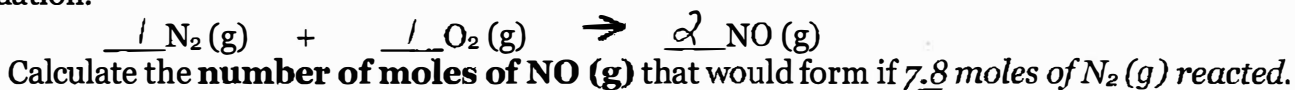


Stoichiometry

Assignment

Answer the following questions:

- 1) In the cylinder of a car nitrogen reacts with oxygen according to the following unbalanced equation.

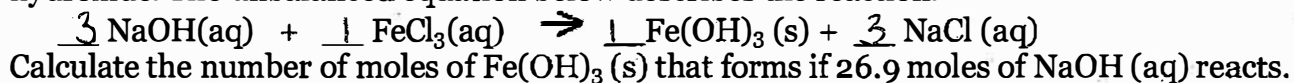


$$\begin{aligned} \text{NO} : \text{N}_2 \\ 2 : 1 \\ x : 7.8 \end{aligned}$$

$$7.8 \text{ mol N}_2 \times \frac{2 \text{ mol NO}}{1 \text{ mol N}_2} = 15.6 \text{ mol NO}$$

16 mol NO

- 2) An orange precipitate of iron(III) hydroxide is formed when iron(III) chloride reacts with sodium hydroxide. The unbalanced equation below describes the reaction.

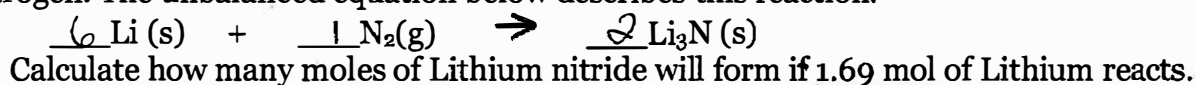


$$\begin{aligned} \text{Fe}(\text{OH})_3 : \text{NaOH} \\ 1 : 3 \\ x : 26.9 \text{ mol} \end{aligned}$$

$$26.9 \text{ mol NaOH} \times \frac{1 \text{ mol Fe}(\text{OH})_3}{3 \text{ mol NaOH}} = 8.96 \text{ mol}$$

8.97 mol Fe(OH)₃

- 3) A black solid of Lithium nitride forms when Lithium is (exposed to the air) and combines with nitrogen. The unbalanced equation below describes this reaction.



$$\begin{aligned} \text{Li}_3\text{N} : \text{Li} \\ 2 : 6 \\ x : 1.69 \text{ mol} \end{aligned}$$

$$1.69 \text{ mol Li} \times \frac{2 \text{ mol Li}_3\text{N}}{6 \text{ mol Li}} = 0.563 \text{ mol}$$

0.563 mol Li₃N

- 4) Carbon in the form of charcoal in briquettes is unsafe to burn indoor due to the production of carbon monoxide. Write a balanced chemical reaction for the burning of carbon in oxygen to form carbon monoxide. Predict how many moles of carbon monoxide would be produced by the burning of a 420 moles of carbon (charcoal briquettes, approximately 5 Kg).



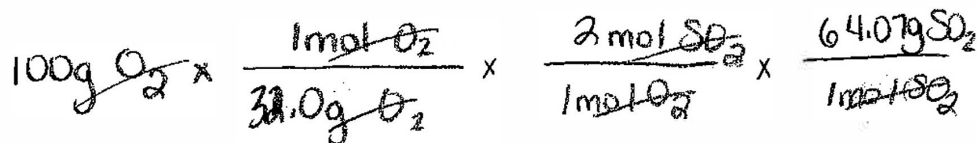
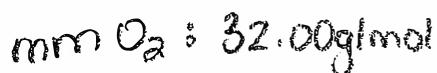
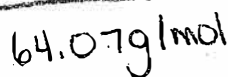
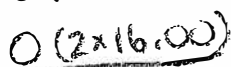
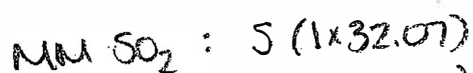
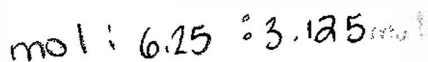
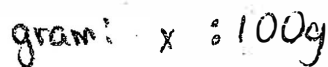
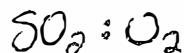
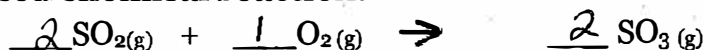
$$\begin{aligned} \text{CO} : \text{C} \\ 2 : 2 \\ 420 : 420 \end{aligned}$$

$$420 \text{ mol C} \times \frac{2 \text{ mol CO}}{2 \text{ mol C}} = 420 \text{ mol CO}$$

