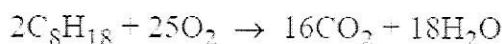


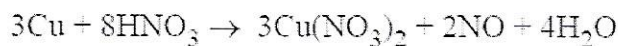
## Stoichiometric Calculations

### Mole to Mole Calculations

1. The octane present in gasoline burns according to the following equation.



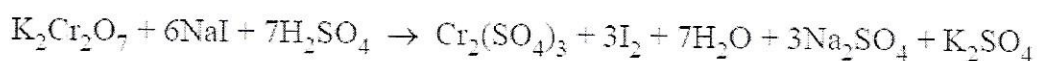
- (a) How many moles of  $\text{O}_2$  are needed to react fully with 7 moles of octane ( $\text{C}_8\text{H}_{18}$ )?
- (b) How many moles of  $\text{CO}_2$  can form from 5 mole of octane?
- (c) If the reaction is to be used to synthesize 8 moles of  $\text{CO}_2$ , how many moles of oxygen are needed?
- (d) How many moles of carbon dioxide are formed if 17 moles of oxygen are reacted?
2. Butane combines with oxygen in a combustion reaction to produce carbon dioxide and water.
- (a) Write the balanced equation for this reaction.
- (b) If 37 moles of water are produced, how many moles of butane were reacted?
- (c) 29 moles of oxygen are reacted with the butane, how many moles of carbon dioxide are produced?
- (d) How many moles of butane are required to react with 17.5 moles of oxygen?
3. Consider the following reaction:



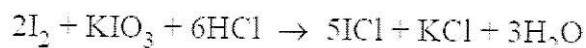
- (a) How many moles of  $\text{NO}$  are produced by the reaction of 4.0 moles of copper with  $\text{HNO}_3$ ?
- (b) How many moles of  $\text{HNO}_3$  are required to react completely with 5.0 mol of copper?
- (c) What mass of  $\text{NO}$  is produced when 6.35 g of copper is reacted with  $\text{HNO}_3$ ?

**Mass to Mass Calculations**

4. Nitrogen gas and hydrogen gas combine to form ammonia ( $\text{NH}_3$ ).
- Write the balanced equation for this reaction.
  - If 30.0 g of nitrogen are reacted, how many moles of ammonia are produced?
  - If 45.0 g of ammonia are required, what mass of hydrogen must be reacted?
  - What mass of nitrogen is needed to react with 38.5 g of hydrogen?
5. Given:  $3\text{Fe}_2\text{O}_3 + \text{CO} \rightarrow 2\text{Fe}_3\text{O}_4 + \text{CO}_2$ . How many grams of  $\text{Fe}_2\text{O}_3$  can be converted to  $\text{Fe}_3\text{O}_4$  by 25.00 g of CO?
6. Calculate how many grams of  $\text{K}_2\text{Cr}_2\text{O}_7$  are needed to make 50.00 g of  $\text{I}_2$  according to the following equation.

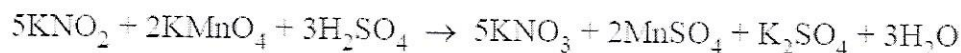


7. Iodine chloride,  $\text{ICl}$ , can be made by the following reaction between iodine,  $\text{I}_2$ , potassium iodate,  $\text{KIO}_3$ , and hydrochloric acid.



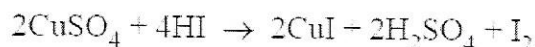
Calculate how many grams of iodine are needed to prepare 35.00 g of  $\text{ICl}$  by this reaction.

8. The nitrite ion ( $\text{NO}_2^-$ ) in potassium nitrite is changed to the nitrate ion by the action of potassium permanganate ( $\text{KMnO}_4$ ) in sulfuric acid solution.



How many moles and how many grams of  $\text{KMnO}_4$  are needed to carry out this reaction on 11.40 g of  $\text{KNO}_2$ ?

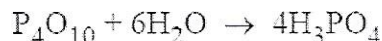
9. Copper (I) iodide,  $\text{CuI}$ , is not stable enough to last long in storage, so it is generally made just prior to its being used. It can be prepared from copper sulfate and hydroiodic acid by the following reaction.



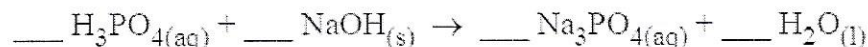
If 10.45 g of  $\text{CuSO}_4$  are used, calculate the number of grams of HI needed.

**Solution Stoichiometry**

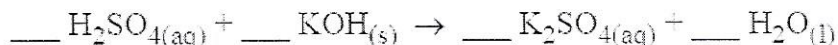
10. Phosphoric acid can be made by boiling a solution of tetraphosphorous decaoxide in water.



- (a) If 88.6 g of  $\text{P}_4\text{O}_{10}$  was reacted, what mass of phosphoric acid was formed?
- (b) If the final volume of the acid was 500 mL, what is the molarity?
11. Calculate the mass of silver that could be obtained by the reaction of a large excess of copper with 500 mL of 0.625 M  $\text{AgNO}_3$ ?
12. Phosphoric acid can be neutralized by sodium hydroxide according to the following reaction.



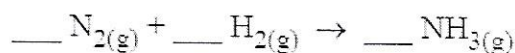
- (a) Balance this equation.
- (b) If 3.75 moles of NaOH are reacted, how moles of  $\text{H}_3\text{PO}_4$  can be neutralized?
- (c) What mass of NaOH would be required to completely neutralize 325 mL of 0.750 M  $\text{H}_3\text{PO}_4$ ?
- (d) If there was no solid NaOH available, but rather a 2.75 M solution of NaOH. What volume of this solution would be required to neutralize 500 mL of 0.750 M  $\text{H}_3\text{PO}_4$ ?
13. Sulphuric acid can be neutralized by potassium hydroxide according to the following reaction:



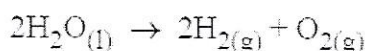
- (a) Balance this equation.
- (b) If 8.25 moles of KOH are reacted, how many moles of  $\text{H}_2\text{SO}_4$  can be neutralized?
- (c) How many grams of KOH are required to neutralize 1.25 L of 16.5 M sulphuric acid?
- (d) What volume of a 4.50 M solution of KOH is required to neutralize 675 mL of 2.60 M sulphuric acid?

**Gas Stoichiometry**

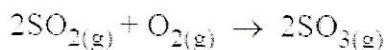
14. Consider the following reaction:



- Balance the equation.
  - If 25.0 g of nitrogen react with oxygen, what volume of  $\text{NH}_3$  is produced at STP?
  - What mass of hydrogen is required to produce 50.0 L of  $\text{NH}_3$  at STP?
15. How many molecules of oxygen are produced when 29.2 g of water is decomposed according to the balanced equation,



16. Assuming STP, how many litres of oxygen are needed to produce 19.8 L of  $\text{SO}_3$  according to the balanced equation.



17. Tin (II) fluoride is formed in the reaction,



- How many grams of  $\text{SnF}_2$  can be made by reacting  $7.42 \times 10^{24}$  molecules of HF with tin?
- How many litres of hydrogen gas (at STP) are produced by reacting 23.4 g of Sn with HF?
- How many litres of HF are needed to produce 14.2 L of  $\text{H}_2$  (at STP)?
- How many molecules of  $\text{H}_2$  are produced by the reaction of tin with 80.0 L of HF (at STP)?