Review Package: Equilibrium Constant Keq & Calculations

3. Consider the following equilibrium system:

$$O_{2(g)} + 2HF_{(g)} \rightleftharpoons OF_{2(g)} \qquad \Delta H = +318 \text{ kJ/mol}$$

If the temperature of the system is increased,

A. K_{eq} will decrease
B. ΔH will decrease
C. K_{eq} will increase
D. ΔH will increase

4. Consider the following equilibrium system:

$$O_{2(g)} + 2HF_{(g)} \rightleftharpoons OF_{2(g)} \qquad \Delta H = +318 \text{ kJ/mol}$$

After a catalyst has been added to the system

A. K_{eq} cannot now be determined
B. K_{eq} increases
C. K_{eq} remains the same as before
D. K_{eq} decreases

5. Consider the following equilibrium system:

$$Fe_2O_{3(s)} + 3CO_{(g)} \rightleftharpoons 2Fe_{(s)} + 3CO_{2(g)}$$

The equilibrium constant expression for the forward reaction is

A. $K = \dfrac{[CO_2]^3}{[CO]^3}$

B. $\dfrac{[Fe]^2[CO_2]^3}{[Fe_2O_3][CO]^3}$

C. $\dfrac{[Fe]^2[CO_2]^3}{[CO]^3}$

D. $\dfrac{[CO_2]^3}{[Fe_2O_3][CO]^3}$

Review Package: Equilibrium Constant Keq & Calculations

6. For which of the following systems at equilibrium will the reaction go most fully to completion?

A. $2KClO_{3(s)} \rightleftharpoons 2KCl_{(s)} + 3O_{2(g)}$ $K_{eq} = 2.6 \times 10^{40}$

B. $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ $K_{eq} = 9.0$

C. $HC_2H_3O_{2(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + C_2H_3O_{2(aq)}$ $K_{eq} = 1.8 \times 10^{-5}$

D. $2HgO_{(s)} \rightleftharpoons 2Hg_{(l)} + O_{2(g)}$ $K_{eq} = 3.4 \times 10^{-40}$

7. Consider the following equilibrium system:

$$N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)} \qquad K_{eq} = 3.4 \times 10^{-3}$$

The equilibrium constant expression for the reverse reaction is

A. 3.4×10^{-6}
B. 3.4×10^{3}
C. 2.9×10^{2}
D. 6.8×10^{-3}

8. Consider the following equilibrium system: $A + B \rightleftharpoons C + D$ $K_{eq} = 2.50 \times 10^{-7}$

At the non-equilibrium situation, [A] = 2.00 M, [B] = 2.00 M, [C] = 1.00 M and [D] = 1.00 M, the reaction will

A. move to the left
B. move to the right
C. remain unchanged
D. not enough information is available.

9. Calculate the value of the equilibrium constant K for the equation

$$A \rightleftharpoons B + 3C$$

when equilibrium concentrations are [A] = 2.00×10^{-4} M, [B] = 8.00×10^{-3} M, [C] = 1.00×10^{-4} M.

A. 2.40×10^{12}
B. 4.00×10^{-11}
C. 4.00×10^{-5}
D. 4.00×10^{-3}

Review Package: Equilibrium Constant Keq & Calculations

10. When initial concentrations [CO] = 2.12 M and [O_2] = 1.10 M are heated, an equilibrium is established in which [CO_2] = 2.02 M. If the equation is

$$2CO + O_2 \rightleftharpoons 2CO_2 \qquad K_{eq} = \frac{[CO_2]^2}{[CO]^2[O_2]}$$

calculate the value of K.

A. 2.24×10^{2}
B. 4.53×10^{3}
C. 8.94×10^{-6}
D. 8.25×10^{-1}

12. What is the value of the equilibrium constant, K, for the reaction

$$A + B \rightleftharpoons 2C$$

if at equilibrium, [A] = 0.0300 M, [B] = 0.0400 M, and [C] = 1.20 M?

A. 8.33×10^{-3}
B. 1.20×10^{3}
C. 1.00×10^{4}
D. 2.00×10^{4}

16. Which one of the following statements about a reaction indicates that the products are favoured at equilibrium?

A. The reaction is endothermic.
B. The equilibrium constant is large.
C. The activation energy of the forward reaction is high.
D. The ΔH value is large.

17. The K_{eq} value for the Haber process: $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

at a particular temperature and pressure is 75. If the equilibrium [N_2] is 0.023 M and [H_2] is 0.078 M, what is the equilibrium [NH_3]?

