2.7: Elements and Ions (Exercises)

These are homework exercises to accompany Chapter 2 of the University of Kentucky's LibreText for CHE 103 - Chemistry for Allied Health. Solutions are available below the questions.

Questions

2.1: Isotopes and Atomic Mass

(click here for solutions)

Q2.1.1

Give the names and symbols of three elements.

Q2.1.2

Describe where protons, neutrons, and electrons are located in an atom.

Q2.1.3

Why are all atoms electrically neutral?

Q2.1.4

How many protons are in the nucleus of each of the following atoms?

a. neon (Ne)
b. gold (Au)
c. strontium (Sr)
d. uranium (U)

Q2.1.5

A certain atom contains 28 protons, 28 electrons, and 31 neutrons. Provide the following:

a. atomic number
b. mass number
c. name of element

Q2.1.6

How many protons, neutrons, and electrons are in an atom of cesium-133?

Q2.1.7

How many protons, neutrons, and electrons are there in the atom $^{19}_{9}\text{F}$?

Q2.1.8

How many protons, neutrons, and electrons are there in an atom of lead-207?

Q2.1.9

A certain atom has an atomic number of 36 and a mass number of 84. Write out the designation for this isotope in both nuclide symbol form and in hyphenated form.

Q2.1.10

An atom has a mass number of 59 and contains 32 neutrons in its nucleus. What element is it?

Q2.1.11

Complete the **Table** below:

Isotope	Isotope Symbol	Atomic Number	Mass Number
sodium-23			

Isotope	Isotope Symbol	Atomic Number	Mass Number
	$^{75}_{33}\text{As}$		
silver-108			

Q2.1.12

Which one is an isotope of $^{40}_{18}\text{Ar}$? Explain.

a. $^{40}_{20}\text{Ca}$
b. $^{39}_{18}\text{Ar}$
c. $^{40}_{18}\text{Ar}$

Q2.1.13

Fill in **Table** below:

Isotope	Number of Protons	Number of Electrons	Number of Neutrons	Isotope Symbol
hydrogen-1				
hydrogen-2				
beryllium-9				
aluminum-27				

Q2.1.14

Fill in **Table** below:

Element	Symbol	Atomic Number	Mass Number	# of Protons	# of Electrons	# of Neutrons	Isotope Symbol
nitrogen			14				
	B		11				
		30				35	
					77	116	
							$^{56}_{26}\text{Fe}$

2.2: Matter

(click here for solutions)

Q2.2.1

Define matter and give three examples of matter.

Q2.2.2

Explain the differences between compounds and mixtures.

Q2.2.3

Explain the differences between pure substances and mixtures.

Q2.2.4

Identify each of the following as a pure substance or a mixture.

a. salt water

b. NaCl
c. brewed coffee
d. air

Q2.2.5

Label each of the following as an element, compound, homogeneous mixture, or heterogeneous mixture.

a. silicon
b. sulfuric acid
c. air
d. soda
e. sugar
f. muddy water
g. chicken noodle soup
h. scoop of sand from the beach

Q2.2.6

Identify each of the following elements as a metal, nonmetal, or metalloid.

a. iron (Fe)
b. gallium (Ga)
c. phosphorus (P)
d. potassium (K)
e. neon (Ne)
f. germanium (Ge)

Q2.2.7

Identify each of the following elements as a metal, nonmetal, or metalloid.

a. chlorine (Cl)
b. hydrogen (H)
c. antimony (Sb)
d. titanium (Ti)
e. nitrogen (N)
f. selenium (Se)

Q2.2.8

Describe how you identify molecular and ionic compounds.

Q2.2.9

Label each as an ionic or molecular compound.

a. H_2O_2
b. N_2O_5
c. PF_3
d. $MgCl_2$
e. KBr
f. $AlCl_3$

Q2.2.10

Label each as an ionic or molecular compound.

a. CaO
b. Na_2S
c. NH_3
d. CO_2
e. N_2H_4

f. N_2O

2.3: Mole and Molar Mass

(click here for solutions)

Q2.3.1

Define "counting number".

Q2.3.2

What is the value of Avogadro's number?

Q2.3.3

What seven elements exist as diatomic molecules in nature?

