

Chapter 4: Atoms and Elements (Questions)

I recommend looking at page 120 of your textbook if you want more practice problems for CH. 4

1. List what each of the following scientists discovered:

Democritus:

- "atomos" or atoms
- matter is made of small indivisible particles

J.J Thomson:

- plum pudding model
- discovered the electron

Ernest Rutherford:

- gold foil experiment
- nucleus of atom = protons + neutrons
- protons & electrons cancel out

} the atom is mostly an empty space with a dense nucleus

John Dalton:

- 1) atoms of an element are similar mass & other properties
- 2) atoms combine in simple, whole # ratios
- 3) atoms are indestructible

2. Describe and draw the structure of a nuclear atom of oxygen (O). Identify each subatomic particle, their charge, location, and mass.

PROTONS

- positive
- nucleus
- 1 amu

ELECTRONS

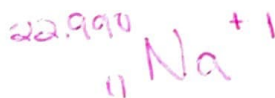
- negative
- electron cloud
- $\frac{1}{2000}$ amu

NEUTRONS

- neutral
- nucleus
- 1 amu

3. State the atomic number, symbol, mass, and charge for the following elements :

Sodium



Chlorine



*Phosphorous



4. To which group or family of elements do each element belong?

Mg

alkaline earth metals
2nd

Ar

noble gases

K

alkali metals

Br

halogens

mass (p+n)

atomic # (p)

5. Determine the charge of each ion (ion charge = #p⁺ - #e⁻)

A magnesium ion with 10 electrons

$$\begin{array}{r} 12 \text{ p}^+ \\ - 10 \text{ e}^- \\ \hline 2^+ \end{array} \quad \boxed{\text{Mg}^{+2}}$$

A sulfur ion with 18 electrons

$$\begin{array}{r} +16 \text{ p} \\ -18 \text{ e}^- \\ \hline -2 \end{array} \quad \boxed{\text{S}^{-2}}$$

*An iron ion with 23 electrons

$$\begin{array}{r} +26 \text{ p} \\ -23 \text{ e}^- \\ \hline +3 \end{array} \quad \boxed{\text{Fe}^{+3}}$$

6. If two atoms have different number of protons, then they must be different elements

7. Define *Ion* and *Isotope*

* *ion*: when the number of electrons differs from the protons

* *isotope*: when the amount of neutrons varies across the same element

8. If an atom with a mass number of 27 has 14 neutrons, it is an isotope of which element?

protons + neutrons!

$$\begin{array}{r} 27 \\ - 14 \\ \hline 13 \end{array}$$

13 protons → aluminum!

9. How many protons and neutrons are in the chromium isotope with a mass of 52 amu?

chromium = $\boxed{24 \text{ protons (PT)}} \quad \boxed{28 \text{ neutrons!}}$

$p + n$

$$\begin{array}{r} 52(p+n) \\ - 24(p) \\ \hline 28(n) \end{array}$$

10. Describe metals, metalloids, and nonmetals

metals
cations

- left of PT
- ductile
- shiny
- conductors

metalloids

- staircase
- mix of attributes
- semi conductors

nonmetals

- right of PT
- brittle
- dull

anions

11. Classify each element as a metal, nonmetal, or metalloid

Ba

m

I

nm

*O

nm

*Te

mt

12. How is the periodic table organized and who created it?

Dmitri Mendeleev

by increasing mass/protons

13. Gallium has two naturally occurring isotopes: Ga-69 with mass 68.9256 amu and a natural abundance of 60.11%, and Ga-71 with mass 70.9247 amu and a natural abundance of 39.89%. Calculate the atomic mass of gallium.

$$\begin{array}{lcl}
 \text{Ga-69} & 68.9256 \times 60.11\% & = 41.43 \text{ amu} \\
 & + & \\
 \text{Ga-71} & 70.9247 \times 39.89\% & = 28.29 \text{ amu} \\
 & & \boxed{69.72 \text{ amu}}
 \end{array}$$

