KEY

13. Give directions on how to make 5.00 L of 0.020 M $Ca(ClO)_2$ using solid $Ca(ClO)_2$ and water. Include proper units in your work and in your answers.

mol / M|L

$mol = M \times L = 0.020\,M \times 5.00\,L = 0.100\,mol$

$mass = 0.100\,mol\ Ca(ClO)_2 \times \frac{143.1\,g}{1\,mol} = 14.31\,g$

Directions: Add 14.31 g of $Ca(ClO)_2$ to less than 5.00 L of water. Dissolve and add water to a final volume of 5.00 L

Unit 6— Chemical Reactions

Pages in Student Workbook	Class Assignments	Extra Questions (SW)
105 - 122	Hand-In Assignment #7—Chemical Equations Do Experiment 5C—Types of Chemical Reactions Hand-In Assignment #8—Completing, Balancing and Classifying Chemical Equations. Do Experiment 17B—Heat of Fusion of Ice Hand-In Assignment #9—Energy in Chemical Reactions	p.110-112, p.113-114, p.118, p.122

1. Balance the following equations

$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$

$3(NH_4)_2C_2O_4 + 2AlCl_3 \rightarrow Al_2(C_2O_4)_3 + 6NH_4Cl$

$2C_{14}H_{30} + 43O_2 \rightarrow 28CO_2 + 30H_2O$

$2Fe + 6HNO_3 \rightarrow 2Fe(NO_3)_3 + 3H_2$

$P_4 + 6Cl_2 \rightarrow 4PCl_3$

$Na_2Cr_2O_7 + 14HCl \rightarrow 2NaCl + 2CrCl_3 + 7H_2O + 3Cl_2$

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

$Ba(ClO_4)_2 \rightarrow Ba + Cl_2 + 4O_2$

$2C_7H_{15}OH + 21O_2 \rightarrow 14CO_2 + 16H_2O$

$MgSO_4 \cdot 5H_2O \rightarrow MgSO_4 + 5H_2O$

NOTE: MULTPLES (x2) (x½) etc. of coefficient sets are also correct if coeff. ratios are the same

KEY

2. Write a balanced chemical equation for each of the following, and classify each as synthesis, decomposition, single replacement, double replacement, neutralization or combustion.

a) potassium sulphate is mixed with cobalt (III) nitrate

$3K_2SO_4 + 2Co(NO_3)_3 \longrightarrow Co_2(SO_4)_3 + 6KNO_3$ (D.R.)

b) liquid propanol (C_3H_7OH) is burned in air

$2C_3H_7OH + 9O_2 \longrightarrow 6CO_2 + 8H_2O$ (combustion)

c) ammonium nitrate is decomposed into it's elements

$2NH_4NO_3 \longrightarrow 2N_2 + 4H_2 + 3O_2$ (decomposition)

d) a piece of zinc is placed in a test-tube containing a solution of silver nitrate

$Zn + 2AgNO_3 \longrightarrow 2Ag + Zn(NO_3)_2$ (S.R.)

e) bromine reacts with sodium iodide

$Br_2 + 2NaI \longrightarrow I_2 + 2NaBr$ (S.R.)

f) bromine reacts with aluminum

$3Br_2 + 2Al \longrightarrow 2AlBr_3$ (synthesis)

g) rubidium reacts with chlorine gas

$2Rb + Cl_2 \longrightarrow 2RbCl$ (synthesis)

h) hydrochloric acid reacts with strontium hydroxide

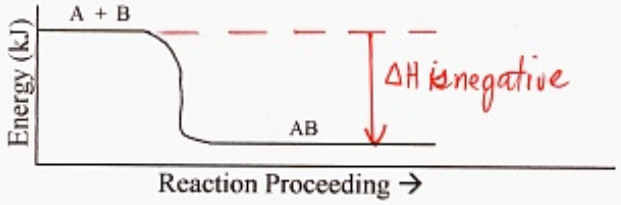
$2HCl + Sr(OH)_2 \longrightarrow 2H_2O + SrCl_2$ (neutralization or D.R.)

