times 10^{23} \text{ f.units}}{1 \text{ mol}} = 9.552 \times 10^{23} \text{ f.units HNO}_3$$

$$23) \frac{7.87 \times 10^{25} \text{ molecules SO}_3}{6.02 \times 10^{23} \text{ molecules}} \Big| \frac{1 \text{ mol}}{1 \text{ mol}} \Big| \frac{80.07 \text{ g}}{1 \text{ mol}} = 10467 \text{ g SO}_3 \\ = 10500 \text{ g SO}_3$$



b) C_3H_8 is empirical



d) $\text{CO}_2(\text{CO}_3)_3$ is empirical

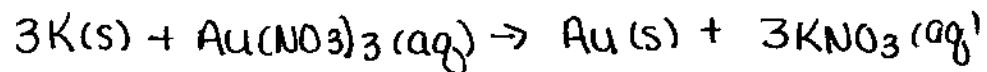
$$25) \frac{32.38 \text{ g Na}}{22.99 \text{ g}} \Big| \frac{1 \text{ mol}}{1 \text{ mol}} = 1.40844 \text{ mol Na} / .70627 \text{ mol} = 2 \text{ Na}$$

$$\frac{22.659 \text{ g S}}{32.07 \text{ g}} \Big| \frac{1 \text{ mol}}{1 \text{ mol}} = .70627 \text{ mol S} / .70627 \text{ mol} = 1 \text{ S}$$

$$\frac{44.99 \text{ g O}}{16.00 \text{ g}} \Big| \frac{1 \text{ mol}}{1 \text{ mol}} = 2.81188 \text{ mol O} / .70627 \text{ mol} = 4 \text{ O}$$

Empirical Formula
 Na_2SO_4

Stoichiometry

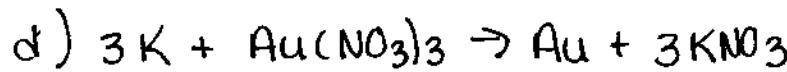


26a)

$$\frac{21.0\text{ mol K}}{3\text{ mol K}} \left| \begin{array}{c} 3\text{ mol KNO}_3 \\ 1\text{ mol K} \end{array} \right| = \boxed{21.0\text{ mol KNO}_3}$$

b) $\frac{1.50\text{ mol Au}}{3\text{ mol K}} \left| \begin{array}{c} 1\text{ mol Au} \\ 3\text{ mol K} \end{array} \right| \frac{196.97\text{ g Au}}{1\text{ mol Au}} = \boxed{98.5\text{ g Au}}$

c) $\frac{50.0\text{ g Au(NO}_3)_3}{383.00\text{ g Au(NO}_3)_3} \left| \begin{array}{c} 1\text{ mol Au(NO}_3)_3 \\ 3\text{ mol KNO}_3 \end{array} \right| \frac{3\text{ mol KNO}_3}{1\text{ mol Au(NO}_3)_3} \left| \begin{array}{c} 101.11\text{ g KNO}_3 \\ 1\text{ mol KNO}_3 \end{array} \right| = \boxed{39.6\text{ g KNO}_3}$



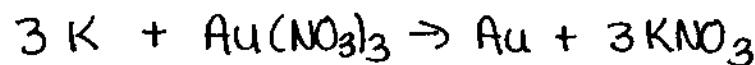
need: $30.00 \frac{\text{mol}}{\text{mol}}$ 10.00 mol

Therefore, $\text{Au(NO}_3)_3$ is the limiting reactant b/c I have 9.00mol & I need 10.0moles!

have: 9.00 mol

e) $\frac{1173\text{ g K}}{39.10\text{ g K}} \left| \begin{array}{c} 1\text{ mol K} \\ 1\text{ mol K} \end{array} \right| = 30.00\text{ mol K}$

$$\frac{3447\text{ g Au(NO}_3)_3}{383.00\text{ g Au(NO}_3)_3} \left| \begin{array}{c} 1\text{ mol Au(NO}_3)_3 \\ 1\text{ mol Au(NO}_3)_3 \end{array} \right| = 9.000\text{ mol Au NO}_3$$



