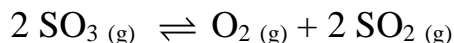


AP CHEMISTRY

TOPIC 6: EQUILIBRIUM, MORE PRACTICE

Day 68

Example: The reaction for:



At 30.0 °C, the masses at equilibrium were found to be (in a six liter container):

$$\text{SO}_3 = 120.45 \text{ grams}, \text{O}_2 = 11.11 \text{ grams}, \text{SO}_2 = 70.00 \text{ grams}$$

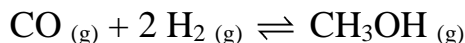
calculate the value of K_c for this reaction.

$$\text{SO}_3 = \frac{120.45 \text{ grams}}{80.06 \text{ g}} \times \frac{1 \text{ mol}}{1} = 1.50 \text{ mol}, \text{O}_2 = \frac{11.11 \text{ grams}}{32.00 \text{ g}} \times \frac{1 \text{ mol}}{1} = 0.347 \text{ mol}, \text{SO}_2 = \frac{70.00 \text{ grams}}{64.06 \text{ g}} \times \frac{1 \text{ mol}}{1} = 1.09 \text{ mol}$$

$$\text{SO}_3 = \frac{1.50 \text{ mol}}{6 \text{ L}} = 0.251 \text{ M}, \text{O}_2 = \frac{0.347 \text{ mol}}{6 \text{ L}} = 0.0579 \text{ M}, \text{SO}_2 = \frac{1.09 \text{ mol}}{6 \text{ L}} = 0.182 \text{ M}$$

$$K_c = \frac{[\text{O}_2][\text{SO}_2]^2}{[\text{SO}_3]^2} = \frac{(0.0579 \text{ M})(0.182 \text{ M})^2}{(0.251 \text{ M})^2} = 0.0304 \text{ M}$$

1) The reaction for:



At 25 °C, the pressures at equilibrium were found to be:

$$P_{\text{CO}} = 1406 \text{ mm Hg}, P_{\text{H}_2} = 0.201 \text{ atm}, P_{\text{CH}_3\text{OH}} = 570 \text{ torr}$$

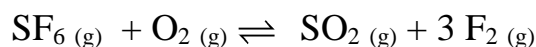
calculate the value of K_p for this reaction at 25 °C.

Answers:

$$P_{\text{CO}} = \frac{1406 \text{ mm Hg}}{760 \text{ mm Hg}} \times \frac{1 \text{ atm}}{1} = 1.85 \text{ atm}, P_{\text{H}_2} = 0.201 \text{ atm}, P_{\text{CH}_3\text{OH}} = \frac{570 \text{ mm Hg}}{760 \text{ mm Hg}} \times \frac{1 \text{ atm}}{1} = 0.75 \text{ atm}$$

$$K_p = \frac{(P_{\text{CH}_3\text{OH}})}{(P_{\text{CO}})(P_{\text{H}_2})^2} = \frac{(0.75 \text{ atm})}{(1.85 \text{ atm})(0.201 \text{ atm})^2} = 10.03 \text{ atm}^{-2}$$

2) The reaction for:



At 25 °C, the concentrations at equilibrium were found to be:

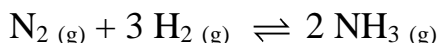
$$\text{SO}_2 = 2.35 \text{ M} , \text{F}_2 = 1.33 \text{ M} , \text{SF}_6 = 0.59 \text{ M} , \text{O}_2 = 2.87 \text{ M}$$

calculate the value of K_c for this reaction at 25 °C.

Answers:

$$K_c = \frac{[\text{SO}_2][\text{F}_2]^3}{[\text{SF}_6][\text{O}_2]} = \frac{(2.35 \text{ M})(1.33 \text{ M})^3}{(0.59 \text{ M})(2.87 \text{ M})} = 3.27 \text{ M}^2 = 3.27 \frac{\text{mol}^2}{\text{L}^2}$$

3) The reaction for:



At 47.0 °C, the masses at equilibrium were found to be (in a ten liter container):

$$\text{NH}_3 = 59.6 \text{ grams} , \text{N}_2 = 15.45 \text{ grams} , \text{H}_2 = 6.788 \text{ grams}$$

calculate the value of K_c for this reaction.

Answers:

$$\text{NH}_3 = \frac{59.6 \text{ g}}{17.0307 \text{ g}} \times \frac{1 \text{ mol}}{1} = 3.47 \text{ mol} , \text{N}_2 = \frac{15.45 \text{ g}}{28.014 \text{ g}} \times \frac{1 \text{ mol}}{1} = 0.552 \text{ mol} , \text{H}_2 = \frac{6.788 \text{ g}}{2.0158 \text{ g}} \times \frac{1 \text{ mol}}{1} = 3.37 \text{ mol}$$

$$\text{NH}_3 = \frac{3.47 \text{ mol}}{10 \text{ L}} = 0.347 \text{ M} , \text{N}_2 = \frac{0.552 \text{ mol}}{10 \text{ L}} = 0.0552 \text{ M} , \text{H}_2 = \frac{3.37 \text{ mol}}{10 \text{ L}} = 0.337 \text{ M}$$

$$K_c = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3} = \frac{(0.347 \text{ M})^2}{(0.0552 \text{ M})(0.337 \text{ M})^3} = 60.3 \text{ M}^{-2} = 60.3 \frac{\text{L}^2}{\text{mol}^2}$$