Answer on Question #44138 - Chemistry - Inorganic Chemistry

Question:

The equilibrium constant for the gaseous reaction $H_2 + I_2 \leftrightarrow 2HI$ is 50.2 at 448 ^{0}C. Calculate the number of grams of HI that are in the equilibrium with 1.25 mole of H_2 and 63.5 g of iodine at this temperature.

Answer:

The constant for the equilibrium $H_2 + I_2 \leftrightarrow 2HI$ is given by the following expression:

$$K = \frac{[HI]^2}{[H_2][I_2]} = \frac{n^2(HI)}{n(H_2)n(I_2)} = 50.2$$

The amount of moles of iodine is:

$n(I_2) = m(I_2)/M(I_2) = 63.5(\text{ g})/254\ (\text{g/mol}) = 0.25$ mol

Using expression for the equilibrium constant one can find the amount of moles of HI that are in the equilibrium with given amounts of H_2 and I_2:

$$50.2 = \frac{n^2(HI)}{1.25 \times 0.25};$$
$$50.2 = \frac{n^2(HI)}{0.3125};$$
$$n^2(HI) = 50.2 \times 0.3125 = 15.7$$
$$n(HI) = 3.96 mol$$

The mass of the HI can be calculated in the following way by multiplying the amount of moles by the molar mass:

$m(HI) = n(HI) \times M(HI) = 3.96\ (\text{mol}) \times 128\ (\text{g/mol}) =$ **507 g**.