InkChemistry

QUESTION WORKBOOK

Ligands, the shapes of complexes, isomerism and ligand substitution

Transition metals · Unit C14

AQA 3.2.5.2, 3.2.5.3 · OCR A 5.3.1

19 questions · 61 marks

NAVY SCREEN EDITION

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SECTION A · Short, 1 to 2 marks

A1 LSC-Q14

Suggest why $[Pt(NH_3)_2Cl_2]$ has cis and trans isomers but $[Zn(NH_3)_2Cl_2]$ does not. [2]

A2 LSC-Q16

Explain why a yellow-green solution of $[CuCl_4]^{2-}$ turns blue when it is diluted with water. [2]

A3 LSC-Q20

Suggest why cisplatin is given to patients as the pure cis isomer and not as a mixture with the trans isomer. [2]

SECTION B · Standard, 3 to 5 marks

B1 LSC-Q1

Give the shape and one bond angle of each of these complexes: $[Cu(H_2O)_6]^{2+}$, $[CuCl_4]^{2-}$, cisplatin $[Pt(NH_3)_2Cl_2]$ and $[Ag(NH_3)_2]^{+}$. [4]

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B2 LSC-Q6 Explain why $[Co(NH_3)_6]^{2+}$ reacts with ethane-1,2-diamine to form $[Co(H_2NCH_2CH_2NH_2)_3]^{2+}$. [4]

B3 LSC-Q11 Explain how cisplatin prevents cancer cells from dividing. [4]

B4 LSC-Q12 Evaluate the use of cisplatin to treat cancer. [4]

B5 LSC-Q3 Describe what happens when excess concentrated ammonia is added to a solution containing $[Co(H_2O)_6]^{2+}$. Include an equation. [3]

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B6 LSC-Q7 Calculate ΔG at 298 K for the reaction $[Cu(H_2O)_6]^{2+} + EDTA^{4-} \rightarrow [Cu(EDTA)]^{2-} + 6H_2O$, for which $\Delta H = -4.0$ kJ mol^{-1} and $\Delta S = +210$ J K^{-1} mol^{-1}. [3]

B7 LSC-Q8 Calculate the percentage by mass of platinum in cisplatin, $[Pt(NH_3)_2Cl_2]$. Ar: Pt 195.1, N 14.0, H 1.0, Cl 35.5. [3]

B8 LSC-Q9 Describe the difference between the cis and trans isomers of $[Co(NH_3)_4Cl_2]^+$. [3]

B9 LSC-Q10 Explain why $[Ni(H_2NCH_2CH_2NH_2)_3]^{2+}$ exists as a pair of optical isomers. [3]

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B10 LSC-Q13 Suggest the cobalt complexes responsible for the colours of silica gel sachets, which contain a little cobalt(II) chloride and are blue when dry and pink when they have absorbed water, and suggest why heating the gel turns it blue again. [3]

B11 LSC-Q17 Suggest the formula, shape and coordination number of the complex formed when excess ethanedioate ions are added to a solution of $[Fe(H_2O)_6]^{3+}$, and suggest why the substitution is favoured. [3]

B12 LSC-Q18 Explain why the cis isomer of $[Pt(NH_3)_2Cl_2]$ is polar but the trans isomer is not. [3]

B13 LSC-Q19 Calculate the ratio of $[Ni(en)_3]^{2+}$ to $[Ni(H_2O)_6]^{2+}$ in a solution in which the free ethane-1,2-diamine concentration is 0.010 mol dm^{-3}. $\log_{10}$ Kstab for $[Ni(en)_3]^{2+}$ is 18.3. [3]

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B14 LSC-Q21 Describe what is seen when sodium hydroxide solution is added until in excess to a solution of $[Co(H_2O)_6]^{2+}$, and the mixture is then left in air. Include an equation. [3]

B15 LSC-Q23 Explain why ethanol is added to the deep blue solution when tetraamminecopper(II) sulfate is prepared, why the crystals are washed with ethanol rather than water, and why the yield is below 100%. [3]

SECTION C · Long, 6 marks or more

C1 LSC-Q4 Explain, with equations, what is seen when excess concentrated ammonia and, separately, concentrated hydrochloric acid are added to copper(II) sulfate solution, and why the two products have different shapes. [6]

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