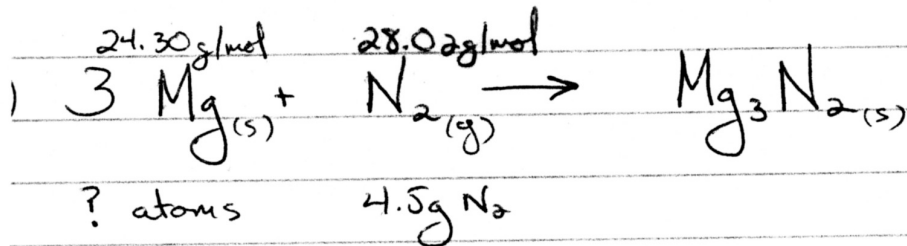


Stoichiometry 5

- ① How many atoms of magnesium will react with 4.5 g of nitrogen to make magnesium nitride (Mg_3N_2)?

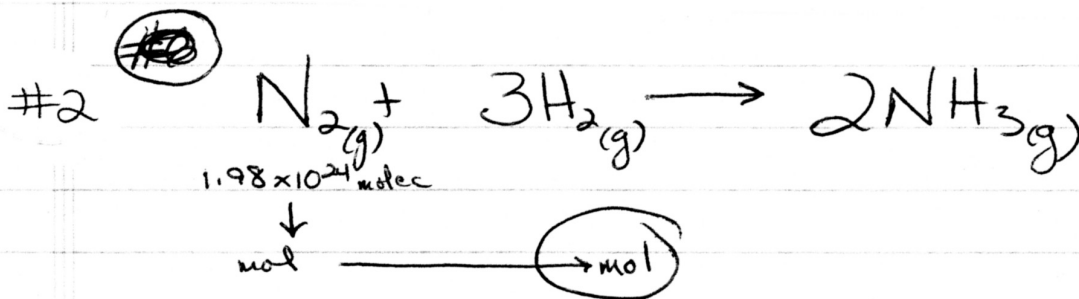


4.5 g N₂	1 mol N₂	3 mol Mg	6.022 × 10²³ Mg atoms
	28.02 g N₂	1 mol N₂	1 mol Mg

$$= 2.9 \times 10^{23} \text{ atoms}$$

2. Consider the reaction of nitrogen gas with hydrogen gas with to make ammonia gas:
 $N_2 + 3 H_2 \rightarrow 2 NH_3$

- A) How many moles of hydrogen are required to fully react with 1.98×10^{24} molecules of nitrogen?
 B) What is the theoretical yield of ammonia produced in this reaction?

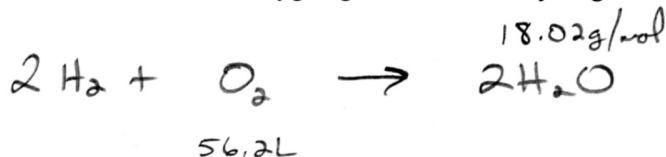


1.98×10^{24} molec N ₂	1 mol N ₂	3 mol H ₂	= 9.86 mol H ₂
	6.022×10^{23} molec N ₂	1 mol N ₂	

1.98×10^{24} molec N ₂	1 mol N ₂	2 mol NH ₃	17.04 g NH ₃
	6.022×10^{23} molec N ₂	1 mol N ₂	1 mol NH ₃

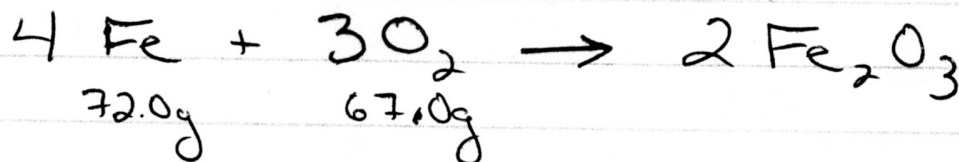
$$= 112 \text{ g NH}_3$$

3. Consider the formation of H_2O : $2H_2 + O_2 \rightarrow 2H_2O$. How many grams of water could be produced from the reaction of 56.2 L of oxygen gas with excess hydrogen at STP?



$$\frac{56.2L}{22.4L} \times \frac{1mol O_2}{1mol O_2} \times \frac{2mol H_2O}{1mol O_2} \times \frac{18.02g H_2O}{1mol H_2O} = 90.4g H_2O$$

4. Iron metal reacts with oxygen to make iron (III) oxide by the following reaction:
 $4Fe + 3O_2 \rightarrow 2Fe_2O_3$. If 72.0 g of iron and 67.0 g of oxygen are present initially,
- What is the limiting reagent?
 - What mass of iron(III) oxide is produced?
 - What mass of the excess reagent remains at the end of the reaction?