A. 8.2×10^{-4} M
B. 6.7×10^{-7} M 4.4×10^{-3} M
C. 0.029 M
D. 0.37 M

Review Package: Equilibrium Constant Keq & Calculations

19. For the equation: $A_{(aq)} + B_{(aq)} \rightleftharpoons C_{(aq)} + \text{heat}$

    how will the equilibrium constant be affected by a temperature increase?

    A. The equilibrium constant increases.
    B. The equilibrium constant decreases.
    C. The equilibrium constant is unchanged.
    D. There are insufficient data to make a prediction.

20. The reaction for the decomposition of hydrogen sulphide gas at high temperatures is

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

    What is the K_{eq} expression for this reaction?

    A. $K_{eq} = \dfrac{[H_2][S_2]}{[H_2S]}$

    B. $K_{eq} = \dfrac{[H_2]^2[S_2]}{[H_2S]^2}$

    C. $K_{eq} = \dfrac{[H_2S]^2}{[H_2]^2[S_2]}$

    D. $K_{eq} = [H_2]^2[S_2]$

25. Consider the following equilibrium system:

$$CO_{2(g)} + H_{2(g)} \rightleftharpoons CO_{(g)} + H_2O_{(g)}$$

    At equilibrium, $[CO_2]$ = 0.648 mol/L, $[H_2]$ = 0.148 mol/L, [CO] = 0.352 mol/L, and $[H_2O]$ = 0.352 mol/L. From these data, the K_{eq} value for the above system is

    A. 0.774
    B. 1.29
    C. 3.07
    D. 3.67

Review Package: Equilibrium Constant Keq & Calculations

26. Given the following equilibrium system:

$$C_{(s)} + H_2O_{(g)} \rightleftharpoons CO_{(g)} + H_{2(g)}$$

The equilibrium constant expression for the above system is

A. $K_{eq} = [CO][H_2]$

B. $K_{eq} = \frac{[CO][H_2]}{[H_2O]}$

C. $K_{eq} = \frac{[CO][H_2]}{[H_2O][C]}$

D. $K_{eq} = \frac{[H_2O]}{[CO][H_2]}$

28. Consider the following equilibrium system:

$$2HI_{(g)} \rightleftharpoons H_{2(g)} + I_{2(g)}$$

An analysis of the above equilibrium system shows that the [reactants] are much larger the [products]. Which of the following equilibrium constant values would be consistent with these data?

A. –0.040
B. 0.0030
C. 1.0
D. 25

33. Given the following equilibrium system:

$$Br_{2(g)} \rightleftharpoons Br_{2(l)}$$

The equilibrium constant expression for the above system is:

A. $K_{eq} = \frac{[Br_{2(l)}]}{[Br_{2(g)}]}$

B. $K_{eq} = [Br_{2(g)}]$

C. $K_{eq} = \frac{1}{[Br_{2(g)}]}$

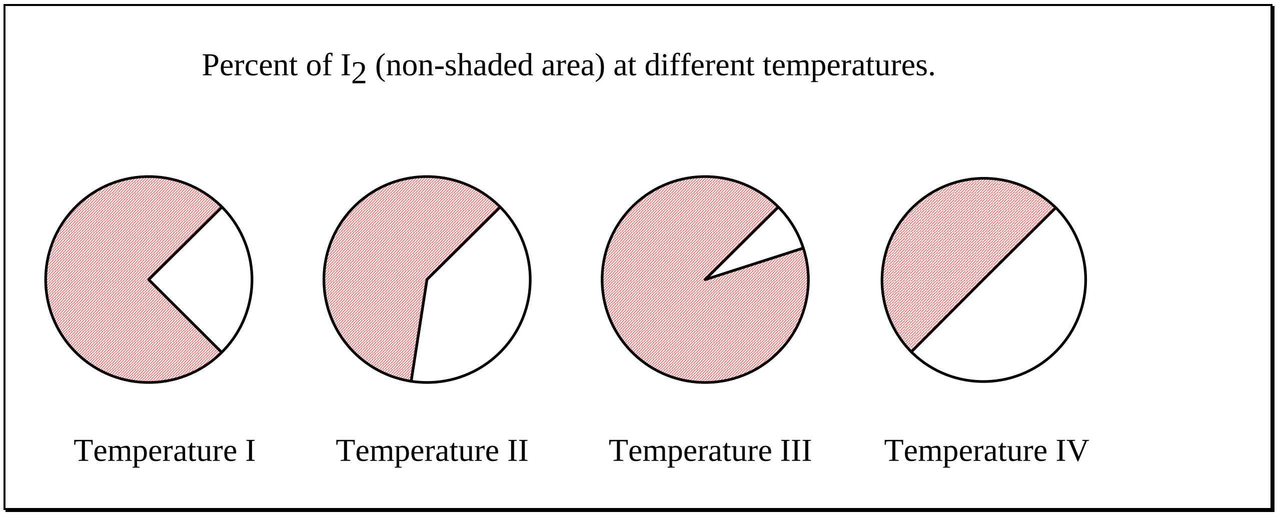
D. $K_{eq} = [Br_{2(g)}][Br_{2(g)}]$

Review Package: Equilibrium Constant Keq & Calculations

34. Consider the following equilibrium system:

$$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$$

The percent of I_2 (by volume) is determined in the above equilibrium at four different temperatures. The results are displayed in the following pie graphs:



From this data, the K_{eq} value for the above equilibrium is largest at temperature

A. I.
B. II.
C. III.
D. IV.

35. Consider the following equilibrium system:

$$2NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_{2(g)}$$

At equilibrium, [NO] = 0.600 M, [O_2] = 0.800 M and [NO_2] = 4.40 M. From these data, the K_{eq} value for the above system is

A. 0.105
B. 9.17
C. 40.3
D. 67.2

Review Package: Equilibrium Constant Keq & Calculations

36. Consider the following equilibrium system:

$$2NO_{(g)} + Cl_{2(g)} \rightleftharpoons 2NOCl_{(g)}$$

0.80 moles of NO and 0.60 moles of Cl_2 are placed into a 1.0 L container and allowed to establish equilibrium. At equilibrium, [NOCl] = 0.56 mol/L. The equilibrium [Cl_2] is

A. 0.28 mol/L
B. 0.32 mol/L
C. 0.40 mol/L
D. 0.60 mol/L

41. Which of the following systems most favours products at equilibrium?

A. $2NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_{2(g)}$ $K_{eq} = 1.55 \times 10^{-6}$

B. $H_{2(g)} + Cl_{2(g)} \rightleftharpoons 2HCl_{(g)}$ $K_{eq} = 1.80 \times 10^{8}$

C. $CO_{(g)} + Cl_{2(g)} \rightleftharpoons COCl_{2(g)}$ $K_{eq} = 8.20 \times 10^{-1}$

D. $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$ $K_{eq} = 2.61 \times 10^{2}$

42. When air is drawn into a car's engine, the following endothermic reaction occurs:

$$N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$$

At room temperature the K_{eq} for this reaction is 4.8×10^{-31}. At the high temperatures found in a car's engine the

A. [NO] increases and the K_{eq} increases.
B. [NO] increases and the K_{eq} decreases.
C. [NO] decreases and the K_{eq} increases.
D. [NO] decreases and the K_{eq} decreases.

43. Consider the following equilibrium:

$$H_{2(g)} + Br_{2(g)} \rightleftharpoons 2HBr_{(g)} \qquad K_{eq} = 1.02$$

Equal moles of H_2 and Br_2 were placed in a flask and at equilibrium the [HBr] was 0.500 mol/L. The equilibrium concentration of $H_{2(g)}$ was

A. 0.123 mol/L
B. 0.245 mol/L
C. 0.495 mol/L
D. 0.700 mol/L

Review Package: Equilibrium Constant Keq & Calculations

44. Consider the following reaction:

$$2O_{3(g)} \rightleftharpoons 3O_{2(g)} \qquad K_{eq} = 55$$

If 0.050 mol of O_3 and 0.70 mol of O_2 are introduced into a 1.0 L vessel, the

A. $K_{trial} > K_{eq}$ and the $[O_2]$ increases.

B. $K_{trial} < K_{eq}$ and the $[O_2]$ increases.

C. $K_{trial} > K_{eq}$ and the $[O_2]$ decreases.

D. $K_{trial} < K_{eq}$ and the $[O_2]$ decreases.

49. Consider the following equilibrium constant expression

$$K_{eq} = [CO_2]$$

Which one of the following equilibrium systems does the above expression represent?

