

Review I: Transition Metals

1. Electron configuration for:
 - a. Cr
 - b. Cr^{2+}
2. Oxidation number for:
 - a. $\text{Cr}_2\text{O}_4^{2-}$
 - b. CrO_4^{2-}
 - c. CrCl_4^{2-}
3. Classify as oxidation or reduction and balance
 $\text{Cr}_2\text{O}_4^{2-} \rightarrow \text{CrO}_4^{2-} + \text{Cr}^{3+}$
4. Identify (i) central ion (ii) ligand (iii) Coordination number
 - a. $\text{Cr}(\text{NH}_3)_4^{2+}$
 - b. $\text{CrCl}(\text{H}_2\text{O})_5^{2+}$
 - c. $(\text{NH}_4)_3\text{VF}_6$
5. Given Coordination number, write the formula and name of the complex ion formed
 - a. $\text{Cu}^{2+} + \text{H}_2\text{O}$ (CN = 4)
 - b. $\text{Fe}^{3+} + \text{CN}^-$ (CN = 6)
 - c. $\text{Ni}^{2+} + \text{Cl}^-$ (CN = 4)
 - d. $\text{Ag}^+ + \text{NH}_3$ (CN = 2)
 - e. $\text{Cu}^{2+} + \text{Cl}^-$ (CN = 4)
6. Identify 4 types of bonding in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
7. Compare the trends in Atomic radii, IE, energy for the elements in a short period (3 marks) to those of TM. Explain in terms of electron arrangement
8. Give 4 properties/characteristics of d-block elements and of their compounds. Illustrate your answers with suitable examples.
9. Why Sc and Zn do not behave as typical d-block elements?
10. $\text{Cu}^{2+}(\text{H}_2\text{O})_4$ is blue. When conc. HCl is added it turns yellow/green. Why? Explain.
11. Which can act as a ligand: PH_3 , PH_4^+ , F^- , $\text{C}_2\text{O}_4^{2-}$, H_2O

12. The stability constants of the following two complex ions are:



a) Write the equation to which these constants refer

b) Use the equation and stability constants to predict what would happen if NH_3 solution were added drop by drop to a solution of CuCl_4^{2-} ions

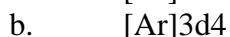
13. a) What are geometric isomers?

c) Draw the structure families of CrS^- and trans dichlorodiammine cobalt(II)

14. Explain why a H_2O solution of copper(II)sulphate is used to filter out heat waves (red end of spectrum)?

ANSWERS: Review I: Transition Metals

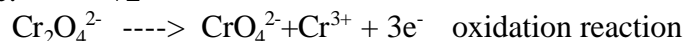
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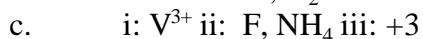
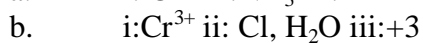
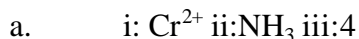
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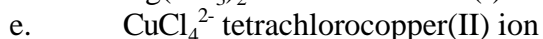
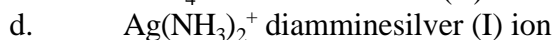
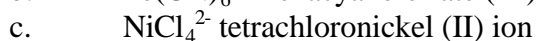
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4.



5.



6.

Covalent bonds within the S and O, in sulphate ion and covalent bonds within the water molecule, Ionic bonds between Cu^{2+} and SO_4^{2-} , ion-dipole attractions between H_2O and CuSO_4

7. While it is common for a short period to experience large differences going across a period, the properties of TM remains fairly constant. This is because transition metals generally differ in electrons in the d-shell, increasing going across the period. However, the chemistry of the electrons is mainly involved in the s orbitals, so going across the period, the increase of electrons in the d-shell helps to shield the 4s electrons, keeping the effective nuclear charge relatively constant.
8. Forms coloured complex in solution, eg copper (II) sulphate is blue; Several oxidation states as a result of similar energy levels of 4s and 3d orbitals; catalytic properties, paramagnetic properties
9. All compounds of scandium have an empty 3d shell and all compounds of zinc have a filled 3d shell, hence they do not behave like TM.
10. The H₂O ligand is replaced by HCl creating the complex ion CuCl₄²⁻. This new ligand leads to repulsion of the electrons in the d shell of the central ion to a different extent, leading to different change in energy during transition, hence different coloured complex.
11. PH₃, F⁻, CrO₄(2-), H₂O
12.
 - a. i: $K_c = \frac{[\text{NH}_3]^4[\text{Cu}^{2+}]}{[\text{Cu}(\text{NH}_3)_2^{2+}]}$ ii: $K_c = \frac{[\text{Cl}^-]^4[\text{Cu}^{2+}]}{[\text{CuCl}_4^{2-}]}$
 - b. Since the equilibrium expression for the dissociation Cu(NH₃)²⁺ is highly product favoured (as per the equilibrium constant), adding drops of NH₃ would be unlikely to lead to the formation of Cu(NH₃)²⁺
14. Copper (II) Sulphate has a characteristic blue coloured solution. This is a result of its absorption of red light, leading to the reflection of blue wavelength light. Since it absorbs red light, it can easily filter out heat waves.