14. *Magnesium has three naturally occurring isotopes with masses of 23.99, 24.99 and 25.98 amu and natural abundances of 78.99%, 10.00%, and 11.01% respectively. Calculate the atomic mass of magnesium.

$$\begin{array}{lcl}
 23.99 \times 78.99\% & = & 18.95 \\
 24.99 \times 10.00\% & = & 2.499 \\
 25.98 \times 11.01\% & = & 2.860 \\
 \hline
 & & 24.309099
 \end{array}$$

$\boxed{24.31 \text{ amu}}$

Chapter 5: Molecules and Compounds (Questions)

I recommend looking at page 154 of your textbook if you want more practice problems for CH. 5
 Look at page 152 for nomenclature summary

1. How do you determine what elements exhibit similarities in their physical and chemical properties?

By families, the vertical columns

2. Label all of the important elements of the chemical formula given. What type of compound is this?



3. Write a chemical formula for each compound.

The compound containing two silver atoms to every sulfur atom



The compound containing two nitrogen atoms to every oxygen atom



*The compound containing two oxygen atoms to every titanium atom



4. What sets polyatomic ions apart from ionic or molecular compounds? Define each part of the word.

polyatomic ions
 multiple atoms charge

5. How many atoms of each element are there in $\text{Al}_2(\text{SO}_4)_3$.

$\text{Al} = 2$
 $\text{S} = 3$
 $\text{O} = 12$

6. Define empirical formula and molecular formula and give an example of each.

empirical formula = equation at its simplest form
 molecular formula = most precise form

7. Describe the components of a molecular (covalent) compound and describe the corresponding nomenclature rules.

molecular =
 • 2 nonmetals
 • anions (-)(-)

prefixes (di, tri...)
 ends in "-ide"

8. Describe the components of an ionic compound and describe the corresponding nomenclature rules.

metals & nonmetals
 - cations - anions
 - positive (+) - negative (-)

ends in "-ide"
 most metallic first
 roman numerals (transition)

9. Classify each substance as a molecular compound, ionic compound, or polyatomic ion and name each accordingly.

CaCl_2 - ionic

calcium chloride

N_2S_3 - molecular

dinitrogen trisulfide

SnCl_2 - ionic

Tin (II) chloride

SO_4^{2-} polyatomic

sulfate

* NiS - ionic

Nickel (II) sulfide

* P_2O_3 - molecular

diphosphorus trioxide

* KBr - ionic

potassium bromide

$\text{B}_2(\text{CrO}_4)_3$

Boron chromate

10. What are the two types of acids? Differentiate between the two and describe the corresponding nomenclature rules.

Binary

- hydrogen & nonmetal

(aq) hydro — -ic acid

(g) hydrogen — -ide

Oxyacids (anion w/ O₂)

ate = — -ic acid

ite = — -ous acid

11. Name the following acids.

element
→ binary
oxyacid
→ O₂



Hydrosulfuric acid



Nitrous acid



Hydrofluoric acid



Carbonic acid

12. Calculate the formula mass of carbon tetrachloride, CCl₄

$$C = 12.011 (1) = 12.011$$

$$Cl = 35.45 (4) = 141.8$$

$$153.811$$

153.8 amu

13. *Calculate the formula mass of dinitrogen monoxide, N₂O.

$$N = 14.007 (2) = 28.014$$

$$15.999 (1) = 15.999 +$$

44.013 amu

Chapter 6: Chemical Composition (Questions)

I recommend looking at page 191 of your textbook if you want more practice problems for CH. 6

1. How do you convert between moles and number of atoms?

avogadro's number: 6.022×10^{23}

2. How do you convert between grams and moles?

periodic table

3. A silver ring contains 1.1×10^{22} silver atoms. How many moles of silver are in the ring?

How many grams?

