

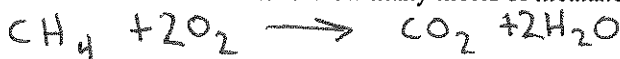
Chapter 10 Problems: Stoichiometry

- molar mass 1. An environmental chemist wants to get rid of a 254.3 gram sample of the illegal pesticide DDT, $\text{CCl}_3\text{CH}(\text{C}_6\text{H}_4\text{Cl})_2$. How many moles of DDT does the chemist have to dispose of?

355 g/mol DDT

$$254.3 \text{ g DDT} \left| \frac{1 \text{ mol DDT}}{355 \text{ g DDT}} \right. = \boxed{0.716 \text{ mol DDT}}$$

- mole \rightarrow mole 2. Methane and oxygen react to produce carbon dioxide and water. How many moles of methane are required to produce 16.6 moles of water?



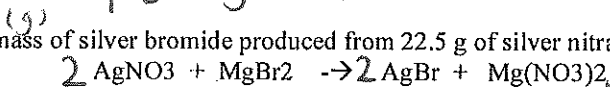
$$16.6 \text{ mol H}_2\text{O} \left| \frac{1 \text{ mol CH}_4}{2 \text{ mol H}_2\text{O}} \right. = \boxed{8.3 \text{ mol CH}_4}$$

- mass \rightarrow mole 3. In the process of photosynthesis plants convert carbon dioxide and water to glucose ($\text{C}_6\text{H}_{12}\text{O}_6$). How many moles of carbon dioxide are required to produce 5.1 grams of glucose?



$$5.1 \text{ g C}_6\text{H}_{12}\text{O}_6 \left| \frac{1 \text{ mol Glu}}{180 \text{ g Glu}} \right| \frac{6 \text{ mol CO}_2}{1 \text{ mol Glu}} = \boxed{0.170 \text{ mol CO}_2}$$

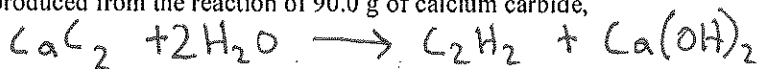
- mass \rightarrow mass 4. Calculate the mass of silver bromide produced from 22.5 g of silver nitrate in the following reaction:



$$22.5 \text{ g AgNO}_3 \left| \frac{1 \text{ mol AgNO}_3}{170 \text{ g AgNO}_3} \right| \frac{1 \text{ mol AgBr}}{1 \text{ mol AgNO}_3} \left| \frac{188 \text{ g AgBr}}{1 \text{ mol AgBr}} \right. = \boxed{24.9 \text{ g AgBr}}$$

- mass-moles 5. How many moles of acetylene, C_2H_2 will be produced from the reaction of 90.0 g of calcium carbide, CaC_2 , with water in the following reaction?

mass \rightarrow mole



$$90.0 \text{ g CaC}_2 \left| \frac{1 \text{ mol CaC}_2}{64 \text{ g CaC}_2} \right| \frac{1 \text{ mol C}_2\text{H}_2}{1 \text{ mol CaC}_2} = \boxed{1.4 \text{ mol C}_2\text{H}_2}$$

6. Chlorine gas can be produced in the laboratory by adding concentrated hydrochloric acid, HCl , to manganese(IV) oxide. The other products are water and manganese(II) chloride.

mass \rightarrow mass a. Calculate the mass of MnO_2 needed to produce 25.0 grams of chlorine gas?

mass \rightarrow mole b. How many moles of manganese chloride is produced when 0.091 g of chlorine gas is generated?



$$\text{a) } 25.0 \text{ g Cl}_2 \left| \frac{1 \text{ mol Cl}_2}{71 \text{ g Cl}_2} \right| \frac{1 \text{ mol MnO}_2}{1 \text{ mol Cl}_2} \left| \frac{87 \text{ g MnO}_2}{1 \text{ mol MnO}_2} \right. = \boxed{31 \text{ g MnO}_2}$$

$$\text{b) } 0.091 \text{ g Cl}_2 \left| \frac{1 \text{ mol Cl}_2}{71 \text{ g Cl}_2} \right| \frac{1 \text{ mol MnCl}_2}{1 \text{ mol Cl}_2} = \boxed{0.0013 \text{ mol MnCl}_2}$$

mass → mass 7. The reaction $N_2 + 3H_2 \rightarrow 2NH_3$ is used to produce ammonia commercially. If 1.4 g of N_2 is used in the reaction determine the mass of H_2 required as well as the mass of NH_3 produced?

