1. Which metal ion has a d^6 electron configuration?
   A) Mn^{2+}
   B) Ni^{2+}
   C) Fe^{3+}
   D) Co^{3+}
   E) Ti^{2+}

2. Which of the following statements is true about coordination complexes?
   A) The metal is a Lewis base and the ligands are Lewis acids.
   B) Only complexes with coordination number 6 are found in nature.
   C) When the ligands approach a transition metal ion in an octahedral field, the d_{xz}, d_{yz}, and d_{xy} atomic orbitals are affected the least by the ligands.
   D) None of these is true.
   E) All of these are true.

3. Which of the following coordination compounds will form a precipitate when treated with an aqueous solution of AgNO_3?
   A) [Cr(NH_3)_3Cl_3]
   B) [Cr(NH_3)_6]Cl_3
   C) Na_4[Cr(CN)_6]
   D) Na_3[CrCl_6]
   E) all of these

4. Which of the metal ions in the following complex ions has a d^5 electron configuration?
   A) [V(H_2O)_6]^{2+}
   B) [Ni(NH_3)_6]^{3+}
   C) [Co(CN)_6]^{3-}
   D) [Fe(CN)_6]^{3-}
   E) [FeCl_6]^{4-}

5. A coordination compound of Cu^{2+} can be described as Cu(NH_3)_xSO_4 and is known to contain 29.9% NH_3. What is the value of x?
   A) 2
   B) 3
   C) 4
   D) 6
   E) none of these

6. _____ isomers and _______ isomers are classes of structural isomers.
   A) Geometric, optical
   B) Coordination, geometric
   C) Linkage, geometric
   D) Coordination, linkage
   E) Geometric, linkage

7. Which of the following complexes shows geometric isomerism?
   A) [Co(NH_3)_5Cl]SO_4
   B) [Co(NH_3)_6]Cl_2
   C) [Co(NH_3)_5Cl]Cl_2
   D) K[Co(NH_3)_2Cl_2]
   E) Na_3[CoCl_6]
8. Give the number of geometric isomers for the octahedral compound \([Ma_2B_2C_2]\), where A, B, and C represent ligands.
A) 1  
B) 2  
C) 3  
D) 5  
E) none of these

9. For the process \(\text{Co(NH}_3\text{)}_5\text{Cl}^{2+} + \text{Cl}^– \rightarrow \text{Co(NH}_3\text{)}_4\text{Cl}^{3+} + \text{NH}_3\), what would be the ratio of \textit{cis} to \textit{trans} isomers in the product?
A) 1:1  
B) 1:2  
C) 1:4  
D) 4:1  
E) 2:1

10. Fluoride ion ranks low in the spectrochemical series and produces a weak crystal field in complex ions. Based on this information, predict the number of unpaired electrons in \([\text{MnF}_6]^{3–}\).
A) 3  
B) 1  
C) 0  
D) 2  
E) 4

11. The complex ion \([\text{NiF}_4]^{2–}\) is tetrahedral. How many unpaired electrons are there in the complex?
A) 0  
B) 1  
C) 2  
D) 3  
E) 4

12. A metal ion in a high-spin octahedral complex has two more unpaired electrons than the same ion does in a low-spin octahedral complex. Which of the following could the metal ion be?
A) \(\text{Ti}^{2+}\)  
B) \(\text{Cu}^{2+}\)  
C) \(\text{Mn}^{2+}\)  
D) \(\text{Co}^{3+}\)  
E) \(\text{Co}^{2+}\)

13. For which of the following metal ions would there be no distinction between low spin and high spin in octahedral complexes?
A) \(\text{Cr}^{2+}\)  
B) \(\text{V}^{2+}\)  
C) \(\text{Co}^{3+}\)  
D) \(\text{Mn}^{3+}\)  
E) \(\text{Ni}^{3+}\)
14. The spectrochemical series is
   \( \text{I}^- < \text{Br}^- < \text{Cl}^- < \text{F}^- < \text{OH}^- < \text{H}_2\text{O} < \text{NH}_3 < \text{en} < \text{NO}_2^- < \text{CN}^- \)
   Which of the following complexes will absorb visible radiation of the highest energy (shortest wavelength)?
   A) \([\text{Co(H}_2\text{O)}_6]^{3+}\)
   B) \([\text{Co(I)}_6]^{3–}\)
   C) \([\text{Co(OH)}_6]^{3–}\)
   D) \([\text{Co(en)}_3]^{3+}\)
   E) \([\text{Co(NH}_3)_6]^{3+}\)

