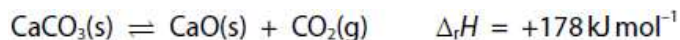


Chemical Equilibria - Questions by Topic

Q1.

Calcium oxide is manufactured by heating limestone at 1000 °C for 30 minutes.

The equation for the reaction is:



(a) The numerical value of the equilibrium constant for this reaction is increased by:

(1)

- A** allowing the carbon dioxide to escape
- B** increasing the heating time
- C** increasing the temperature
- D** reducing the pressure

(b) Which is the correct expression for the equilibrium constant, K_c , for this reaction?

(1)

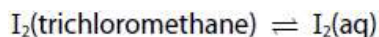
- A** $K_c = [\text{CO}_2]$
- B** $K_c = \frac{1}{[\text{CO}_2]}$
- C** $K_c = \frac{[\text{CaCO}_3]}{[\text{CaO}][\text{CO}_2]}$
- D** $K_c = \frac{[\text{CaO}][\text{CO}_2]}{[\text{CaCO}_3]}$

(Total for question = 2 marks)

Q2.

Iodine was dissolved in an organic solvent, trichloromethane, and the resulting solution added to an equal volume of deionised water. The mixture was then shaken, producing two immiscible solutions: iodine in water and iodine in trichloromethane.

At equilibrium, the equation for the reaction can be written as:



(a) What is the expression for this equilibrium constant, K_c ?

(1)

A $K_c = \frac{[\text{I}_2(\text{trichloromethane})]}{[\text{I}_2(\text{aq})]}$

B $K_c = \frac{(\text{I}_2(\text{aq}))}{(\text{I}_2(\text{trichloromethane}))}$

C $K_c = \frac{\text{I}_2(\text{aq})}{\text{I}_2(\text{trichloromethane})}$

D $K_c = \frac{[\text{I}_2(\text{aq})]}{[\text{I}_2(\text{trichloromethane})]}$

(b) Which statement describes what is happening at equilibrium?

(1)

A iodine molecules move from the water to the trichloromethane layer only

B iodine molecules move from the trichloromethane to the water layer only

C iodine molecules move from the water to the trichloromethane and from the trichloromethane to the water layer.

D there is no movement of individual iodine molecules

(Total for question = 2 marks)

Q3.

This question is about the thermodynamics of the reaction:



Compound	Standard molar entropy at 298 K, $S^\ominus / \text{J K}^{-1} \text{ mol}^{-1}$	Standard molar enthalpy of formation at 298 K, $\Delta_f H^\ominus / \text{kJ mol}^{-1}$	Colour
NO_2	+240.0	+33.2	brown
N_2O_4	+304.2		colourless

(a) Calculate the entropy change for the reaction, using the information in the table.

Include a sign and units in your answer.

(2)

(b) Calculate the enthalpy change of formation, $\Delta_f H$, of N_2O_4 (g) at 298 K, using the information in the table and the enthalpy change of the reaction.

Include a sign and units in your answer.

(2)

(c) Calculate the entropy change of the surroundings, $\Delta S_{\text{surroundings}}$, at 298 K.

Give your answer to an appropriate number of significant figures.
Include a sign and units in your answer.

(3)

(d) (i) Use your answers to parts (a) and (c) to calculate the total entropy change, ΔS_{total} , for this reaction at 298 K.

(1)

(ii) This reaction can also be written as an equilibrium:



Calculate the temperature at which ΔS_{total} is zero for this equilibrium.

(2)

(e) (i) Write the expression for the equilibrium constant, K_p , for this reaction, including the units, if any.

(2)

(ii) In an experiment, 10 mol of $\text{N}_2\text{O}_4(\text{g})$ was placed in a closed container at $50\text{ }^\circ\text{C}$. At equilibrium, 27% of the $\text{N}_2\text{O}_4(\text{g})$ had dissociated, and the pressure in the container was 4.0 atm.

Calculate the value of K_p at $50\text{ }^\circ\text{C}$.

(4)

(iii) The total pressure is doubled to 8.0 atm.

State the effect on K_p .

(1)

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(iv) The total pressure is doubled to 8.0 atm at constant temperature.

Explain the change in the percentage dissociation of $\text{N}_2\text{O}_4(\text{g})$ by considering the effect on the partial pressures of $\text{NO}_2(\text{g})$ and $\text{N}_2\text{O}_4(\text{g})$.

(3)

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(Total for question = 20 marks)