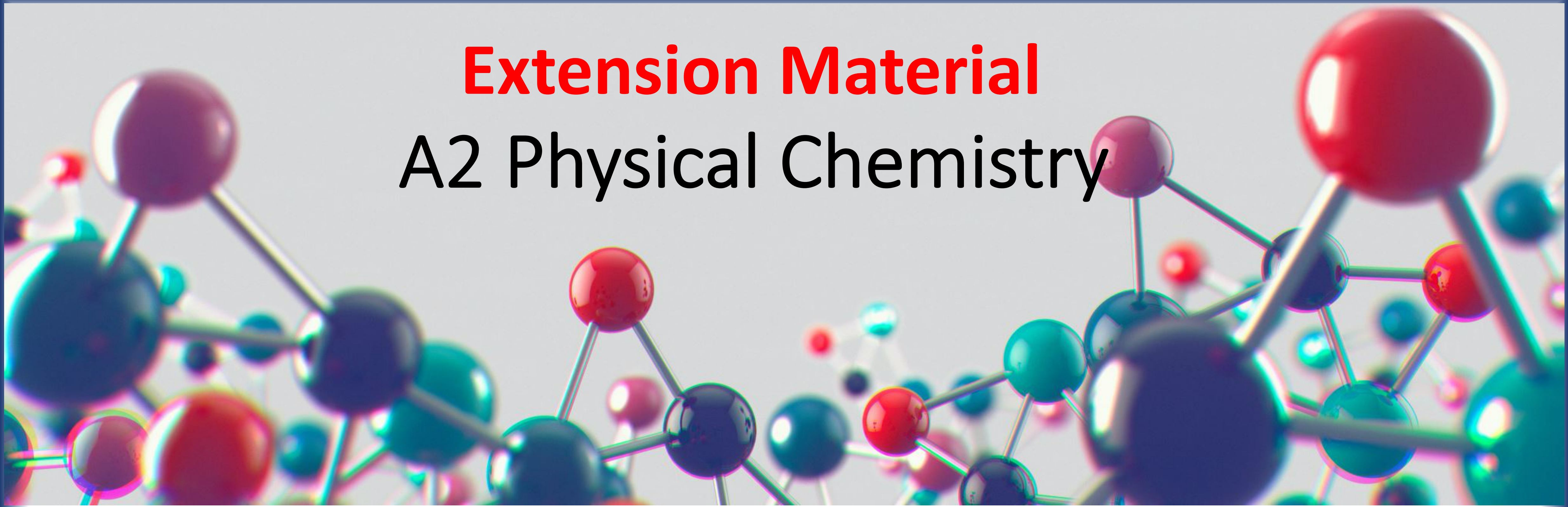


Extension Material

A2 Physical Chemistry

Why Equilibrium Constants change with temperature

Arrhenius Equation

Rate constant

Activation Energy

Temperature

$$\ln k = \ln A - E_a/RT$$

Pre-exponential factor

Gas Constant

At two different temperatures:

$$\ln\left(\frac{k_2}{k_1}\right) = \frac{-E_a}{R\left(\frac{1}{T_2} - \frac{1}{T_1}\right)}$$

At two different temperatures:

If T_2 is greater than T_1

$$\ln\left(\frac{k_2}{k_1}\right) = \frac{-E_a}{R\left(\frac{1}{T_2} - \frac{1}{T_1}\right)}$$

At two different temperatures:

If T_2 is greater than T_1

$$\ln\left(\frac{k_2}{k_1}\right) = \frac{-E_a}{R\left(\frac{1}{T_2} - \frac{1}{T_1}\right)}$$

This expression becomes negative

At two different temperatures:

If T_2 is greater than T_1

$$\ln\left(\frac{k_2}{k_1}\right) = \frac{-E_a}{R\left(\frac{1}{T_2} - \frac{1}{T_1}\right)}$$

Therefore, due to the negative sign here, the right-hand side becomes positive

This expression becomes negative

At two different temperatures:

If T_2 is greater than T_1

Therefore, due to the negative sign here, the right-hand side becomes positive

$$\ln\left(\frac{k_2}{k_1}\right) = \frac{-E_a}{R\left(\frac{1}{T_2} - \frac{1}{T_1}\right)}$$

This expression becomes negative

Resulting in $k_2 > k_1$.

