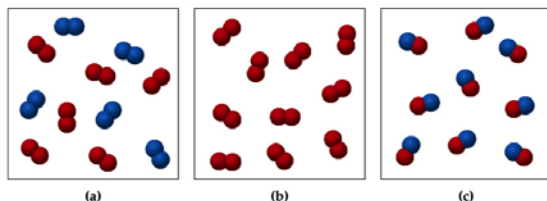


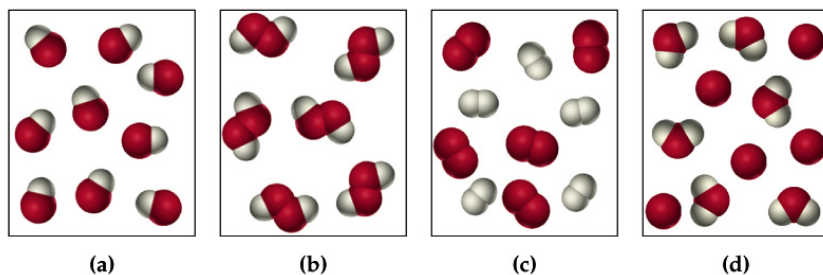
Problems Used During Lecture

CHAPTER ONE

1). Which of the following represents a mixture?



2. If the red spheres are oxygen and the white are hydrogen, which of the following represents (a) hydrogen peroxide, (b) hydroxide ions, and (c) a mixture of hydrogen and oxygen gas?



3). What is the density of glass (in grams per cubic centimeter) if a sample weighing 26.43 g has a volume of 12.40 cm³?

4). Chloroform, a substance once used as an anesthetic, has a density of 1.483 g/mL at 20°C. How many mL would you use if you needed 9.37 g?

5). The volcanic explosion that destroyed Krakatau on August 17, 1883, released an estimated 4.3 cubic miles (mi³) of debris into the atmosphere. In SI units, how many cubic meters (m³) were released?

6). How many meters are there in a marathon race (26 miles and 385 yd)?

7). Carry out the indicated temperature conversions:

- (a) $-78^{\circ}\text{C} = ? \text{ K}$
- (b) $158^{\circ}\text{C} = ? ^{\circ}\text{F}$
- (d) $98.6^{\circ}\text{F} = ? ^{\circ}\text{C}$
- (e) $98.6^{\circ}\text{F} = ? \text{ K}$

CHAPTER TWO

1). The isotope $^{75}_{34}\text{Se}$ is used medically for diagnosis of pancreatic disorders. How many protons, neutrons, and electrons does an atom of $^{75}_{34}\text{Se}$ have?

2). An atom of element X contains 47 protons and 62 neutrons. Identify the element, and write the symbol for the isotope in the standard format.

3). Chlorine has two naturally occurring isotopes: $^{35}_{17}\text{Cl}$ with an abundance of 75.77% and an isotopic mass of 34.969 amu, and $^{37}_{17}\text{Cl}$ with an abundance of 24.23% and an isotopic mass of 36.966 amu. What is the atomic mass of chlorine?

4). Calculate the molar mass of the following:

Fe_2O_3 (Rust)

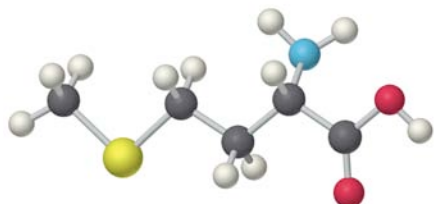
$\text{C}_6\text{H}_8\text{O}_7$ (Citric acid)

5). How many atoms are there in a sample of uranium that has a mass of 1.000×10^{-6} g?

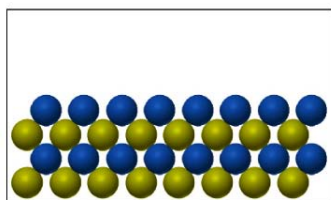
6). Calculate the number of atoms in 2.45 mol of copper.