$$1.4 \text{ g } N_2 \left| \frac{1 \text{ mol } N_2}{28 \text{ g } N_2} \right| \frac{3 \text{ mol } H_2}{1 \text{ mol } N_2} \left| \frac{2.02 \text{ g } H_2}{1 \text{ mol } H_2} \right| = 0.30 \text{ g } H_2$$

$$1.4 \text{ g } N_2 \left| \frac{1 \text{ mol } N_2}{28 \text{ g } N_2} \right| \frac{2 \text{ mol } NH_3}{1 \text{ mol } N_2} \left| \frac{17 \text{ g}}{1 \text{ mol } NH_3} \right| =$$

mass → mole
mass → mass

8. What mass and moles of sulfuric acid, H_2SO_4 , is required to react with 1.27 g of potassium hydroxide? The products of this reaction are potassium sulfate and water.



$$1.27 \text{ g } KOH \left| \frac{1 \text{ mol } KOH}{56.1 \text{ g } KOH} \right| \frac{1 \text{ mol } H_2SO_4}{2 \text{ mol } KOH} \left| \frac{98 \text{ g } H_2SO_4}{1 \text{ mol } H_2SO_4} \right| = 1.10 \text{ g } H_2SO_4$$

mass → mole

9. Joseph Priestley is credited with the discovery of oxygen. He produced O_2 by heating mercury(II) oxide to decompose into its elements. How many moles of oxygen gas could Priestley have produced if he had decomposed 517.84 g of mercury oxide?



$$517.84 \text{ g } HgO \left| \frac{1 \text{ mol } HgO}{217 \text{ g } HgO} \right| \frac{1 \text{ mol } O_2}{2 \text{ mol } HgO} = 1.19 \text{ mol } O_2$$

mole → mass

10. In the space shuttle, the carbon dioxide the crew exhales is removed from the air by a reaction within a canister of lithium hydroxide. On average, each astronaut exhales about 20.0 mol carbon dioxide daily. What mass of water will be produced when this amount reacts with $LiOH$? The other products of the reaction is lithium carbonate.



$$20.0 \text{ mol } CO_2 \left| \frac{1 \text{ mol } H_2O}{1 \text{ mol } CO_2} \right| \frac{18 \text{ g } H_2O}{1 \text{ mol } H_2O} = 360 \text{ g } H_2O$$

mass → mass

11. Ethanol, C_5H_5OH , is considered a clean fuel because it burns in oxygen and produces few trace pollutants. If 95.0 g H_2O are produced during the combustion of ethanol, how many grams of ethanol were present at the beginning of the reaction



$$95.0 \text{ g } H_2O \left| \frac{1 \text{ mol } H_2O}{18 \text{ g } H_2O} \right| \frac{1 \text{ mol } C_5H_5OH}{3 \text{ mol } H_2O} \left| \frac{82.1 \text{ g } C_5H_5OH}{1 \text{ mol } C_5H_5OH} \right| = 140 \text{ g } C_5H_5OH$$

mass → mass

12. Challenge Question: Rusting of iron occurs in the presence of moisture according to the following reaction $4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$. Suppose that 3.19% of a heap of steel scrap with a mass of 1650 kg rusts in a year. What mass will the heap have after one year of rusting?

$$.0319 \times 1650 \text{ kg} = 52.7 \text{ kg rust/yr.}$$

$$52.7 \text{ kg} = 52700 \text{ grams}$$

$$52700 \text{ g } Fe_2O_3 \left| \frac{1 \text{ mol } Fe_2O_3}{160 \text{ g } Fe_2O_3} \right| \frac{2 \text{ mole } Fe}{1 \text{ mole } Fe_2O_3} \left| \frac{55.9 \text{ g } Fe}{1 \text{ mol } Fe} \right| = 108000 \text{ g } Fe$$