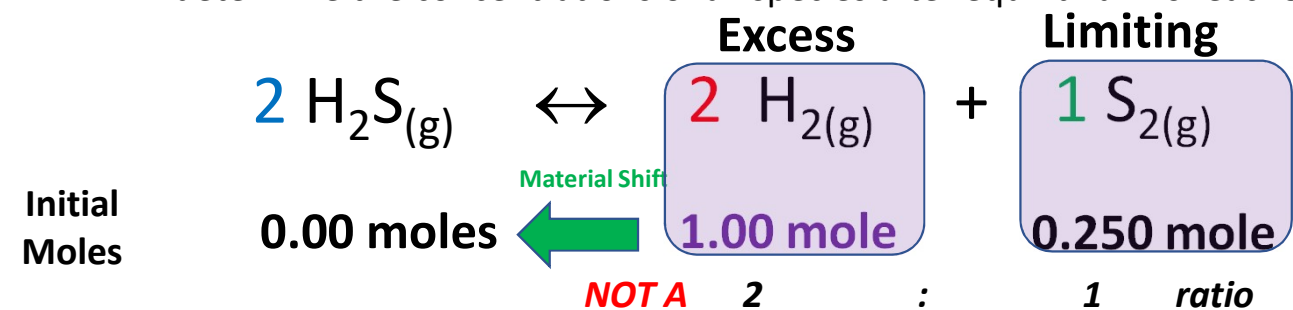


3. Material Shift Required

1.00 mole of H₂ gas and 0.250 mole S₂ are placed in a closed 2.00 liter container. Assuming no H₂S is originally present, determine the concentrations of all species after equilibrium is reached.



H₂ Limiting Determination

$$\frac{1.00 \text{ mole H}_2}{1} \times \frac{\text{Mole ratio } 2 \text{ mole H}_2\text{S}}{2 \text{ mole H}_2} = \boxed{1.00 \text{ mole H}_2\text{S}}$$

Larger ⇒ Excess

S₂ Limiting Determination

$$\frac{0.250 \text{ mole S}_2}{1} \times \frac{\text{Mole ratio } 2 \text{ mole H}_2\text{S}}{1 \text{ mole S}_2} = \boxed{0.500 \text{ mole H}_2\text{S}}$$

Smaller ⇒ Limiting

Left-over H₂ Determination

$$\frac{0.250 \text{ mole S}_2}{1} \times \frac{\text{Mole ratio } 2 \text{ mole H}_2}{1 \text{ mole S}_2} = 0.500 \text{ mole H}_2 \text{ consumed}$$

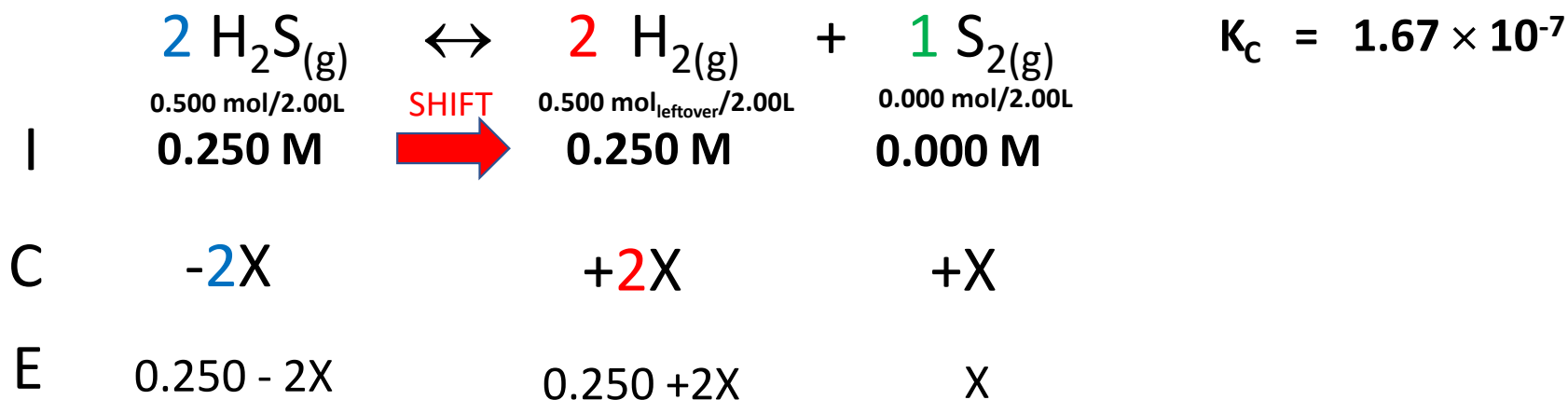
Left-over H₂ = $\frac{1.00 \text{ mole H}_2 \text{ initially} - 0.500 \text{ mole H}_2 \text{ consumed}}{0.500 \text{ mole H}_2 \text{ leftover}}$

$K_c = 1.67 \times 10^{-7}$
 Small $K_c \Rightarrow$ Favors Reactants
 Initially, only products are present.
 Shifts strongly to the left (reactants).
 Can't use $X \sim 0$ assumption.
 Nasty math ahead.
 Material Shift:
 Convert product to reactant



3. Material Shift Required

1.00 mole of H_2 gas and 0.250 mole S_2 are placed in a closed 2.00 liter container
 Assuming no H_2S is originally present,
 determine the concentrations of all species after equilibrium is reached.



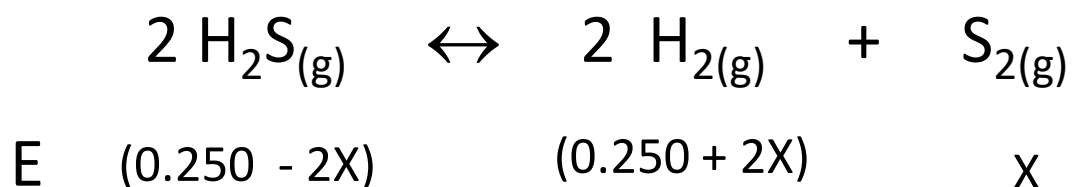
$$\frac{[\text{H}_2]^2 [\text{S}_2]}{[\text{H}_2\text{S}]^2} = \frac{(0.250 + \overset{X=0}{\textcircled{2X}})^2 \overset{X=0}{\textcircled{X}}}{(0.250 - \overset{X=0}{\textcircled{2X}})^2} = \frac{(0.250)^2 \overset{X=0}{\textcircled{X}}}{(0.250)^2} = 1.67 \times 10^{-7}$$

$(0.250)^2 \overset{X=0}{\textcircled{X}}$

$\overset{X=0}{\textcircled{X}} = 1.67 \times 10^{-7}$



3. Material Shift Required



$$K_C = 1.67 \times 10^{-7}$$

$$X = 1.67 \times 10^{-7}$$

i. Equilibrium Concentrations

$$[\text{H}_2\text{S}]_{\text{eq}} = 0.250 - 2X = 0.250 \text{ M}$$

$$[\text{H}_2]_{\text{eq}} = 0.250 + 2X = 0.250 \text{ M}$$

$$[\text{S}_2]_{\text{eq}} = X = 1.67 \times 10^{-7} \text{ M}$$

...most of material shifted reactant remains.

...only small changes to product amounts

ii. 5% check

$$(0.250 - 2X)^2$$

$$\frac{2X}{0.250} \times 100 = 0.000001336 \%$$

$$0.000001336\% < 5\% \quad \text{😊}$$

iii. Equilibrium Check

$$\frac{[\text{H}_2]^2 [\text{S}_2]}{[\text{H}_2\text{S}]^2}$$

$$\frac{(0.250)^2 (1.67 \times 10^{-7})}{(0.250)^2}$$

$$= 1.67 \times 10^{-7} = K_C \quad \text{😊}$$