3. State whether each of the following are ***exothermic*** or ***endothermic***.

$HCl + 432\ kJ \rightarrow H + Cl$ Answer endothermic

$C_{12}H_{22}O_{11} + 12\ O_2 \rightarrow 12CO_2 + 11H_2O$ $\Delta H = -5638$ kJ Answer exothermic

$H_2O_{(s)} \rightarrow H_2O_{(l)}$ Answer endothermic (melting)



Answer exothermic

KEY

$CD \rightarrow C + D \quad \Delta H = 65.7$ kJ Answer endothermic

$E + F + 437$ kJ $\rightarrow G + H$ Answer endothermic

4. Given the equation: $C_{12}H_{22}O_{11} + 12O_2 \rightarrow 12CO_2 + 11H_2O + 5638$ kJ

a. How much heat is released during the formation of 880.0 g of CO_2?

$880.0\,g\,CO_2 \times \frac{1\,mol\,CO_2}{44.0\,g\,CO_2} \times \frac{5638\,KJ}{12\,mol\,CO_2} =$ Answer 9396.67 KJ

b. How much heat is released during the formation of 5.6 moles of H_2O?

$5.6\,mol\,H_2O \times \frac{5638\,kJ}{11\,mol\,H_2O} = 2870.25\,KJ$

Answer 2870.25 KJ

c. If 179.2 L of O_2 (STP) are consumed, how much heat is released?

$179.2\,L\,O_2 \times \frac{1\,mol\,O_2}{22.4\,L\,O_2} \times \frac{5638\,KJ}{12\,mol\,O_2} = 3758.67\,kJ$

Answer 3758.67 KJ

5. Calculate the amount of heat (in Joules) required to warm 200.0 g of water from 8.0°C to 45.0°C. (Heat Capacity (C) for H_2O is 4180 J/kg·°C)

$Heat_{(J)} = m_{(kg)} \cdot C \cdot \Delta t$

$= 0.2000\,kg \times \frac{4180\,J}{kg \cdot °C} \times 37.0°C = 30932\,J$

Answer 30932 J or 30.932 KJ

6. 13.376 kJ of heat are added to a 400.0 gram sample of water initially at 4.0°C. Calculate the final temperature of the water sample. Be careful with units! (Heat Capacity (C) for H_2O is 4180 J/kg·°C)

$Heat_{(J)} = m_{(kg)} \cdot C \cdot \Delta t$

$13{,}376\,J = 0.4000\,kg \times \frac{4180\,J}{kg \cdot °C} \times \Delta t\,°C$

$\Delta t = \frac{13{,}376}{(0.4000)4180} = 8.0°C$

Answer $T_{final} = 12.0°C$

$T_{final} = T_{initial} + \Delta t = 4.0°C + 8.0°C = 12.0°C$

KEY

Unit 7— Stoichiometry

Pages in Student Workbook	Class Assignments	Extra Questions (SW)
123 - 138	Experiment 6A—Mass and Moles in a Chemical Reaction Hand-In Assignment # 10—Stoichiometry Problems Experiment 20-C Acid-Base Titration Hand-In Assignment # 11—Molarity, Excess and Percentage Yield Problems.	p.124, p.127, p.131, p.133, p.137

1. Given the following balanced equation, answer the questions following it:

$$2NF_{3(g)} + 3H_{2(g)} \rightarrow N_{2(g)} + 6HF_{(g)}$$

a) If 5.5 moles of H_2 are reacted, how many moles of NF_3 will be consumed?

$$5.5\ mol\ H_2 \times \frac{2\ mol\ NF_3}{3\ mol\ H_2} = 3.67\ mol\ NF_3$$

Answer 3.67 mol

b) In order to produce 0.47 moles of HF, how many moles of NF_3 would be consumed?

$$0.47\ mol\ HF \times \frac{2\ mol\ NF_3}{6\ mol\ HF} = 0.157\ mol$$

Answer 0.157 mol

c) If you needed to produce 180.6 g of N_2, how many moles of H_2 would you need to start with? $g\ N_2 \rightarrow mol\ N_2 \rightarrow mol\ H_2$

$$180.6\ g\ N_2 \times \frac{1\ mol\ N_2}{28.0\ g\ N_2} \times \frac{3\ mol\ H_2}{1\ mol\ N_2} = 19.35\ mol\ H_2$$

Answer 19.35 mol

d) If you completely react 17.04 g of NF_3, what mass of HF will be produced?

$g\ NF_3 \rightarrow mol\ NF_3 \rightarrow mol\ HF \rightarrow g\ HF$

$$17.04\ g\ NF_3 \times \frac{1\ mol\ NF_3}{71.0\ g\ NF_3} \times \frac{6\ mol\ HF}{2\ mol\ NF_3} \times \frac{20.0\ g\ HF}{1\ mol\ HF} = 14.4\ g\ HF$$

Answer 14.4 g HF

KEY

2. Given the following balanced equation, answer the questions following it:

$$HBrO_3 + 5\ HBr \rightarrow 3\ H_2O_{(l)} + 3\ Br_{2(g)}$$

a) If 3.56 moles of HBr are reacted, how many Litres of Br_2 will be formed at STP?

mol HBr → mol Br_2 → L Br_2

$$3.56\,mol\ HBr \times \frac{3\ mol\ Br_2}{5\ mol\ HBr} \times \frac{22.4\ L\ Br_2}{1\ mol\ Br_2} = 47.85\ L\ Br_2$$

Answer 47.85 L Br_2

b) In order to produce 3.311×10^{24} molecules of Br_2, what mass of HBr is needed?

molec Br_2 → mol Br_2 → mol HBr → g HBr

$$3.311\times10^{24}\,molec.\ Br_2 \times \frac{1\ mol\ Br_2}{6.02\times10^{23}\,molec.\ Br_2} \times \frac{5\ mol\ HBr}{3\ mol\ Br_2} \times \frac{80.9\ g\ HBr}{1\ mol\ HBr}$$

Answer = 741.6 g HBr

3. Given the following balanced chemical equation, answer the question below it.

$$MgCO_{3\,(s)} + 2HCl_{\,(aq)} \rightarrow CO_{2\,(g)} + H_2O_{\,(l)} + MgCl_{2(aq)}$$

a) What mass of $MgCO_3$ will react completely with 15.0 mL of 1.5 M HCl?

mol / M L

mol HCl = 0.0150 L × 1.5 M = 0.0225 mol HCl

$$0.0225\ mol\ HCl \times \frac{1\ mol\ MgCO_3}{2\ mol\ HCl} \times \frac{84.3\ g\ MgCO_3}{1\ mol\ MgCO_3} = 0.948\ g$$

Answer 0.948 g

b) Calculate the volume of 2.0 M HCl which would be needed to react completely with 37.935 grams of magnesium carbonate.

g $MgCO_3$ → mol $MgCO_3$ → mol HCl → L HCl

$$37.935\ g\ MgCO_3 \times \frac{1\ mol\ MgCO_3}{84.3\ g} \times \frac{2\ mol\ HCl}{1\ mol\ MgCO_3} = 0.900\ mol\ HCl$$

mol / M L

$$L = \frac{mol}{M} = \frac{0.900\ mol}{2.0\ M} = 0.45\ L$$

Answer 0.450 L or 450. mL

KEY

4. Given the following balanced equation, answer the questions below it.

$$Ba(OH)_{2(aq)} + 2\,HNO_{3(aq)} \rightarrow 2\,H_2O_{(l)} + Ba(NO_3)_2$$

a) In a titration, 18.20 mL of 0.300 M $Ba(OH)_2$ is required to react completely with a 25.0 mL sample of a solution of HNO_3. Find the $[HNO_3]$.

$0.300\ M\ Ba(OH)_2 \times 0.01820\ L = 0.00546\ mol\ Ba(OH)_2$

$0.00546\ mol\ Ba(OH)_2 \times \frac{2\ mol\ HNO_3}{1\ mol\ Ba(OH)_2} = 0.01092\ mol\ HNO_3$

$[HNO_3] = \frac{0.01092\ mol}{0.0250\ L} = 0.4368\ M$

Answer $[HNO_3] = 0.437\ M$

b) In a titration, 11.06 mL of 0.200 M HNO_3 is required to react completely with a sample of 0.250M $Ba(OH)_2$. Find the volume of the $Ba(OH)_2$ sample.

$0.200\ M\ HNO_3 \times 0.01106\ L = 0.002212\ mol\ HNO_3$

$0.002212\ mol\ HNO_3 \times \frac{1\ mol\ Ba(OH)_2}{2\ mol\ HNO_3} = 0.001106\ mol\ Ba(OH)_2$

$L = \frac{mol}{M} = \frac{0.001106\ mol}{0.250\ M} = 0.004424\ L$

Answer 0.004424 L or 4.424 mL

5. Given the following balanced equation, answer the questions below it.

$$3\,Cu_{(s)} + 8HNO_{3(l)} \rightarrow 3\,Cu(NO_3)_{2(aq)} + 2NO_{(g)} + 4\,H_2O_{(l)}$$

a) If 317.5 grams of Cu are placed into 756.0 grams of HNO_3, determine which reactant is in excess.

$317.5\ g\ Cu \times \frac{1\ mol\ Cu}{63.5\ g\ Cu} = 5.0\ mol\ Cu$

$756.0\ g\ HNO_3 \times \frac{1\ mol}{63.0\ g} = 12.0\ mol\ HNO_3$

$\times 8/3$

5.0 mol $3Cu + 8HNO_3 \rightarrow$ 13.33 mol (need), 12.0 mol (have)

Answer Cu is in excess

b) If the reaction in (a) is carried out, what mass of NO will be formed?

$12.0\ mol\ HNO_3 \times \frac{2\ mol\ NO}{8\ mol\ HNO_3} \times \frac{30.0\ g\ NO}{1\ mol\ NO} = 90.0\ g\ NO$

Answer 90.0 g

KEY

6. Given the balanced equation: $2BN + 3F_2 \rightarrow 2BF_3 + N_2$,

When 161.2 grams of BN are added to an excess of F_2, a reaction occurs in which 326.118 grams of BF_3 are formed.

a) Calculate the *theoretical* yield of BF_3 in grams.

$$161.2\text{g BN} \times \frac{1\text{ mol BN}}{24.8\text{g BN}} \times \frac{2\text{ mol BF}_3}{2\text{ mol BN}} \times \frac{67.8\text{g BF}_3}{1\text{ mol BF}_3} = 440.7\text{g BF}_3$$

Answer 440.7g BF_3

b) Calculate the *percentage* yield of BF_3.

$$\%\text{ yield} = \frac{\text{Actual Yield}}{\text{Theoretical Yield}} \times 100\% = \frac{326.118\text{g}}{440.7\text{g}} \times 100\% = 74.0\%$$

Answer 74.0%

7. When reacting NH_3 with O_2 according to the reaction:

$$4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$$

Using 163.2 grams of NH_3 with an excess of O_2 produces a 67% yield of NO.

a) Calculate the *theoretical yield* of NO in grams.

$$163.2\text{g NH}_3 \times \frac{1\text{ mol NH}_3}{17.0\text{g NH}_3} \times \frac{4\text{ mol NO}}{4\text{ mol NH}_3} \times \frac{30.0\text{g NO}}{1\text{ mol NO}} = 288.0\text{g NO}$$

Answer 288.0g NO

b) Calculate the *actual yield* of NO in grams.

$$288.0\text{g} \times \frac{67.0}{100.0} = 192.96\text{g}$$

Answer 192.96g

KEY

Unit 8— Atoms, Periodic Table and Bonding

Pages in Student Workbook	Class Assignments	Extra Questions (SW)
139 - 192	Hand-In Assignment # 12—Electronic Structure of the Atom Experiment on Trends in Reactivity of Elements Activity on Trends on the Periodic Table Hand-In Assignment #13—Electron Arrangement and Ion Formation "Web-Elements" Computer Activity Hand-In Assignment #14—Chemical Bonding Review Sheet on Unit 8	p.146-147, p.149, p.150, p.155, p.157-158, p.164, p.170-171, p.181, p.183, p.191-192

1. The Greek who developed the idea of atoms was Democritus

2. Consider the following ideas:
   - Compounds are made up of molecules which are combinations of atoms
   - All atoms of an element are the same
   - Atoms of different elements are different
   - Atoms are indivisible particles

   Who came up with these ideas? John Dalton He called the ideas, the Atomic Theory.

3. J.J. Thomson measured the charge/mass ratio of an electron and came up with the so-called "plum pudding" model of the atom.

4. Ernest Rutherford devised the Scattering Experiment, which showed that all atoms had a small dense nucleus.

5. Bohr came up with an atomic model to explain the spectrum of hydrogen.

   He said that the atom has certain energy levels which are allowed. These levels corresponded to orbits (shells) in which electrons move. If an electron absorbs a certain photon of energy, it will jump to a higher level. It will release this energy (in the form of light (photons)) when it jumps back to a lower level.

   What were two limitations of Bohr's atomic model?
   - it only worked exactly for hydrogen
   - no evidence that electrons travel in orbits

KEY

6. Give the number of protons, neutrons and electrons in the following:

Isotope	*Protons*	*Neutrons*	*Electrons*
$^{194}Ir^{3+}$	77	194-77 = 117	77-3 = 74
$^{202}Hg^{2+}$	80	122	78
$^{125}Te^{2-}$	52	73	54
^{263}Sg	106	157	106
$^{2}H^{+}$	1	1	0

7. Give the nuclear notation of the following:

Isotope	*Protons*	*Neutrons*	*Electrons*
$^{262}Db^{2+}$	105	157	103
$^{123}Sb^{3+}$	51	72	48
$^{75}As^{3-}$	33	42	36
^{133}Xe	54	79	54
$^{244}Pu^{3+}$	94	150	91

8. Element "X" is composed of the following naturally occurring isotopes:

Isotope	% Abundance
^{79}X	50.69
^{81}X	49.31

Calculate the average atomic mass of element "X" to 3 decimal places.

$79(0.5069) + 81(0.4931) =$ 79.986 g/mol

Element "X" is actually the real element Bromine.

KEY

9. Regions in space occupied by electrons are called orbitals

10. The principal quantum number is given the letter n and refers to the energy level.

11. Write the ground state electron configurations (eg. $1s^2\ 2s^2\ 2p^6$) for the following atoms or ions. You may use the core notation.

a) P (15) $[Ne_{10}]\ 3s^2 3p^3$

b) Mo (42) $[Kr_{36}]\ 5s^2 4d^4$

c) Se (34) $[Ar_{18}]\ 4s^2 3d^{10} 4p^4$

d) Rb (37) $[Kr_{36}]\ 5s^1$

e) Cl^- (18) $[Ne_{10}]\ 3s^2 3p^6$

f) Al^{3+} (10) $[He_2]\ 2s^2 2p^6$

g) K^+ (18) $[Ne_{10}]\ 3s^2 3p^6$

h) S^{2-} (18) $[Ne_{10}]\ 3s^2 3p^6$

12. In order to become stable,

an atom of Sr will lose 2 electrons and become the ion Sr^{2+}

an atom of As will gain 3 electrons and become the ion As^{3-}

an atom of Al will lose 3 electrons and become the ion Al^{3+}

an atom of Se will gain 2 electrons and become the ion Se^{2-}

an atom of N will gain 3 electrons and become the ion N^{3-}

an atom of I will gain 1 electron and become the ion I^-

an atom of Cs will lose 1 electron and become the ion Cs^+

an atom of Te will gain 2 electrons and become the ion Te^{2-}

13. Circle the metalloid: Be Rb Os (Ge) Pb Al

KEY

14. Circle the most reactive element in the following: (Na) Mg Si Al Ar

15. Circle the most reactive element in the following: Na K Rb (Cs) Li

16. Circle the most reactive element in the following: (Cl) Br I At Ne

17. Circle the element with the largest atomic radius of these: (Na) Mg Si Al Ar

18. Circle the element with the largest atomic radius of these: N P As Sb (Bi)

19. Circle the element with the largest ionization energy of these: K Ca Ga As (Kr)

20. Circle the element with the largest ionization energy of these: (C) Si Ge Sn Pb

21. What is meant by ionization energy? energy required to remove the outermost electron from a gaseous atom.

22. Circle the element with the largest density of these: C Si Ge Sn (Pb)

23. Circle the element with the largest density of these: Na K Rb (Cs) Li

24. Circle the element with the highest electronegativity of these: (Mg) Sr Ba Ra

25. Circle the element with the highest electronegativity of these: Mg Si S (Cl)

26. Circle the element with the highest electronegativity of these: (F) Cl Br I

27. What is meant by electronegativity? the attraction an atom has for the electrons of another atom.

28. Circle the most metallic element of these: Be Mg Ca Sr (Ba)

29. Circle the most metallic element of these: B Al Ga In (Tl)

30. Circle the most metallic element of these: (Ga) Ge Se Br Kr

31. Write a balanced equation for the reaction of potassium with water.

$2K + 2H_2O \rightarrow H_2 + 2KOH$

32. Write a balanced equation for the reaction of aluminum with bromine.

$2Al + 3Br_2 \rightarrow 2AlBr_3$

33. Which gas is used to fill ordinary light bulbs? Argon Why? inert

34. Why is argon used when welding metals like aluminum?

inert atmosphere. Does not allow Al to oxidize as it would in air.

KEY

35. Which halogen is pale yellow? fluorine pale green chlorine
a silvery solid iodine a reddish liquid bromine

36. Why is sodium iodide added to our table salt? to provide our diet with iodine which prevents goiter (Derbyshire neck)

37. In an ionic bond, electrons are
   a. shared equally by two atoms
   b. shared unequally by two atoms
   (c) transferred from a metal to a non-metal
   d. transferred from a non-metal to a metal
   e. closer to one end of a molecule, forming a temporary dipole Answer c

38. In a covalent bond, electrons are
   (f.) shared equally by two atoms
   g. shared unequally by two atoms
   h. transferred from a metal to a non-metal
   i. transferred from a non-metal to a metal
   j. closer to one end of a molecule, forming a temporary dipole Answer f

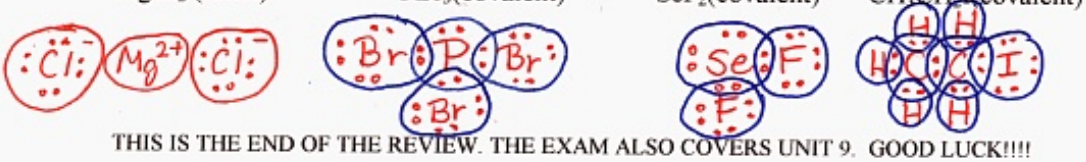
39. In a polar covalent bond, electrons are
   k. shared equally by two atoms
   (l.) shared unequally by two atoms
   m. transferred from a metal to a non-metal
   n. transferred from a non-metal to a metal
   (o.) closer to one end of a molecule, forming a temporary dipole Answer l & o
   but not temporary

40. In London forces, electrons are
   p. shared equally by two atoms
   q. shared unequally by two atoms
   r. transferred from a metal to a non-metal
   s. transferred from a non-metal to a metal
   (t.) closer to one end of a molecule, forming a temporary dipole Answer t

41. What physical evidence to we have that ionic bonds are very strong?
Ionic compounds have very high melting points.

42. Diamond, silicon carbide and boron nitride have covalent bonds between all the atoms. This type of bonding is called network bonding.

43. Write electron-dot diagrams for:
$MgCl_2$ (ionic) PBr_3(covalent) SeF_2(covalent) CH_3CH_2I(covalent)



THIS IS THE END OF THE REVIEW. THE EXAM ALSO COVERS UNIT 9. GOOD LUCK!!!!