

Chemistry 130
Practice on "Finding Moles"

When you **FIND MOLES**, IT IS VERY IMPORTANT YOU LABEL YOUR MOL UNIT! That is, if you find moles of Na, your unit should be "mol Na," not just "mol."

ANOTHER NOTE: when you take molar masses off the periodic table, 2 places after the decimal is usually fine.

Examples:

$$0.752 \text{ g of Fe} \rightarrow \frac{0.752 \text{ g}}{55.85 \text{ g/mol}} = 0.0135 \text{ mol Fe}$$

$$2.3 \times 10^{19} \text{ He atoms} \rightarrow \frac{2.3 \times 10^{19} \text{ He atoms}}{6.022 \times 10^{23} \text{ atom/mol}} = 3.8 \times 10^{-5} \text{ mol He}$$

LABEL YOUR MOLE UNITS!

Now you try these:

1) What is the same about a mole and a dozen? What is the main difference between a mole and a dozen?

2) **FIND MOLES** for each of the following:

a) 77.2 g of Ir

b) 38,700 Ba atoms

c) 25 golf balls

d) 0.002300 g of B

e) 6.1 kg of Ti

f) 4.7×10^{25} atoms of Br

3) What mass of Ca is contained in 0.0752 moles of Ca?

4) What mass of $\text{Al}_2(\text{SO}_3)_3$ is contained in 0.0752 moles of $\text{Al}_2(\text{SO}_3)_3$?

5) How many Ca atoms are contained in 0.0752 moles of Ca?

Answers to Page 1

1) What is the same about a mole and a dozen? What is the main difference between a mole and a dozen?

A mole and a dozen are both words that mean a number; the main difference between a mole and a dozen is a dozen means 12, and a mole means 6.022×10^{23} .

2) FIND MOLES for each of the following:

a) 77.2 g of Ir

$$\frac{77.2 \text{ g Ir}}{192.2 \text{ g/mol}} = 0.402 \text{ mol Ir}$$

b) 38,700 Ba atoms

$$\frac{38700 \text{ Ba atom}}{6.022 \times 10^{23} \text{ atoms/mol}} = 6.43 \times 10^{-20} \text{ mol Ba}$$

c) 25 golf balls

$$\frac{25 \text{ golf balls}}{6.022 \times 10^{23} \text{ balls/mol}} = 4.151 \times 10^{-23} \text{ mol golf balls}$$

d) 0.002300 g of B

$$\frac{0.002300 \text{ g B}}{10.81 \text{ g/mol}} = 0.0002128 \text{ mol B}$$

e) 6.1 kg of Ti

$$\frac{6.1 \times 10^3 \text{ g Ti}}{47.90 \text{ g/mol}} = 130 \text{ mol Ti}$$

f) 4.7×10^{25} atoms of Br

$$\frac{4.7 \times 10^{25} \text{ Br atoms}}{6.022 \times 10^{23} \text{ atoms/mol}} = 78 \text{ mol Br}$$

3) What mass of Ca is contained in 0.0752 moles of Ca?

$$0.0752 \text{ mol Ca} \times \frac{40.08 \text{ g}}{\text{mol Ca}} = 3.01 \text{ g Ca}$$

4) What mass of $\text{Al}_2(\text{SO}_3)_3$ is contained in 0.0752 moles of $\text{Al}_2(\text{SO}_3)_3$?

For $\text{Al}_2(\text{SO}_3)_3 \rightarrow$ M.M. $\text{Al}_2(\text{SO}_3)_3 = 2 \text{ M.M. Al} + 3 \text{ M.M. S} + 9 \text{ M.M. O} = 2(26.98) + 3(32.06) + 9(16.00)$

$$= 294.14 \frac{\text{g}}{\text{mol}}$$

$$0.0752 \text{ mol Al}_2(\text{SO}_3)_3 \times \frac{294.14 \text{ g}}{\text{mol Al}_2(\text{SO}_3)_3} = 22.1 \text{ g Al}_2(\text{SO}_3)_3$$

5) How many Ca atoms are contained in 0.0752 moles of Ca?

$$0.0752 \text{ mol Ca} \times \frac{6.022 \times 10^{23} \text{ atoms}}{\text{mol Ca}} = 4.53 \times 10^{22} \text{ Ca atoms}$$

Practice on Using Moles

Show your work for each of the following. Answers are given for most of the questions so you know you are doing things correctly. The sig figs in the given answers are incorrect -- be sure your answers have the correct sig figs! Also, label your mole units when you show your work. **Note:** If you use a different periodic table than I did or you round intermediate calculations, you may not get exactly the answers I did; this is no problem if everything else is right.