atoms $\rightarrow$ moles

moles $\rightarrow$ grams

$$\frac{1.1 \times 10^{22} \text{ Ag atoms}}{6.022 \times 10^{23} \text{ atoms Ag}} \times \frac{1 \text{ mol Ag}}{1 \text{ mol Ag}} = 1.8 \times 10^{-2} \text{ moles Ag}$$

$$\frac{1.8 \times 10^{-2} \text{ mol Ag}}{1 \text{ mol Ag}} \times \frac{107.87 \text{ g Ag}}{1 \text{ mol Ag}} = 1.97039 \dots$$

$\downarrow$

2.0 g Ag

4. Which sample contains the greatest number of atoms

15g Ne $\rightarrow$ greatest

15g Ar

15g Kr $\rightarrow$ least

$$\frac{15 \text{ g Ne}}{20.180 \text{ g Ne}} \times \frac{1 \text{ mol Ne}}{1 \text{ mol Ne}} \times \frac{6.022 \times 10^{23} \text{ atoms Ne}}{1 \text{ mol Ne}} = 4.5 \times 10^{23} \text{ atoms Ne}$$

$$\frac{15 \text{ g Ar}}{39.948 \text{ g Ar}} \times \frac{1 \text{ mol Ar}}{1 \text{ mol Ar}} \times \frac{6.022 \times 10^{23} \text{ atoms Ar}}{1 \text{ mol Ar}} = 2.3 \times 10^{23} \text{ atoms Ar}$$

$$\frac{15 \text{ g Kr}}{83.798 \text{ g Kr}} \times \frac{1 \text{ mol Kr}}{1 \text{ mol Kr}} \times \frac{6.022 \times 10^{23} \text{ atoms Kr}}{1 \text{ mol Kr}} = 1.1 \times 10^{23} \text{ atoms Kr}$$

5. Calculate the mass percent composition of potassium in potassium oxide



part whole

$$\text{K} = 39.098 (2) = 78.196$$

$$\text{O} = 15.999 (1) = 15.999$$

$$94.195 \text{ g/mol K}_2\text{O}$$

$$\frac{78.196}{94.195} = .83015$$

$$\times 100$$

$$\boxed{83.015\%}$$

$$\frac{\text{part}}{\text{whole}} \times 100$$

Empirical

- ① change % $\rightarrow$ g ③ divide by least number

② g $\rightarrow$ mols

6. A laboratory analysis of vanillin, the flavoring agent in vanilla, determined the mass percent composition: C-63.15%, H-5.30%, O-31.55%

$$\text{C } \frac{63.15 \text{ g C}}{12.011 \text{ g C}} \times \frac{1 \text{ mol C}}{12.011 \text{ g C}} = \frac{5.258 \text{ mol}}{1.972 \text{ mol}} = 3$$

$$\text{H } \frac{5.30 \text{ g H}}{1.00794 \text{ g H}} \times \frac{1 \text{ mol H}}{1.00794 \text{ g H}} = \frac{5.258 \text{ mol}}{1.972 \text{ mol}} = 3$$

$$\text{O } \frac{31.55 \text{ g O}}{15.999 \text{ g O}} \times \frac{1 \text{ mol O}}{15.999 \text{ g O}} = \frac{1.972 \text{ mol}}{1.972 \text{ mol}} = 1$$



7. A 3.24-g sample of titanium reacts with oxygen to form 5.40g of the metal oxide. What is the empirical formula of the metal oxide?

$$\text{Ti } \frac{3.24 \text{ g Ti}}{47.867 \text{ g Ti}} \times \frac{1 \text{ mol Ti}}{47.867 \text{ g Ti}} = \frac{0.067 \text{ mol}}{0.067 \text{ mol}} = 1$$

$$\text{O } \frac{5.40 \text{ g O}}{15.999 \text{ g O}} \times \frac{1 \text{ mol O}}{15.999 \text{ g O}} = \frac{0.338 \text{ mol}}{0.067 \text{ mol}} = 5$$



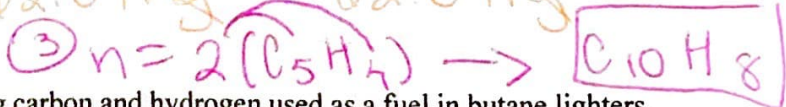
8. Naphthalene is a compound containing carbon and hydrogen that is used in mothballs. Its empirical formula is C_5H_4 and its molar mass is 128.16 g/mol. What is its molecular formula?