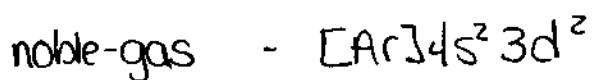
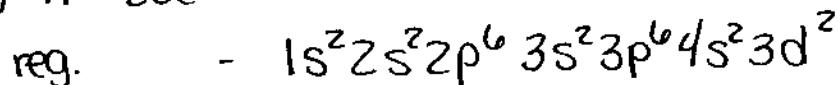
need 30.00 mol 10.00 mol

have 9.00 mol

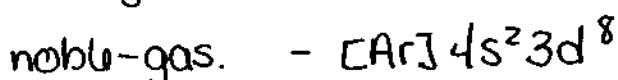
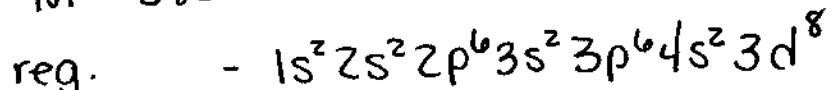
$\text{Au(NO}_3)_3$ is still the limiting reactant for the same reason as in 26d

<u>Element</u>	<u>atomic #</u>	<u>mass #</u>	<u>#protons</u>	<u>#electrons</u>	<u>#neutrons</u>
sulfur	16	32	16	16	$32 - 16 = 16$
cadmium	48	$48 + 64 = 112$	48	48	64
tantalum	73	181	73	73	254
neptunium	93	$93 + 153 = 246$	93	93	153

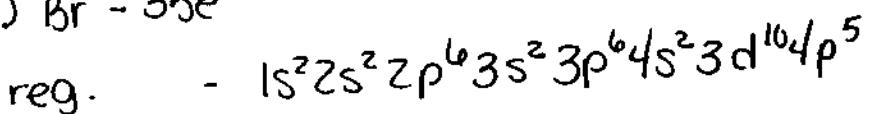
28a) Ti - $22e^-$



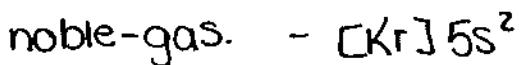
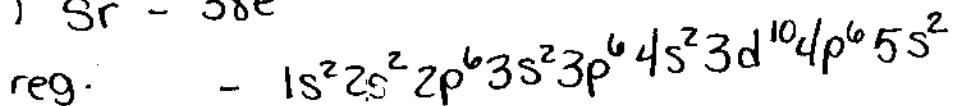
b) Ni - $28e^-$



c) Br - $35e^-$



d) Sr - $38e^-$



Chemical Bonds

29 a) CO_2 - covalent (2 nonmetals)

b) FeF_2 - ionic (metal + nonmetal)

c) NH_3 - covalent (2 nonmetals)

d) $CaBr_2$ - ionic (metal + nonmetal)

e) $MgSO_4$ - both (Mg-S ionic + SO_4^{2-} - covalent)

f) $KC_2H_3O_2$ - both (K-C ionic + $C_2H_3O_2^-$ - covalent)

$$39) q = mc\Delta T$$

$$m = 15.75 \text{ g}$$

$$q = 1086.75 \text{ J}$$

$$\Delta T = 175^\circ\text{C} - 25^\circ\text{C} = 150^\circ\text{C}$$

$$C = ?$$

$$1086.75 \text{ J} = (15.75 \text{ g})(C)(150^\circ\text{C})$$

$$\frac{1086.75 \text{ J}}{2362.5 \text{ g}^\circ\text{C}} = \frac{(2362.5 \text{ g}^\circ\text{C})}{2362.5 \text{ g}^\circ\text{C}} C$$

