KEY

Mole Conversions

1.) How many atoms are contained in 1 molecule of each of the following?

a.) CH_3CO_2H 8

b.) NH_4Cl 6

c.) $(CH_3)_2CO$ 10

d.) $(NH_4)_2SO_4$ 15

e.) $C_{15}H_{22}O_6N_2S$ 46

f.) $Ni(H_2O)_4(NH_3)_2Cl_2$ 23

2.) Find the mass, in grams, of each of the following.

a.) $2 \times 10^6\ CO\ molecules$

$$2 \times 10^6\ molec \times \frac{1\ mol}{6.022 \times 10^{23}\ molec} \times \frac{28.01\ g\ CO}{1\ mol} = 9 \times 10^{-17}\ g\ CO$$

b.) $1.25\ L$ of NH_3 (g) at STP

$$1.25\ NH_3\ L \times \frac{1\ mol}{22.41\ L} \times \frac{17.04\ g\ NH_3}{1\ mol} = 0.950\ g\ NH_3$$

c.) $5 \times 10^{14}\ N_2\ molecules$

$$5 \times 10^{14}\ N_2\ molec \times \frac{1\ mol}{6.022 \times 10^{23} molec} \times \frac{28.02\ g\ N_2}{1\ mol} = 2 \times 10^{-8}\ g\ N_2$$

d.) $1\ KOH\ molecule$

$$1\ KOH\ molec \times \frac{1\ mol}{6.022 \times 10^{23} molec} \times \frac{56.11 g\ KOH}{1\ mol} = 9.318 \times 10^{-23}\ g\ KOH$$

e.) $125\ He\ atoms$

$$125\ He\ atom \times \frac{1\ mol}{6.022 \times 10^{23} atom} \times \frac{4.00\ g\ He}{1\ mol} = 8.31 \times 10^{-22}\ g\ He$$

f.) $1\ Ag\ atom$

$$1\ Ag\ atom \times \frac{1\ mol}{6.022 \times 10^{23} atom} \times \frac{107.87\ g\ Ag}{1\ mol} = 1.791 \times 10^{-22}\ g\ Ag$$

g.) $4.15 \times 10^{15}\ CH_4\ molecules$

$$4.15 \times 10^{15}\ molec \times \frac{1\ mol}{6.022 \times 10^{23} molec} \times \frac{16.04\ g\ CH_4}{1\ mol} = 1.11 \times 10^{-7}\ g\ CH_4$$

h.) $175\ N\ atoms$

$$175\ atom \times \frac{1\ mol}{6.022 \times 10^{23} atom} \times \frac{14.01\ g\ N}{1\ mol} = 4.07 \times 10^{-21}\ g\ N$$

i.) $3.45\ mL$ of O_2 (g) at STP

$$0.00345\ O_2\ L \times \frac{1\ mol}{22.41\ L} \times \frac{32.00\ g\ O_2}{1\ mol} = 0.00493\ g\ O_2$$

j.) $1.00 \times 10^8\ L$ of H_2 (g) at STP

$$1.00 \times 10^8\ L \times \frac{1\ mol}{22.41\ L} \times \frac{2.02\ g\ H_2}{1\ mol} = 9.01 \times 10^6\ g\ H_2$$

3.) How many atoms are contained in each of the following?

a.) $1.00\ mol$ of NH_4Cl

$$1.00\ mol\ NH_4Cl \times \frac{6.022 \times 10^{23} molec}{1\ mol} \times \frac{6\ atoms}{1\ molec} = 3.61 \times 10^{24}\ atoms\ NH_4Cl$$

b.) $2.5\ mol\ O_2$ (g)

$$2.5\ mol\ O_2 \times \frac{6.022 \times 10^{23} molec}{1\ mol} \times \frac{2\ atoms}{1\ molec} = 3.0 \times 10^{24}\ atoms\ O_2$$

c.) $8.00\ g$ of Fe

$$8.00\ g\ Fe \times \frac{1\ mol}{55.85\ g\ Fe} \times \frac{6.022 \times 10^{23} atoms}{1\ mol} = 8.63 \times 10^{22}\ atoms\ Fe$$

d.) $15.0\ L$ of Ag (g) at STP

$$15.0\ L\ Ag \times \frac{1 mol}{22.41\ L} \times \frac{6.022 \times 10^{23} atoms}{1\ mol} = 4.03 \times 10^{23}\ atoms\ Ag$$

