InkChemistry

QUESTION WORKBOOK

The electrochemical series and predicting feasibility

Electrochemistry · Unit C10

AQA 3.1.11.1 · OCR A 5.2.3

18 questions · 58 marks

NAVY SCREEN EDITION

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SECTION B · Standard, 3 to 5 marks

B1 ESP-Q5

Calculate E°_{cell} for the reaction of acidified dichromate(VI) ions with iron(II) ions, and write the overall ionic equation. $E^\circ(Cr_2O_7^{2-}/Cr^{3+}) = +1.33$ V; $E^\circ(Fe^{3+}/Fe^{2+}) = +0.77$ V. [4]

B2 ESP-Q7

Explain why aluminium shows little reaction with dilute hydrochloric acid at room temperature, although $E^\circ(Al^{3+}/Al) = -1.66$ V predicts that it should react, and give one other reason why a reaction predicted from E° values may not be observed. [4]

B3 ESP-Q9

Explain the effect on the EMF of the cell $Cu(s) \mid Cu^{2+}(aq) \parallel Ag^+(aq) \mid Ag(s)$, set up with standard solutions, of (a) adding solid potassium chloride to the silver half-cell, and (b) adding water to the copper half-cell. [4]

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B4 ESP-Q17 Evaluate the conclusion of a student who calculates from E° values that acidified dichromate(VI) does not oxidise chloride ions, and concludes that dichromate(VI) can never be used to make chlorine. $E^\circ(Cr_2O_7^{2-}/Cr^{3+}) = +1.33$ V; $E^\circ(Cl_2/Cl^-) = +1.36$ V. [4]

B5 ESP-Q3 Calculate E°cell for the reaction $Sn^{2+}(aq) + 2Fe^{3+}(aq) \rightarrow Sn^{4+}(aq) + 2Fe^{2+}(aq)$, and state whether it is feasible under standard conditions. $E^\circ(Sn^{4+}/Sn^{2+}) = +0.15$ V; $E^\circ(Fe^{3+}/Fe^{2+}) = +0.77$ V. [3]

B6 ESP-Q4 Calculate E°cell for $2Ag^+(aq) + Cu(s) \rightarrow 2Ag(s) + Cu^{2+}(aq)$. A student gives $2 \times 0.80 - 0.34 = +1.26$ V. $E^\circ(Ag^+/Ag) = +0.80$ V; $E^\circ(Cu^{2+}/Cu) = +0.34$ V. [3]

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B7 ESP-Q6 Explain, using E° values, why manganate(VII) titrations are acidified with sulfuric acid and not hydrochloric acid. $E^\circ(MnO_4^-/Mn^{2+}) = +1.51$ V; $E^\circ(Cl_2/Cl^-) = +1.36$ V. [3]

B8 ESP-Q8 Explain the effect on the electrode potential of a Cu^{2+}/Cu half-cell of increasing the concentration of Cu^{2+} ions above 1.00 mol dm^{-3}. [3]

B9 ESP-Q10 Explain why gold is found in nature as the metal, whereas sodium is found only in compounds. $E^\circ(Au^{3+}/Au) = +1.50$ V; $E^\circ(Na^+/Na) = -2.71$ V; $E^\circ(O_2/H_2O) = +1.23$ V. [3]

B10 ESP-Q11 Suggest, using E° values, what is seen when white copper(I) sulfate is added to water. $Cu^+(aq) + e^- \rightleftharpoons Cu(s)$, $E^\circ = +0.52$ V; $Cu^{2+}(aq) + e^- \rightleftharpoons Cu^+(aq)$, $E^\circ = +0.15$ V. [3]

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B11 ESP-Q12 Suggest why pale green iron(II) sulfate solution left open to the air slowly turns yellow-brown, and write the equation. $O_2(g) + 4H^+(aq) + 4e^- \rightleftharpoons 2H_2O(l)$, $E^\circ = +1.23$ V; $Fe^{3+}(aq) + e^- \rightleftharpoons Fe^{2+}(aq)$, $E^\circ = +0.77$ V. [3]

B12 ESP-Q13 Suggest why the EMF of a zinc–copper cell falls as it delivers a current, until no current flows. [3]

B13 ESP-Q14 Describe how the anticlockwise rule predicts the reaction between the Zn^{2+}/Zn half-cell, $E^\circ = -0.76$ V, and the Cu^{2+}/Cu half-cell, $E^\circ = +0.34$ V. [3]

B14 ESP-Q16 Compare zinc, iron and copper as reducing agents, using $E^\circ(Zn^{2+}/Zn) = -0.76$ V, $E^\circ(Fe^{2+}/Fe) = -0.44$ V and $E^\circ(Cu^{2+}/Cu) = +0.34$ V, and say which of them react with H^+ ions in a dilute acid. [3]

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B15 ESP-Q18 Calculate the electrode potential at 298 K of a silver half-cell in which $[Ag^+] = 0.010$ mol dm^{-3}, and the EMF of the cell it makes with a standard copper half-cell. Use the Nernst equation, $E = E^\circ + (0.059/z) \log_{10}[Ag^+]$. $E^\circ(Ag^+/Ag) = +0.80$ V; $E^\circ(Cu^{2+}/Cu) = +0.34$ V. [3]

B16 ESP-Q19 Calculate ΔG°, in kJ mol^{-1}, for the reaction $Cl_2(g) + 2Br^-(aq) \rightarrow 2Cl^-(aq) + Br_2(aq)$, for which $E^\circ cell = +0.27$ V. $F = 96\,500$ C mol^{-1}. [3]

B17 ESP-Q20 Explain why doubling the equation for a cell reaction doubles its ΔG° but leaves its $E^\circ cell$ unchanged. [3]

B18 ESP-Q21 Explain why a reaction with $E^\circ cell = +0.80$ V goes essentially to completion, whereas one with $E^\circ cell = +0.02$ V gives an equilibrium mixture. [3]

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