

Practice Problems

1) Find the number of protons, neutrons and electrons in the following:

Element	Protons	Neutrons	electrons
Copper	29	35	29
zinc	30	35	30
Carbon-12	6	6	6
Carbon-14	6	8	6
Sodium	11	12	11
Phosphorus	15	16	15
calcium	20	20	20
silver	47	61	47
tungsten	74	110	74
mercury	80	121	80

2) What is average atomic mass of Lithium if 7.42% exists as ${}^6\text{Li}$ (6.015 g/mol) and 92.58% exists as ${}^7\text{Li}$ (7.016 g/mol)?

$$\begin{aligned} \text{Avg. atomic mass} &= (0.0742 \times 6.015 \text{ g/mol}) + (0.9258 \times 7.016 \text{ g/mol}) \\ &= \boxed{6.94 \text{ amu}} \quad (\text{changed g/mol to amu since the problem deals with atomic mass of an atom}) \end{aligned}$$

3. Neon has two major isotopes, Neon-20 and Neon-22. Out of every 250 neon atoms, 225 will be Neon-20 (19.992 g/mol), and 25 will be Neon-22 (21.991 g/mol). What is the average atomic mass of Neon?

$$\begin{aligned} \text{Avg. At. mass} &= (0.90 \times 19.992 \text{ g/mol}) + (0.10 \times 21.991 \text{ g/mol}) \\ &= \boxed{20.19 \text{ amu}} \end{aligned} \quad \begin{aligned} \frac{225}{250} &= 0.90 \\ \frac{25}{250} &= 0.10 \end{aligned}$$

4. What is the atomic mass of Hafnium if out of every 200 atoms, 10 have mass 176.00 g/mol, 38 have mass 177.00 g/mol, 54 have mass 178.00 g/mol, 28 have mass 179.00 g/mol, and 70 have mass 180.00 g/mol?

$$\begin{aligned} \text{Avg. Atomic Mass} &= (0.05 \times 176.00 \text{ amu}) + (0.19 \times 177.00 \text{ amu}) + (0.27 \times 178.00 \text{ amu}) + \\ &\quad (0.14 \times 179.00 \text{ amu}) + (0.35 \times 180.00 \text{ amu}) \\ &= \boxed{178.49 \text{ amu}} \end{aligned}$$

5. In a sample of 200 Chlorine atoms, it is found that 151 are ^{35}Cl (34.969 g/mol), and 49 are ^{37}Cl (36.966 g/mol). What is the average atomic mass of Chlorine?

$$\text{Avg Atomic Mass} = (0.755 \times 34.969 \text{ amu}) + (0.245 \times 36.966 \text{ g/mol})$$

ii = 35.46 amu

2. ~~2~~ Without doing any math, are there more Bromine-79 atoms or more Bromine-80 atoms on earth? Explain your reasoning.

Br-80. The average atomic mass of bromine is 79.90 which is closer to 80. This means that the most common isotope of Bromine has a mass number of 80.

3. ~~3~~ Find the molar mass of the following substances:

Cu_2SO_4 223.16 g/mol

$\text{C}_{20}\text{H}_{30}\text{O}_2$ 302.45 g/mol

HNO_3 63.01 g/mol

$\text{C}_5\text{H}_{10}\text{O}_5$ 150.13 g/mol

$\text{HC}_2\text{H}_3\text{O}_2$ 60.05 g/mol

Na 22.99 g/mol

NaCl 58.44 g/mol

4. 8. Name or write the formula of the following:

potassium nitrate KNO_3

Ammonium phosphate $(NH_4)_3PO_4$

sodium phosphate Na_3PO_4

chromium (IV) chloride $CrCl_4$

ammonium phosphide $(NH_4)_3P$

zinc sulfate $ZnSO_4$

aluminum oxide Al_2O_3

diphosphorus pentoxide P_2O_5

$LiClO_2$ Lithium chlorite

NO_2 nitrogen dioxide

~~$NaMnO_4$~~ $NaMnO_4$ sodium permanganate CO Carbon monoxide

Copper (II) oxide CuO

Xenon tetrafluoride XeF_4

Fe_2O_3 Iron (III) oxide

5. 9. How many atoms are in 208 grams of lead? How many atoms are in 12 grams of carbon? How many molecules are in 16 grams of methane (CH_4)? Explain the relationship between these numbers.