1.6

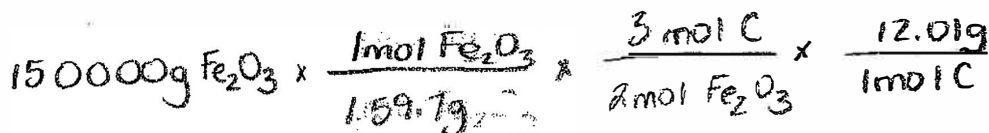
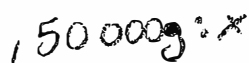
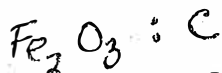
17 Stoichiometry

- 5) Sulfur dioxide may be catalytically oxidized to sulfur trioxide. How many grams of sulfur dioxide could be converted by this process if 100.0 grams of oxygen are available for the oxidation by the following **unbalanced chemical reaction**?

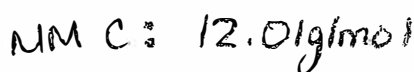
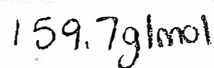
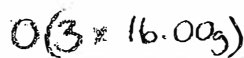


$$400.4\text{g SO}_2$$

- 6) Ferric oxide (Iron (III) oxide) may be reduced to pure iron with coke (pure carbon). If we have 150 Kg of Iron (III) oxide how much coke would be needed to completely convert it to iron by the following **unbalanced equation**. (in g)



$$= 16907.2\text{g}$$

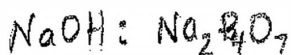


$$17\text{Kg}$$

$$1.69 \times 10^4\text{g}$$

Stoichiometry

- 7) Sodium tetraborate is produced by combining boric acid with sodium hydroxide, according to the following unbalanced chemical reaction. How many grams of NaOH would we need to produce 5.00 grams of sodium tetraborate?

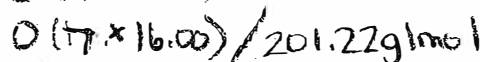
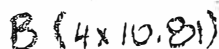
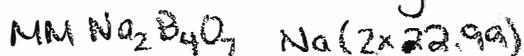
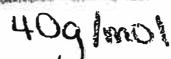
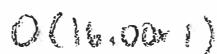
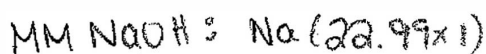


$$2 : 1$$

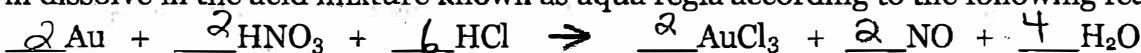
$$x : 5.00\text{g}$$

$$5.00\text{g NaOH} \times \frac{1\text{mol Na}_2\text{B}_4\text{O}_7}{201.22\text{g}} \times \frac{2\text{mol NaOH}}{1\text{mol Na}_2\text{B}_4\text{O}_7} \times \frac{40\text{g}}{1\text{mol NaOH}}$$

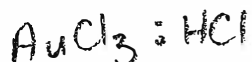
$$= 1.99\text{g NaOH}$$



- 8) Gold will dissolve in the acid mixture known as aqua regia according to the following reaction.

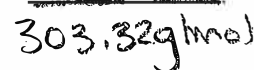
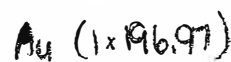
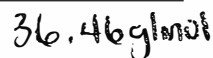
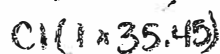
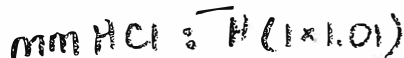


How much gold (III) chloride would be produced if 250 grams of HCl is consumed in the reaction?



$$2 : 6$$

$$x : 250\text{g}$$



$$250\text{g HCl} \times \frac{2\text{mol HCl}}{36.46\text{g}} \times \frac{2\text{mol AuCl}_3}{6\text{mol HCl}} \times \frac{303.32\text{g}}{1\text{mol AuCl}_3} = 693.27\text{g AuCl}_3$$

$$= 690\text{g AuCl}_3$$

1.7 Stoichiometry

- 9) How many grams of ammonia will be evolved when 34 grams of ammonium chloride is added to an excess of potassium hydroxide, by the following equation.



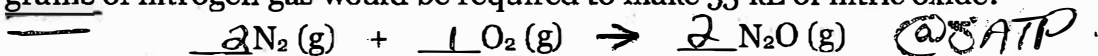
$\text{NH}_3 : \text{NH}_4\text{Cl}$ $1 : 1$ $x : 34\text{g}$	$\text{mm NH}_4\text{Cl}$ $\text{N } (1 \times 14.01)$ $\text{H } (4 \times 1.01)$ $\text{Cl } (1 \times 35.45)$ <hr/> 53.5g/mol	MM NH_3 $\text{N } (1 \times 14.01)$ $\text{H } (3 \times 1.01)$ <hr/> 17.04g/mol
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$$34\text{g NH}_4\text{Cl} \times \frac{1\text{mol NH}_4\text{Cl}}{53.5\text{g}} \times \frac{1\text{mol NH}_3}{1\text{mol NH}_4\text{Cl}} \times \frac{17.04\text{g}}{1\text{mol NH}_3} = 10.829\text{g}$$

$= 11\text{g NH}_3$

- 10) Lightning discharges in the atmosphere catalyze the conversion of nitrogen gas to nitric oxide gas.