$$460 \text{ J/g}^\circ\text{C} = C$$

$$40) q = mc\Delta T$$

$$q = ?$$

$$m = 2300. \text{ g}$$

$$C = 0.90 \text{ J/g}^\circ\text{C}$$

$$\Delta T = 16^\circ\text{C} - 2^\circ\text{C} = 14^\circ\text{C}$$

$$q = (2300. \text{ g})(0.90 \text{ J/g}^\circ\text{C})(14^\circ\text{C})$$

$$q = 28,980 \text{ J}$$

$$41) q = mc\Delta T$$

$$q = ?$$

$$m = 454 \text{ g}$$

$$C = -386 \text{ J/g}^\circ\text{C}$$

$$\Delta T = 28.0^\circ\text{C} - 96.0^\circ\text{C} = -68.0^\circ\text{C}$$

Solutions

Factors that affect the rate a solute dissolves.

1) Temperature

- a) Solids - the higher the temperature, the faster particles move so they dissolve more quickly
- b) Gases - the colder the temperature, the slower the gas particles move, so they can stay in the liquid longer

2) Stirring - moves solute & solvent particles together more often

3) Surface Area - Increasing surface area of the solute means more solute is available to interact with the solvent.

$$42) M = \frac{n}{V}$$

$$n = \frac{15.0 \text{ g Mg(OH)}_2}{58.33 \text{ g}} \cdot \frac{1 \text{ mol}}{1 \text{ mol}} = .257 \text{ mol}$$

$$V = 400 \text{ mL} = .400 \text{ L}$$

$$M = ?$$

$$M = \frac{.257 \text{ mol}}{.400 \text{ L}} = .643 \text{ mol/L}$$

$$43) M = \frac{n}{V}$$



$$M = .76 \text{ mol/L}$$

$$n = \frac{5.00 \text{ g HCl}}{36.46 \text{ g}} \mid \frac{1 \text{ mol}}{1 \text{ mol}} = .137 \text{ mol}$$

$$V = ?$$

$$V = \frac{n}{M} = \frac{.137 \text{ mol}}{.76 \text{ mol/L}} = .180 \text{ L}$$

$$44) M = \frac{n}{V}$$



$$M = 1.23 \text{ mol/L}$$

$$n = ?$$

$$V = 1.00 \text{ L}$$

$$n = M \cdot V = (1.23 \text{ mol/L}) \times (1.00 \text{ L})$$

$$n = 1.23 \text{ mol NH}_3$$

$$\frac{1.23 \text{ mol NH}_3}{1 \text{ mol}} \mid \frac{17.04 \text{ g}}{1 \text{ mol}} \rightarrow 2.0 \text{ g NH}_3$$

45) Not necessary.

$$m = \frac{n}{kg}$$



$$m = ?$$

$$n = \frac{19.0 \text{ g NaCl}}{58.44 \text{ g}} \mid \frac{1 \text{ mol}}{1 \text{ mol}} = .325 \text{ mol}$$

$$kg = 121 \text{ kg}$$

$$m = \frac{.325 \text{ mol}}{121 \text{ kg}} = .00269 \text{ mol/kg}$$

$$46) m = \frac{n}{kg}$$



not necessary

$$m = \frac{.999 \text{ mol}}{140.0 \text{ kg}} = .00714 \text{ mol/kg}$$

$$m = ?$$

$$n = \frac{100.0 \text{ g CaCO}_3}{100.099} \mid \frac{1 \text{ mol}}{1 \text{ mol}} = .999 \text{ mol}$$

$$kg = 140.0 \text{ kg}$$

Colligative Properties

- Boiling Pt. Elevation - adding a solute to a pure solvent increases the boiling point because the solute particles block the solvent particles from escaping to the gas state. So, the temperature must be even higher to force the solvent particles past the solute particles.

• Freezing Pt. Depression - adding a solute to the pure solvent lowers the freezing pt because the solute particles interfere with the formation of the crystal lattice of the solvent when it freezes. Therefore, the temperature must decrease even more to force the lattice to form.

47 a) Increasing molality increases the boiling pt.

b) Increasing molality lowers the freezing pt.

