InkChemistry

QUESTION WORKBOOK

Transition metal characteristics and complex formation

Transition metals · Unit C14

AQA 3.2.5.1, 3.2.5.2 · OCR A 5.3.1

15 questions · 53 marks

NAVY SCREEN EDITION

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SECTION A · Short, 1 to 2 marks

A1 TMC-Q18

Describe the shapes of the 3dxy and 3dz² orbitals, relative to the x, y and z axes. [2]

SECTION B · Standard, 3 to 5 marks

B1 TMC-Q5

Name the four characteristic properties of the transition metals, and explain why the transition metals show variable oxidation states. [5]

B2 TMC-Q1

State what is meant by the term transition metal. Ti^{4+} has no d electrons; use the electron configurations of Ti^{2+}, Ti^{3+} and Ti^{4+} to explain why titanium is still a transition metal. [4]

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B3 TMC-Q2 Give the electron configurations of a chromium atom and of the Cr^{3+} ion, using [Ar] for the argon core, and explain why the ion has no electrons left in its 4s subshell. [4]

B4 TMC-Q6 Explain how the water molecules are bonded to the copper ion in $[Cu(H_2O)_6]^{2+}$, using the terms ligand and coordination number. [4]

B5 TMC-Q15 Compare water, ethane-1,2-diamine and $EDTA^{4-}$ as ligands for a Cu^{2+} ion. [4]

B6 TMC-Q3 Explain why zinc is a d-block element but is not a transition metal. [3]

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B7 TMC-Q9 Describe how $EDTA^{4-}$ bonds to a Cu^{2+} ion, and give the formula of the complex formed. [3]

B8 TMC-Q11 Calculate the concentration of Ca^{2+} ions in a sample of tap water, given that 25.0 cm^3 of the water needs 12.40 cm^3 of 0.0100 mol dm^{-3} $EDTA^{4-}$ solution to complex all of its Ca^{2+} ions. $EDTA^{4-}$ and Ca^{2+} react in a 1 : 1 ratio. [3]

B9 TMC-Q12 Calculate the percentage by mass of copper in hydrated copper(II) sulfate, $CuSO_4 \cdot 5H_2O$. Ar: Cu 63.5, S 32.1, O 16.0, H 1.0. [3]

B10 TMC-Q14 Suggest why the disodium salt of EDTA is added to some mayonnaise, given that traces of Fe^{3+} and Cu^{2+} ions catalyse the oxidation of fats, which makes food rancid. [3]

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B11 TMC-Q19 Explain why excess silver nitrate precipitates three moles of silver chloride from one mole of $[Co(NH_3)_6]Cl_3$ but only two moles from one mole of $[Co(NH_3)_5Cl]Cl_2$. [3]

B12 TMC-Q20 Suggest the structure of a green hydrate with the formula $CrCl_3 \cdot 6H_2O$, given that one mole of it gives one mole of silver chloride with excess silver nitrate and that chromium(III) has a coordination number of 6. [3]

B13 TMC-Q21 Justify the statement that copper is a transition metal although its Cu^+ ion has a completely filled 3d subshell. [3]

SECTION C · Long, 6 marks or more

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C1 TMC-Q10 Explain, with reference to the structure of the haem group, how haemoglobin carries oxygen round the body and why carbon monoxide is toxic. [6]

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