Chemistry Semester 2 Review **Name** Key

Ch 9 Review: Chemical Reactions

$2\ AlCl_3(aq) + 3\ Pb(NO_3)_2(aq) \rightarrow 3\ PbCl_2(s) + 2Al(NO_3)_3(aq)$

1. In the reaction above, which compounds are the reactants? The products?
   Reactants: $AlCl_3$ and $Pb(NO_3)_2$ Products: $PbCl_2$ and $Al(NO_3)_3$
2. Balance each equation and then label as double displacement/precipitation, single replacement, decomposition, synthesis, or combustion.
   a. $H_2 + O_2 \rightarrow H_2O$ Synthesis
   b. $CH_3 + O_2 \rightarrow CO_2 + H_2O$ combustion
   c. $MgO \rightarrow Mg + O_2$ decomposition
   d. $CaCl_2 + Ag_3PO_4 \rightarrow Ca_3(PO_4)_2 + AgCl$ double replacement
   e. $AlBr_3 + Fe \rightarrow FeBr_2 + Al$ single replacement
3. Predict the products of these precipitation/double displacement reactions, balance. If there is a precipitate circle it, if not write "NR".
   a. $Ba(NO_3)_{2(aq)} + K_2SO_{4(aq)} \rightarrow$ $BaSO_4(s)$ $+ 2KNO_3(aq)$
   b. $2\ NH_4Cl_{(aq)} + PbI_{2(aq)} \rightarrow 2\ NH_4I_{(aq)} +$ $PbCl_2(s)$
4. Predict the products of these single replacement reactions, balance, or write "NR" if they don't react.
   a. $Al(NO_3)_3 + 3Li \rightarrow 3LiNO_3 + Al$
   b. $ZnSO_4 + Ag \rightarrow$ NR
5. What does it mean for an element to be diatomic? List the seven diatomic elements.
   Diatomic elements form pairs in their pure form. Br, I, N, Cl, H, O, F

Ch. 10 Review: The Mole

6. 3.75 mole nickel (#28) = ? g
   $3.75\ mol\ Ni \times \frac{58.69\ g\ Ni}{1\ mol\ Ni} =$ 220.9
7. 25.0 grams phosphorus (#15) = ? atoms
   $25.0\ g\ P \times \frac{1\ mol\ P}{30.974\ g\ P} \times \frac{6.02 \times 10^{23}\ atoms\ P}{1\ mol\ P} =$ 4.86×10^{23} atoms

CO_2: $12.01 + 2\times16.00 = 44.01$ g/mol

8. 98.4 grams CO_2 = ? molecules

$$98.4\text{ g } CO_2 \times \frac{1\text{ mol } CO_2}{44.01\text{ g } CO_2} \times \frac{6.02\times10^{23}\text{ molecules}}{1\text{ mol } CO_2} = 1.35\times10^{24}\text{ molecules}$$

9. 5.80×10^{23} molecules of ethanol (C_2H_5OH) = ? g

$$5.80\times10^{23}\text{ molecules} \times \frac{1\text{ mol } C_2H_5OH}{6.02\times10^{23}\text{ molecules}} \times \frac{43.1\text{ g } C_2H_5OH}{1\text{ mol } C_2H_5OH} = 41.5\text{ g}$$

10. C_2H_5OH: $2\times12.01 + 6\times1.01 + 16.00 = 43.1$ g/mol

a. What is the molar mass of $Ba(NO_3)_2$?

Ba: $1\times137.33 = 137.33$
N: $2\times14.01 = 28.02$
O: $6\times16.00 = 96.00$
$+$ = 261.35 g/mol

b. How many moles are in 3.00×10^{24} $Ba(NO_3)_2$ molecules?

$$3.00\times10^{24}\text{ molecules} \times \frac{1\text{ mol}}{6.02\times10^{23}\text{ molecules}} = 4.98\text{ moles}$$

c. How many moles are in 101 g of $Ba(NO_3)_2$?

$$101\text{ g } Ba(NO_3)_2 \times \frac{1\text{ mol } Ba(NO_3)_2}{261.35\text{ g } Ba(NO_3)_2} = 0.386\text{ mol}$$

11. Calculate the mass percent composition of each element in $Ca(OH)_2$

Ca: $1\times40.08 = 40.08 / 74.1 =$ 54% Ca
O: $2\times16.00 = 32.00 / 74.1 =$ 43% O
H: $2\times1.01 = 2.02 / 74.1 =$ 2.7% H
$+$ 74.1

12.

a. A compound is 82.63% carbon and 17.37% hydrogen. What is its empirical formula?

$$C: 82.63\text{ g} \times \frac{1\text{ mol C}}{12.01\text{ g}} = 6.88\text{ mol} / 6.88 = 1 \times 2 = 2$$

$$H: 17.37\text{ g} \times \frac{1\text{ mol H}}{1.01\text{ g H}} = 17.19\text{ mol} / 6.88 = 2.5 \times 2 = 5$$

C_2H_5

b. If the molecular weight of the substance from part a is 116 g/mol, what is the molecular formula?