15. Which of the following complexes would be diamagnetic (all electrons paired)?
   A) \([\text{Ni(CN)}_6]^{4–}\)
   B) \([\text{V(CN)}_6]^{3–}\)
   C) \([\text{Co(CN)}_6]^{3–}\)
   D) \([\text{Cr(CN)}_6]^{3–}\)

16. How many unpaired electrons are found in \(\text{Zn(H}_2\text{O)}_6^{2+}\)?
   A) 0
   B) 1
   C) 2
   D) 4
   E) 5

17. Specify the number of unpaired electrons in \(\text{CoF}_6^{3–}\) (weak field).
   A) 0
   B) 1
   C) 2
   D) 4
   E) 5

18. The structural formula for the square planar coordination compound aquatricarbonylplatinum(II) bromide is
   A) \([\text{Pt(H}_2\text{O)}_3\text{Br}]\text{CO}\)
   B) \([\text{PtH}_2\text{O(CO)}_3]\text{Br}\)
   C) \([\text{PtH}_2\text{O(CO)}_3\text{Br}]\text{Br}\)
   D) \([\text{PtH}_2\text{O(CO)}_3\text{Br}_2]\)
   E) none of these

19. Give the correct name for the compound \(\text{Na}_2[\text{Pt(CN)}_4(\text{NH}_3)_2]\)
   A) disodium diamminetetracyanoplatinate(II)
   B) sodium diamminetetracyanoplatinum(II)
   C) sodium tetracyanodiammineplatinate(II)
   D) sodium diamminetetracyanoplatinum(IV)
   E) sodium diamminetetracyanoplatinic(II)

20. The following compounds were synthesized: \([\text{Fe(H}_2\text{O)}_6]^{3+}\) and \([\text{Fe(NH}_3)_6]^{3+}\). One is blue and the other is red. Which compound is blue? (spectrochemical series: \(\text{I}^- < \text{Br}^- < \text{Cl}^- < \text{F}^- < \text{OH}^- < \text{H}_2\text{O} < \text{NH}_3 < \text{en} < \text{NO}_2^- < \text{CN}^-\))
   A) \([\text{Fe(H}_2\text{O)}_6]^{3+}\)
   B) \([\text{Fe(NH}_3)_6]^{3+}\)
21. The phenomenon called the ________ contraction is responsible for the great similarity in atomic size and chemistry between 4d and 5d elements.
   A) transition
   B) coordination
   C) none of these
   D) isomeric
   E) lanthanide

22. Which of the following statements is true of the crystal field model?
   A) The interaction between metal ion and ligand is treated as a Lewis acid–base interaction.
   B) The ligands are treated as negative point charges.
   C) The metal ion–ligand bonds are considered completely ionic.
   D) The electrons are assumed to be localized.
   E) None of thee statements is true.

23. The color of a transition metal complex results from
   A) bending vibrations.
   B) stretching vibrations.
   C) transition of an electron between d orbitals.
   D) transition of an electron between an s orbital and a p orbital.
   E) nuclear magnetic resonance.

24. Which of the following is paramagnetic?
   A) [Zn(H₂O)₆]²⁺
   B) [Co(NH₃)₆]³⁺ (strong field)
   C) [Cu(en)₂]⁺
   D) [Mn(en)₃]²⁺ (strong field)
   E) [Fe(en)₃]²⁺ (strong field)

25. Which of the following statements is true about the octahedral complexes of Ni²⁺?
   A) Both strong- and weak-field complexes are diamagnetic.
   B) The strong-field complex is diamagnetic and the weak-field complex is paramagnetic.
   C) The strong-field complex is paramagnetic and the weak-field complex is diamagnetic.
   D) Both strong- and weak-field complexes are paramagnetic.

26. Which of the following ligands are capable of linkage isomerism?
   Ni⁺, NO₂⁻, NH₃, NH₂CH₂CH₂NH₂, OCN⁻, Cl⁻, H₂O, SCN⁻
Answers: