

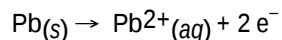
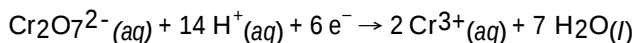
1012_3rd Exam_1020522

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 1) Ethylenediaminetetraacetate ion (EDTA^{4-}) is commonly referred to as a _____ ligand.
 A) hexadentate B) monodentate C) bidentate D) tetradentate

Answer: A

- 2) For a galvanic cell that uses the following two half-reactions,



how many moles of $\text{Pb}(\text{s})$ are oxidized by one mole of $\text{Cr}_2\text{O}_7^{2-}$?

- A) 2 B) 1 C) 6 D) 3

Answer: D

- 3) For an electrolytic cell

- A) E is negative and ΔG is negative for the cell reaction.
 B) E is positive and ΔG is positive for the cell reaction.
 C) E is negative and ΔG is positive for the cell reaction.
 D) E is positive and ΔG is negative for the cell reaction.

Answer: C

- 4) The bond between the metal and the ligand in a complex is best described as

- A) an ionic bond.
 B) a nonpolar covalent bond.
 C) a metallic bond.
 D) a coordinate covalent bond.
 E) none of these

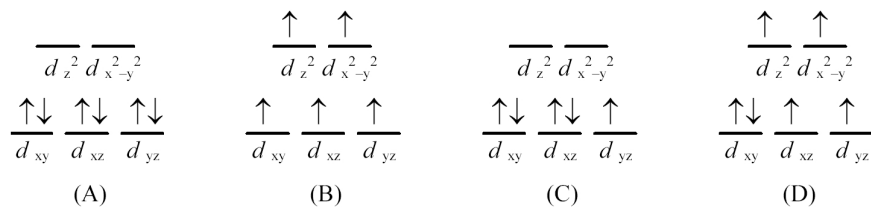
Answer: D

- 5) The complex $[\text{Ni}(\text{CN})_4]^{2-}$ is diamagnetic and the complex $[\text{NiCl}_4]^{2-}$ is paramagnetic. What can you conclude about their molecular geometries?

- A) $[\text{NiCl}_4]^{2-}$ has a tetrahedral geometry while $[\text{Ni}(\text{CN})_4]^{2-}$ has a square planar geometry.
 B) Both complexes have tetrahedral geometries.
 C) $[\text{NiCl}_4]^{2-}$ has a square planar geometry while $[\text{Ni}(\text{CN})_4]^{2-}$ has a tetrahedral geometry.
 D) Both complexes have square planar geometries.

Answer: A

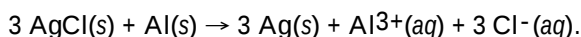
- 6) What is the crystal field energy level diagram for the complex $[\text{Co}(\text{CN})_6]^{3-}$?



- A) (A) B) (B) C) (C) D) (D)

Answer: A

7) At 25°C, $E^\circ = +1.88 \text{ V}$ for a cell based on the reaction



Find the cell potential E if $[\text{Al}^{3+}] = 0.20 \text{ M}$ and $[\text{Cl}^{-}] = 0.010 \text{ M}$.

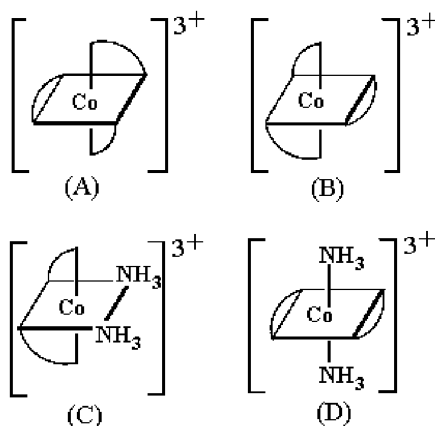
- A) +2.04 V
- B) +2.28 V
- C) +2.01 V
- D) cannot be calculated without the amounts of AgCl, Al, and Ag

Answer: C

8) The reaction of $\text{Cu(s)} + 2 \text{ AgNO}_3(\text{aq}) \rightarrow \text{Cu(NO}_3)_2(\text{aq}) + 2 \text{ Ag(s)}$ is best classified as a(n)

- A) precipitation reaction.
- B) acid-base neutralization reaction.
- C) oxidation-reduction reaction.
- D) double replacement reaction.

Answer: C



9) Which of the Co(III) complexes above are optically active?

- A) (A) and (B)
- B) (C) and (D)
- C) (A), (B), and (C)
- D) (A), (B), (C), and (D)

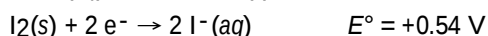
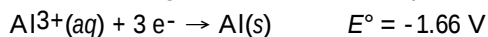
Answer: C

10) Which of the Co(III) complexes above are enantiomers of each other?

