#63424 Chemistry, General Chemistry

Chapter 15 (15.56)

At 80∘C, Kc=1.87×10^{-3} for the reaction $PH_3BCl_{3(s)} \rightleftharpoons PH_{3(g)} + BCl_{3(g)}$

1) **Calculate the equilibrium concentration of PH_3 if a solid sample of PH_3BCl_3 is placed in a closed vessel at 80∘C and decomposes until equilibrium is reached.**
2) **Calculate the equilibrium concentration of BCl_3 if a solid sample of PH_3BCl_3 is placed in a closed vessel at 80∘C and decomposes until equilibrium is reached.**
3) **If the flask has a volume of 0.24 L, what is the minimum mass of $PH_3BCl_{3(s)}$ that must be added to the flask to achieve equilibrium?**

Answer:

	PH_3BCl_3	PH_3	BCl_3
Initial	don't know	0	0
Change	-x	+x	+x
Equilibrium		+x	+x

The amount of PH_3BCl_3 to begin with is unknown. However, this is irrelevant because we dont compute solids into the K_{eq} formula.
Then: $K_c = 1.87 \cdot 10^{-3} = [PH_3]\,[BCl_3] = x^2$
$x = 4.32 \cdot 10^{-2}$ mol/ L

If we have a flask of 0.24 L, then we must have $4.32 \cdot 10^{-2} \cdot 0.24 = 1.04 \cdot 10^{-2}$ mol of $PH_{3(g)}$ and $BCl_{3(g)}$.
The moles of PH_3 and BCl_3 are the same. Therefore, either one gives the min amount of PH_3Cl_3. We then have $1.04 \cdot 10^{-2}$ mol of PH_3BCl_3, but in mass units this will be:
$m(PH_3BCl_3) = 1.04 \cdot 10^{-2}$ mol $\cdot$ 151.13 g/mol = 1.57 g.