At two different temperatures:

If T_2 is greater than T_1

Therefore, due to the negative sign here, the right-hand side becomes positive

$$\ln\left(\frac{k_2}{k_1}\right) = \frac{-E_a}{R\left(\frac{1}{T_2} - \frac{1}{T_1}\right)}$$

This expression becomes negative

Resulting in $k_2 > k_1$.

Increasing the temperature increases the rate constant.

From

$$\ln k = \ln A - \frac{E_a}{RT}$$

From

$$\ln k = \ln A - \frac{E_a}{RT}$$

The effect of temperature on k is proportional to the activation energy.

From

$$\ln k = \ln A - \frac{E_a}{RT}$$

The effect of temperature on k is proportional to the activation energy.

From

$$\ln k = \ln A - \frac{E_a}{RT}$$

The effect of temperature on k is proportional to the activation energy.

As activation energy increases, the effect of changing temperature increases.

From

$$\ln k = \ln A - \frac{E_a}{RT}$$

The effect of temperature on k is proportional to the activation energy.

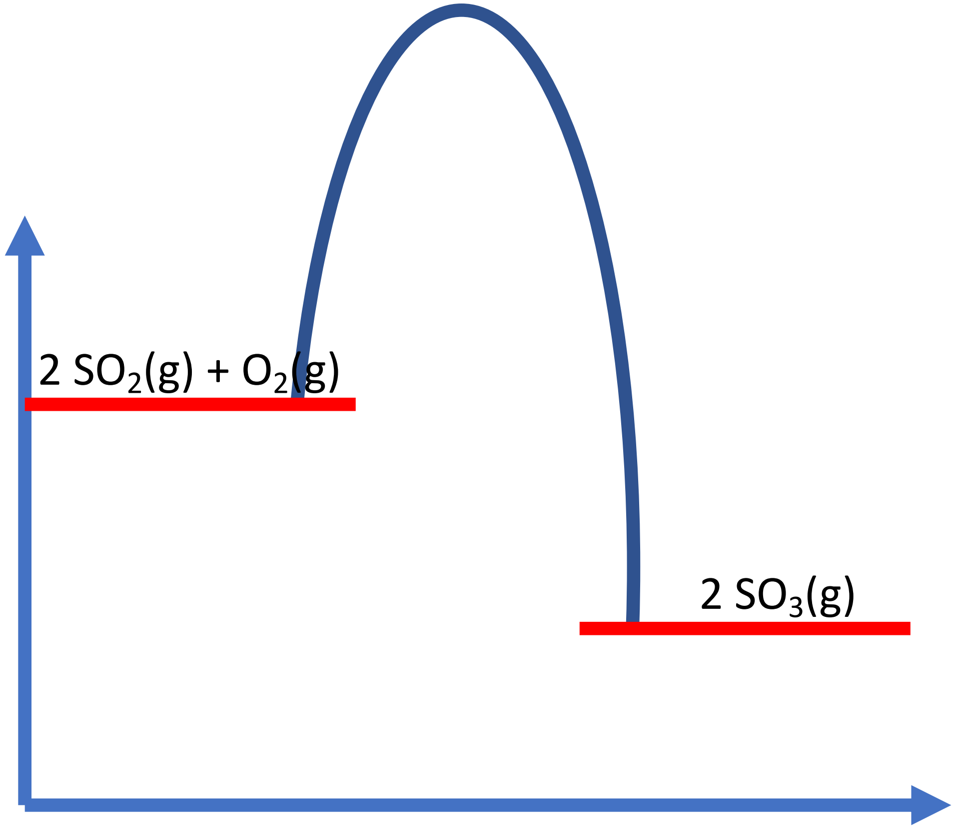
As activation energy increases, the effect of changing temperature increases.

One direction of a reaction is always exothermic and the other direction is endothermic.

The endothermic direction has the larger activation energy.