A) $\frac{72.0g Fe}{55.85g Fe} \times \frac{1mol Fe}{4mol Fe} \times \frac{2mol Fe_2O_3}{1mol Fe} = 0.6446 mol Fe_2O_3$

$\frac{67.0g O_2}{32.0g} \times \frac{1mol O_2}{3mol O_2} \times \frac{2mol Fe_2O_3}{1mol O_2} = 1.396 mol Fe_2O_3$

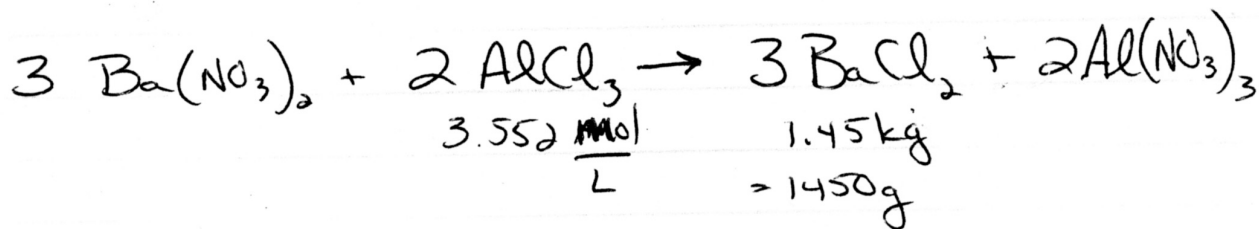
Fe is LR

B) $\frac{0.6446 mol Fe_2O_3}{1mol Fe_2O_3} \times 159.7g Fe_2O_3 = 103g$

C) $\frac{72.0g Fe}{55.85g Fe} \times \frac{1mol Fe}{4mol Fe} \times \frac{3mol O_2}{1mol O_2} \times 32.0g O_2 = 30.9g O_2$
 used

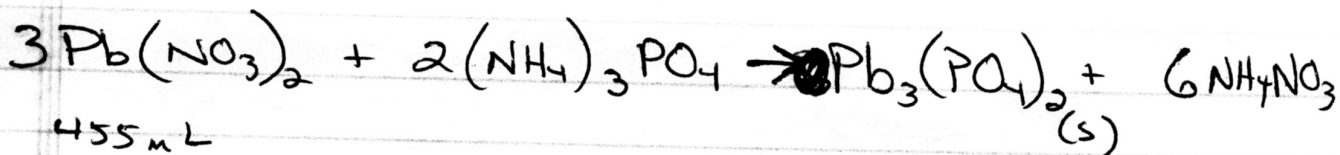
$67.0g O_2 - 30.9g O_2 = 36.1g O_2$
 start used remain

5. Given the reaction: $3 \text{Ba}(\text{NO}_3)_2 + 2 \text{AlCl}_3 \rightarrow 2 \text{Al}(\text{NO}_3)_3 + 3 \text{BaCl}_2$. If you wish to make 1.45 kg of BaCl_2 , what volume of a 3.552 M solution of AlCl_3 would be required?



1450g BaCl₂	1 mol BaCl₂	2 mol AlCl ₃	1 L AlCl ₃
208.23g BaCl₂	3 mol BaCl₂	3.552 mol AlCl ₃	= 1.31 L AlCl ₃

6. Lead (II) nitrate reacts with ammonium phosphate to produce a precipitate. If 455 mL of a 2.55 M lead (II) nitrate solution is reacted with excess ammonium phosphate, what mass of the precipitate will be formed?



0.455 L ^{Pb(NO₃)₂}	2.55 mol Pb(NO ₃) ₂	1 mol Pb ₃ (PO ₄) ₂	811.54 g Pb ₃ (PO ₄) ₂
1 L Pb(NO ₃) ₂	3 mol Pb(NO ₃) ₂	1 mol Pb ₃ (PO ₄) ₂	

= 313 g Pb₃(PO₄)₂

7. Consider the reaction of Mg with HCl. If a long strip of Mg with a volume of 2.85 cm^3 were allowed to react with excess HCl,

A) How many moles of MgCl_2 would be produced?

B) What would be the molarity of MgCl_2 if the total volume of the solution were 250 mL?

$$1.74 \text{ g/cm}^3$$

$$24.30 \text{ g/mol}$$



$$\frac{2.85 \text{ cm}^3 \text{ Mg}}{1 \text{ cm}^3 \text{ Mg}} \times \frac{1.74 \text{ g Mg}}{1 \text{ cm}^3 \text{ Mg}} \times \frac{1 \text{ mol Mg}}{24.30 \text{ g Mg}} \times \frac{1 \text{ mol MgCl}_2}{1 \text{ mol Mg}} = 0.204 \text{ mol MgCl}_2$$

$$M = \frac{\text{mol}}{L} = \frac{0.204 \text{ mol}}{0.250 \text{ L}} = 0.816 \text{ M}$$

8. A sample of sandstone contains silica (SiO_2) and calcite (CaCO_3). When the sandstone is heated the CaCO_3 decomposes by the reaction: $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$. What is the percentage of silica in the sandstone if heating 18.7 mg of the rock yields 3.95 mg CO_2 ?

$$\frac{3.95 \text{ mg CO}_2}{44.01 \text{ g CO}_2} \times \frac{1 \text{ mol CO}_2}{1 \text{ mol CO}_2} \times \frac{1 \text{ mol CaCO}_3}{1 \text{ mol CaCO}_3} \times \frac{100.09 \text{ g CaCO}_3}{1 \text{ mol CaCO}_3} =$$

$$8.98 \text{ mg CaCO}_3$$

$$\frac{8.98 \text{ mg CaCO}_3}{18.7 \text{ mg rock}} = \frac{48.0\%}{\cancel{48.0\%}} \text{ CaCO}_3$$

$$= 52.0\% \text{ SiO}_2$$