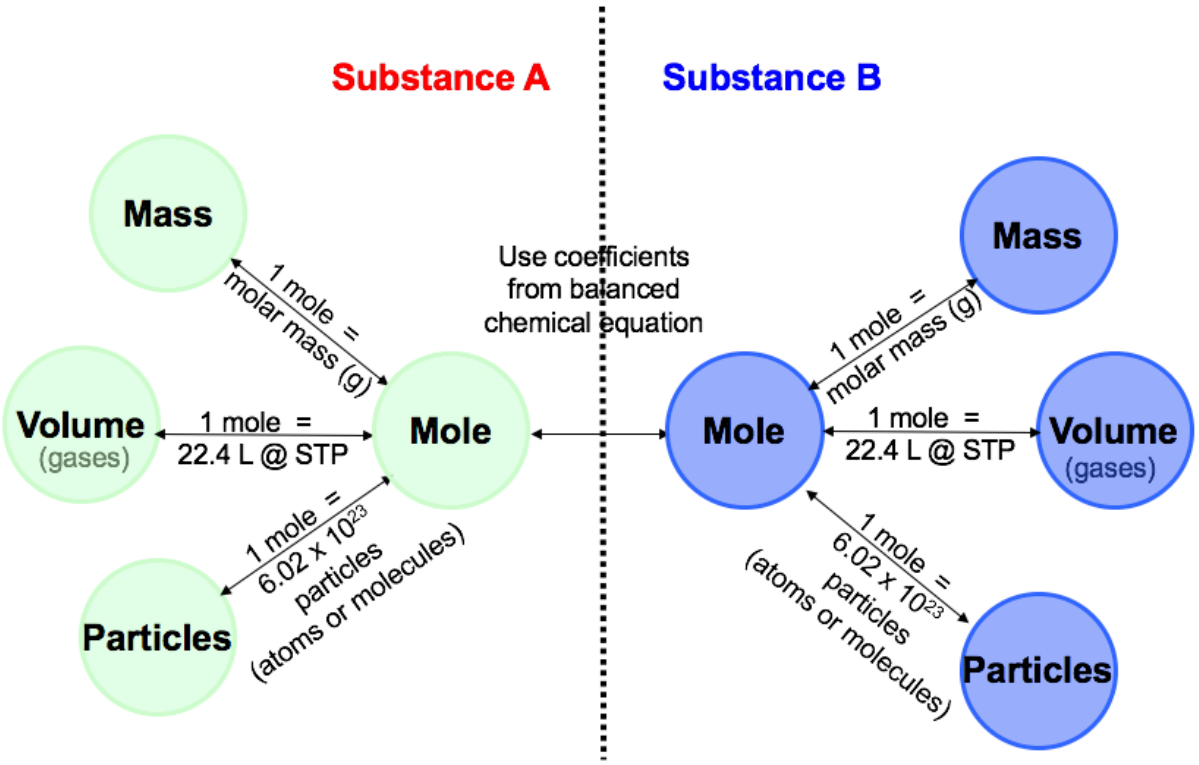
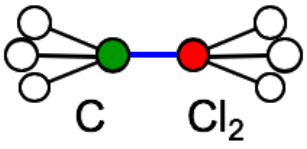
Mole Island Diagram



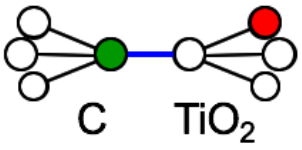
$$\_2\_\,TiO_2 + \_4\_\,Cl_2 + \_3\_\,C \longrightarrow \_2\_\,TiCl_4 + \_1\_\,CO_2 + \_2\_\,CO$$

1. How many mol chlorine will react with 4.55 mol carbon?



$$\frac{4.55 \text{ mol C} \mid 4 \text{ mol } Cl_2}{3 \text{ mol C}} = 6.07 \text{ mol } Cl_2$$

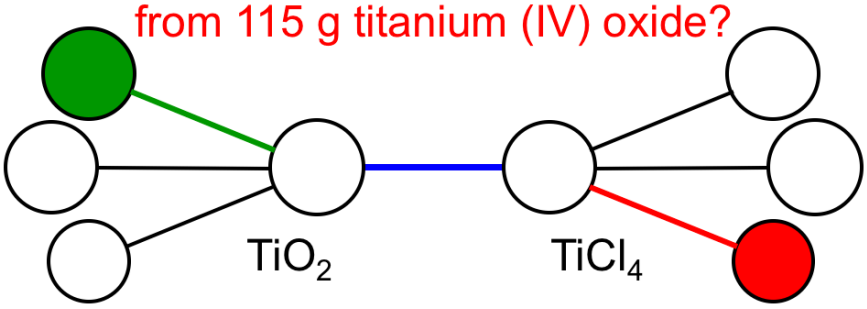
2. What mass titanium (IV) oxide will react with 4.55 mol carbon?