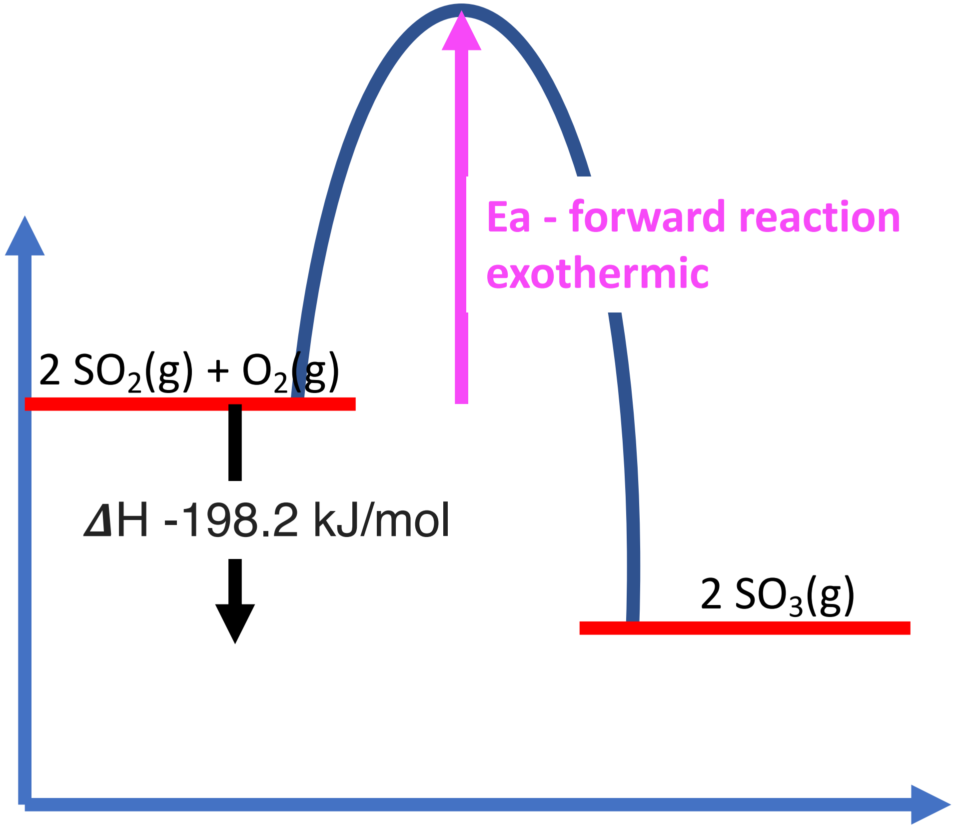
$$2\ SO_2(g) + O_2(g) \rightleftharpoons 2\ SO_3(g)$$

