1 Calculate the moles at equilibrium in each of the following.

<table>
<thead>
<tr>
<th>Reaction</th>
<th>Initial Moles</th>
<th>Change in Moles</th>
<th>Equilibrium Moles</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3 )</td>
<td>( 1.0 ) ( 2.0 ) ( 0 )</td>
<td>( -0.3 ) ( -0.9 ) ( +0.6 )</td>
<td>( 0.7 ) ( 1.1 ) ( 0.6 )</td>
</tr>
<tr>
<td>( 2\text{SO}_2 + \text{O}_2 \rightleftharpoons 2\text{SO}_3 )</td>
<td>( 5.0 ) ( 2.0 ) ( 0 )</td>
<td>( -1.2 ) ( -0.6 ) ( +1.2 )</td>
<td>( 3.8 ) ( 1.4 ) ( 1.2 )</td>
</tr>
<tr>
<td>( \text{H}_2 + \text{I}_2 \rightleftharpoons 2\text{HI} )</td>
<td>( 3.0 ) ( 4.0 ) ( 0 )</td>
<td>( -1.4 ) ( -1.4 ) ( +2.8 )</td>
<td>( 1.6 ) ( 2.6 ) ( 2.8 )</td>
</tr>
<tr>
<td>( 2\text{PCl}_5 \rightleftharpoons \text{PCl}_3 + \text{Cl}_2 )</td>
<td>( 2.0 ) ( 0 ) ( 1.0 )</td>
<td>( -0.4 ) ( +0.4 ) ( +0.4 )</td>
<td>( 1.6 ) ( 0.4 ) ( 1.4 )</td>
</tr>
</tbody>
</table>

2 A and B react to form C and D in an equilibrium in a closed system. At temperature \( T \), the equilibrium constant \( K_c \) has a value of 4.72. The forward reaction is exothermic.

\[
\text{A}(g) + \text{B}(g) \rightleftharpoons \text{C}(g) + \text{D}(g) \quad \Delta H = -57 \text{ kJ mol}^{-1}
\]

a What would happen to the yield of C and \( K_c \) if the pressure was increased. Explain your answer.

- equilibrium position does not move as there are same number of gas particles on each side
- no effect on yield of C
- no change in \( K_c \)

b What would happen to the yield of C and \( K_c \) if the temperature was increased. Explain your answer.

- equilibrium position moves left in endothermic direction to oppose increase in temperature
- decreases yield of C
- \( K_c \) decreases

c 2.0 moles of A and 2.0 moles of B were placed in a flask at temperature \( T \). Calculate the number of moles of C in the equilibrium mixture.

\[
\begin{align*}
\text{moles at start} & \quad \text{2.0} \quad \text{2.0} \quad \text{0} \quad \text{0} \\
\text{change in moles} & \quad -x \quad -x \quad x \quad x \\
\text{moles at equilibrium} & \quad 2-x \quad 2-x \quad x \quad x
\end{align*}
\]

\[
K_c = \frac{[\text{C}][\text{D}]}{[\text{A}][\text{B}]} = \frac{(\frac{x}{V})^2}{(\frac{2-x}{V})^2} = 4.72
\]

square rooting both sides and cancelling \( V \):

\[
\frac{x}{2-x} = 2.17
\]

\[
x = 2.17(2-x)
\]

\[
x = 4.34 - 2.17x
\]

\[
3.17x = 4.34 \quad x = 1.37
\]