$C_2H_5 = (2\times12.01) + (5\times1.01) = 29.07$ g/mol $\quad \frac{116}{29.07} = 4$ $(C_2H_5)\times4 =$ C_8H_{20}

Ch 11 Review: Stoichiometry

13. How are each of these yields determined/measured/calculated:

a. actual yield: Based on lab results

b. theoretical yield: calculated with stoichiometry

c. percent yield: $\frac{\text{Actual}}{\text{Theoretical}} \times 100$

14. If 10.98 grams ZnO were expected, but only 8.07 grams of ZnO are actually produced, what is the the **percent yield** for this reaction? $\frac{8.07}{10.98} \times 100 =$ 73.5%

for 15 and 16: Consider this reaction: **$2\text{ ZnS} + 3\text{ O}_2 \rightarrow 2\text{ ZnO} + 2\text{ SO}_2$**

15. If 21 moles of sulfur dioxide are produced, theoretically how many grams of oxygen (O_2) reacted?

$$21\text{ moles } SO_2 \times \frac{3\text{ mol } O_2}{2\text{ mol } SO_2} \times \frac{32.00\text{ g } O_2}{1\text{ mol } O_2} = 1008\text{ g}$$

$(1.0\times10^3\text{ g})$ correct sig figs

16. If 15.0 grams of zinc sulfide react with 8.45 grams of oxygen (O_2), *theoretically* how many **grams of zinc oxide** could be produced? What is the limiting reactant?

$$15.0\text{ g ZnS} \times \frac{1\text{ mol ZnS}}{97.45\text{ g ZnS}} \times \frac{2\text{ mol ZnO}}{2\text{ mol ZnS}} \times \frac{81.35\text{ g ZnO}}{1\text{ mol ZnO}} = 12.5\text{ g ZnO}$$

$$8.45\text{ g } O_2 \times \frac{1\text{ mol } O_2}{32.00\text{ g } O_2} \times \frac{2\text{ mol ZnO}}{3\text{ mol } O_2} \times 2\frac{81.35\text{ g ZnO}}{1\text{ mol ZnO}} = 14.3\text{ g ZnO}$$

Ch 14 Review: Solutions

17. 52.7 grams of NaCl is put in a volumetric flask and diluted to the 250.0 mL mark. What is the molarity of the solution?

$52.7\text{g NaCl} \times \frac{1\text{mol NaCl}}{58.44\text{g NaCl}} = 0.902\text{ mol NaCl}$ $\quad M = \frac{\text{mol}}{L} = \frac{.902}{.250} =$ **3.61 M**

18. How many grams of KBr are in 325 mL of 2.15 M KBr solution?

$\text{mol} = ML = (2.15)(.325) = 0.699\text{ mol KBr}$ $\quad 0.699\text{mol KBr} \times \frac{119\text{g}}{1\text{mol}} =$ **83.2 g**

19. You have a stock solution of 1.40 M acetic acid. You want to make 450.0 mL of 0.250 M acetic acid solution. How much stock solution should you use to make this solution?

$M_1 = 1.41\text{ M}$, $V_1 = \square$, $M_2 = .250\text{M}$, $V_2 = 450\text{mL}$

$M_1V_1 = M_2V_2$ so $V_1 = \frac{M_2V_2}{M_1} = \frac{(.250)(450)}{1.41} =$ **79.8 mL**

20. You want to use 0.0236 moles of sulfuric acid to make a 0.30 M solution. What should the final volume of the solution be?

$L = \frac{\text{mol}}{M}$ $\quad L = \frac{0.0236\text{mol}}{0.30\text{M}} =$ **0.079 L**

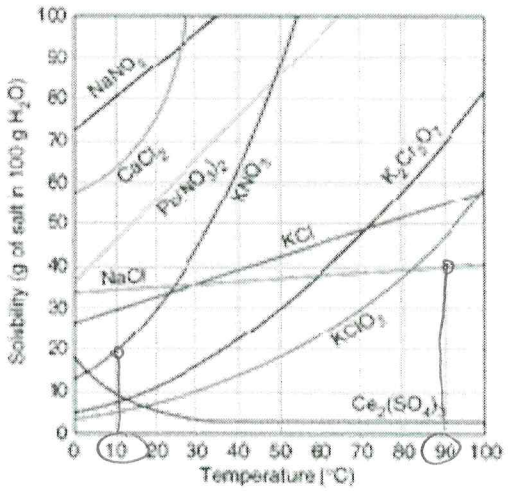
21. If you want to prepare a saturated solution of NaCl, how many grams of NaCl would you add to 100 grams of water at 90 °C? use graph →