- 1) How many atoms are contained in 3.782 g of Ca? (Ans: $5.682436128 \times 10^{22}$ Ca atoms)
- 2) What is the mass in g of 1 Ca atom? (Ans: $6.655596147 \times 10^{-23}$ g)
- 3) How many N_2O_5 molecules are contained in 10.0 g of N_2O_5 ? (Ans: 5.5748936×10^{22} molecules)
- 4) What mass of N_2O_5 contains 250,000 O atoms? (Ans: 8.96878×10^{-18} g)
- 5) What mass of $(\text{NH}_4)_2\text{SO}_4$ contains 25.0 g of ammonium? (Ans: 91.5235457 g)
- 6) What mass of $(\text{NH}_4)_2\text{SO}_4$ contains 3.7×10^{12} NH_4^+ ions? (Ans: $4.0600465 \times 10^{-10}$ g)
- 7) How many hydrogen atoms are in a sample of $(\text{NH}_4)_2\text{SO}_4$ that contains 0.0065 g of oxygen?
(Ans: 4.892875×10^{20} H atoms)
- 8) What mass of oxygen is contained in a sample of $(\text{NH}_4)_2\text{SO}_4$ that contains 28.0 g of sulfur?
(Ans: 55.8952 g)
- 8) A sample of pure H_2O contains 3.35×10^{24} hydrogen atoms.
 - a) How many H_2O molecules are in the sample? (Ans: 1.675×10^{24} molecules)
 - b) What is the mass of the sample? (Ans: 50.1220525 g)
- 9) How many atoms total (Cl and S) are there in a sample of Cl_2S_7 that contains 25.0 g of sulfur?
(Hint: there are 9 atoms total in each Cl_2S_7 molecule) (Ans: 6.0375635×10^{23} atoms)
- 10) What is the weight percent of nitrogen in N_2O_5 ?
- 11) What is the weight percent of ammonium in $(\text{NH}_4)_2\text{SO}_4$?

Answers

- 1) How many atoms are contained in 3.782 g of Ca?
$$\frac{3.782 \text{ g Ca}}{40.08 \text{ g/mol}} = 0.09436 \text{ mol Ca} \times \frac{6.022 \times 10^{23} \text{ atoms}}{\text{mol Ca}} = 5.682 \times 10^{22} \text{ Ca atoms}$$
- 2) What is the mass in g of 1 Ca atom?
$$\frac{1 \text{ Ca atom}}{6.022 \times 10^{23} \text{ atoms/mol}} = 1.6606 \times 10^{-24} \text{ mol Ca} \times \frac{40.08 \text{ g}}{\text{mol Ca}} = 6.656 \times 10^{-23} \text{ g Ca}$$
- 3) How many N_2O_5 molecules are contained in 10.0 g of N_2O_5 ?
$$\frac{10.0 \text{ g N}_2\text{O}_5}{108.02 \text{ g/mol}} = 0.0926 \text{ mol N}_2\text{O}_5 \times \frac{6.022 \times 10^{23} \text{ molecules}}{\text{mol N}_2\text{O}_5} = 5.57 \times 10^{22} \text{ N}_2\text{O}_5 \text{ molecules}$$
- 4) What mass of N_2O_5 contains 250,000 O atoms?

$$\frac{250,000 \text{ O atoms}}{6.022 \times 10^{23} \text{ atoms/mol}} = 4.2 \times 10^{-19} \text{ mol O} \times \frac{1 \text{ mol N}_2\text{O}_5}{5 \text{ mol O}} \times \frac{108.02 \text{ g}}{\text{mol N}_2\text{O}_5} = 9.0 \times 10^{-18} \text{ g}$$

- 5) What mass of $(\text{NH}_4)_2\text{SO}_4$ contains 25.0 g of ammonium?

$$\frac{25.0 \text{ g NH}_4^+}{18.05 \text{ g/mol}} = 1.385 \text{ mol NH}_4^+ \times \frac{1 \text{ mol } (\text{NH}_4)_2\text{SO}_4}{2 \text{ mol NH}_4^+} \times \frac{132.16 \text{ g}}{\text{mol } (\text{NH}_4)_2\text{SO}_4} = 91.5 \text{ g } (\text{NH}_4)_2\text{SO}_4$$

Note: divide by the molar mass of ammonium (NH_4^+), because its mass is given in the problem.