Q2.3.4

How many atoms of helium are present in each of the following samples?

a. 1 mole
b. 2 moles
c. 2.5 moles
d. 0.5 moles
e. 0.35 moles

Q2.3.5

How many molecules of water are present in each of the following samples?

a. 1 mole
b. 2 moles
c. 2.5 moles
d. 0.5 moles
e. 0.35 moles

Q2.3.6

Compare the answers for each part of questions 4 and 5 to one another. How do they compare? Explain why.

Q2.3.7

How many moles of silicon is 6.73×10^{25} atoms of silicon?

Q2.3.8

How many moles of sodium is 4.29×10^{22} atoms of sodium?

Q2.3.9

How many atoms of each element are in one unit of each compound?

a. H_2O_2
b. N_2O_5
c. PF_3
d. $MgCl_2$
e. KBr
f. $AlCl_3$
g. CaO
h. Na_2S
i. NH_3
j. CO_2
k. N_2H_4
l. N_2O

Q2.3.10

How many moles of each element are in one mole of each compound?

a. H_2O_2
b. N_2O_5
c. PF_3
d. $MgCl_2$
e. KBr
f. $AlCl_3$
g. CaO
h. Na_2S
i. NH_3
j. CO_2
k. N_2H_4
l. N_2O

Q2.3.11

How do the answers in questions 9 and 10 compare to one another? Explain the similarities or differences.

Q2.3.12

How many moles of carbon are in 0.75 moles of CCl_4? How many moles of chlorine?

Q2.3.13

How many atoms of carbon are in 0.75 moles of CCl_4? How many atoms of chlorine?

Q2.3.14

How many moles of hydrogen are in 2.5 moles of H_2O? How many moles of oxygen?

Q2.3.15

How many atoms of hydrogen are in 2.5 moles of H_2O? How many atoms of oxygen?

Q2.3.16

A sample of $CaNO_3$ contains 3.87×10^{25} atoms of oxygen. How many molecules of $CaNO_3$ are in the sample?

Q2.3.17

A sample of propane gas (C_3H_8) contains 5.39×10^{24} atoms of carbon. How many atoms of hydrogen are in the sample?

Q2.3.18

What is the molar mass of each of the following elements (in atomic form)?

a. carbon
b. nitrogen
c. sodium
d. hydrogen
e. potassium
f. phosphorus

Q2.3.19

How many moles of each element listed in the previous question are present in a 25.0 g sample of the element?

Q2.3.20

For question 19, all of the samples have the same mass. Are the moles the same? Why or why not?

Q2.3.21

What is the mass of each of the following samples?

a. 0.35 moles sodium

b. 0.75 moles carbon
c. 1.34 moles potassium
d. 1.21 moles silicon
e. 0.95 moles calcium
f. 2.85 moles helium

Q2.3.22

Determine the molar mass of each of the following compounds?

a. CO_2
b. N_2H_4
c. CaF_2
d. $C_6H_{12}O_6$
e. CH_4
f. C_6H_6
g. Na_2SO_4
h. K_3PO_4
i. $Al(NO_3)_3$
j. $Mg_3(PO_4)_2$

Q2.3.23

Calculate the moles of each of the following samples.

a. 25.0 g CO_2
b. 10.0 g N_2H_4
c. 85.0 g CaF_2
d. 15.5 g $C_6H_{12}O_6$
e. 20.0 g CH_4
f. 100.0 g C_6H_6
g. 30.0 g Na_2SO_4
h. 75.0 g K_3PO_4
i. 50.0 g $Al(NO_3)_3$
j. 47.2 g $Mg_3(PO_4)_2$

Q2.3.24

Calculate the mass of each of the following samples.

a. 3.5 mol CO_2
b. 0.45 mol N_2H_4
c. 2.25 mol CaF_2
d. 1.75 mol $C_6H_{12}O_6$
e. 4.9 mol CH_4
f. 8.75 mol C_6H_6
g. 2.35 mol Na_2SO_4
h. 0.672 mol K_3PO_4
i. 0.95 mol $Al(NO_3)_3$
j. 1.15 mol $Mg_3(PO_4)_2$

2.4: Electron Arrangements

(click here for solutions)

Q2.4.1

What is the electron arrangement for each of the elements?

a. Na
b. Ne

c. Be
d. N
e. S
f. Cl

Q2.4.2

How many valence electrons are in each element?

a. K
b. P
c. F
d. S
e. Li
f. B

Q2.4.3

What is the octet rule?