ΔH -198.2 kJ/mol

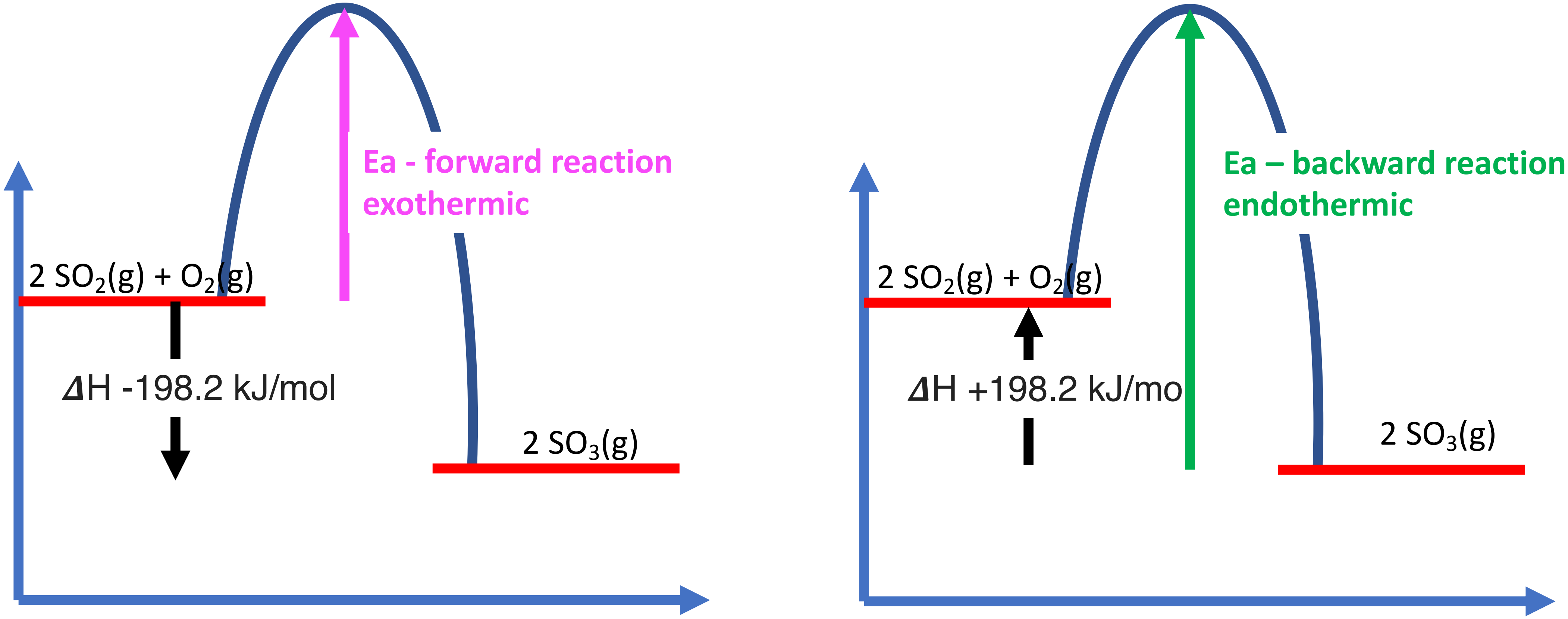


$$2\,SO_2(g) + O_2(g) \rightrightarrows 2\,SO_3(g)$$

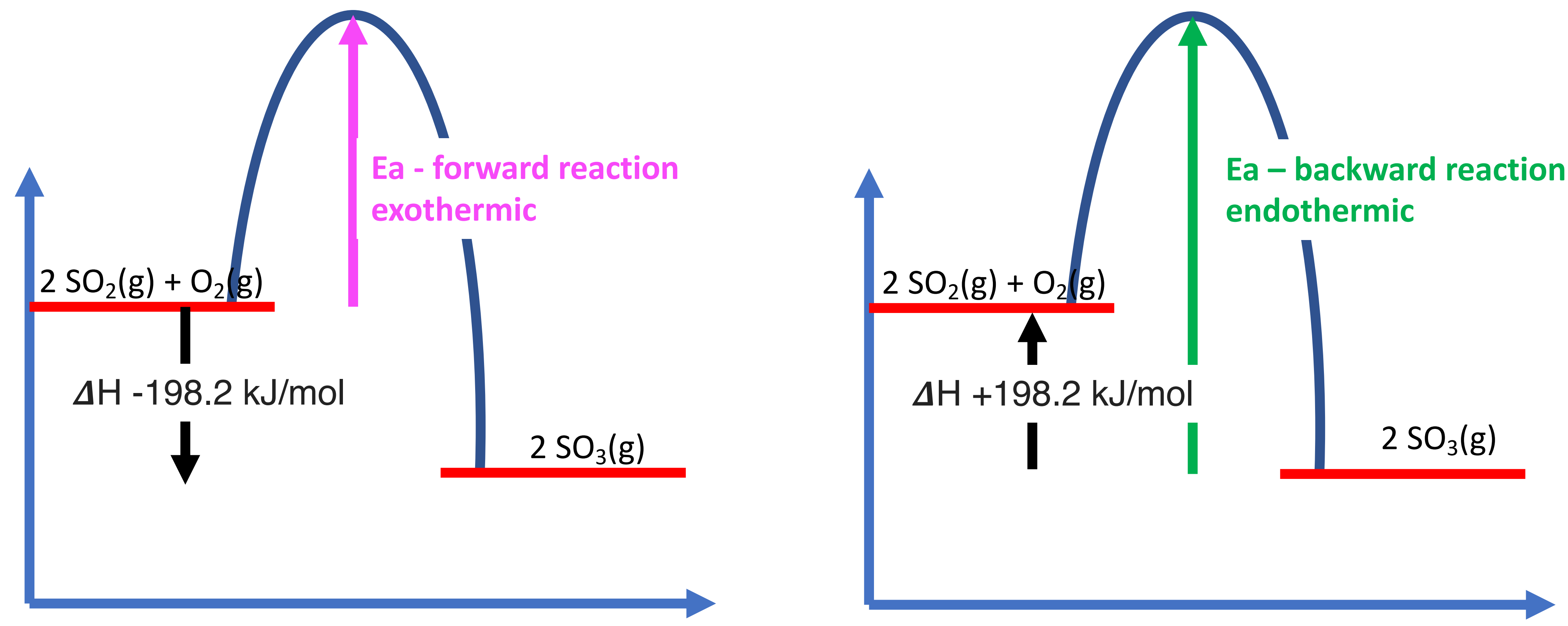
ΔH -198.2 kJ/mol



$$2\,SO_2(g) + O_2(g) \rightleftharpoons 2\,SO_3(g) \qquad \Delta H\ -198.2\ kJ/mol$$

