Question

2.804 g of a mixture containing manganese (IV) oxide and concentrated hydrochloric acid was heated. The resultant mixture weighed 2.591 g and 71 cm^3 of chlorine, measured at s.t.p., was given off. Show that the reaction obeys the law of conservation of mass. [1 mole gas at s.t.p. occupies 22.4 dm^3].

Solution

The reaction equation is

$$MnO_2 + HCl \rightarrow MnCl_2 + H_2O + Cl_2$$

Number of moles of Cl_2 (volume of Cl_2 should be converted to dm^3):

$$n_{Cl_2} = \frac{V_{Cl_2}}{V_m} = \frac{0.071}{22.4} = 0.0032 \; moles$$

Mass of Cl_2 (molar mass of Cl_2 = 70.9 g/mol):

$$m_{Cl_2} = n_{Cl_2} \cdot M_{Cl_2} = 0.0032 \cdot 70.9 = 0.213 \; g$$

Mass of resultant mixture:

$$m_{rm} = 2.591 + 0.213 = 2.804 \; g$$

As we can see that mass of resultant mixture is equal to the mass of initial mixture, so the reaction obeys the law of conservation of mass.