2.5: Ion Formation

(click here for solutions)

Q2.5.1

Define ion.

Q2.5.2

How are anions and cation the same? Different?

Q2.5.3

What is the most common ion formed from each element?

a. Li
b. Na
c. Ca
d. B
e. P
f. S
g. Cl
h. Br

Q2.5.4

How many protons, neutrons, and electrons are present in the ions indicated in the previous question?

Q2.5.5

Identify the following elements.

a. An ion with a 3+ charge and two electrons.
b. An ion with a 1− charge and 18 electrons.
c. An ion with a 1+ charge and 18 electrons.
d. An ion with a 3− charge and 10 electrons.

Q2.5.6

Describe a polyatomic ion.

Q2.5.7

Which are polyatomic ions?

a. NO_3^-

b. O^{2-}
c. NH_4^+
d. Mg^{2+}
e. Na^+
f. O_2^{2-}

2.6: Ionic Compounds

(click here for solutions)

Q2.6.1

What element is present in all organic compounds?

Q2.6.2

Give three examples of metallic elements.

Q2.6.3

Give three examples of nonmetallic elements.

Q2.6.4

What types of elements form an ionic compound?

Q2.6.5

How do the electrons behave in the formation of an ionic bond?

Q2.6.6

What is the overall charge of an ionic compound?

Q2.6.7

What is the formula for the ionic compound formed from each of the following pairs?

a. potassium and sulfur
b. silver and chlorine (silver has a 1+ charge)
c. calcium and oxygen
d. aluminum and iodine
e. barium and nitrogen
f. sodium and phosphorus
g. lithium and fluorine
h. magnesium and nitrogen
i. calcium and sulfur
j. beryllium and bromine
k. zinc and nitrogen (zinc has a 2+ charge)
l. tin and iodine (tin has a 4+ charge)

Q2.6.8

Write the formula for the compound formed between sodium and each of these polyatomic ions. You can look up the formula and charge for each polyatomic ion.

a. carbonate
b. chlorate
c. chlorite
d. phosphate
e. nitrate
f. sulfate
g. chromate
h. dichromate

Q2.6.9

Write the formula for the compound formed between magnesium and each of the polyatomic ions listed in the previous question.

Q2.6.10

Explain when parentheses should and should not be used in the formulas of ionic compounds.

Answers

2.1: Isotopes and Atomic Mass

Q2.1.1

Answers will vary.

Q2.1.2

Protons and neutrons are in the nucleus and electrons are located outside the nucleus.

Q2.1.3

The sum of the charges on ions in an ionic compound must equal zero.

Q2.1.4

a. 10
b. 79
c. 38
d. 92

Q2.1.5

A certain atom contains 28 protons, 28 electrons, and 31 neutrons. Provide the following:

a. 28
b. 59
c. nickel

Q2.1.6

55 protons, 78 neutrons, 55 electrons

Q2.1.7

9 protons, 10 neutrons, 9 electrons

Q2.1.8

82 protons, 125 neutrons, 82 electrons

Q2.1.9

$^{84}_{36}\text{Kr}$, krypton-84

Q2.1.10

cobalt

Q2.1.11

Isotope	Isotope Symbol	Atomic Number	Mass Number
sodium-23	$^{23}_{11}\text{Na}$	11	23
aresenic-75	$^{75}_{33}\text{As}$	33	75
silver-108	$^{108}_{47}\text{Ag}$	47	108

Q2.1.12

a. $^{40}_{20}\text{Ca}$ - not an isotope because it is a different element
b. $^{39}_{18}\text{Ar}$ - isotope because it has the same atomic number but a different atomic mass
c. $^{40}_{18}\text{Ar}$ - not an isotope because it has the same atomic number and the same atomic mass

