1987 B

$$2\,HgCl_{2(aq)} + C_2O_4^{2-} \rightarrow 2\,Cl^- + 2\,CO_{2(g)} + Hg_2Cl_{2(aq)}$$

The equation for the reaction between mercuric chloride and oxalate ion in hot aqueous solution is shown above. The reaction rate may be determined by measuring the initial rate of formation of chloride ion, at constant temperature, for various initial concentrations of mercuric chloride and oxalate as shown in the following table

Experiment	Initial $[HgCl_2]$	Initial $[C_2O_4^{2-}]$	Initial Rate of Formation of Cl^- ($mol \cdot L^{-1} \cdot min^{-1}$)
(1)	0.0836 M	0.202M	0.52×10^{-4}
(2)	0.0836 M	0.404M	2.08×10^{-4}
(3)	0.0418 M	0.404M	1.06×10^{-4}
(4)	0.0316 M	?	1.27×10^{-4}

(a) According to the data shown, what is the rate law for the reaction above?

(b) On the basis of the rate law determined in part (a), calculate the specific rate constant. Specify the units.

(c) What is the numerical value for the initial rate of disappearance of $C_2O_4^{2-}$ for Experiment 1?

(d) Calculate the initial oxalate ion concentration for Experiment 4.

2005

$$AgNO_{3(s)} \rightarrow Ag^+_{(aq)} + NO_3^-{}_{(aq)}$$

The dissolving of $AgNO_{3(s)}$ in pure water is represented by the equation above..

(a) Is ΔG for the dissolving of $AgNO_{3(s)}$ positive, negative, or zero? Justify your answer.

(b) Is ΔS for the dissolving of $AgNO_{3(s)}$ positive, negative, or zero? Justify your answer.

2004 B

$$2\,Fe_{(s)} + \tfrac{3}{2}\,O_{2(g)} \rightarrow Fe_2O_{3(s)} \quad \Delta H_f^\circ = -824 \text{ kJ mol}^{-1}$$

Iron reacts with oxygen to produce iron(III) oxide as represented above. A 75.0 g sample of $Fe_{(s)}$ is mixed with 11.5 L of $O_{2(g)}$ at 2.66 atm and 298 K.

(a) Calculate the number of moles of each of the following before the reaction occurs.

(i) $Fe_{(s)}$

(ii) $O_{2(g)}$

(b) Identify the limiting reactant when the mixture is heated to produce Fe_2O_3. Support your answer with calculations.

(c) Calculate the number of moles of Fe_2O_3 produced when the reaction proceeds to completion.

(d) The standard free energy of formation, ΔG_f° of Fe_2O_3 is –740. kJ mol^{-1} at 298 K.

(i) Calculate the standard entropy of formation ΔS_f° of Fe_2O_3 at 298 K. Include units with your answer.

(ii) Which is more responsible for the spontaneity of the formation reaction at 298K, the standard enthalpy or the standard entropy?

The reaction represented below also produces iron(III) oxide. The value of ΔH° for the reaction is –280 kJ per mol.

$$2\,FeO_{(s)} + \tfrac{1}{2}\,O_{2(g)} \rightarrow Fe_2O_{3(s)}$$

(e) Calculate the standard enthalpy of formation, ΔH_f° of $FeO_{(s)}$.