

Solutions

Original marking guidance: M1 method, A1 accuracy, B1 explanation.

2.1 Homogeneous: same phase, for example aqueous iron ions catalysing iodide/peroxodisulfate. Heterogeneous: different phase, for example solid V_2O_5 with gaseous SO_2/O_2 .

2.2 $\text{S}_2\text{O}_8^{2-} + 2\text{I}^- \rightarrow 2\text{SO}_4^{2-} + \text{I}_2$; Fe^{2+} is regenerated via Fe^{3+} .

2.3 CO competes for binding to haem Fe^{2+} , strongly occupying sites needed for reversible oxygen binding.

3.1 Double the first step; cancel $2\text{V}_2\text{O}_5$ and $2\text{V}_2\text{O}_4$, giving $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$. Vanadium changes oxidation state and returns, providing an alternative pathway.

3.2 Mn^{2+} product acts as catalyst. Its concentration builds up and supplies more catalysed pathway. Later reactant depletion slows the reaction.

3.3 Six free waters replace three free en particles, often increasing entropy. Each en gives two donor bonds, so both complexes have six metal–donor bonds/coordination six.