Equilibrium Quiz - Study Guide : Answers

1. See book.

2. a) $CO_{2(g)} + H_{2(g)} \rightleftharpoons CO_{(g)} \quad K_c = (23.2)^{-1} = 0.043$

b) $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)} \quad K_c = (56)^2 = 3,136$

c) $H_{2(g)} + \frac{1}{2}S_{2(g)} \rightleftharpoons H_2S_{(g)} \quad K_c = (2.3\times10^{-4})^{-\frac{1}{2}} = 65.94$

d) $2CO_{(g)} + 2H_2O_{(g)} + S_{2(g)} \rightleftharpoons 2CO_{2(g)} + 2H_2S_{(g)} \quad K_c = (23.2)^2 \times (2.3\times10^{-4})^{-1}$

$= 2.34\times10^6$

3. $2H_2S_{(g)} \rightleftharpoons 2H_{2(g)} + S_{2(g)}$

$$K_p = \frac{P_{H_2}^2 P_{S_2}}{P_{H_2S}^2} = \frac{\left[\frac{(.22)(.0821)(1405)}{3}\right]^2\left[\frac{(.11)(.0821)(1405)}{3}\right]}{\left[\frac{(2.78)(.0821)(1405)}{3}\right]} = 1.02$$

4. $N_2O_{4(g)} \rightleftharpoons 2NO_{2(g)}$

$$K_c = \frac{[NO_2]^2}{[N_2O_4]} = \frac{\left(\frac{\text{mol } NO_2}{V}\right)^2}{\left(\frac{\text{mol } N_2O_4}{V}\right)} =$$

$$= \frac{\left(1.56\text{ g } NO_2 \times \frac{1\text{ mol } NO_2}{46\text{ g } NO_2} / 3\right)^2}{\left(7.46\text{ g } N_2O_4 \times \frac{1\text{ mol } N_2O_4}{92\text{ g } N_2O_4} / 3\right)}$$

$$K_c = 4.73\times10^{-3}$$

5. $7.46\,g \times \frac{1\,mol}{92\,g} = 0.0811$ mol N_2O_4 ; $1.56\,g \times \frac{1\,mol}{46\,g} = 0.0339$ mol NO_2

	N_2O_4	$\rightleftharpoons$	$2NO_2$
I	.0811 mol		.0339 mol
C	$-x$ mol		$+2x$ mol
E	$.0811-x$ mol		$.0339+2x$ mol

$$K_c = \frac{\left(\frac{.0339+2x}{10}\right)^2}{\left(\frac{.0811-x}{10}\right)} = 4.73\times10^{-3}$$

$x = 0.0117$

mol $N_2O_4 = .0811 - (.0117) = 0.0694$ mol $N_2O_4 \times \frac{92\,g\,N_2O_4}{1\,mol\,N_2O_4} = 6.38\,g\,N_2O_4$

mol $NO_2 = .0339 + 2(.0117) = 0.0573$ mol $NO_2 \times \frac{46\,g\,NO_2}{1\,mol\,NO_2} = 2.64\,g\,NO_2$

This makes sense, since the equilibrium should shift right w/ an increase in volume.

6.

	$2SO_{3(g)}$	$\rightleftharpoons$	$2SO_{2(g)}$	+	$O_{2(g)}$
I	0.02 mol		0		0
C	$-2x$		$+2x$		$+x$
E	$.02-2x$		$2x$		x

$$K_c = \frac{\left(\frac{2x}{1.52}\right)^2\left(\frac{x}{1.52}\right)}{\left(\frac{.02-2x}{1.52}\right)} = ?$$

$0.02-2x = 0.0142$

$x = 0.0029$

$K_c = 2.97\times10^{-6}$

7.

	$Ag^+_{(aq)}$	+	$Fe^{2+}_{(aq)}$	$\rightleftharpoons$	$Ag_{(s)}$	+	$Fe^{3+}_{(aq)}$
I	0.2 M		0.1 M		—		0.3 M
C	$+x$		$+x$		—		$-x$
E	$.2+x$		$.1+x$		—		$.3-x$

$K_c = 2.98$

$$K_c = \frac{(.3-x)}{(.2+x)(.1+x)} = 2.98 \Rightarrow x = 0.108$$

$[Ag^+]_{eq} = .2 + .108 = 0.308$ M

$[Fe^{2+}]_{eq} = .1 + .108 = 0.208$ M

$[Fe^{3+}]_{eq} = .3 - .108 = 0.192$ M