①

$n(\text{formula}) = \frac{\text{g/mol}}{\text{periodic table}} \text{ or } n = \frac{\text{molar mass}}{\text{empirical formula molar mass}}$

$$\begin{array}{l} \text{C } 12.011(5) = 60.055 \\ \text{H } 1.00794(4) = 2.01588 \\ \hline 62.07088 \\ \downarrow \\ 62.071 \text{ g C}_5\text{H}_4 \end{array}$$

$$\text{② } n(62.071 \text{ g}) = \frac{128.16 \text{ g/mol}}{62.071 \text{ g}} = 2$$



9. *Butane is a compound containing carbon and hydrogen used as a fuel in butane lighters. Its empirical formula is C_2H_5 , and its molar mass is 58.12 g/mol. Find its molecular formula.

$n(\text{formula}) = \frac{\text{g/mol}}{\text{periodic table}} \text{ or } n = \frac{\text{molar mass}}{\text{empirical formula molar mass}}$

$$\begin{array}{l} \text{C } 12.011(2) = 24.022 \\ \text{H } 1.00794(5) = 5.0397 \\ \hline 29.0617 \\ \downarrow \\ 29.062 \text{ g} \end{array}$$

$$n = \frac{58.12 \text{ g/mol}}{29.062 \text{ g}} = 2$$



Conversion Test Practice

1. Find the mass of oxygen in 2.50 g of calcium sulfate, CaSO_4 .

$$\frac{2.50 \text{ g } \text{CaSO}_4}{136.15 \text{ g } \text{CaSO}_4} \times \frac{1 \text{ mol } \text{CaSO}_4}{1 \text{ mol } \text{CaSO}_4} \times \frac{63.996 \text{ g } \text{CaSO}_4}{1 \text{ mol } \text{CaSO}_4} = 1.175100992$$

↓
1.18 g O

2. Determine the mass of hydrogen in 3.75 g of glucose, $\text{C}_6\text{H}_{12}\text{O}_6$.

$$\frac{3.75 \text{ g } \text{C}_6\text{H}_{12}\text{O}_6}{180.15528 \text{ g } \text{C}_6\text{H}_{12}\text{O}_6} \times \frac{1 \text{ mol } \text{C}_6\text{H}_{12}\text{O}_6}{1 \text{ mol } \text{C}_6\text{H}_{12}\text{O}_6} \times \frac{12 \text{ molecules H}}{1 \text{ molecule } \text{C}_6\text{H}_{12}\text{O}_6} \times \frac{1.00794 \text{ g H}}{1 \text{ molecule H}}$$

$= 0.251768021 \rightarrow$ **0.252 g H**

3. How many oxygen atoms are present in 0.562 g of sulfur trioxide, SO_3 ?

$$\frac{0.562 \text{ g } \text{SO}_3}{80.057 \text{ g } \text{SO}_3} \times \frac{1 \text{ mol } \text{SO}_3}{1 \text{ mol } \text{SO}_3} \times \frac{6.022 \times 10^{23} \text{ formula units}}{1 \text{ mol } \text{SO}_3} \times \frac{3 \text{ atoms O}}{1 \text{ formula unit } \text{SO}_3}$$

$= 1.27 \times 10^{22} \text{ O atoms}$

4. Find the number of hydrogen atoms in 0.245 g of ammonia, NH_3 .

$$\frac{0.245 \text{ g } \text{NH}_3}{17.03082 \text{ g } \text{NH}_3} \times \frac{1 \text{ mol } \text{NH}_3}{1 \text{ mol } \text{NH}_3} \times \frac{6.022 \times 10^{23} \text{ formula units}}{1 \text{ mol } \text{NH}_3} \times \frac{3 \text{ atoms H}}{1 \text{ formula unit } \text{NH}_3}$$

$= 2.60 \times 10^{22} \text{ atoms H}$