Equilibrium constant Kp for homogeneous systems – A2 2022 Chemistry P1&P3

1. June/2022/Paper_7405/3/No.5

0 5 This question is about catalysis.

0 5 . 1 Zeolites are used as heterogeneous catalysts in the catalytic cracking of alkanes.

Tetradecane ($C_{14}H_{30}$) can be cracked to form octane and a cycloalkane.

Give an equation for this reaction.

State the meaning of the term heterogeneous.

[2 marks]

Equation

Heterogeneous

0 5 . 2 A student determines the concentration of ethanedioate ions in an acidified solution by titration with potassium manganate(VII) solution.

$$2\,MnO_4^- + 5\,C_2O_4^{2-} + 16\,H^+ \rightarrow 2\,Mn^{2+} + 10\,CO_2 + 8\,H_2O$$

The mixture is warmed before the addition of potassium manganate(VII) solution because the reaction is slow at first. When more potassium manganate(VII) solution is added, the mixture goes colourless quickly due to the presence of an autocatalyst.

Explain the meaning of the term autocatalyst.

Explain, using equations where appropriate, why the reaction is slow at first and then goes quickly.

[6 marks]

0 5 . 3 The reaction between peroxodisulfate ions and iodide ions in aqueous solution can be catalysed by Co^{2+} ions.

$$S_2O_8^{2-} + 2\,I^- \rightarrow 2\,SO_4^{2-} + I_2$$

Table 6 gives relevant standard electrode potentials.

Table 6

Electrode half-equation	$E^{\ominus}$ / V
$S_2O_8^{2-}(aq) + 2\,e^- \rightarrow 2\,SO_4^{2-}(aq)$	+2.01
$Co^{3+}(aq) + e^- \rightarrow Co^{2+}(aq)$	+1.82
$I_2(aq) + 2\,e^- \rightarrow 2\,I^-(aq)$	+0.54

Use the electrode potential data to suggest how Co^{2+} catalyses the reaction.

[3 marks]