AQA Chemistry A-level

Topic 1.6 - Chemical Equilibria, Le Chatelier's principle and K_c

Flashcards

Define the term dynamic equilibrium.

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The rate of the forward reaction is equal to the rate of the reverse reaction.

(Hence, the concentrations of reactant and product do not change)

Give an essential condition for an equilibrium mixture.

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- Equilibrium occurs in a **closed system** (where reactants and products cannot escape)

OR

- Macroscopic properties do not change with time

State Le Chatelier's principle.

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If a system at equilibrium is disturbed, the equilibrium moves in the direction that tends to reduce the disturbance.

In the equation:

$$CH_{4(g)} + H_2O_{(g)} \rightleftharpoons CO_{(g)} + 3H_{2(g)}$$

$\Delta H° = +210 \text{ kJ mol}^{-1}$

What effect would increasing the **temperature** have on the position of equilibrium?

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The equilibrium position **shifts to the right**.

(This is because the forward reaction is endothermic. Yield of hydrogen increases.)

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$$CH_{4(g)} + H_2O_{(g)} \rightleftharpoons CO_{(g)} + 3H_{2(g)}$$

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What effect would increasing the **pressure** have on the position of equilibrium?

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The equilibrium position **shifts to the left**.

This is because the forward reaction is produces more moles of gas than the reverse reaction (4 moles of product, 2 moles of reactant). Yield of hydrogen decreases.

The reaction:

$$CH_{4(g)} + H_2O_{(g)} \rightleftharpoons CO_{(g)} + 3H_{2(g)} \qquad \Delta H° = +210 \text{ kJ mol}^{-1}$$

Suggest and explain why an industrial chemist may use a **high pressure** for this production of hydrogen from the above reaction?

Suggest and explain why an industrial chemist may use a high pressure for the production of hydrogen from: $CH_{4(g)} + H_2O_{(g)} \rightleftharpoons CO_{(g)} + 3H_{2(g)}$ $\Delta H° = +210 \text{ kJ mol}^{-1}$

1. The high pressure increases the **collision frequency**, increasing the **rate of reaction**.

2. This is a **compromise pressure** between an economically viable rate of reaction and a slightly lower yield of hydrogen.

What effect does a catalyst have on the position of equilibrium?

What effect does a catalyst have on the position of equilibrium?

No effect.

(because catalyst affects rate of forward and reverse reactions equally)

What condition affects the value of K_c ?

- ❑ Concentration
- ❑ Catalyst
- ❑ Pressure
- ❑ Temperature

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- ☐ Concentration
- ☐ Catalyst
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- ☑ Temperature

For the reaction below, deduce an expression for K_c .

$$2[A] + 3[B] + [C] \rightleftharpoons [D] + 4[E]$$

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$$2[A] + 3[B] + [C] \rightleftharpoons [D] + 4[E]$$

$$K_c = \frac{[D][E]^4}{[A]^2[B]^3[C]}$$

Deduce units for the value of K_c

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Deduce units for the value of K_c

$$mol^{-1}\ dm^3$$

What type of system is K_c relevant for?

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Homogeneous systems in equilibrium

What does K_c being greater of lesser than 1 suggest for the position of equilibrium?

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Greater than 1 = over to the right

Lesser than 1 = over to the left

What effect does **decreasing the temperature** in an **endothermic** reaction have on $\mathbf{K_c}$?

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K_c decreases

What effect does **increasing the temperature** in an **endothermic** reaction have on $\mathbf{K_c}$?

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K_c increases

What effect does **decreasing the temperature** in an **exothermic** reaction have on $\mathbf{K_c}$?

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$\mathbf{K_c}$ increases

What effect does **increasing the temperature** in an **exothermic** reaction have on $\mathbf{K_c}$?

What effect does **increasing the temperature** in an **exothermic** reaction have on $\mathbf{K_c}$?

$\mathbf{K_c}$ decreases