

GSC Assignment – 24-3

Q1. $[\text{Fe}(\text{NCS})_6]^{3-}$ ion has five unpaired d electrons. From these results, what can you conclude about whether each complex is a high-spin or low-spin complex? What can you say about the placement of NCS^- in the spectrochemical series? [2+2]

Q2. Predict the geometry of the following four-coordinate complexes: $[\text{AuBr}_4]^-$ and $[\text{NiBr}_4]^{2-}$. Justify your answer. [4]

Q3. One of the following solids is yellow, and the other is green: $\text{Fe}(\text{NO}_3)_2 \cdot 6 \text{H}_2\text{O}$; $\text{K}_4[\text{Fe}(\text{CN})_6] \cdot 3 \text{H}_2\text{O}$. Indicate which is which and explain your reasoning.

Q4. The experimental magnetic moment of the complex ion, $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$, is given as $3.87 \mu_{\text{B}}$ (Bohr magnetons). Comment on the validity of the 'spin only' formula for this species. [4]

Q5. The standard reduction potentials for three octahedral Co(III) coordination compounds



with ligands, H_2O , NH_3 , and CN^- are: +1.83, +0.11, and -0.83 V versus NHE, respectively. Using CFT, determine which of the ligands corresponds with which standard reduction potential. [6]

Q6. The complex $[\text{Ni}(\text{NH}_3)_6]^{2+}$ has a ligand field splitting of $209 \text{ kJ}\cdot\text{mol}^{-1}$ and forms a purple solution. What is the wavelength and color of the absorbed light? [4]

Q7. The complex $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ is an extremely pale pink-colored complex while $[\text{CoCl}_4]^{2-}$ is an intensely blue-colored complex. Explain the *relative colors* and color *intensities* of the two coordination compounds. [6]

Q8. Which of the following complexes would undergo Jahn-Teller distortion? [10]

- (a) $[\text{FeCl}_6]^{3-}$; (b) $[\text{MnCl}_6]^{3-}$; (c) $[\text{CuCl}_6]^{4-}$; (d) $[\text{CrCl}_6]^{3-}$; (e) $[\text{VCl}_6]^{4-}$

Q9. Which d -orbitals on the metal ion are used to form σ -bonds between octahedral metal ions and ligands? [2]

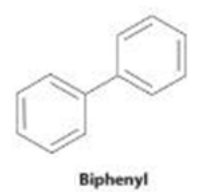
Q10. Which d -orbitals on the metal ion are used to form π -bonds between octahedral metal ions and ligands? [2]

Q11. State the bonding/nonbonding/antibonding nature of t_{2g} and e_g orbitals according to the ligand field theory for octahedral complexes of the ligands: CO , NH_3 , and Br^- . [9]

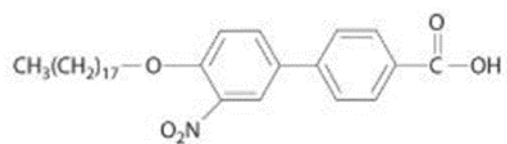
Q12. Which of the following molecules is most likely to form a liquid crystalline phase? [6]

- (a) isooctane (2,2,4-trimethylpentane)
(b) ammonium thiocyanate $[\text{NH}_4(\text{SCN})]$
(c) sodium decanoate $\{\text{Na}[\text{CH}_3(\text{CH}_2)_8\text{CO}_2]\}$

(d)



(e)



(f)