- 6) What mass of $(\text{NH}_4)_2\text{SO}_4$ contains 3.7×10^{12} NH_4^+ ions?

$$\frac{3.7 \times 10^{12} \text{ NH}_4^+ \text{ ions}}{6.022 \times 10^{23} \text{ ions/mol}} = 6.1 \times 10^{-12} \text{ mol NH}_4^+ \times \frac{1 \text{ mol } (\text{NH}_4)_2\text{SO}_4}{2 \text{ mol NH}_4^+} \times \frac{132.16 \text{ g}}{\text{mol } (\text{NH}_4)_2\text{SO}_4} = 4.1 \times 10^{-10} \text{ g}$$

- 7) How many hydrogen atoms are in a sample of $(\text{NH}_4)_2\text{SO}_4$ that contains 0.0065 g of oxygen?

$$\frac{0.0065 \text{ g O}}{16.00 \text{ g/mol}} = 4.0625 \times 10^{-4} \text{ mol O} \times \frac{8 \text{ mol H}}{4 \text{ mol O}} \times \frac{6.022 \times 10^{23} \text{ H atoms}}{\text{mol H}} = 4.9 \times 10^{20} \text{ H atoms}$$

- 8) What mass of oxygen is contained in a sample of $(\text{NH}_4)_2\text{SO}_4$ that contains 28.0 g of sulfur?

(Ans: 55.8952 g)

$$\frac{28.0 \text{ g S}}{32.06 \text{ g/mol}} = 0.873 \text{ mol S} \times \frac{4 \text{ mol O}}{1 \text{ mol S}} \times \frac{16.00 \text{ g}}{\text{mol O}} = 55.9 \text{ g O}$$

- 8) A sample of pure H_2O contains 3.35×10^{24} hydrogen atoms.

- a) How many H_2O molecules are in the sample?

$$\frac{3.35 \times 10^{24} \text{ H atoms}}{6.022 \times 10^{23} \text{ H atoms/mol}} = 5.563 \text{ mol H} \times \frac{1 \text{ mol H}_2\text{O}}{2 \text{ mol H}} \times \frac{6.022 \times 10^{23} \text{ H}_2\text{O molec.}}{\text{mol H}_2\text{O}} = 1.68 \times 10^{24} \text{ molecules}$$

- b) What is the mass of the sample?

$$\frac{3.35 \times 10^{24} \text{ H atoms}}{6.022 \times 10^{23} \text{ H atoms/mol}} = 5.563 \text{ mol H} \times \frac{1 \text{ mol H}_2\text{O}}{2 \text{ mol H}} \times \frac{18.02 \text{ g}}{\text{mol H}_2\text{O}} = 50.1 \text{ g H}_2\text{O}$$

- 9) How many atoms total (Cl and S) are there in a sample of Cl_2S_7 that contains 25.0 g of sulfur?

(Hint: there are 9 atoms total in each Cl_2S_7 molecule)

$$\frac{25.0 \text{ g S}}{32.06 \text{ g/mol}} = 0.780 \text{ mol S} \times \frac{9 \text{ mol Cl and S}}{7 \text{ mol S}} \times \frac{6.022 \times 10^{23} \text{ Cl and S atoms}}{\text{mol Cl and S atoms}} = 6.04 \times 10^{23} \text{ atoms}$$

- 10) What is the weight percent of nitrogen in N_2O_5 ?

$$\frac{2(14.01)}{108.02} \times 100 = 25.94 \% \text{ N by mass}$$

- 11) What is the weight percent of ammonium in $(\text{NH}_4)_2\text{SO}_4$?

The molar mass of the NH_4 unit is $14.01 + 4(1.01) = 18.05 \text{ g/mol}$

$$\text{Therefore we have } \frac{2(18.05)}{132.16} \times 100 = 27.32 \% \text{ ammonium by mass}$$