CHAPTER THREE

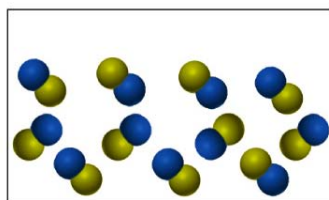
1). Methionine, an amino acid used by organisms to make proteins, is represented below. Write the formula for methionine and calculate its molar mass. (red = O; gray = C; blue = N; yellow = S; ivory = H)



- 2). How many molecules are in 50.0 g of PbO_2 ? ($\text{PbO}_2 = 239.2$)
- 3). Glucose has the molecular formula $\text{C}_6\text{H}_{12}\text{O}_6$. What is its empirical formula, and what is the percentage composition of glucose?
- 4). A compound was analyzed to be 82.67% carbon and 17.33% hydrogen by mass. An osmotic pressure experiment determined that its molar mass is 58.11 g/mol. What is the empirical formula and molecular formula for the compound?
- 5). A 0.5438 sample of a compound containing only C, H and O was burned in oxygen. 1.039 g CO_2 and 0.6369 g of H_2O were formed. What is the empirical formula of this compound?
- 6). A sample of a compound containing tin and chlorine with a mass of 2.571 g was found to contain 1.171 g of tin. What is its empirical formula?
- 7). Which of the following drawings represents an ionic compound, and which a molecular compound?



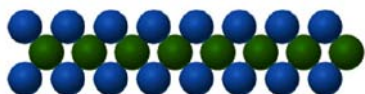
(a)



(b)

8). If the green spheres represent cations, and the blue represent anions, which of the formulas are consistent with the figure?

- (a) LiBr
- (b) NaNO₂
- (c) CaCl₂
- (d) K₂CO₃
- (e) Fe₂(SO₄)₃



9). Name the following compounds and identify whether they are ionic or covalent

Na₂S

SO₃

PF₅

CuF

MgS₂

10). Name the following acids:

a. HBrO(aq)

b. HCN(aq)

c. HIO₄(aq)

d. HBrO₂(aq)

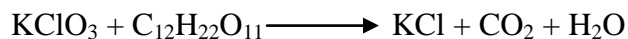
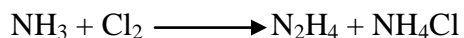
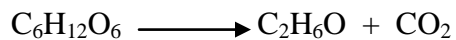
e. H₂CrO₄(aq)

f. HI (aq)

11). What is the formula of magnesium sulfate heptahydrate?

12). What is the name of NiCl₂•6H₂O?

13). Balance the following reactions:



CHAPTER FOUR

1). Aqueous solutions of NaOCl (household bleach) are prepared by the reaction of NaOH with Cl₂:

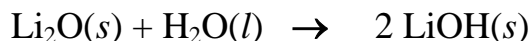


How many grams of NaOH are needed to react with 85.0 g of Cl₂?

2). Aspirin is prepared by reaction of salicylic acid (C₇H₆O₃) with acetic anhydride (C₄H₆O₃) to form aspirin (C₉H₈O₄) and acetic acid (CH₃CO₂H). Use this information to determine the mass of salicylic acid needed to react with 20.0 g acetic anhydride.

3). Dichloromethane (CH₂Cl₂) is prepared by reaction of methane (CH₄) with chlorine (Cl₂) giving hydrogen chloride as a by-product. How many grams of dichloromethane result from the reaction of 1.30 kg of methane if the yield is 50.1%?

4). Lithium oxide is a drying agent used on the space shuttle. If **80.0 kg** of water is to be removed and **65 kg** of lithium oxide is available, which reactant is limiting?



$$\text{MM}(\text{Li}_2\text{O}) = 29.88 \text{ g/mol}$$

$$\text{MM}(\text{H}_2\text{O}) = 18.02 \text{ g/mol}$$

5). How many moles of solute are present in 254 mL of 0.15 M NaHCO₃?

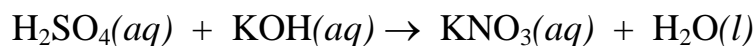
6). How many grams of solute would you use to prepare 193.0 mL of 1.15 M NaOH?

7). What volume of 15.0 M H₂SO₄ is required to prepare 193.0 mL of 0.500 M aqueous H₂SO₄?

8). What is the final concentration if 123 mL of 3.44 M glucose is diluted to a volume of 300.0 mL?

9). Stomach acid, a dilute solution of HCl in water, can be neutralized by reaction with sodium hydrogen carbonate, NaHCO₃. How many milliliters of 0.125 M NaHCO₃ solution are needed to neutralize 18.0 mL of 0.100 M HCl?

10). What is the molarity of a sulfuric acid solution if a 18.0 mL sample is titrated to equivalence with 23.0 mL of 0.165 M potassium hydroxide solution?



11). Identify the following as strong or weak electrolytes: HNO₂, PF₅, HBr, NaCl, Cu(OH)₂*

12). Predict the solubility of:

- (a) CdCO₃ (b) MgO (c) Na₂S
(d) PbSO₄ (e) (NH₄)₃PO₄

13). Predict whether a precipitate will form for:

- (a) NiCl₂(aq) + (NH₄)₂S(aq) →
(b) Na₂CrO₄(aq) + Pb(NO₃)₂(aq) →
(c) AgClO₄(aq) + CaBr₂(aq) →

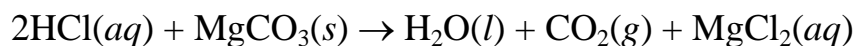
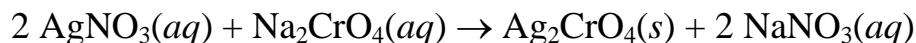
14). Assign oxidation numbers to each atom in the following substances:

- A. CdS B. AlH₃ C. Na₂Cr₂O₇ D. SnCl₄
E. CrO₃ F. VOCl₃ G. V₂O₃ H. HNO₃

15). For each of the following, identify which species is the reducing agent and which is the oxidizing agent.

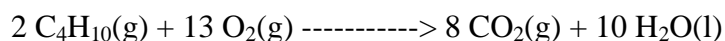
- a. Ca(s) + 2 H⁺(aq) → Ca²⁺(aq) + H₂(g)
b. 2 Fe²⁺(aq) + Cl₂(aq) → 2 Fe³⁺(aq) + 2 Cl⁻(aq)
c. SnO₂(s) + 2 C(s) → Sn(s) + 2 CO(g)

16). Write net ionic equations for the following reactions:

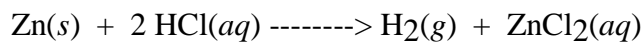


CHAPTER FIVE

- 1). Convert 380 mm Hg to atmospheres and kilopascals
- 2). Oxygen gas is normally sold in 49.0 L steel containers at a pressure of 150.0 atm. What volume would the gas occupy if the pressure was reduced to 1.02 atm and the temperature raised from 20°C to 35°C?
- 3). An inflated balloon with a volume of 0.55 L at sea level, where the pressure is 1.0 atm, is allowed to rise to a height of 6.5 km, where the pressure is about 0.40 atm. Assuming that the temperature remains constant, what is the final volume of the balloon?
- 4). Sulfur hexafluoride (SF₆) is a colorless, odorless, very unreactive gas. Calculate the pressure (in atm) exerted by 1.82 moles of the gas in a steel vessel of volume 5.43 L at 69.5°C.
- 5). What is the volume (in liters) occupied by 7.40 g of CO₂ at STP?
- 6). What is the molar mass of a gas with a density of 1.342 g/L at STP?
- 7). What is the density of uranium hexafluoride, UF₆, (MM = 352 g/mol) under conditions of STP?
- 8). The density of a gaseous compound is 3.38 g/L at 40°C and 1.97 atm. What is its molar mass?
- 9). Exactly 2.0 moles of Ne and 3.0 moles of Ar were placed in a 40.0 L container at 25°C. What are the partial pressures of each gas and the total pressure?
- 10). A sample of natural gas contains 6.25 moles of methane (CH₄), 0.500 moles of ethane (C₂H₆), and 0.100 moles of propane (C₃H₈). If the total pressure of the gas is 1.50 atm, what are the partial pressures of the gases?
- 11). Hydrogen gas generated when calcium metal reacts with water is collected at 30°C and a pressure of 988 mm Hg. The volume collected is 641 ml. What is the mass (in grams) of the hydrogen gas obtained? The pressure of the water vapor at 30°C is 31.82 mm Hg.
760 mm Hg = 1.00 atm
- 12). Assuming no change in temperature and pressure, calculate the volume of O₂ (in liters) required for the complete combustion of 14.9 L of butane (C₄H₁₀) at STP:



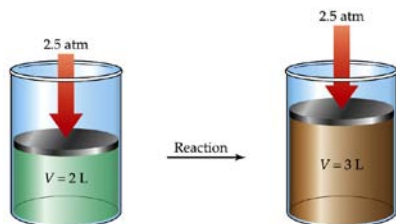
13). Hydrogen gas, H₂, can be prepared by letting zinc metal react with aqueous HCl. How many liters of H₂ can be prepared at 742 mm Hg and 15°C if 25.5 g of zinc (MM = 65.4 g/mol) was allowed to react?



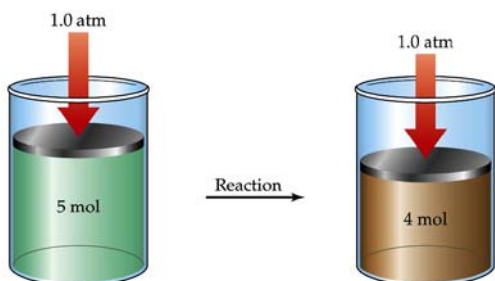
14). Magnesium metal reacts with HCl to produce hydrogen gas. The gas that is formed is found to have a volume of 3.557 L at 25 degrees Celsius, 747 mm Hg. Assuming the gas is saturated with water vapor (partial pressure 23.8 mm Hg), what is the partial pressure of hydrogen gas? How many grams of magnesium were used in the reaction?

CHAPTER SIX

1). How much work is done (in kilojoules), and in which direction, as a result of the following reaction?

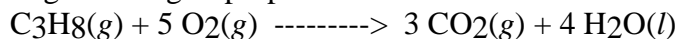


2). The following reaction has $\Delta E = -186$ kJ/mol. Is the sign of $P\Delta V$ positive or negative?



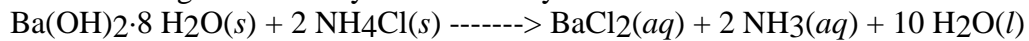
3). How much heat (in kilojoules) is evolved or absorbed in each of the following reactions?

a). Burning of 15.5 g of propane:



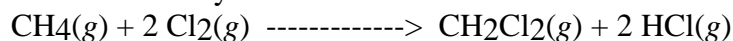
$$\Delta H = -2219 \text{ kJ}$$

b). Reaction of 4.88 g of barium hydroxide octahydrate with ammonium chloride:

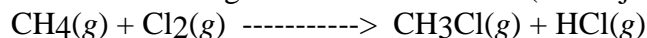


$$\Delta H = +80.3 \text{ kJ}$$

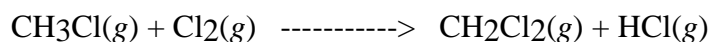
4). The industrial degreasing solvent methylene chloride (CH_2Cl_2 , dichloromethane) is prepared from methane by reaction with chlorine:



Use the following data to calculate ΔH° (in kilojoules) for the above reaction:



$$\Delta H^\circ = -98.3 \text{ kJ}$$



$$\Delta H^\circ = -104 \text{ kJ}$$

5). Calculate ΔH° (in kilojoules) for the reaction of ammonia with O_2 to yield nitric oxide (NO) and $\text{H}_2\text{O}(g)$, a step in the Ostwald process for the commercial production of nitric acid.

6). Calculate ΔH° (in kilojoules) for the photosynthesis of glucose from CO_2 and liquid water, a reaction carried out by all green plants.

7). What is the specific heat of lead if it takes 96 J to raise the temperature of a 75 g block by 10.0°C ?

8). When 25.0 mL of 1.0 M H_2SO_4 is added to 50.0 mL of 1.0 M NaOH at 25.0°C in a calorimeter, the temperature of the solution increases to 33.9°C . Assume specific heat of solution is $4.184 \text{ J}/(\text{g}^{-1}\cdot^\circ\text{C}^{-1})$, and the density is $1.00 \text{ g}/\text{mL}^{-1}$, calculate ΔH for the reaction.

9). What is the heat capacity of iron if it takes 150 J to raise the temperature of a 10.0 g block of the metal from 10 to 30 degrees Celsius?