How many grams of nitrogen gas would be required to make 55 kL of nitric oxide?



$\text{N}_2 : \text{N}_2\text{O}$ $2 : 2$ $: 55\text{kL} = 55000\text{L}$	MM N_2 $\text{N } (2 \times 14.01)$ <hr/> 28.02g/mol
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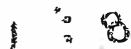
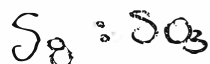
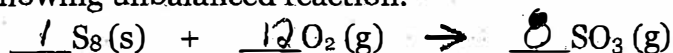
$$55000\text{L N}_2\text{O} \times \frac{1\text{mol N}_2\text{O}}{24.8\text{L}} \times \frac{2\text{mol N}_2}{2\text{mol N}_2\text{O}} \times \frac{28.02\text{g}}{1\text{mol N}_2} = 62141.129\text{g}$$

N_2

$= 6.2 \times 10^4\text{g}$
 N_2

1.7 Stoichiometry

- 11) What mass of sulfur will be required to produce 150 L of sulfur dioxide when it is burned in oxygen gas, according to the following unbalanced reaction.

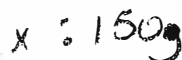
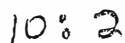


$$\text{MM S}_8 \Rightarrow \frac{5(8 \times 32.07)}{256.56 \text{ g/mol}}$$

$$150 \text{ L SO}_2 \times \frac{1 \text{ mol SO}_2}{22.4 \text{ L}} \times \frac{1 \text{ mol S}_8}{8 \text{ mol SO}_2} \times \frac{256.56 \text{ g}}{1 \text{ mol S}_8} = 214.75 \text{ g S}_8$$

$$= 220 \text{ g S}_8$$

- 12) How much carbon monoxide in kL (at SATP) will be produced when 150 grams of calcium phosphate reacts with enough silicon dioxide and carbon, according to the following unbalanced reaction.



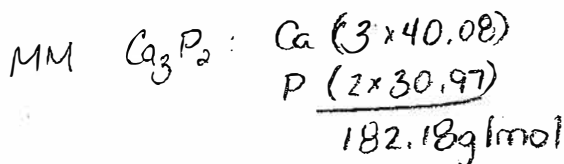
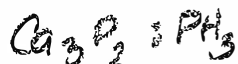
$$\text{MM Ca}_3(\text{PO}_4)_2 : \begin{array}{l} \text{Ca } 3(40.08) \\ \text{P } 2(30.97) \\ \text{O } 8(16.00) \\ \hline 310.17 \text{ g/mol} \end{array}$$

$$150 \text{ g Ca}_3(\text{PO}_4)_2 \times \frac{1 \text{ mol Ca}_3(\text{PO}_4)_2}{310.17 \text{ g}} \times \frac{10 \text{ mol CO}}{2 \text{ mol Ca}_3(\text{PO}_4)_2} \times \frac{24.8 \text{ L}}{1 \text{ mol CO}} = 59.96 \text{ L CO}$$

$$0.060 \text{ kL CO}$$

1.7 Stoichiometry

- 13) Calcium phosphide when added to water produces phosphine gas (PH_3). How many kL at SATP of the gas will be produced when 350 grams of calcium phosphide is added to an excess amount of water.

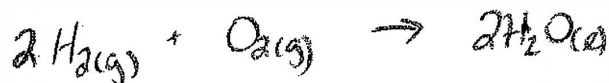


L?

$$350\text{g Ca}_3\text{P}_2 \times \frac{1\text{mol Ca}_3\text{P}_2}{182.18\text{g}} \times \frac{2\text{mol PH}_3}{1\text{mol Ca}_3\text{P}_2} \times \frac{24.8\text{L}}{1\text{mol PH}_3} = 95.29\text{L}$$

$$= \boxed{0.095\text{KL PH}_3}$$

- 14) What mass of O_2 is consumed in the complete synthesis of water if 6.86 g of H_2 participate in the reaction?



$$6.86\text{g H}_2 \times \frac{1\text{mol H}_2}{2.02\text{g H}_2} \times \frac{1\text{mol O}_2}{2\text{mol H}_2} \times \frac{32.00\text{g O}_2}{1\text{mol O}_2} =$$

$$= \boxed{54.4\text{g O}_2}$$