AP CHEMISTRY

TOPIC 6: EQUILIBRIUM, MORE PRACTICE

Day 68

Example: The reaction for:

$$2\ SO_{3\ (g)} \rightleftharpoons O_{2\ (g)} + 2\ SO_{2\ (g)}$$

At 30.0 ^{0}C, the masses at equilibrium where found to be (in a six liter container):

$$SO_3 = 120.45\ grams,\ O_2 = 11.11\ grams,\ SO_2 = 70.00\ grams$$

calculate the value of K_c for this reaction.

$$SO_3 = \frac{120.45\ grams}{} \times \frac{1\ mol}{80.06\ g} = 1.50\ mol,\ O_2 = \frac{11.11\ grams}{} \times \frac{1\ mol}{32.00\ g} = 0.347\ mol,\ SO_2 = \frac{70.00\ grams}{} \times \frac{1\ mol}{64.06\ g} = 1.09\ mol$$

$$SO_3 = \frac{1.50\ mol}{6\ L} = 0.251\ M\ ,\ O_2 = \frac{0.347\ mol}{6\ L} = 0.0579\ M\ ,\ SO_2 = \frac{1.09\ mol}{6\ L} = 0.182\ M$$

$$K_c = \frac{[O_2][SO_2]^2}{[SO_3]^2} = \frac{(0.0579\ M)(0.182\ M)^2}{(0.251\ M)^2} = 0.0304\ M$$

1) The reaction for:

$$CO_{\ (g)} + 2\ H_{2\ (g)} \rightleftharpoons CH_3OH_{\ (g)}$$

At 25 ^{0}C, the pressures at equilibrium where found to be:

$$P_{CO} = 1406\ mm\ Hg,\ P_{H_2} = 0.201\ atm,\ P_{CH_3OH} = 570\ torr$$

calculate the value of K_p for this reaction at 25 ^{0}C.

Answers:

$$P_{CO} = \frac{1406\ mm\ Hg}{} \times \frac{1\ atm}{760\ mm\ Hg} = 1.85\ atm,\ P_{H_2} = 0.201\ atm,\ P_{CH_3OH} = \frac{570\ mm\ Hg}{} \times \frac{1\ atm}{760\ mm\ Hg} = 0.75\ atm$$

$$K_p = \frac{(P_{CH_3OH})}{(P_{CO})(P_{H_2})^2} = \frac{(0.75\ atm)}{(1.85\ atm)(0.201\ atm)^2} = 10.03\ atm^{-2}$$

2) The reaction for:

$$SF_{6\,(g)} + O_{2\,(g)} \rightleftharpoons SO_{2\,(g)} + 3\,F_{2\,(g)}$$

At 25 ^{0}C, the concentrations at equilibrium where found to be:

$$SO_2 = 2.35\ M\ ,\ F_2 = 1.33\ M\ ,\ SF_6 = 0.59\ M\ ,\ O_2 = 2.87\ M$$

calculate the value of K_c for this reaction at 25 ^{0}C.

Answers:

$$K_c = \frac{[SO_2][F_2]^3}{[SF_6][O_2]} = \frac{(2.35\ M)(1.33\ M)^3}{(0.59\ M)(2.87\ M)} = 3.27\ M^2 = 3.27\ \frac{mol^2}{L^2}$$

3) The reaction for:

$$N_{2\,(g)} + 3\,H_{2\,(g)} \rightleftharpoons 2\,NH_{3\,(g)}$$

At 47.0 ^{0}C, the masses at equilibrium where found to be (in a ten liter container):

$$NH_3 = 59.6\ grams,\ N_2 = 15.45\ grams,\ H_2 = 6.788\ grams$$

calculate the value of K_c for this reaction.

Answers:

$$NH_3 = \frac{59.6\ g}{} \times \frac{1\ mol}{17.0307\ g} = 3.47\ mol,\ N_2 = \frac{15.45\ g}{} \times \frac{1\ mol}{28.014\ g} = 0.552\ mol,\ H_2 = \frac{6.788\ g}{} \times \frac{1\ mol}{2.0158\ g} = 3.37\ mol$$

$$NH_3 = \frac{3.47\ mol}{10\ L} = 0.347\ M\ ,\ N_2 = \frac{0.552\ mol}{10\ L} = 0.0522\ M\ ,\ H_2 = \frac{3.37\ mol}{10\ L} = 0.337\ M$$

$$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3} = \frac{(0.347\ M)^2}{(0.0522\ M)(0.337\ M)^3} = 60.3\ M^{-2} = 60.3\ \frac{L^2}{mol^2}$$