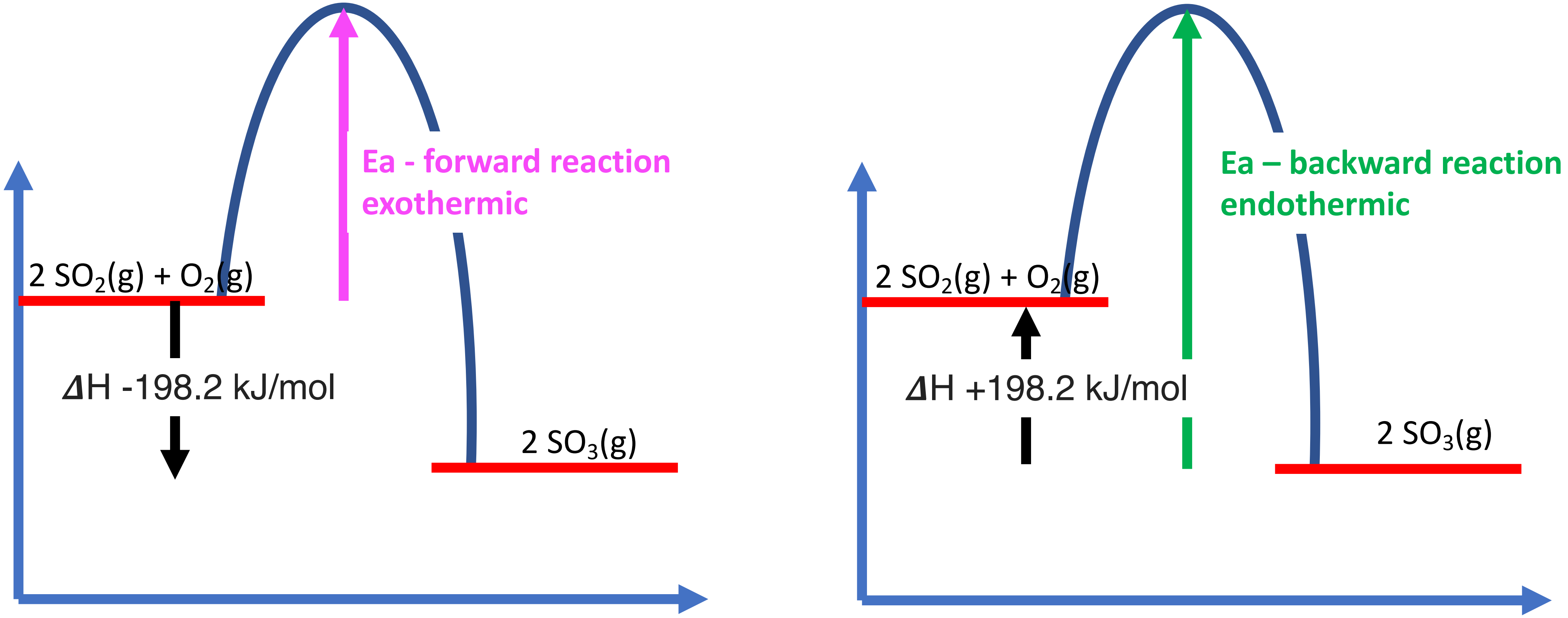


$$2\ SO_2(g) + O_2(g) \rightleftharpoons 2\ SO_3(g) \qquad \Delta H\ -198.2\ kJ/mol$$



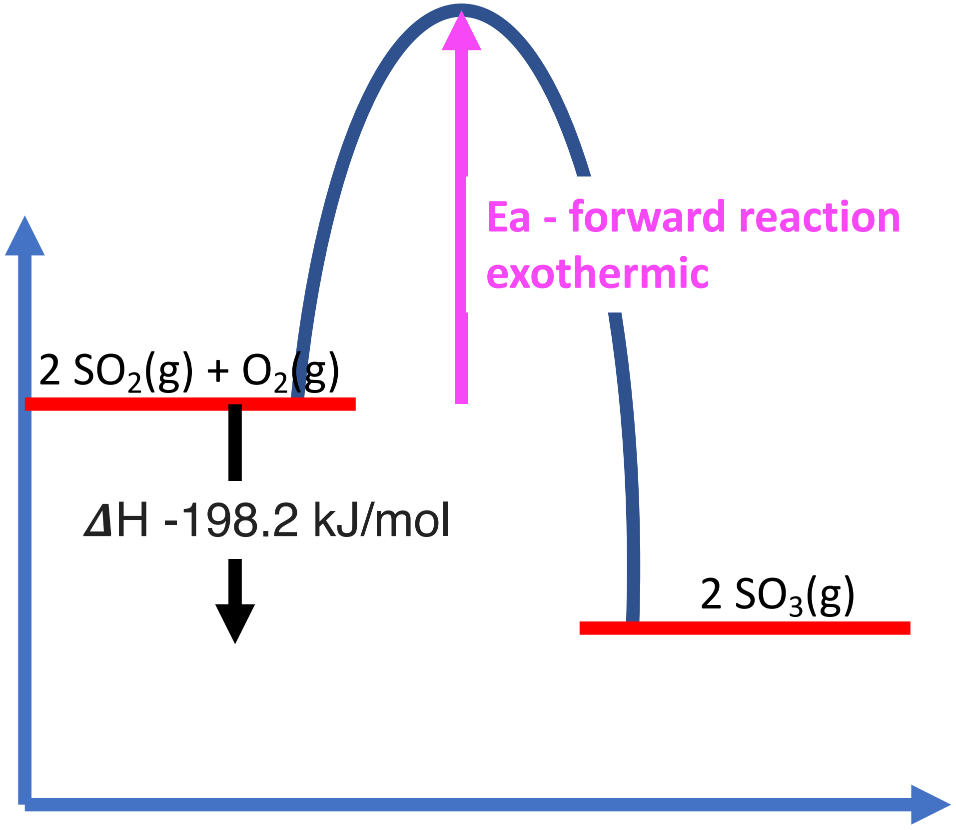
When temperature increases, both rates (forward and reverse) <u>increase</u> but the rate of the <u>endothermic reaction increases more.</u>

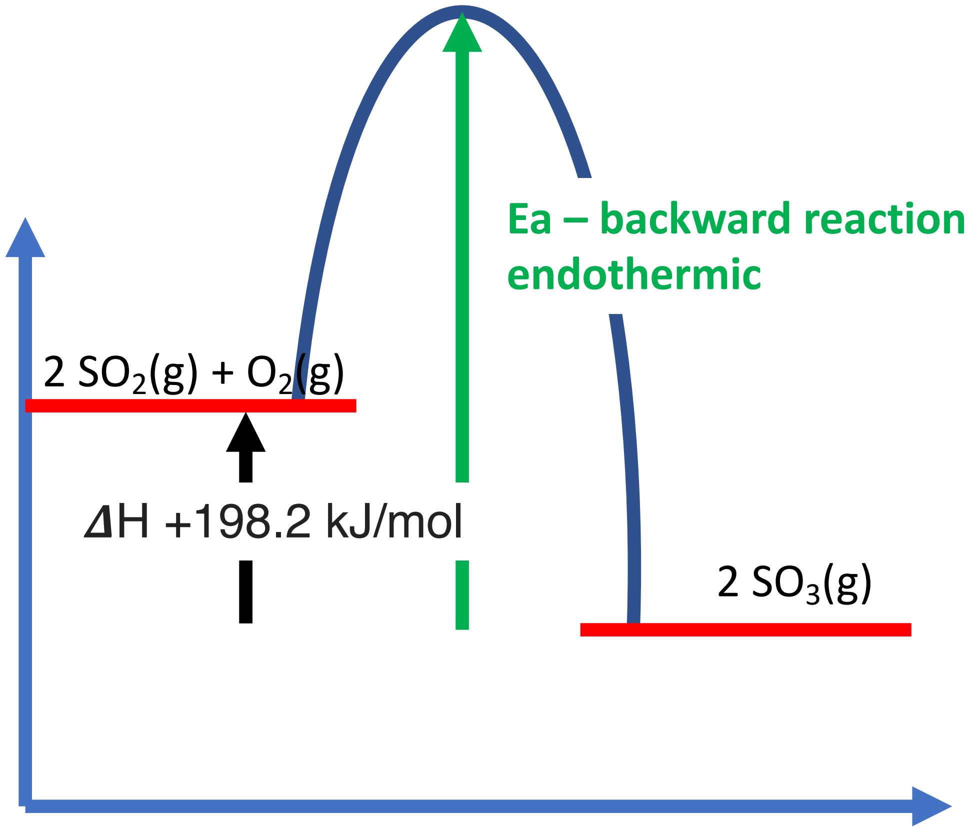
Equilibrium shifts in the endothermic direction.