A. $CO_{2(g)} \rightleftharpoons CO_{2(s)}$

B. $PbO_{(s)} + CO_{2(g)} \rightleftharpoons PbCO_{3(s)}$

C. $CaCO_{3(s)} \rightleftharpoons CaO_{(s)} + CO_{2(g)}$

D. $H_2CO_{3(aq)} \rightleftharpoons H_2O_{(l)} + CO_{2(aq)}$

50. Hydrogen gas dissociates into atomic hydrogen as follows:

$$H_{2(g)} \rightleftharpoons 2H_{(g)} \qquad K_{eq} = 1.2 \times 10^{-71}$$

The value of the equilibrium constant for the above system indicates that

A. the reaction rate is very slow.
B. the equilibrium is exothermic.
C. reactants are favoured at equilibrium.
D. a catalyst is necessary to establish equilibrium.

Review Package: Equilibrium Constant Keq & Calculations

51. Consider the following equilibrium system:

$$CO_{(g)} + Cl_{2(g)} \rightleftharpoons COCl_{2(g)}$$

At equilibrium, a 2.0 litre sample was found to contain 1.00 mol CO, 0.500 mol Cl_2 and 0.100 mol $COCl_2$. The K_{eq} value for the above system is

A. 0.40
B. 0.20
C. 2.5
D. 5.0

52. Consider the following equilibrium system:

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)} \qquad K_{eq} = 4.0$$

In an experiment, 0.40 mol $SO_{2(g)}$, 0.20 mol $O_{2(g)}$ and 0.20 mol $SO_{3(g)}$ are placed into a 1.0 litre container. Which of the following statements relates the changes in $[SO_2]$ and $[O_2]$ as the equilibrium becomes established?

A. The $[SO_2]$ and $[O_2$ increase.
B. the $[SO_2]$ and $[O_2]$ decrease.
C. The $[SO_2]$ and $[O_2]$ do not change.
D. The $[SO_2]$ increases and the $[O_2]$ decreases.

57. Consider the following equilibrium system:

$$SnO_{2(s)} + 2CO_{(g)} \rightleftharpoons Sn_{(s)} + 2CO_{2(g)}$$

The equilibrium constant expression for the above system is

A. $K_{eq} = \dfrac{[CO_2]^2}{[CO]^2}$

B. $K_{eq} = \dfrac{[2CO_2]^2}{[2CO]^2}$

C. $K_{eq} = \dfrac{[CO_2]^2 [Sn]}{[CO]^2[SnO_2]}$

D. $K_{eq} = \dfrac{[2CO_2]^2 [Sn]}{[2CO]^2[SnO_2]}$

Review Package: Equilibrium Constant Keq & Calculations

58. An equal number of moles of $I_{2(g)}$ and $Br_{2(g)}$ are placed into a closed container and allowed to establish the following equilibrium:

$$I_{2(g)} + Br_{2(g)} \rightleftharpoons 2IBr_{(g)} \qquad K_{eq} = 280$$

Which one of the following relates [IBr] to $[I_2]$ at equilibrium?

A. $[I_2] = [IBr]$

B. $[I_2] < [IBr]$

C. $[I_2] = 2[IBr]$

D. $[I_2] = 280[IBr]$

59. Consider the following equilibrium

$$2NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_{2(g)} \qquad K_{eq} = 65$$

At equilibrium, the [NO] = 0.600 M and the $[O_2]$ = 0.300 M. Using this data, the equilibrium $[NO_2]$ is

A. 7.0 M
B. 3.4 M
C. 2.6 M
D. 0.60 M

60. Consider the following equilibrium system:

$$CO_{2(g)} + H_{2(g)} \rightleftharpoons CO_{(g)} + H_2O_{(g)}$$

1.00 mole of $CO_{2(g)}$ and 2.0 moles of $H_{2(g)}$ are placed into a 2.00 litre container. At equilibrium, the [CO] = 0.31 mol/L. Based on this data, the equilibrium $[CO_2]$ is

A. 0.19 M
B. 0.31 M
C. 0.38 M
D. 0.69 M

Review Package: Equilibrium Constant Keq & Calculations

WRITTEN RESPONSE

For the remainder of the questions, marks will be awarded as shown. Your steps and assumptions leading to a solution must be shown. In questions involving calculations, full marks will not be given for providing only an answer. Students will be expected to communicate the knowledge and understanding of chemical principles in a clear and logical manner.