Q2.1.13

Isotope	Number of Protons	Number of Electrons	Number of Neutrons	Isotope Symbol
hydrogen-1	1	1	0	$^{1}_{1}\text{H}$
hydrogen-2	1	1	1	$^{2}_{1}\text{H}$
beryllium-9	4	4	5	$^{9}_{4}\text{Be}$
aluminum-27	13	13	14	$^{27}_{13}\text{Al}$

Q2.1.14

Element	Symbol	Atomic Number	Mass Number	# of Protons	# of Electrons	# of Neutrons	Isotope Symbol
nitrogen	N	7	14	7	7	7	$^{14}_{7}\text{N}$
boron	B	5	11	5	5	6	$^{11}_{5}\text{B}$
zinc	Zn	30	65	30	30	35	$^{65}_{30}\text{Zn}$
iridium	Ir	77	193	77	77	116	$^{193}_{77}\text{Ir}$
iron	Fe	26	56	26	26	30	$^{56}_{26}\text{Fe}$

2.2: Matter

Q2.2.1

Matter is anything that has mass and occupies space. Examples of matter will vary and can be any object from an atom to a macroscopic object.

Q2.2.2

A compound is a combination of elements with a fixed composition. The elements in the compound do not retain their individual identity by have the properties of the compound. A mixture does not have a fixed composition and each component of the mixture retains its identity and properties.

Q2.2.3

A pure substance contains only one component, either an element or compound, while a mixture contains multiple pure substances.

Q2.2.4

a. mixture
b. pure substance
c. mixture
d. mixture

Q2.2.5

a. element
b. compound
c. homogeneous mixture
d. heterogeneous mixture
e. compound
f. heterogeneous mixture
g. heterogeneous mixture

h. heterogeneous mixture

Q2.2.6

a. metal
b. metal
c. nonmetal
d. metal
e. nonmetal
f. metalloid

Q2.2.7

a. nonmetal
b. nonmetal
c. metalloid
d. metal
e. nonmetal
f. nonmetal

Q2.2.8

Ionic compounds are generally formed between a metal and nonmetal or between a polyatomic ion and another ion. Molecular compounds are composed of two ore more nonmetals.

Q2.2.9

a. molecular
b. molecular
c. molecular
d. ionic
e. ionic
f. ionic

Q2.2.10

a. ionic
b. ionic
c. molecular
d. molecular
e. molecular
f. molecular

2.3: Mole and Molar Mass

Q2.3.1

A counting number is a word that is associated with a specific number.

Q2.3.2

6.022×10^{23}

Q2.3.3

H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2

Q2.3.4

a. 6.022×10^{23} atoms
b. 1.204×10^{24} atoms
c. 1.506×10^{24} atoms
d. 3.011×10^{23} atoms
e. 2.108×10^{23} atoms

Q2.3.5

a. 6.022×10^{23} molecules
b. 1.204×10^{24} molecules
c. 1.506×10^{24} molecules
d. 3.011×10^{23} molecules
e. 2.108×10^{23} molecules

Q2.3.6

The numbers are the same for the same number of moles because moles are a counting number. Regardless of what is being counted, a mole will have the same number of items.

Q2.3.7

$6.73 \times 10^{25}\ atoms\ \text{Si} \left(\frac{1\ mole}{6.022 \times 10^{23}\ atoms} \right) = 112\ moles\ \text{Si}$

Q2.3.8

$4.29 \times 10^{22}\ atoms\ \text{Na} \left(\frac{1\ mole}{6.022 \times 10^{23}\ atoms} \right) = 0.0712\ moles\ \text{Na}$

Q2.3.9

a. 2 hydrogen atoms, 2 oxygen atoms
b. 2 nitrogen atoms, 5 oxygen atoms
c. 1 phosphorus atom, 3 fluorine atoms
d. 1 magnesium atom, 2 chlorine atoms
e. 1 potassium atom, 1 bromine atom
f. 1 aluminum atom, 3 chlorine atoms
g. 1 calcium atom, 1 oxygen atom
h. 2 sodium atoms, 1 oxygen atom
i. 1 nitrogen atom, 3 hydrogen atoms
j. 1 carbon atom, 2 oxygen atoms
k. 2 nitrogen atoms, 4 hydrogen atoms
l. 2 nitrogen atoms, 1 oxygen atom