40g

22. If 40 grams of KNO_3 was added to 100 grams of water at 10 °C, what would happen? use graph →

20g would dissolve

and 20g would precipitate



Chapter 15 Review: Thermochemistry

23. Gold has a specific heat capacity of 0.129 J/(g°C). How many joules of heat energy are required to raise the temperature of 29.4 grams of gold from 13°C to 79°C?

$q = \square$, $c = .129\text{J/g°C}$, $m = 29.4\text{g}$, $\Delta T = 79 - 13 = 66°C$

$q = cm\Delta T$ $\quad q = (.129)(29.4)(66) =$ **250 J**

24. Determine the final temperature when 85.0 g of water at 25.0°C mixes with 39.7 grams of water at 92.7°C. The specific heat of water is 4.184 J/g°C.

$q = m_{hot} = 39.7\text{g}$, $T_{i\,hot} = 92.7°C$, $m_{cold} = 85.0$, $T_{i\,cold} = 25.0$

$-q_{hot} = q_{cold}$

$-mc\Delta T_h = mc\Delta T_{cold}$

$-m_h(T_f - T_{ih}) = m_c(T_f - T_c)$

$-(39.7)(T_f - 92.7) = (85.0)(T_f - 25)$

$-39.7T_f + 3680.19 = 85.0T_f - 2125$

$+39.7T_f \quad +2125 \quad +39.7T_f \quad +2125$

$5805.19 = 124.7T_f$ $\quad T_f =$ **45.6°C**

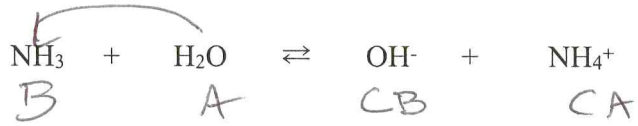
25. How much energy is required to melt 32.8 grams of ice at 0°C? (ΔH_{fus} = 6.01 kJ/mol, ΔH_{vap} = 40.7 kJ/mol)

$32.8\text{g } H_2O \times \frac{1\text{mol } H_2O}{18.02\text{g } H_2O} \times \frac{6.01\text{ kJ}}{1\text{mol } H_2O} =$ **10.9 kJ**

Chapter 18 Review: Acids and Bases

26. Fill in the following definitions:
    a. Arrhenius acid Ionizes to produce H^+ ions
    b. Arrhenius base Ionizes to produce OH^- ions
    c. Bronsted-Lowry acid Proton donor
    d. Bronsted-Lowry base Proton acceptor

27. In the reaction below, label each substance as an acid, base, conjugate acid, or conjugate base. Draw arrows to show the movement of the H^+ ion.



28. What does it mean of a substance is amphoteric? Give an example of an amphoteric substance.
    Amphoteric substances can act as acids or bases. ex: H_2O

29. pH = 2.98 Calculate the $[H^+]$. Show work. Is this solution an acid or base?
    $[H^+] = 10^{-pH} = 10^{-2.98} =$ 1.05×10^{-3} M Acid

30. $[OH^-] = 6.82 \times 10^{-4}$ M Calculate the pH. Show work. Is this solution an acid or base?
    $pOH = -\log[OH^-] = -\log(6.82 \times 10^{-4}) = 3.17$ $pH = 14 - pOH = 14 - 3.17 =$ 10.8 Base

31. Predict the products of these neutralization reactions, then balance the equations.
    a. $2H_3PO_4 + 3Mg(OH)_2 \rightarrow Mg_3(PO_4)_2 + 6HOH$
    b. $2NaOH + H_2CO_3 \rightarrow Na_2CO_3 + 2HOH$

32. To determine the concentration of an HCl solution, 25.0 mL of this solution are titrated with a 1.50 M solution of KOH. Before titrating, a buret is filled with 1.50 M KOH to 0.23 mL. After reaching the equivalence point, the buret reading is 19.87 mL. Calculate the molarity of HCl.

$M_A =$?
$V_A = 25.0$ mL
$M_B = 1.50$ M
$V_B = 19.87 - .23 = 19.64$ mL

$M_A V_A = M_B V_B$

so $M_A = \frac{M_B V_B}{V_A} = \frac{(1.50)(19.64)}{(25.0)} =$ 1.18 M