1. For the reaction, $H_{2\,(g)} + I_{2\,(g)} \Leftrightarrow 2\,HI_{(g)}$, the equilibrium constant is 49. If the initial $[H_2] = 5.0 \times 10^{-2}$ M and the initial $[I_2] = 5.0 \times 10^{-2}$ M, find the equilibrium concentration of HI. **(4 marks)**

2. 1.0 mol of $NH_{3\,(g)}$ was introduced into a 1.0 L flask and allowed to come to equilibrium. At equilibrium, analysis indicated that 0.60 mol of hydrogen had been produced. Calculate the equilibrium constant for the reaction given the equation below : **(4 marks)**

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

3. $K_{eq} = 798$ for the reaction $2\,SO_{2\,(g)} + O_{2\,(g)} \Leftrightarrow 2\,SO_{3\,(g)}$
In a particular mixture at equilibrium, $[SO_2] = 4.20$ M and $[SO_3] = 11.0$ M.
Calculate the equilibrium $[O_2]$ in this mixture. **(3 marks)**

4. $K_{eq} = 0.0183$ for the reaction $2\,HI_{(g)} \Leftrightarrow H_{2\,(g)} + I_{2\,(g)}$
If 3.00 mol of HI is placed in a 5.00 L vessel and allowed to reach equilibrium, what is the equilibrium concentration of H_2 ? **(4 marks)**

5. $$SO_{3\,(g)} + NO_{(g)} \Leftrightarrow NO_{2\,(g)} + SO_{2\,(g)}$$
The value of K_{eq} for the above mixture is 0.800. A particular reaction mixture has the following concentrations :
$[SO_3] = 0.400$ M $\quad$ $[NO] = 0.480$ M
$[NO_2] = 0.600$ M $\quad$ $[SO_2] = 0.450$ M
a) Show, by calculation, that this mixture is not at equilibrium. (2 marks)
b) What will happen to the concentration of SO_3 and SO_2 as the system moves towards equilibrium ? **(1 mark)**

7. Consider the following reaction :
$$2\,NO_{(g)} + Br_{2\,(g)} \Leftrightarrow 2\,NOBr_{(g)}$$
When 0.30 mol of NO and 0.30 mol of Br_2 are placed in a 1.0 L container, it is found that the equilibrium [NOBr] = 0.20 M. Calculate the value of K_{eq}.
(3 marks)

9. When 1.00 mol of HBr is placed in a 1.00 L flask at 510°C, the following equilibrium is achieved :
$2\,HBr_{(g)} \Leftrightarrow H_{2\,(g)} + Br_{2\,(g)}$
At equilibrium, 0.14 mol of H_2 is present. Calculate the value of K_{eq}. **(3 marks)**

10. $2\,NO_{2\,(g)} + Cl_{2\,(g)} \Leftrightarrow 2\,NO_2Cl_{(g)}$
Initially, 0.600 mol of NO_2 and 0.800 mol of Cl_2 are placed in a 2.00 L container.
At equilibrium, the $[NO_2Cl]$ is found to be 0.200 M. Calculate the value of K_{eq}.
(4 marks)

Review Package: Equilibrium Constant Keq & Calculations

12. $2 HBr_{(g)} \Leftrightarrow H_{2 (g)} + Br_{2 (g)}$

K_{eq} for the above reaction is 1.47 at 32°C. 2.0 mol of HBr are placed in a 1.0 L vessel and the system is allowed to achieve equilibrium. Calculate the equilibrium $[H_2]$. **(4 marks)**

13. Consider the following equilibrium system:

$NH_4Cl_{(s)} \Leftrightarrow NH_{3(g)} + HCl_{(g)}$ $K_{eq} = 0.45$ at 250°C

Calculate the equilibrium concentration of NH_3 when an excess of NH_4Cl is placed in a container at 250°C and allowed to reach equilibrium. **(2 marks)**

15. Consider the following equilibrium:

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

When 0.600 mole of SO_2 and 0.600mole of O_2 are placed into a 1.00 litre container and allowed to establish equilibrium, the equilibrium $[SO_3]$ is found to be 0.500 M. Calculate the K_{eq} value. **(3 marks)**

17. Consider the following equilibrium system:

$2SO_{2(g)} + O_{2(g)} \Leftrightarrow 2SO_{3(g)}$ $K_{eq} = 75$

A student places 0.40 moles of SO_2, 0.050 moles of O_2 and 0.80 moles of SO_3 into a 1.00 litre sealed flask. The students predicts that the $[SO_2]$ will decrease as the equilibrium is established. Do you agree with the student's prediction? Explain, using appropriate calculations. **(3 marks)**

19. 0.400 mol of H_2 and 0.200 mol of I_2 were placed in a 2.00 L flask and allowed to reach equilibrium according to the reaction:

$H_{2(g)} + I_{2(g)} \Leftrightarrow 2HI_{(g)}$

At equilibrium the concentration of HI was 0.150 mol/L. Calculate the equilibrium constant value. **(3 marks)**

