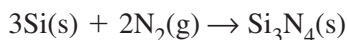
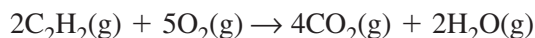


Stoichiometry

1. Silicon nitride is used in the manufacturing of high-temperature thermal insulation for heat engines and turbines. It is produced by the following reaction.

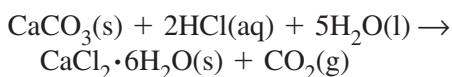


- a. Interpret the equation in terms of particles, moles, and masses.
- b. Show that mass is conserved in the reaction.
2. The heat from a welder's torch is produced by the burning of acetylene gas. The reaction is represented by the following balanced chemical equation.

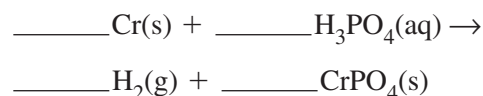


Calculate the mole ratios from the balanced equation.

3. Limestone (CaCO_3) is treated with hydrochloric acid and water to manufacture calcium chloride hexahydrate. This compound is used to melt ice and snow on pavements and roads. The following balanced chemical equation represents the reaction.



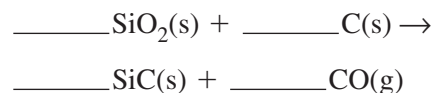
- a. How many moles of calcium chloride hexahydrate will be produced from 4.00 mol calcium carbonate?
- b. How many moles of hydrogen chloride will be needed to produce 1.25 mol of the hydrate?
- c. If 8.33 mol water is available for the reaction, how many moles of carbon dioxide will be released?
4. To prevent corrosion and make paints adhere better, some aluminum products are treated with chromium(III) phosphate before finishing. Chromium(III) phosphate (CrPO_4) is commercially produced by treating chromium metal with orthophosphoric acid (H_3PO_4).
- a. Balance the following equation for the reaction.



- b. How many moles of chromium metal are needed to produce 855 g of chromium(III) phosphate?
- c. The reaction of 206 g chromium will release how many moles of hydrogen gas?

5. Sand (silicon dioxide) and coke (carbon) are combined to form silicon carbide (SiC), a compound used in high-strength ceramic materials.

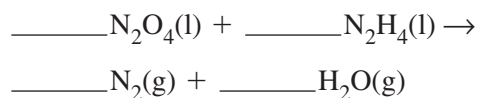
- a. Balance the following equation for the reaction.



- b. What mass of silicon carbide will be produced from the reaction of 352 g silicon dioxide?
- c. If 1.00 g of carbon is reacted, what mass of carbon monoxide is released?

6. Two compounds of nitrogen, nitrogen tetroxide (N_2O_4) and hydrazine (N_2H_4), are used as rocket fuels. When the two compounds are mixed, they ignite spontaneously and produce nitrogen gas and water.

- a. Balance the following equation for the reaction.

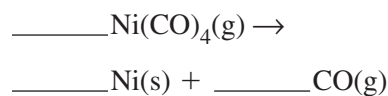


- b. If 8.00 g nitrogen tetroxide and 4.00 g hydrazine are mixed, determine the following quantities.

1. limiting reactant
2. mass of product (N_2)
3. mass of excess reactant

7. One step in the industrial refining of nickel is the decomposition of nickel carbonyl ($\text{Ni}(\text{CO})_4$) into nickel and carbon monoxide. In a laboratory reaction, 25.0 g nickel carbonyl yielded 5.34 g nickel.

- a. Balance the following equation for the reaction.



- b. Determine the theoretical yield of nickel.
- c. Determine the percent yield.