Edexcel Chemistry A-level

Topic 10 - Equilibrium I

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 reactants and products 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 altered, the position of equilibrium moves in the direction that reduces the effect of the initial change.

In the equation:

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

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

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

What effect would increasing the temperature have on the position of equilibrium? In the equation: $CH_{4(g)} + H_2O_{(g)} \rightleftharpoons CO_{(g)} + 3H_{2(g)}$ $\Delta H° = +210\ kJ\ mol^{-1}$

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

(This is because the forward reaction is endothermic shown by the +ve ΔH value.)

In the equation:

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

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

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

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

(This is because the rhs of the equation has more moles of gas than the lhs. The side with fewer moles is favoured.)

Consider the reaction:

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

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

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 from the equilibrium reaction.

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

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

No effect.

(This is because a catalyst affects rate of forward and reverse reactions equally rsulting in no overall effect.)

What condition affects the value of K_c ?

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

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- ☐ Concentration
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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 when:

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

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 or less than 1 suggest for the position of equilibrium?

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

Greater than 1 = shifted to the right

Lesser than 1 = shifted to the left

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

What effect does **decreasing the temperature** in an **endothermic** reaction have on K_c ?

K_c decreases

(The endothermic reaction isn't favoured so equilibrium shifts to the left.)

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

What effect does **increasing the temperature** in an **endothermic** reaction have on K_c ?

K_c increases

(The endothermic reaction is favoured so equilibrium shifts to the right.)

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

What effect does **decreasing the temperature** in an **exothermic** reaction have on K_c ?

K_c increases

(The exothermic reaction is favoured so equilibrium shifts to the right.)

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What effect does **increasing the temperature** in an **exothermic** reaction have on K_c ?

K_c decreases

(The exothermic reaction isn't favoured so equilibrium shifts to the left.)