21. Consider the following equilibrium system:

$PCl_{3(g)} + Cl_{2(g)} \Leftrightarrow PCl_{5(g)}$

At 250°C, 0.40 mol of PCl_3 and 0.60 mol of Cl_2 are placed into a 1.0 L container. At equilibrium, the $[PCl_5] = 0.11$ mol/L. Calculate the value of K_{eq}. **(3 marks)**

Review Package: Equilibrium Constant Keq & Calculations

ANSWER KEY

MULTIPLE CHOICE

1.	D	16.	B	31.	C	46.	C
2.	C	17.	C	32.	B	47.	C
3.	C	18.	D	33.	C	48.	C
4.	C	19.	B	34.	C	49.	C
5.	A	20.	B	35.	D	50.	C
6.	A	21.	B	36.	B	51.	A
7.	C	22.	D	37.	C	52.	B
8.	A	23.	A	38.	A	53.	D
9.	B	24.	B	39.	B	54.	A
10.	B	25.	B	40.	C	55.	A
11.	D	26.	B	41.	B	56.	A
12.	B	27.	C	42.	A	57.	A
13.	B	28.	B	43.	C	58.	B
14.	B	29.	A	44.	C	59.	C
15.	D	30.	A	45.	D	60.	A

WRITTEN RESPONSE

1. 0.078 M

2. $K_{eq} = 0.12$

3. 8.60×10^{-3} M

4. 0.0639 M

5. a) $K_{trial} = 1.4$ This does not equal K_{eq} therefore the system is not at equilibrium.
   b) Because $K_{trial} > K_{eq}$, the system will shift to the left so $[SO_3]$ will increase and $[SO_2]$ will decrease.

7. 20

9. 3.8×10^{-2}

10. 13.3

12. 0.71 mol/L

13. $K_{eq} = [NH_3][HCl]$ ½ **mark** let $x = [NH_3]_{eq} = [HCl]_{eq}$ ½ **mark**

$0.45 = x^2$ ½ **mark**

$0.67 = x = [NH_3]$ ½ **mark**

Review Package: Equilibrium Constant Keq & Calculations

15. $2SO_{2(g)} + O_{2(g)} \Leftrightarrow 2SO_{3(g)}$

	$2SO_{2(g)}$	$O_{2(g)}$	$2SO_{3(g)}$
I	0.600	0.600	0
C	−0.500	−0.250	+0.500
E	0.100	0.350	0.500

(1 ½ marks)

$K_{eq} = \frac{[SO_3]^2}{[SO_2]^2[O_2]}$ **(1/2 mark)**

$K_{eq} = \frac{(0.500)^2}{(0.100)^2(0.350)} = 71.4$ **(1 mark: ½ for substituting, ½ for ans)**

17. Trial $K_{eq} = \frac{[SO_3]^2}{[SO_2]^2[O_2]}$

$= \frac{0.80^2}{(0.40)^2(0.050)}$

$= 80$

(1 ½ marks)

Disagree because Trial $K_{eq} > K_{eq}$ so the system will shift left to establish equilibrium and $[SO_2]$ will increase. **(1 ½ marks)**

19. $[H_2] = 0.400 \text{ mol}/2.00 \text{ L} = 0.200 \text{ M}$ **(1/2 mark)**

$[I_2] = 0.200 \text{ mol}/2.00 \text{ L} = 0.100 \text{ M}$ **(1/2 mark)**

$K_{eq} = \frac{[HI]^2}{[H_2][I_2]}$ **(1/2 mark)**

$= \frac{(0.150)^2}{(0.200)(0.100)}$ **(1/2 mark)**

$= 1.125 = 1.12$ **(1 mark; −1/2 for incorrect sig figs; −1/2 for incorrect rounding)**

Review Package: Equilibrium Constant Keq & Calculations

21. $PCl_{3(g)} + Cl_{2(g)} \Leftrightarrow PCl_{5(g)}$

	$PCl_{3(g)}$	$Cl_{2(g)}$	$PCl_{5(g)}$	
I	0.40	0.60	0.00	
C	−0.11	−0.11	+0.11	**(1 ½ marks)**
E	0.29	0.49	0.11	

$K_{eq} = \frac{[PCl_5]}{[PCl_3][Cl_2]}$ **(1/2 mark)**

$= \frac{(0.11)}{(0.29)(0.49)}$ **(1/2 mark)**

$= 0.77$ **(1/2 mark)**