

Solutions

Each answer shows the steps, then the **result**.

2.1

- hydrogen gas at 1 atm bubbled over a platinum electrode in 1 mol dm⁻³ H⁺, defined as 0.00 V

2.2

- it must be positive

2.3

- 298 K; a pressure of 1 bar for any gas; all solutions at a concentration of 1 mol dm⁻³

2.4

- $E_{\text{cell}}^{\ominus}$ describes only the thermodynamic feasibility, not the rate; a large activation energy can make the reaction immeasurably slow, so nothing is seen

2.5

- It becomes more positive; Fe³⁺ is on the left of the half-equation, so raising its concentration shifts the equilibrium to the right by Le Chatelier's principle

3.1 B

- A more positive $E^{\ominus}$ is a stronger oxidising agent

3.2 A

- More oxidised species makes the potential more positive

3.3

(a)

- $E_{\text{cell}}^{\ominus} = (+0.80) - (-0.44) = +1.24 \text{ V}$

(b)

- the Fe²⁺/Fe electrode (more negative) is the negative terminal; electrons flow from the iron to the silver electrode in the external circuit

3.4

- yes; $E_{\text{cell}}^{\ominus}$ for Ag⁺ oxidising Fe is positive (+1.24 V), so the reaction is feasible

3.5

(a)

- The strongest oxidising agent is MnO₄⁻, because it has the most positive $E^{\ominus}$ and is most readily reduced; the strongest reducing agent is V²⁺, because its half-cell has the most negative $E^{\ominus}$

(b)

- $E_{\text{cell}}^{\ominus} = +0.77 - 0.15 = +0.62 \text{ V}$, which is positive, so the reaction is feasible; $2\text{Fe}^{3+} + \text{Sn}^{2+} \rightarrow 2\text{Fe}^{2+} + \text{Sn}^{4+}$

(c)

- $\text{MnO}_4^- + 8\text{H}^+ + 5\text{Fe}^{2+} \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O} + 5\text{Fe}^{3+}$; $E_{\text{cell}}^{\ominus} = +1.52 - 0.77 = +0.75 \text{ V}$

(d)

- For Sn²⁺ to reduce V³⁺: $E_{\text{cell}}^{\ominus} = -0.26 - 0.15 = -0.41 \text{ V}$, which is negative, so that reaction is not feasible. Even where a value is positive, a high activation energy can make the reaction too slow to observe

(e)

- It becomes more positive; the oxidised species is in excess, so by Le Chatelier's principle the equilibrium shifts to the right, favouring reduction