Q2.3.10

a. 2 moles hydrogen, 2 moles oxygen
b. 2 moles nitrogen, 5 moles oxygen
c. 1 mole phosphorus, 3 moles fluorine
d. 1 mole magnesium, 2 moles chlorine
e. 1 mole potassium, 1 mole bromine
f. 1 mole aluminum, 3 moles chlorine
g. 1 mole calcium, 1 mole oxygen
h. 2 moles sodium, 1 mole oxygen
i. 1 mole nitrogen, 3 moles hydrogen
j. 1 mole carbon, 2 moles oxygen
k. 2 moles nitrogen, 4 moles hydrogen
l. 2 moles nitrogen, 1 mole oxygen

Q2.3.11

The numbers are the same because the ratios are the same between atoms and moles. Moles are a counting number so they are a multiple of the number of atoms.

Q2.3.12

$0.75\ mol\ \text{CCl}_4 \left(\frac{1\ mol\ \text{C}}{1\ mol\ \text{CCl}_4} \right) = 0.75\ mol\ \text{C}$

$$0.75\ mol\ CCl_4 \left(\frac{4\ mol\ Cl}{1\ mol\ CCl_4}\right) = 3.0\ mol\ Cl$$

Q2.3.13

$$0.75\ mol\ CCl_4 \left(\frac{1\ mol\ C}{1\ mol\ CCl_4}\right)\left(\frac{6.02\times10^{23}\ atoms}{1\ mol\ C}\right) = 4.52\times10^{23}\ atoms\ C$$

$$0.75\ mol\ CCl_4 \left(\frac{4\ mol\ Cl}{1\ mol\ CCl_4}\right)\left(\frac{6.02\times10^{23}\ atoms}{1\ mol\ Cl}\right) = 1.81\times10^{24}\ atoms\ Cl$$

Q2.3.14

$$2.5\ mol\ H_2O \left(\frac{2\ mol\ H}{1\ mol\ H_2O}\right) = 5.0\ mol\ H$$

$$2.5\ mol\ H_2O \left(\frac{1\ mol\ O}{1\ mol\ H_2O}\right) = 2.5\ mol\ O$$

Q2.3.15

$$2.5\ mol\ H_2O \left(\frac{2\ mol\ H}{1\ mol\ H_2O}\right)\left(\frac{6.02\times10^{23}\ atoms}{1\ mol\ H}\right) = 3.01\times10^{24}\ atoms\ H$$

$$2.5\ mol\ H_2O \left(\frac{1\ mol\ O}{1\ mol\ H_2O}\right)\left(\frac{6.02\times10^{23}\ atoms}{1\ mol\ O}\right) = 1.51\times10^{24}\ atoms\ O$$

Q2.3.16

$$3.87\times10^{25}\ atoms\ O \left(\frac{1\ molec\ CaNO_3}{3\ atoms\ O}\right) = 1.29\times10^{25}\ molec\ CaNO_3$$

Q2.3.17

$$5.39\times10^{24}\ atoms\ C \left(\frac{8\ atoms\ H}{3\ atoms\ C}\right) = 1.44\times10^{25}\ atoms\ H$$

Q2.3.18

a. 12.01 g/mol
b. 14.01 g/mol
c. 22.99 g/mol
d. 1.008 g/mol
e. 39.10 g/mol
f. 30.97 g/mol

Q2.3.19

a. $25.0\ g\ C \left(\frac{1\ mol\ C}{12.01\ \frac{g}{mol}}\right) = 2.08\ mol\ C$
b. $25.0\ g\ N \left(\frac{1\ mol\ N}{14.01\ \frac{g}{mol}}\right) = 1.78\ mol\ N$
c. $25.0\ g\ Na \left(\frac{1\ mol\ Na}{22.99\ \frac{g}{mol}}\right) = 1.09\ mol\ Na$
d. $25.0\ g\ H \left(\frac{1\ mol\ H}{1.008\ \frac{g}{mol}}\right) = 24.8\ mol\ H$
e. $25.0\ g\ K \left(\frac{1\ mol\ K}{39.10\ \frac{g}{mol}}\right) = 0.639\ mol\ K$
f. $25.0\ g\ P \left(\frac{1\ mol\ P}{30.97\ \frac{g}{mol}}\right) = 0.807\ mol\ P$

Q2.3.20

The moles are different because a mole of atoms of each element has a different mass. Although they have the same mass, the number of atoms of each sample is different. Compare a ton of feathers to a ton of books. The same total mass but a different quantity of each.

Q2.3.21

What is the mass of each of the following samples?

a. $0.35\ mol\ \text{Na}\left(\frac{22.99\ g}{mol\ \text{Na}}\right) = 8.0\ g\ \text{Na}$

b. $0.75\ mol\ \text{C}\left(\frac{12.01\ g}{mol\ \text{C}}\right) = 9.0\ g\ \text{C}$

c. $1.34\ mol\ \text{K}\left(\frac{39.10\ g}{mol\ \text{K}}\right) = 52.4\ g\ \text{K}$

d. $1.21\ mol\ \text{Si}\left(\frac{28.09\ g}{mol\ \text{Si}}\right) = 34.0\ g\ \text{Si}$

e. $0.95\ mol\ \text{Ca}\left(\frac{40.08\ g}{mol\ \text{Ca}}\right) = 38\ g\ \text{Ca}$

f. $2.85\ mol\ \text{He}\left(\frac{4.003\ g}{mol\ \text{He}}\right) = 11.4\ g\ \text{He}$

Q2.3.22

a. CO_2 has 1 mole of carbon and 2 moles of oxygen; $\left(12.01\frac{g}{mol}\times 1\right)+\left(16.00\frac{g}{mol}\times 2\right)=44.01\frac{g}{mol}$

b. N_2H_4 has 2 moles of nitrogen and 4 moles of hydrogen; $\left(14.01\frac{g}{mol}\times 2\right)+\left(1.008\frac{g}{mol}\times 4\right)=32.05\frac{g}{mol}$

c. CaF_2 has 1 mole of calcium and 2 moles of fluorine; $\left(40.08\frac{g}{mol}\times 1\right)+\left(19.00\frac{g}{mol}\times 2\right)=78.08\frac{g}{mol}$

d. $C_6H_{12}O_6$ has 6 moles of carbon, 12 moles of hydrogen, and 6 moles of oxygen; $\left(12.01\frac{g}{mol}\times 6\right)+\left(1.008\frac{g}{mol}\times 12\right)+\left(16.00\frac{g}{mol}\times 6\right)=180.16\frac{g}{mol}$

e. CH_4 has 1 mole of carbon and 4 moles of hydrogen; $\left(12.01\frac{g}{mol}\times 1\right)+\left(1.008\frac{g}{mol}\times 4\right)=16.04\frac{g}{mol}$

f. C_6H_6 has 6 moles of carbon and 6 moles of hydrogen; $\left(12.01\frac{g}{mol}\times 6\right)+\left(1.008\frac{g}{mol}\times 6\right)=78.11\frac{g}{mol}$

g. Na_2SO_4 has 2 moles of sodium, 1 mole of sulfur, and 4 moles of oxygen; $\left(22.99\frac{g}{mol}\times 2\right)+\left(32.06\frac{g}{mol}\times 1\right)+\left(16.00\frac{g}{mol}\times 4\right)=142.04\frac{g}{mol}$

h. K_3PO_4 has 3 moles of potassium, 1 mole of phosphorus, and 4 moles of oxygen; $\left(39.10\frac{g}{mol}\times 3\right)+\left(30.97\frac{g}{mol}\times 1\right)+\left(16.00\frac{g}{mol}\times 4\right)=212.27\frac{g}{mol}$

i. $Al(NO_3)_3$ has 1 mole of aluminum, 3 moles of nitrogen, and 9 moles of oxygen; $\left(26.98\frac{g}{mol}\times 1\right)+\left(14.01\frac{g}{mol}\times 3\right)+\left(16.00\frac{g}{mol}\times 9\right)=213.01\frac{g}{mol}$

j. $Mg_3(PO_4)_2$ has 3 moles of magnesium, 2 moles of phosphorus, and 8 moles of oxygen; $\left(24.31\frac{g}{mol}\times 3\right)+\left(30.97\frac{g}{mol}\times 2\right)+\left(16.00\frac{g}{mol}\times 8\right)=262.87\frac{g}{mol}$