10). What is the molar heat capacity of the same metal?

11). 10 grams of an unknown metal is heated from room temperature (25°C) to 100°C in a boiling water bath. It is then immediately dropped in a calorimeter containing 25 grams of water. The temperature of the water rises by 5°C . What is the heat capacity of the metal?

CHAPTER SEVEN

- 1). The yellow light in a stop light has a wavelength of 625 nm. What is the frequency of the light?
- 2). For a red light with a wavelength of about 630 nm, what is the energy of a single photon and one mole of photons?
- 3). Why can't an electron have the following quantum numbers?
(a) $n = 2, l = 2, m_l = 1$ (b) $n = 3, l = 0, m_l = 3$
(c) $n = 5, l = -2, m_l = 1$
- 4). Give orbital notations for electrons with the following quantum numbers:
(a) $n = 2, l = 1, m_l = 1$ (b) $n = 4, l = 3, m_l = -2$

CHAPTER EIGHT

1). Give the ground-state electron configurations for the following:

Ne ($Z = 10$)

Mn ($Z = 25$)

Zn ($Z = 30$)

Eu ($Z = 63$)

W ($Z = 74$)

Lr ($Z = 103$)*

*use short hand for this one

2). Identify elements with ground-state configurations:

$1s^2 2s^2 2p^4$

$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 5s^2 4d^6$

$1s^2 2s^2 2p^6$

[Ar] $4s^2 3d^1$

[Xe] $6s^2 4f^{14} 5d^{10} 6p^5$

3). Draw an orbital filling diagram for sodium and tell how many unpaired electrons there are.

4). Draw an orbital filling diagram for bromine and tell how many unpaired electrons there are. You may use short hand notation.

5). Rank the following sets of atoms in order of increasing atomic radius:

As, P, N

Ca, Cr, Se

Cs, Cu, F

6). Predict the electron configuration that each of the following elements will form in making an ionic compound: Ca, S, Cl, N

7). Identify the element whose +3 ion has the electron configuration of vanadium

8). Identify which of the following pairs are larger:

Ca or Ca^{+2} , Se or O, O or O^{-2}

9). Rank the following sets of elements according to ionization energy:

F, Br, At; Ca, Fe, Cl; Cs, Ag, S

10). Which would you expect to have the larger fourth ionization energy Ga or Se?

11). Explain the near zero electron affinity of the noble gases.

12). Explain why O^{-2} has a much lower electron affinity than a single oxygen atom

CHAPTER NINE

1). Rank the following in order of highest to lowest electronegativity values:

Na, Cl, Si;

Fr, Cd, F, He;

F, Cl, Br

2). Using electronegativity values, predict whether the following compounds are nonpolar covalent, polar covalent, or ionic:

GeCl₄

KBr

FeBr₃

CCl₄

HCl

CH₄

NH₃

H₂O

3). Draw Lewis dot structures for the following elements: Na, Br, P, O, S

4). Draw electron-dot structures for:

C₃H₈

H₂O₂

CO₂

N₂H₄

CH₅N

C₂H₄

C₂H₂

Cl₂CO

5). Draw electron-dot structures for:

SF₄

SF₆

XeOF₄

XeF₅⁺

XeF₄

H₃S⁺

HCO₃⁻

6). The nitrate ion, NO₃⁻, has three equivalent oxygen atoms, and its electronic structure is a resonance hybrid of three electron-dot structures. Draw them.

7). Draw as many electron-dot resonance structures as possible for:

SO₂, CO₃²⁻, HCO₂⁻, SO₄²⁻, PO₄³⁻.

8). Calculate the formal charge and determine the most favorable of the following electron dot structures:

SO₂

NO₃⁻

NCO⁻

N₂O

O₃

CO₃²⁻

CHAPTER TEN

1). Draw the Lewis electron-dot structure and predict the shapes of the following molecules or ions:



2). Predict the expected bond angles for the following molecules:

F-Xe-F bond in XeF_2

P-F-P bond in PF_6^-

3). Which of the following compounds will have a dipole moment? Show the direction of each.

a. SO_2

b. NH_3

c. CF_4

d. TeH_4

4). What hybridization would you expect for the indicated atom in each of the following ions atoms:

