Marks 5

- For the reaction $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ at 25 °C

  $\Delta H° = -198.4$ kJ mol^{-1} and $\Delta S° = -187.9$ J K^{-1} mol^{-1}

  Show that this reaction is spontaneous in the forward direction at 25 °C.

If the volume of the reaction system is increased at 25 °C, in which direction will the equilibrium move?

Calculate the value of the equilibrium constant, K_p, at 25 °C.

K_p =

Assuming $\Delta H°$ and $\Delta S°$ are independent of temperature, in which temperature range is the reaction non-spontaneous?

Answer:

Marks 5

- Glucose is a common food source. The net reaction for its metabolism in humans is:

$$C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$$

Calculate $\Delta H°$ for this reaction given the following heats of formation.

$\Delta H°_f$ ($C_6H_{12}O_6(s)$) = –1274 kJ mol^{-1}, $\Delta H°_f$ ($CO_2(g)$) = –393 kJ mol^{-1} and $\Delta H°_f$ ($H_2O(l)$) = –285 kJ mol^{-1}

Answer:

If the combustion of glucose is carried out in air, water is produced as a vapour. Calculate the $\Delta H°$ for the combustion of glucose in air given that

$$H_2O(l) \rightarrow H_2O(g) \qquad \Delta H° = +44 \text{ kJ mol}^{-1}$$

Answer:

Will ΔS be different for the two oxidation reactions? If so, how will it differ and why?

Marks 5

- Stearic acid, $C_{18}H_{36}O_2$, is a fatty acid common in animal fats and vegetable oils and is a valuable energy source for mammals. The net reaction for its metabolism in humans is:

$$C_{18}H_{36}O_2(s) + 26O_2(g) \rightarrow 18CO_2(g) + 18H_2O(l)$$

Calculate $\Delta H°$ for this reaction given the following heats of formation.

ΔH_f^o ($C_{18}H_{36}O_2(s)$) = –948 kJ mol^{-1}, ΔH_f^o ($CO_2(g)$) = –393 kJ mol^{-1} and ΔH_f^o ($H_2O(l)$) = –285 kJ mol^{-1}

Answer:

If the combustion of stearic acid is carried out in air, water is produced as a vapour. Calculate the $\Delta H°$ for the combustion of stearic acid in air given that

$$H_2O(l) \rightarrow H_2O(g) \qquad \Delta H° = +44 \text{ kJ mol}^{-1}$$

Answer:

Will ΔS be different for the two oxidation reactions? If so, how will it differ and why?

Calculate the mass of carbon dioxide produced by the complete oxidation of 1.00 g of stearic acid.

Answer:

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- Nitrous oxide decomposes at 25 °C according to the following equation.

$$2N_2O(g) \rightleftharpoons 2N_2(g) + O_2(g) \qquad K_p = 1.8 \times 10^{36}$$

What is the value for K_p at 40 °C?

Answer:

Is the reaction endothermic or exothermic? Give a reason for your answer.

Marks 5

- Stearic acid, $C_{18}H_{36}O_2$, is a fatty acid common in animal fats and vegetable oils and is a valuable energy source for mammals. The net reaction for its metabolism in humans is:

$$C_{18}H_{36}O_2(s) + 26O_2(g) \rightarrow 18CO_2(g) + 18H_2O(l)$$

Calculate $\Delta H°$ for this reaction given the following heats of formation.

Compound	$C_{18}H_{36}O_2(s)$	$CO_2(g)$	$H_2O(l)$
$\Delta_f H°$ / kJ mol^{-1}	–948	–393	–285

$\Delta H°$ =

If the combustion of stearic acid is carried out in air, water is produced as a vapour. Calculate the $\Delta H°$ for the combustion of stearic acid in air given that:

$$H_2O(l) \rightarrow H_2O(g) \qquad \Delta H° = +44 \text{ kJ mol}^{-1}$$

$\Delta H°$ =

Will ΔS be different for the two oxidation reactions? If so, how will it differ and why?

Calculate the mass of carbon dioxide produced by the complete oxidation of 1.00 g of stearic acid.

Answer:

Marks 5

- The autoionisation of water conforms to the following balanced equation:

$$2H_2O(l) \rightleftharpoons H_3O^+(aq) + OH^-(aq) \qquad \Delta H = 56.3 \text{ kJ mol}^{-1}$$

Is this an exothermic or endothermic reaction?

What will happen to the equilibrium if the temperature is raised?

The equilibrium constant, K, for this reaction is 1.8×10^{-16} at 25 °C. Calculate ΔG.

Answer:

Why is ΔG not equal to ΔH for this reaction?

The pH of pure water is 6.81 at 37 °C. Is water acidic, basic or neutral at this temperature? Explain.