

2.

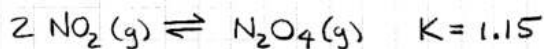
$$Q = \frac{[\text{HOC}]^2}{[\text{H}_2\text{O}][\text{Cl}_2\text{O}]} \quad K = 0.0900$$

$$(a) \quad Q = \frac{(1.0)^2}{(0.10)(0.10)} = 1.0 \times 10^2 \quad \left| \quad \begin{array}{l} Q > K \\ \therefore \text{system will} \\ \text{shift left.} \end{array} \right.$$

$$(b) \quad Q = \frac{(0.042)^2}{(0.49)(0.040)} = 0.090 \quad \left| \quad \begin{array}{l} Q = K \\ \therefore \text{system is at} \\ \text{equilibrium.} \end{array} \right.$$

$$(c) \quad Q = \frac{(0.0833\ldots)^2}{(0.1866\ldots)(0.000333\ldots)} = 1.1 \times 10^2 \quad \left| \quad \begin{array}{l} Q > K \\ \therefore \text{system will} \\ \text{shift left} \end{array} \right.$$

3.



I	0.85	0
C	-2x	+x
E	0.85-2x	x

$$K = \frac{[\text{N}_2\text{O}_4]}{[\text{NO}_2]^2}$$

$$1.15 = \frac{x}{(0.85-2x)^2}$$

$$1.15(0.85-2x)^2 = x$$

$$1.15(0.7225 - 3.4x + 4x^2) = x$$

$$0.830875 - 3.91x + 4.6x^2 = x$$

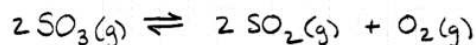
$$4.6x^2 - 4.91x + 0.830875 = 0$$

$$x = \cancel{0.85650\ldots}, 0.21088\ldots$$

$$\begin{aligned} [\text{NO}_2]_{eq} &= (0.850 - 2x) \text{ mol/L} \\ &= (0.850 - 2(0.21088\ldots)) \text{ mol/L} \\ &= 0.428 \text{ mol/L} \end{aligned}$$

$$\begin{aligned} [\text{N}_2\text{O}_4]_{eq} &= x \text{ mol/L} \\ &= 0.211 \text{ mol/L} \end{aligned}$$

5.



I	4	0	0
C	-2x	+2x	+x
E	4-2x	2x	x

$$[\text{SO}_2]_{\text{eq}} = 1.0 \text{ mol/L} \leftarrow \text{data}$$

$$[\text{SO}_2]_{\text{eq}} = 2x \text{ mol/L} \leftarrow \text{ICE table}$$

$$2x = 1.0$$

$$x = 0.5$$

$$[\text{SO}_3]_{\text{eq}} = (4-2x) \text{ mol/L}$$

$$= (4-2(0.5)) \text{ mol/L}$$

$$= 3.0 \text{ mol/L}$$

$$[\text{O}_2]_{\text{eq}} = x \text{ mol/L}$$

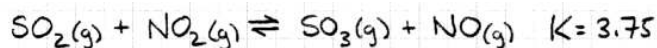
$$= 0.50 \text{ mol/L}$$

$$K = \frac{[\text{SO}_2]^2 [\text{O}_2]}{[\text{SO}_3]^2}$$

$$= \frac{(1.0)^2 (0.50)}{(3.0)^2}$$

$$= 5.6 \times 10^{-2}$$

6.



I	0.8	0.8	0.8	0.8
C	-x	-x	+x	+x
E	0.8-x	0.8-x	0.8+x	0.8+x

$$K = \frac{[\text{SO}_3][\text{NO}]}{[\text{SO}_2][\text{NO}_2]}$$

$$3.75 = \frac{(0.8+x)(0.8+x)}{(0.8-x)(0.8-x)}$$

$$3.75 = \frac{(0.8+x)^2}{(0.8-x)^2}$$

$$1.9364... = \frac{0.8+x}{0.8-x} \quad (\text{square-root both sides})$$

$$1.5491... - 1.9364...x = 0.8 + x$$

$$-2.9364...x = -0.74919...$$

$$x = \frac{-0.74919...}{-2.9364...}$$

$$x = 0.25513...$$

$$[\text{SO}_2]_{\text{eq}} = [\text{NO}_2]_{\text{eq}} = (0.8-x) \text{ mol/L}$$

$$= (0.8-0.25513...) \text{ mol/L}$$

$$= 0.54 \text{ mol/L}$$

$$[\text{SO}_3]_{\text{eq}} = [\text{NO}]_{\text{eq}} = (0.8+x) \text{ mol/L}$$

$$= (0.8+0.25513...) \text{ mol/L}$$

$$= 1.06 \text{ mol/L}$$

7.

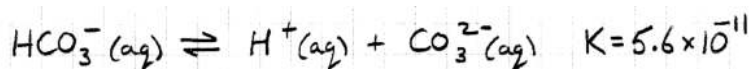
$$K = \frac{[H_2]^2 [O_2]}{[H_2O]^2}$$

$$2.4 \times 10^{-3} = \frac{(1.2 \times 10^{-2})^2 [O_2]}{(1.1 \times 10^{-1})^2}$$

$$[O_2] = \frac{(2.4 \times 10^{-3})(1.1 \times 10^{-1})^2}{(1.2 \times 10^{-2})^2}$$

$$= 0.20 \frac{\text{mol}}{\text{L}}$$

8.



I	0.16	0	0
C	-x	+x	+x
E	0.16 - x	x	x

$$K = \frac{[\text{H}^+][\text{CO}_3^{2-}]}{[\text{HCO}_3^-]}$$

$$5.6 \times 10^{-11} = \frac{(x)(x)}{0.16 - x}$$

$$5.6 \times 10^{-11} \approx \frac{x^2}{0.16}$$

$$\text{assume } 0.16 - x \approx 0.16$$

$$x = \sqrt{0.16(5.6 \times 10^{-11})}$$

$$= 2.9933 \times 10^{-6}$$

$$[\text{CO}_3^{2-}]_{\text{eq}} = x \text{ mol/L}$$

$$= 3.0 \times 10^{-6} \frac{\text{mol}}{\text{L}}$$

↑
VALIDATION

$$\left(\frac{x}{0.16} \times 100 \right) \%$$

$$= 1.9 \times 10^{-3} \%$$

$$< 5 \%$$