48) not necessary

$$m = \frac{n}{kg}$$

$$m = \frac{2.67\text{ mol}}{1.5\text{ kg}} = 1.75\text{ mol/kg}$$

$$m = ?$$

$$n = \frac{85.390\text{ g}}{32.00\text{ g}} \times 1\text{ mol} = 2.67\text{ mol}$$

$$\text{kg} = 1500\text{ g} = 1.5\text{ kg}$$

$$\Delta T_f = K_f \cdot i \cdot m$$

$$\Delta T_f = (1.86\text{ }^{\circ}\text{C/m})(1)(1.75\text{ m}) = 3.26\text{ }^{\circ}\text{C}$$

$$\text{new } T_f = T_{f_{\text{old}}} - \Delta T = 0\text{ }^{\circ}\text{C} - 3.26\text{ }^{\circ}\text{C}$$

$$= \boxed{-3.26\text{ }^{\circ}\text{C}}$$

Acids and Bases

49) Arrhenius acid - contains H^{+} ions.

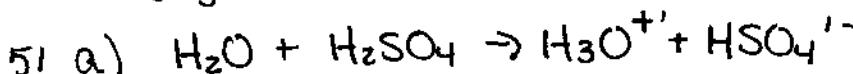
Arrhenius base - contains OH^{-} ions.

50) Bronsted-Lowry acid - donates H^{+} ions

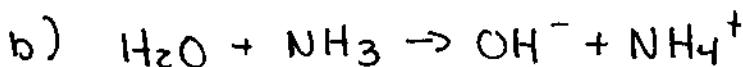
Bronsted-Lowry base - accepts H^{+} ions

conjugate acid - what the base becomes after it accepts H^{+} ions

conjugate base - what is left after the acid loses an H^{+} .



B-L	B-L	conj.	conj.
base	acid	acid	base



B-L	B-L	conj.	conj.
acid	base	base	acid

52) Strong acids - dissociate 100% in solution.

6 strong acids

H_2SO_4 - sulfuric acid

HNO_3 - nitric acid

HClO_4 - perchloric acid

HI - hydroiodic acid

HCl - hydrochloric acid

HBr - hydrobromic acid

weak acids - dissociate 5% in solution.

53) i) $\text{pH} = -\log [4.04 \times 10^{-5}] = \boxed{4.39}$

ii) $\text{pOH} = -\log [8.88 \times 10^{-8}] = \boxed{7.05}$

$$\text{pH} + \text{pOH} = 14$$

$$\text{pH} + 7.05 = 14$$

$$\boxed{\text{pH} = 6.95}$$

iii) $M = ?$

$$n = \frac{45.0 \text{ g HNO}_3}{63.02 \text{ g}} \times 1 \text{ mol} = .714 \text{ mol}$$

$$V = 500 \text{ mL} = .500 \text{ L}$$

$$M = \frac{.714 \text{ mol}}{.500 \text{ L}} = 1.43 \text{ mol/L}$$

$$\text{pH} = -\log (1.43) = \boxed{-1.154}$$

iv) $M = ?$

$$n = \frac{45.0 \text{ g NaOH}}{40.00 \text{ g}} \times 1 \text{ mol} = 1.13 \text{ mol}$$

$$V = 500 \text{ mL} = .500 \text{ L}$$

$$M = \frac{1.13 \text{ mol}}{.500 \text{ L}} = 2.26 \text{ mol/L}$$

$$\text{pOH} = -\log [2.26] = -3.54$$

$$\text{pH} + \text{pOH} = 14$$

$$\text{pH} + -3.54 = 14$$

$$\boxed{\text{pH} = 14.354}$$

54) $M_A V_A = M_B V_B$

$$M_A = .85 \text{ M}$$

$$V_A = .0250 \text{ L}$$

$$V_B = ?$$

$$M_B = .75 \text{ M}$$

$$(.85 \text{ M})(.0250 \text{ L}) = (.75 \text{ M})V_B$$

$$\frac{(.85 \text{ M})(.0250 \text{ L})}{.75 \text{ M}} = V_B$$

$$\boxed{.0283 \text{ L} = V_B}$$

(11)