$$4.55 \text{ mol C} \left| \frac{2 \text{ mol } TiO_2}{3 \text{ mol C}} \right| \frac{79.9 \text{ g } TiO_2}{1 \text{ mol } TiO_2}$$

$$= \boxed{242 \text{ g } TiO_2}$$

3. How many molecules titanium (IV) chloride can be made from 115 g titanium (IV) oxide?

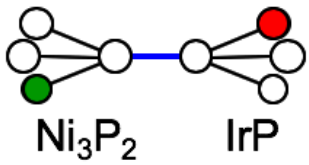


$$115 \text{ g } TiO_2 \left(\frac{1 \text{ mol } TiO_2}{79.9 \text{ g } TiO_2} \right) \left(\frac{2 \text{ mol } TiCl_4}{2 \text{ mol } TiO_2} \right) \left(\frac{6.02 \times 10^{23} \text{ m'c } TiCl_4}{1 \text{ mol } TiCl_4} \right)$$

$$= \boxed{8.66 \times 10^{23} \text{ m'c } TiCl_4}$$

$$2 \text{ Ir} + Ni_3P_2 \longrightarrow 3 \text{ Ni} + 2 \text{ IrP}$$

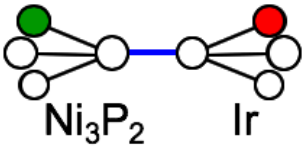
1. If 5.33×10^{28} m'cules nickel (II) phosphide react w/excess iridium, what mass iridium (III) phosphide is produced?



$$5.33 \times 10^{28} \text{ m'c } Ni_3P_2 \left| \frac{1 \text{ mol } Ni_3P_2}{6.02 \times 10^{23} \text{ m'c } Ni_3P_2} \right| \frac{2 \text{ mol IrP}}{1 \text{ mol } Ni_3P_2} \left| \frac{223.2 \text{ g IrP}}{1 \text{ mol IrP}} \right.$$

$$= \boxed{3.95 \times 10^{7} \text{ g IrP}}$$

2. How many grams iridium will react with 465 grams nickel (II) phosphide?

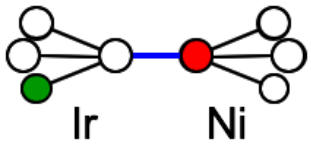


$$\frac{465\ \text{g}\ Ni_3P_2}{} \times \frac{1\ \text{mol}\ Ni_3P_2}{238.1\ \text{g}\ Ni_3P_2} \times \frac{2\ \text{mol Ir}}{1\ \text{mol}\ Ni_3P_2} \times \frac{192.2\ \text{g Ir}}{1\ \text{mol Ir}}$$

$$= \boxed{751\ \text{g Ir}}$$

$$2\ Ir + Ni_3P_2 \longrightarrow 3\ Ni + 2\ IrP$$

3. How many moles of nickel are produced if 8.7×10^{25} atoms of iridium are consumed?



$$\frac{8.7 \times 10^{25}\ \text{at. Ir}}{} \times \frac{1\ \text{mol Ir}}{6.02 \times 10^{23}\ \text{at. Ir}} \times \frac{3\ \text{mol Ni}}{2\ \text{mol Ir}}$$

$$= \boxed{220\ \text{mol Ni}}$$

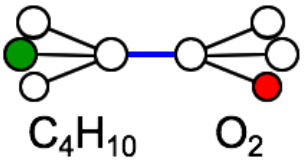
$$\underline{1}\ Zn + \underline{2}\ HCl \longrightarrow \underline{1}\ H_2 + \underline{1}\ ZnCl_2$$

50 g excess ? L

$$\frac{50\ \text{g Zn}}{} \times \frac{1\ \text{mol Zn}}{65.4\ \text{g Zn}} \times \frac{1\ \text{mol}\ H_2}{1\ \text{mol Zn}} \times \frac{22.4\ \text{L}\ H_2}{1\ \text{mol}\ H_2}$$

$$= \boxed{20\ \text{L}\ H_2}$$

5. At STP, how many m'cules oxygen react with 632 dm^3 butane (C_4H_{10})?



$$\underline{2}\ C_4H_{10} + \underline{13}\ O_2 \longrightarrow \underline{8}\ CO_2 + \underline{10}\ H_2O$$

$$\frac{632\ dm^3\ C_4H_{10}}{} \left| \frac{1\ mol\ C_4H_{10}}{22.4\ dm^3\ C_4H_{10}} \right| \frac{13\ mol\ O_2}{2\ mol\ C_4H_{10}} \left| \frac{6.02 \times 10^{23}\ m'c\ O_2}{1\ mol\ O_2} \right.$$

$$= \boxed{1.10 \times 10^{26}\ m'c\ O_2}$$

Suppose the question had been,"How many ATOMS of oxygen…"