Q2.3.23

a. $25.0\ g\ CO_2\left(\frac{1\ mol\ CO_2}{44.01\ g}\right) = 0.568\ mol\ CO_2$

b. $10.0\ g\ N_2H_4\left(\frac{1\ mol\ N_2H_4}{32.05\ g}\right) = 0.312\ mol\ N_2H_4$

c. $85.0\ g\ CaF_2\left(\frac{1\ mol\ CaF_2}{78.08\ g}\right) = 1.09\ mol\ CaF_2$

d. $15.5\ g\ C_6H_{12}O_6\left(\frac{1\ mol\ C_6H_{12}O_6}{180.16\ g}\right) = 0.0860\ mol\ C_6H_{12}O_6$

e. $20.0\ g\ CH_4\left(\frac{1\ mol\ CH_4}{16.04\ g}\right) = 1.25\ mol\ CH_4$

f. $100.0\ g\ C_6H_6\left(\frac{1\ mol\ C_6H_6}{78.11\ g}\right) = 1.28\ mol\ C_6H_6$

g. $30.0\ g\ Na_2SO_4\left(\frac{1\ mol\ Na_2SO_4}{142.04\ g}\right) = 0.211\ mol\ Na_2SO_4$

h. $75.0\ g\ K_3PO_4\left(\frac{1\ mol\ K_3PO_4}{212.27\ g}\right) = 0.353\ mol\ K_3PO_4$

i. $50.0\ g\ Al(NO_3)_3\left(\frac{1\ mol\ Al(NO_3)_3}{213.01\ g}\right) = 0.235\ mol\ Al(NO_3)_3$

j. $47.2\ g\ Mg_3(SO_4)_2\left(\frac{1\ mol\ Mg_3(SO_4)_2}{262.87\ g}\right) = 0.180\ mol\ Mg_3(SO_4)_2$

Q2.3.24

a. $3.5\ mol\ CO_2\left(\frac{44.01\ g}{mol\ CO_2}\right) = 1.50\times 10^2\ g\ CO_2$

b. $0.45\ mol\ N_2H_4\left(\frac{32.05\ g}{mol\ N_2H_4}\right) = 14\ g\ N_2H_4$

c. $2.25\ mol\ CaF_2\left(\frac{78.08\ g}{mol\ CaF_2}\right) = 176\ g\ CaF_2$

d. $1.75\ mol\ C_6H_{12}O_6\left(\frac{180.16\ g}{mol\ C_6H_{12}O_6}\right) = 315\ g\ C_6H_{12}O_6$

e. $4.9\ mol\ CH_4\left(\frac{16.04\ g}{mol\ CH_4}\right) = 79\ g\ CH_4$

f. $8.75\ mol\ \mathrm{C_6H_6}\left(\frac{78.11\ g}{mol\ \mathrm{C_6H_6}}\right) = 683\ g\ \mathrm{C_6H_6}$

g. $2.35\ mol\ \mathrm{Na_2SO_4}\left(\frac{142.04\ g}{mol\ \mathrm{Na_2SO_4}}\right) = 334\ g\ \mathrm{Na_2SO_4}$

h. $0.672\ mol\ \mathrm{K_3PO_4}\left(\frac{212.27\ g}{mol\ \mathrm{K_3PO_4}}\right) = 143\ g\ \mathrm{K_3PO_4}$

i. $0.95\ mol\ \mathrm{Al(NO_3)_3}\left(\frac{213.01\ g}{mol\ \mathrm{Al(NO_3)_3}}\right) = 2.0 \times 10^2\ g\ \mathrm{Al(NO_3)_3}$

j. $1.15\ mol\ \mathrm{Mg_3(PO_4)_2}\left(\frac{262.87\ g}{mol\ \mathrm{Mg_3(PO_4)_2}}\right) = 302\ g\ \mathrm{Mg_3(PO_4)_2}$

2.4: Electron Arrangements

Q2.4.1

a. 2, 8, 1
b. 2, 8
c. 2, 2
d. 2, 5
e. 2, 8, 6
f. 2, 8, 7

Q2.4.2

a. 1
b. 5
c. 7
d. 6
e. 1
f. 3

Q2.4.3

The octet rule predicts the stability of an atom based on having eight electrons in its electron shell.