When temperature increases, both rates (forward and reverse) increase but the rate of the endothermic reaction increases more.

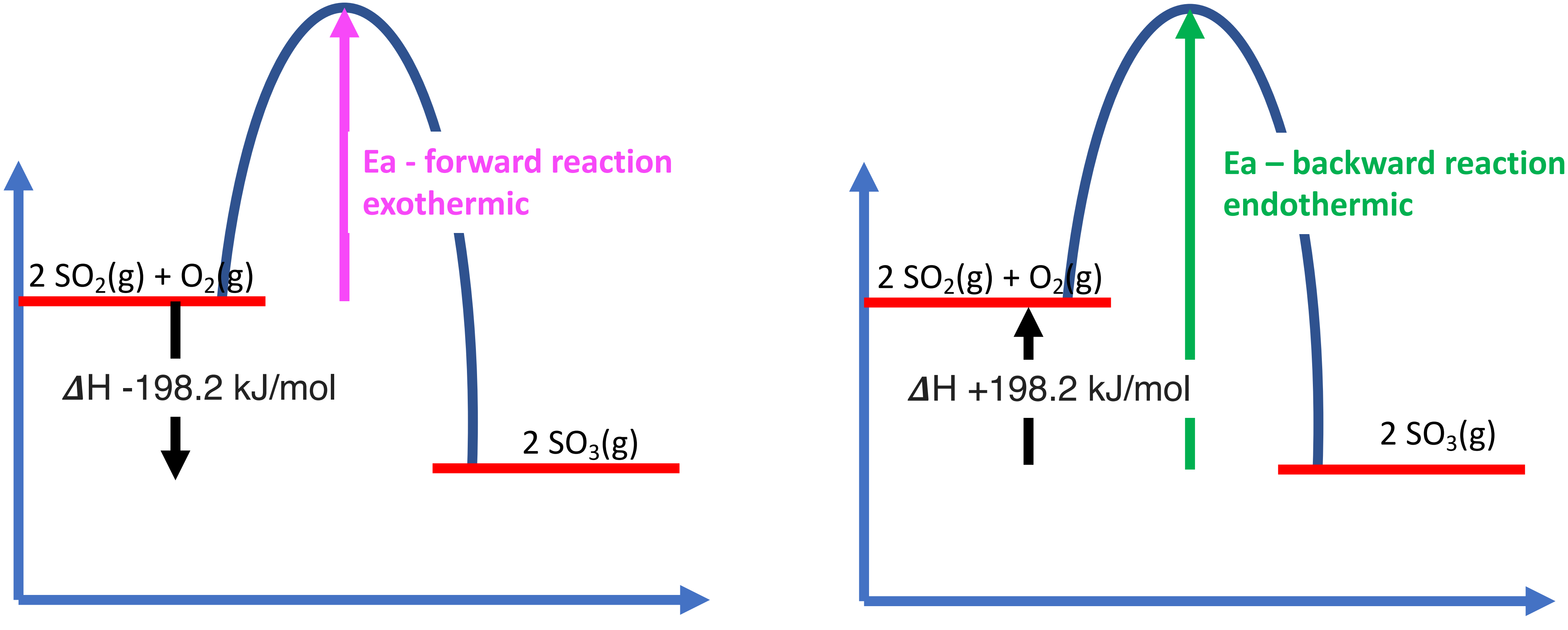
Equilibrium shifts in the endothermic direction.



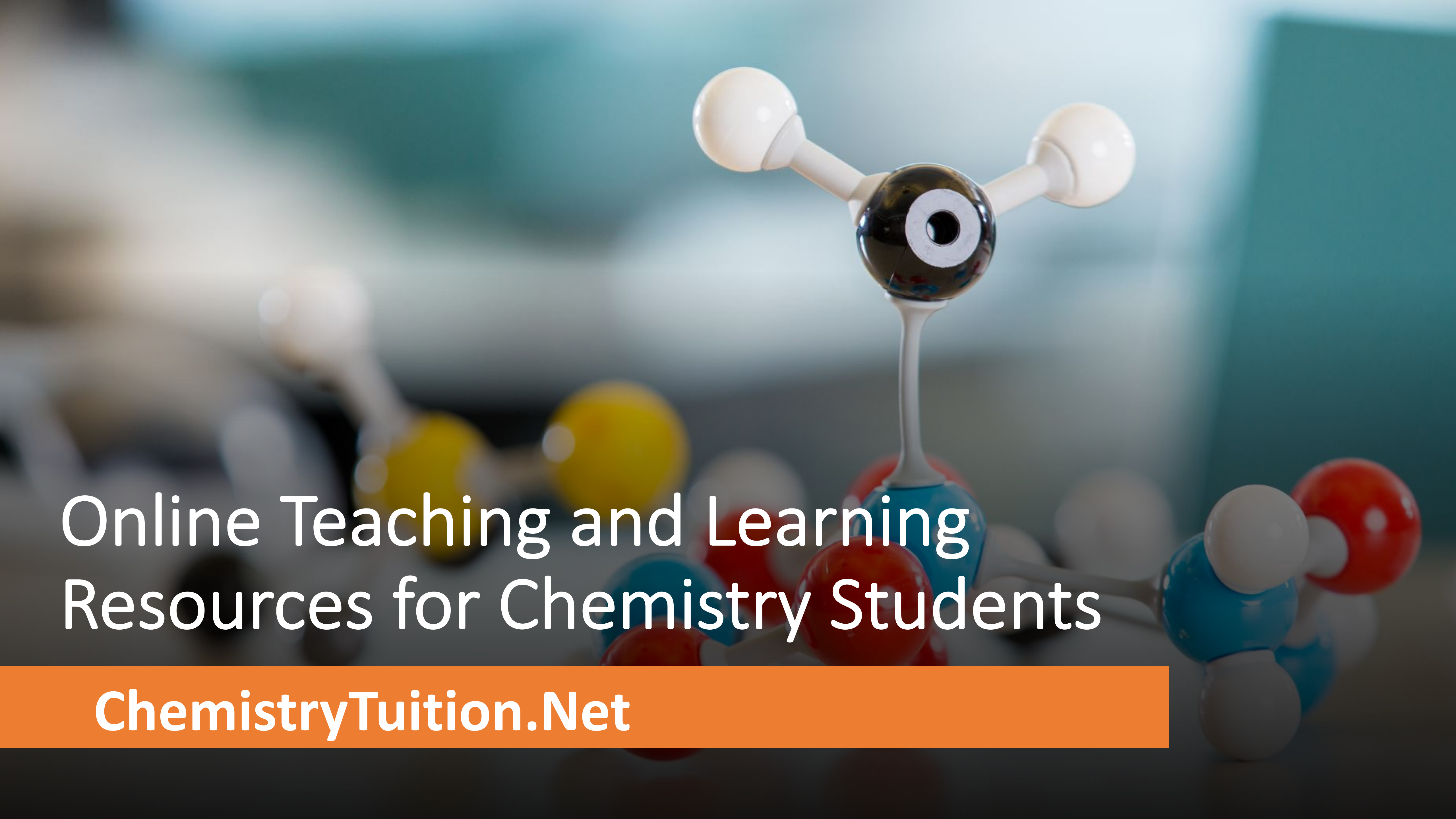


When temperature decreases, both rates (forward and reverse) decrease but the rate of the endothermic reaction decreases more!

Equilbrium shifts in the exothermic direction.



Raising the temperature increases K_c/K_p for an endothermic reaction and lowers K_c/K_p for an exothermic reaction



Online Teaching and Learning Resources for Chemistry Students

ChemistryTuition.Net