1. Calculate molar mass of gas

$$n = \frac{PV}{RT} = \frac{150 \times 4.0}{8.31 \times 300} = 0.2407 \approx 0.24 \text{ mol} M = \frac{6.00}{0.2407} = 25\ g/mol$$

(2 significant figures)

2. Convert 150 kPa to atm

$$P = \frac{150}{101.3} = 1.48$$

(3 significant figures)

3. Find molar mass of gas

$$n = \frac{120 \times 8.00}{8.31 \times 298} = 0.3878 \approx 0.388 \text{ mol} M = \frac{12.00}{0.388} = 30.9$$

(3 significant figures)

4. Calculate pressure exerted by CO_2

$$n = \frac{10.0}{44.0} = 0.2273 \approx 0.227 \text{ mol} P = \frac{0.227 \times 8.31 \times 350}{5.00} = 132\ kPa$$

(3 significant figures)

5. Balance the reaction

$$\boxed{2Al + Fe_2O_3 \rightarrow Al_2O_3 + 2Fe}$$

a. Calculate mass of iron formed

$$n_{Al} = \frac{25.0}{27.0} = 0.9259 = 0.926 \text{ mol} \qquad n_{Fe_2O_3} = \frac{40.0}{159.7} = 0.2504$$

$0.250 \text{ mol} Fe_2O_3$ limiting reactant

$$n_{Fe} = 2 \times 0.250 = 0.500 \text{ mol} \quad => m_{Fe} = 0.500 \times 55.85 = 27.9g$$

(3 significant figures)

6. Volume of CO_2 from 50 g $CaCO_3$ at SLC

$$n = \frac{50}{100.1} = 0.499 \ => \ \text{mol} V = 0.500 \times 24.8 = 12.4\ L = 12\ L$$

(2 significant figures)

7. a. Identify excess reactant in reaction of H_2 and Cl_2

$n_{H_2} = \frac{4.00}{2.016} = 1.984$ mol$n_{Cl_2} = \frac{12.0}{70.90} = 0.1693$ molRatio 1:1 → Cl_2 is limiting
→ H_2 is excess

b. Mass of excess reactant (H_2) remaining

$$n_{H_2 \text{ remaining}} = 1.984 - 0.1693 = 1.815 \text{ mol} m = 1.815 \times 2.016 = 3.66 g$$

(3 significant figures)

c. Mass of HCl produced

$$n_{HCl} = 2 \times 0.1693 = 0.3386 \approx 0.339 \text{ mol} m = 0.339 \times 36.46 = 12.4$$

(3 significant figures)

8 a. Volume of CO_2 produced from ethane combustion

$$n_{C_2H_6} = \frac{30}{30.07} = 1.00 \text{ mol } => V_{CO_2} = 2 \times 1.00 \times 24.8 = 50\ L$$

(2 significant figures)

b. Mass of oxygen consumed

$$n_{O_2} = \frac{7}{2} \times 1.00 = 3.50 \text{ mol} => m = 3.50 \times 32.00 = 1.1\ X\ 10^2 g$$

(2 significant figures)

9. a. Limiting reactant in ammonia synthesis

Given volumes: $N_2 = 15.0\ L$, $H_2 = 45.0\ L$
Ratio 1:3 matches given exactly → **No limiting reactant**

b. Volume of NH_3 produced

$V = 2 \times 15.0 = 30.0\ L$(3 significant figures)

10. Mass of magnesium oxide produced

$n_{Mg} = \frac{12.00}{24.31} = 0.494$ mol $\qquad n_{O_2} = \frac{40.00}{32.00} = 1.25$ mol Mg limiting

$$m = 0.494 \times 40.31 = 19.9\ g$$

(3 significant figures)

11. a. Limiting reactant for Ca and HCl

$$n_{Ca} = \frac{10.0}{40.08} = 0.250 \text{ mol} \qquad n_{HCl} = 1.5 \times 0.150 = 0.225$$

=> mol Ca needs 2 moles HCl per mole = 0.500 mol required > 0.225 mol available → HCl limiting

b. Concentration of $CaCl_2$ produced

$$n_{CaCl_2} = \frac{0.225}{2} = 0.1125 \text{ mol} c = \frac{0.1125}{0.150} = 0.75\ mol/L$$

(2 significant figures)