2.5: Ion Formation

Q2.5.1

An ion is a charged species which results from the gain or loss of one ore more electrons.

Q2.5.2

Anions and cations are both charged species which results from the change in the number of electrons. Anions have a negative charge while cations have a positive charge.

Q2.5.3

a. $\mathrm{Li^+}$
b. $\mathrm{Na^+}$
c. $\mathrm{Ca^{2+}}$
d. $\mathrm{B^{3+}}$
e. $\mathrm{P^{3-}}$
f. $\mathrm{S^{2-}}$
g. $\mathrm{Cl^-}$
h. $\mathrm{Br^-}$

Q2.5.4

a. 3 protons, 4 neutrons, 2 electrons
b. 11 protons, 12 neutrons, 10 electrons
c. 20 protons, 20 neutrons, 18 electrons
d. 5 protons, 6 neutrons, 2 electrons
e. 15 protons, 16 neutrons, 18 electrons

CK-12 LICENSED UNDER CK-12 License © CK-12 Foundation • Visit us at ck12.org

f. 16 protons, 16 neutrons, 18 electrons
g. 17 protons, 18 neutrons, 18 electrons
h. 35 protons, 45 neutrons, 36 electrons

Q2.5.5 (∴ = therefore)

a. ion with 3+ charge and 2 electrons ∴ neutral atom had 5 electrons ∴ atom has 5 protons ∴ boron (B)
b. ion with 1− charge and 18 electrons ∴ neutral atom had 17 electrons ∴ atom has 17 protons ∴ chlorine (Cl)
c. ion with 1+ charge and 18 electrons ∴ neutral atom had 19 electrons ∴ atom has 19 protons ∴ potassium (K)
d. ion with a 3− charge and 10 electrons ∴ neutral atom had 7 electrons ∴ atom has 7 protons ∴ nitrogen (N)

Q2.5.6

A polyatomic ion contains multiple atoms working together as a group and has an overall charge.

Q2.5.7

a. polyatomic
b. monatomic
c. polyatomic
d. monatomic
e. monatomic
f. polyatomic

2.6: Ionic Compounds

Q2.6.1

carbon

Q2.6.2

Answers will vary. Most metals are in the first two columns of the periodic table or in the transition metal block.

Q2.6.3

Answers will vary. Nonmetallic elements are located in the upper right corner of the periodic table (examples include nitrogen, oxygen, phosphorus, chlorine, bromine, etc)

Q2.6.4

Ionic compounds are composed of ions of metals and nonmetals. Ionic compounds can also include a polyatomic ion.

Q2.6.5

To form an ionic bond, electrons are transferred from the metal to the nonmetal.

Q2.6.6

Zero

Q2.6.7

What is the formula for the ionic compound formed from each of the following pairs?

a. K_2S
b. AgCl
c. CaO
d. AlI_3
e. Ba_3N_2
f. Na_3P
g. LiF
h. Mg_3N_2
i. CaS
j. $BeBr_2$
k. Zn_3N_2

l. SnI_4

Q2.6.8

a. Na_2CO_3
b. $NaClO_3$
c. $NaClO_2$
d. Na_3PO_4
e. $NaNO_3$
f. Na_2SO_4
g. Na_2CrO_4
h. $Na_2Cr_2O_7$

Q2.6.9

a. $MgCO_3$
b. $Mg(ClO_3)_2$
c. $Mg(ClO_2)_2$
d. $Mg_3(PO_4)_2$
e. $Mg(NO_3)_2$
f. $MgSO_4$
g. $MgCrO_4$
h. $MgCr_2O_7$

Q2.6.10

Parentheses are used when there is more than one of a polyatomic ion in the formula of an ionic compound.

This page titled 2.7: Elements and Ions (Exercises) is shared under a CK-12 license and was authored, remixed, and/or curated by CK-12 Foundation via source content that was edited to the style and standards of the LibreTexts platform.