Question
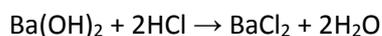
8.12 gm of barium hydroxide reacts with 5.10 gm of hydrogen chloride to give how many gm of barium chloride and water? What is the number of moles of barium chloride and water here and how can I calculate it?

Solution

The chemical equation is

$$Ba(OH)_2 + 2HCl \rightarrow BaCl_2 + 2H_2O$$

So, we can see that 2 moles of HCl correspond to 1 mole $Ba(OH)_2$.

At first, we should find out which reactant is limiting and which one was taken with excess.

The reactants molar weights are $M(Ba(OH)_2) = 171.34$ gm/mol, $M(HCl) = 36.46$ gm/mol.

Based on these values and chemical equation, we may write a proportion

$$171.34 \text{ gm/mol } (Ba(OH)_2) - 2 \cdot 36.46 \text{ gm/mol } (HCl)$$

$$8.12 \text{ gm } (Ba(OH)_2) - m(HCl), \text{ gm } (HCl),$$

where $m(HCl)$ – mass of HCl reacting with 8.12 gm of $Ba(OH)_2$.

$x = 2 \cdot 36.46 \cdot 8.12/171.34 = 3.46$ gm

Thus, HCl was taken with excess and $Ba(OH)_2$ is limiting reactant.

The reaction products molar weights are $M(BaCl_2) = 208.23$ gm/mol, $M(H_2O) = 18.02$ gm/mol.

$$171.34 \text{ gm/mol } (Ba(OH)_2) - 208.23 \text{ gm/mol } (BaCl_2)$$

$$8.12 \text{ gm } (Ba(OH)_2) - m(BaCl_2), \text{ gm}$$

$m(BaCl_2) = 208.23 \cdot 8.12/171.34 = 9.87$ gm

$$171.34 \text{ gm/mol } (Ba(OH)_2) - 2 \cdot 18.02 \text{ gm/mol } (H_2O)$$

$$8.12 \text{ gm } (Ba(OH)_2) - m(H_2O), \text{ gm}$$

$m(H_2O) = 2 \cdot 18.02 \cdot 8.12/171.34 = 1.71$ gm

The number of moles of barium chloride and water can be calculated by dividing the calculated weight values by the corresponding molar weight values.

$n(BaCl_2) = m(BaCl_2)/M(BaCl_2) = 9.87/208.23 = 0.0474$ moles

$n(H_2O) = m(H_2O)/M(H_2O) = 1.71/18.02 = 0.0949$ moles

Answer

$m(BaCl_2) = 9.87$ gm

$m(H_2O) = 1.71$ gm

$n(BaCl_2) = 0.0474$ moles

$n(H_2O) = 0.0949$ moles