all of them are 6.02×10^{23} particles. They are all one mole of each substance

6. 10. Do the following conversions: (Don't forget sig figs!)

a) 36.5 grams of calcium to moles

$$36.5 \text{ g Ca} \times \frac{1 \text{ mol Ca}}{40.08 \text{ g Ca}} = \boxed{0.911 \text{ moles Ca}}$$

b) 0.598 g of iron to moles

$$0.598 \text{ g Fe} \times \frac{1 \text{ mol Fe}}{55.85 \text{ g Fe}} = \boxed{0.0107 \text{ mol Fe}}$$

c) 1.37×10^3 g of Cu to moles

$$1.37 \times 10^3 \text{ g Cu} \times \frac{1 \text{ mol Cu}}{63.55 \text{ g Cu}} = \boxed{21.6 \text{ mol Cu}}$$

7. ~~10~~. A substance contains 26.57% potassium, 35.36% chromium, and 38.07% oxygen. What is the empirical and molecular formula if its molar mass is 294.19 g/mol? What is the name of the compound?

$$\begin{aligned}
 26.57 \text{ g K} &\times \frac{1 \text{ mol K}}{39.10 \text{ g K}} = \frac{0.6795 \text{ mol K}}{0.6795} = 1.00 \times 2 = 2 \\
 35.36 \text{ g Cr} &\times \frac{1 \text{ mol Cr}}{52.00 \text{ g Cr}} = \frac{0.6800 \text{ mol Cr}}{0.6795} \approx 1 \times 2 = 2 \\
 38.07 \text{ g O} &\times \frac{1 \text{ mol O}}{16 \text{ g O}} = \frac{2.379 \text{ mol O}}{0.6795} = 3.50 \times 2 = 7
 \end{aligned}$$

Name is potassium dichromate

$$\frac{294.19 \text{ g/mol}}{294.19 \text{ g/mol}} = 1 \rightarrow \text{K}_2\text{Cr}_2\text{O}_7$$

8. ~~11~~. The compound propylene glycol is used in commercial antifreeze. What is the empirical and molecular formula if the percent composition is 47.37% carbon, 10.59% hydrogen and 42.04% oxygen and its molar mass is 76.09 g/mol?

$$\begin{aligned}
 47.37 \text{ g C} &\times \frac{1 \text{ mol C}}{12.01 \text{ g C}} = \frac{3.944 \text{ mol C}}{2.628} = 1.520 \times 2 \approx 3 \\
 10.59 \text{ g H} &\times \frac{1 \text{ mol H}}{1.01 \text{ g H}} = \frac{10.49 \text{ mol H}}{2.628} = 3.992 \times 2 \approx 8 \\
 42.04 \text{ g O} &\times \frac{1 \text{ mol O}}{16.00 \text{ g O}} = \frac{2.628 \text{ mol O}}{2.628} = 1.000 \times 2 \approx 2
 \end{aligned}$$

$$\frac{76.09}{76.11} \approx 1 \rightarrow \text{molecular formula also } \text{C}_3\text{H}_8\text{O}_2$$

9. ~~12~~. An acid is 2.04% hydrogen, 32.65% sulfur, and 65.31% oxygen. Find the empirical and molecular formula and name the acid. The molar mass is 98.08 g/mol.

$$\begin{aligned}
 2.04 \text{ g H} &\times \frac{1 \text{ mol H}}{1.01 \text{ g H}} = \frac{2.02 \text{ mol H}}{1.018} = 2 \\
 32.65 \text{ g S} &\times \frac{1 \text{ mol S}}{32.06 \text{ g S}} = \frac{1.018 \text{ mol S}}{1.018} \approx 1 \\
 65.31 \text{ g O} &\times \frac{1 \text{ mol O}}{16.00 \text{ g O}} = \frac{4.082 \text{ mol O}}{1.018} \approx 4
 \end{aligned}$$

emp + molecular formula
 $\text{H}_2\text{SO}_4 \rightarrow$ sulfuric acid