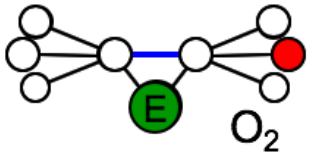
$$\frac{1.10 \times 10^{26}\ m'c\ O_2}{} \left| \frac{2\ atoms\ O}{1\ m'c\ O_2} \right. = \boxed{2.20 \times 10^{26}\ at.\ O}$$

$$CH_4(g) + 2\ O_2(g) \rightarrow CO_2(g) + 2\ H_2O(g) + 891\ kJ$$

$$\frac{54\ g\ CH_4}{} \left| \frac{1\ mol\ CH_4}{16.04\ g\ CH_4} \right| \frac{891\ kJ}{1\ mol\ CH_4} = \boxed{3.0 \times 10^3\ kJ}$$

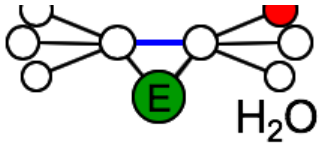
$$CH_4(g) + 2\,O_2(g) \rightarrow CO_2(g) + 2\,H_2O(g) + 891\ kJ$$

2. At STP, what volume oxygen is consumed in producing 5430 kJ of energy?



$$\frac{5430\ \cancel{kJ}}{} \left| \frac{2\ \cancel{mol\ O_2}}{891\ \cancel{kJ}} \right| \frac{22.4\ L\ O_2}{1\ \cancel{mol\ O_2}} = \boxed{273\ L\ O_2}$$

3. What mass of water is made if 10,540 kJ are released?



$$\frac{10{,}540\ \cancel{kJ}}{} \left| \frac{2\ \cancel{mol\ H_2O}}{891\ \cancel{kJ}} \right| \frac{18.02\ g\ H_2O}{1\ \cancel{mol\ H_2O}} = \boxed{426.2\ g\ H_2O}$$

Name: Key Date:

homework solutions

1. Consider the unbalance chemical reaction: $B_2H_6 + 3O_2 \rightarrow 2HBO_2 + 2H_2O$
   a. What mass of O_2 will be needed to burn 36.1 g of B_2H_6?

$$36.1\text{ g } B_2H_6 \times \frac{1\text{ mol}}{27.67\text{ g}} \times \frac{3\text{ mol } O_2}{1\text{ mol } B_2H_6} \times \frac{32\text{ g}}{1\text{ mol } O_2} = 125.6\text{ g}$$

   b. How many moles of water are produced from 19.2 g of B_2H_6?

$$19.2\text{ g } B_2H_6 \times \frac{1\text{ mol } B_2H_6}{27.67\text{ g}} \times \frac{2\text{ H}_2O}{1\text{ B}_2H_6} \times \frac{32\text{ g}}{1\text{ mol}} = 1.39\text{ moles}$$

2. Calculate the number of moles of carbon dioxide formed when 40 mol of oxygen is consumed in the burning of propane (C_3H_8). *Hint: You must complete and balance the equation first.*

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

$$40\text{ mol } O_2 \times \frac{3\text{ CO}_2}{5\text{ mol } O_2} = 24\text{ mol } CO_2$$

3. Consider the following reaction: $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
   a. Determine the volume of carbon dioxide that will be produced from 112.5 g of iron at STP

$$112.5\text{ g Fe} \times \frac{1\text{ mol Fe}}{55.8\text{ g Fe}} \times \frac{3\text{ CO}}{2\text{ Fe}} \times \frac{22.4\text{ L}}{1\text{ mol } CO_2} = 67.7\text{ L}$$

4. Given the following reaction, find the volume of sulfur dioxide gas that is produced from 25.36 ml of 0.966 M hydrochloric acid at STP.
   a. $Na_2SO_3 + 2HCl \rightarrow 2NaCl + SO_2 + H_2O$

$$SO_2 = .0245\text{ mol HCl} \times \frac{1\text{ SO}_2}{2\text{ HCl}} \times \frac{22.4\text{ L}}{1\text{ mol SO}_2}$$

$= 0.2744\text{ L}$

M C V

$V = ?$

$n = C \cdot V$

$n = .966 \times .025$

$n = .0245\text{ mol}$

Name:_____ Date:_____

5. Sodium hydroxide is used to neutralize sulfuric acid. If 19.52 mL of 0.285 M sulfuric acid was needed to titrate 42.81 mL of sodium hydroxide. Find the molarity of the sodium hydroxide. Hint: *You must first write out and balance the reaction*

$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

$n = C \cdot V$

$n = .285 \times .01952$

$= .0055632 \text{ mol}$

$.0055632 \text{ mol } H_2SO_4 \times \frac{2 \text{ mol } NaOH}{1 \text{ mol } H_2SO_4} = .0111264 \text{ mol } NaOH$

$C = \frac{n}{V}$

$C = \frac{.0111264 \text{ mol}}{.04281 \text{ L}}$

$= 0.260 M$