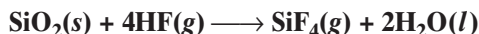


SAMPLE PROBLEM F

Silicon dioxide (quartz) is usually quite unreactive but reacts readily with hydrogen fluoride according to the following equation.



If 6.0 mol HF is added to 4.5 mol SiO₂, which is the limiting reactant?

SOLUTION**1 ANALYZE**

Given: amount of HF = 6.0 mol
amount of SiO₂ = 4.5 mol
Unknown: limiting reactant

2 PLAN

For one of the products, the given amounts of reactants are used to calculate the amount of product that could be produced under ideal conditions. The lesser amount of product represents the maximum amount that could be formed, and the reactant that gives the lesser amount of product is the limiting reactant.

$$\text{mol HF} \times \frac{\text{mol SiF}_4}{\text{mol HF}} = \text{mol SiF}_4 \text{ produced} \quad \text{mol SiO}_2 \times \frac{\text{mol SiF}_4}{\text{mol SiO}_2} = \text{mol SiF}_4 \text{ produced}$$

3 COMPUTE

$$6.0 \text{ mol HF} \times \frac{1 \text{ mol SiF}_4}{4 \text{ mol HF}} = 1.5 \text{ mol SiF}_4 \text{ produced}$$

$$4.5 \text{ mol SiO}_2 \times \frac{1 \text{ mol SiF}_4}{1 \text{ mol SiO}_2} = 4.5 \text{ mol SiF}_4 \text{ produced}$$

Under ideal conditions, the 6.0 mol HF present can make 1.5 mol SiF₄, and the 4.5 mol SiO₂ present can make 4.5 mol SiF₄. Because 6.0 mol HF can make only 1.5 mol SiF₄, HF is the limiting reactant.

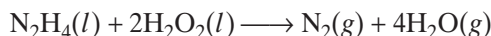
4 EVALUATE

From the balanced equation, we can see that the reaction requires four times the number of moles of HF as it does moles of SiO₂. Because the molar amount of HF that we have is less than four times the moles of SiO₂, our calculations clearly show that HF is the limiting reactant.

PRACTICE

Answers in Appendix E

- Some rocket engines use a mixture of hydrazine, N₂H₄, and hydrogen peroxide, H₂O₂, as the propellant. The reaction is given by the following equation.



- Which is the limiting reactant in this reaction when 0.750 mol N₂H₄ is mixed with 0.500 mol H₂O₂?
- How much of the excess reactant, in moles, remains unchanged?
- How much of each product, in moles, is formed?

extension

Go to **go.hrw.com** for more practice problems that ask you to determine the limiting reactant.



Keyword: HC6STCX