

SCH 4U

PREDICTING DIRECTION OF REACTION

$$K_c = \frac{[\text{Products}]^x}{[\text{Reactants}]^y}$$

1. If Reactants \rightleftharpoons Products, then $[P] \gg [R]$ $\therefore K_c \gg 1$

2. If Reactants \rightleftharpoons Products, then $[P] \approx [R]$ $\therefore K_c \approx 1$

3. If Reactants \rightleftharpoons Products, then $[P] \ll [R]$ $\therefore K_c \ll 1$

To Check if a Reaction has reached Equilibrium,

1. Use reaction quotient, Q_c , (same as K_c , but used to test an equilibrium system).
2. Substitute values into Q_c .
3. If $Q_c = K_c$, system is at equilibrium.

If $Q_c > K_c$, too many products, so reaction will reach equilibrium by going to the LEFT.

If $Q_c < K_c$, too few products, so reaction will reach equilibrium by going to the RIGHT.

Eg. At 500°C, $K_c=0.40$ for $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

In a container, $[N_{2(g)}] = 0.10 \text{ mol/L}$, $[H_{2(g)}] = 0.30 \text{ mol/L}$, and $[NH_3] = 0.20 \text{ mol/L}$.

- Is this reaction at equilibrium?
- If not, which direction will it go to reach equilibrium?

$$Q_c = \frac{[NH_3]^2}{[N_2][H_2]^3} \quad K_c = 0.40$$

Le Chatelier's Principle

“If a system at equilibrium is subjected to an external stress, the equilibrium will shift so as to minimize the stress.”

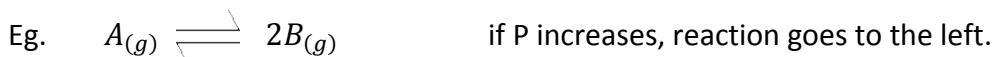
(A) CHANGES IN [R] & [P]

- If $[R]$ increases or $[P]$ decreases, $Q_c < K_c$, therefore reaction goes to the right.
- If $[R]$ decreases or $[P]$ increases, $Q_c > K_c$, therefore reaction goes to the left.



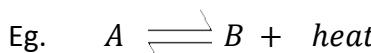
(B) CHANGES IN VOLUME OR PRESSURE (OF GASES)

- If V decreases or P increases, reaction goes to side with fewer moles
- If V increases or P decreases, reaction goes to side with more moles



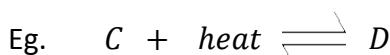
(C) CHANGES IN TEMPERATURE

- If exothermic, treat NRG as a product
- If endothermic, treat NRG as a reactant



If temperature increases (more heat), reaction goes to the left.

If temperature decreases (less heat), reaction goes to the right.



If temperature increases, reaction goes to the right.

If temperature decreases, reaction goes to the left.

(D) EFFECT OF A CATALYST

- No effect on equilibrium (would only get there faster)

(E) ADDITION OF A NON-REACTANT/PRODUCT

- Not part of reaction, so it does not affect equilibrium

Eg. How can you shift equilibrium to the right?



A) Temperature –

B) $[SO_2]$ –

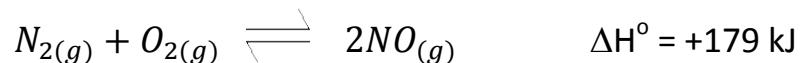
C) $[O_2]$ –

D) $[SO_3]$ –

E) Pressure –

F) Volume –

Eg. Which direction will equilibrium shift for ...



A) add N_2 –

B) remove O_2 –

C) add catalyst –

D) add He –

E) reduce volume to half –