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e.) 12 g of H_2O_2

$$12\ g\ H_2O_2 \times \frac{1\ mol}{34.02\ g\ H_2O_2} \times \frac{6.022 \times 10^{23} molec}{1\ mol} \times \frac{4\ atoms}{1\ molec}$$
$$= 8.5 \times 10^{23}\ atoms\ H_2O_2$$

f.) 55.0 mL of N_2O (g) at STP

$$0.055\ L\ N_2O \times \frac{1\ mol}{22.41\ L\ N_2O} \times \frac{6.022 \times 10^{23} molec}{1\ mol} \times \frac{3\ atoms}{1\ molec}$$
$$= 4.43 \times 10^{21}\ atoms\ N_2O$$

i.) 125 g of CH_3Cl

$$125\ g\ CH_3Cl \times \frac{1\ mol}{50.49\ g\ CH_3Cl} \times \frac{6.022 \times 10^{23}\ molec}{1\ mol} \times \frac{5\ atoms}{1\ molec}$$
$$= 7.45 \times 10^{24}\ atoms\ CH_3Cl$$

j.) 8.30 $\times 10^{-4}$ mL of BF_3 (g) at STP

$$8.30 \times 10^{-7}\ L\ BF_3 \times \frac{1\ mol}{22.41\ L\ BF_3} \times \frac{6.022 \times 10^{23}\ molec}{1\ mol} \times \frac{4\ atoms}{1\ molec}$$
$$= 8.92 \times 10^{16}\ atoms\ BF_3$$

g.) 40.0 g of K

$$40.0\ g\ K \times \frac{1\ mol}{39.10\ g\ K} \times \frac{6.022 \times 10^{23} atoms}{1\ mol} = 6.16 \times 10^{23}\ atoms\ K$$

h.) 5.0 g of NaCl

$$5.0\ g\ NaCl \times \frac{1\ mol}{58.44\ g\ NaCl} \times \frac{6.022 \times 10^{23} molec}{1\ mol} \times \frac{2\ atoms}{1\ molec}$$
$$= 1.0 \times 10^{23}\ atoms\ NaCl$$

k.) 6.5 $\times 10^{-6}$ g of Kr

$$6.5 \times 10^{-6} g\ Kr \times \frac{1\ mol}{83.80\ g\ Kr} \times \frac{6.022 \times 10^{23}\ atoms}{1\ mol}$$
$$= 4.7 \times 10^{16}\ atoms\ Kr$$

l.) 9.5 $\times 10^{-3}$ g of NH_3

$$9.5 \times 10^{-3} g\ NH_3 \times \frac{1\ mol}{17.04\ g\ NH_3} \times \frac{6.022 \times 10^{23}\ molec}{1\ mol}$$
$$\times \frac{4\ atoms}{1\ molec} = 1.3 \times 10^{21}\ atoms\ NH_3$$

4.) What volume at STP is occupied by each of the following?

a.) 16.5 g of AsH_3 (g)

$$16.5\ g\ AsH_3 \times \frac{1\ mol}{77.95\ g\ AsH_3} \times \frac{22.41\ L}{1\ mol} = 4.74\ L\ AsH_3$$

b.) 5.65 $\times 10^{22}$ $molecules$ of POF_3 (g)

$$5.65 \times 10^{22}\ molec\ POF_3 \times \frac{1\ mol}{6.022 \times 10^{23}\ molec} \times \frac{22.41\ L}{1\ mol} = 2.10\ L\ POF_3$$

c.) 0.750 g of O_3 (g)

$$0.750\ g\ O_3 \times \frac{1\ mol}{48.00\ g\ O_3} \times \frac{22.41\ L}{1\ mol} = 0.350\ L\ O_3$$

d.) 9.04 $\times 10^{24}$ $atoms$ of He (g)

$$9.04 \times 10^{24} atoms\ He \times \frac{1\ mol}{6.022 \times 10^{23} atoms} \times \frac{22.41\ L}{1\ mol} = 336\ L\ He$$

5.) What is the density of CO_2 (g) at STP?

$$d = \frac{g}{L} \qquad d = \frac{44.01\ g}{22.4\ L} \qquad d = 1.96\ g/L$$

e.) 8.65 $\times 10^{21}$ $molecules$ of SO_2 (g)

$$8.65 \times 10^{21} molec\ SO_2 \times \frac{1\ mol}{6.022 \times 10^{23} molec} \times \frac{22.41\ L}{1\ mol} = 0.322\ L\ SO_2$$

f.) 6.98 $\times 10^{15}$ $atoms$ of Xe (g)

$$6.98 \times 10^{15}\ atoms\ Xe \times \frac{1\ mol}{6.022 \times 10^{23}\ atoms} \times \frac{22.41\ L}{1\ mol}$$
$$= 2.60 \times 10^{-7}\ L\ Xe$$

g.) 28.4 mg of H_2Te (g)

$$0.0284\ g\ H_2Te \times \frac{1\ mol}{129.62\ g\ H_2Te} \times \frac{22.41\ L}{1\ mol} = 4.91 \times 10^{-3}\ L\ H_2Te$$

h.) 3.25 kg of C_2H_6 (g)

$$3250\ g\ C_2H_6 \times \frac{1\ mol}{30.08\ g\ C_2H_6} \times \frac{22.41\ L}{1\ mol} = 2.42 \times 10^3\ L\ C_2H_6$$

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6.) How many atoms of Nitrogen are there in $30.0\ g$ of NH_4NO_3?

$$30.0\ g\ NH_4NO_3 \times \frac{1\ mol}{80.06\ g\ NH_4NO_3} \times \frac{6.022 \times 10^{23} molec}{1\ mol} \times \frac{2\ atoms}{1\ molec} = 4.51 \times 10^{23}\ atoms\ N$$