- A) (C) and (D)
- B) (A) and (B)
- C) (A), (B), and (C)
- D) (A), (B), (C), and (D)

Answer: B

11) Consider the following standard reduction potentials,



Under standard conditions,

- A) $\text{I}^{-}(\text{aq})$ is a stronger oxidizing agent than Al(s) , and $\text{I}_2(\text{s})$ is a stronger reducing agent than $\text{Al}^{3+}(\text{aq})$.
- B) Al(s) is a stronger oxidizing agent than $\text{I}^{-}(\text{aq})$, and $\text{Al}^{3+}(\text{aq})$ is a stronger reducing agent than $\text{I}_2(\text{s})$.
- C) $\text{I}_2(\text{s})$ is a stronger oxidizing agent than $\text{Al}^{3+}(\text{aq})$, and Al(s) is a stronger reducing agent than $\text{I}^{-}(\text{aq})$.
- D) $\text{Al}^{3+}(\text{aq})$ is a stronger oxidizing agent than $\text{I}_2(\text{s})$, and $\text{I}^{-}(\text{aq})$ is a stronger reducing agent than Al(s) .

Answer: C

12) Which elements will not react with liquid water but will react with aqueous H^+ ions?

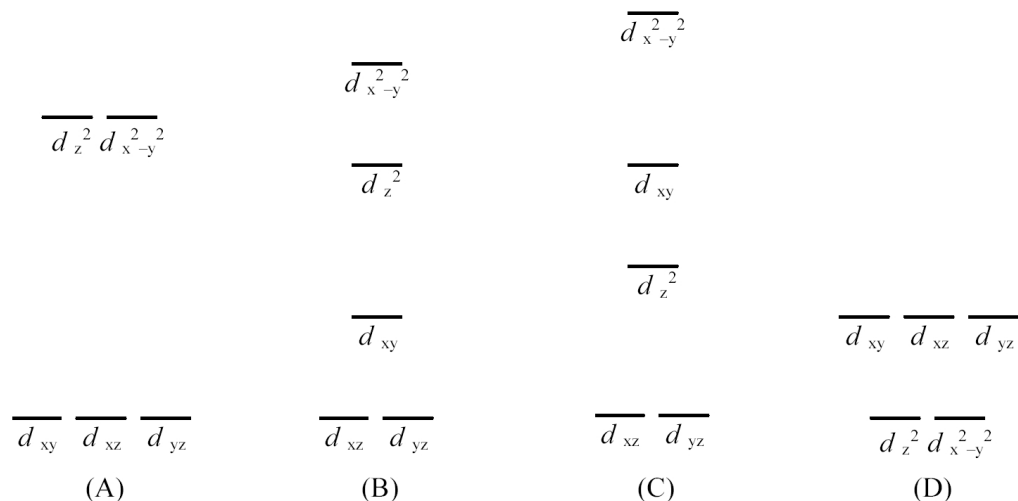
A) Al, Cr, Mn, Zn

B) Ba, Ca, Li, Na

C) Ag, Cu, Hg, Pt

D) Ag, Au, Ca, K

Answer: A



13) Which is the crystal field energy level diagram for a tetrahedral ML_4 ?

A) (A)

B) (B)

C) (C)

D) (D)

Answer: D

14) Which is the crystal field energy level diagram for an octahedral ML_6 complex?

A) (A)

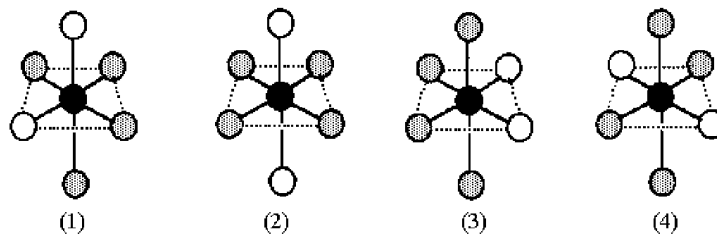
B) (B)

C) (C)

D) (D)

Answer: A

Consider the following isomers of $[Co(NH_3)_4Br_2]^+$. The black sphere represents Co, gray spheres represent NH_3 , and unshaded spheres represent Br.



15) Which are cis-isomers?

A) isomers (3) and (4)

B) isomers (1) and (2)

C) isomers (2) and (4)

D) isomers (1) and (3)

Answer: D

16) Which are trans-isomers?

A) isomers (1) and (2)

B) isomers (3) and (4)

C) isomers (2) and (4)

D) isomers (1) and (3)

Answer: C

17) Which exist as enantiomers?

- A) All exist as enantiomers.
C) isomers (2) and (4)

- B) isomers (1) and (3)
D) None exist as enantiomers.

Answer: D

18) Which structures are identical?

- A) None of the structures are identical.
B) structure (1) = structure (2) and structure (3) = structure (4)
C) structure (1) = structure (3) and structure (2) = structure (4)
D) structure (1) = structure (4) and structure (2) = structure (3)

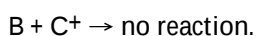
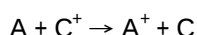
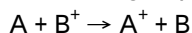
Answer: C

19) Most of the compounds of the 2+ ions of the first row of the transition metals from Mn to Zn are colored due to absorption of visible light promoting an electron from one 3d orbital to another. Which of these ions should tend to form colorless compounds?

- A) Mn^{2+} B) Cu^{2+} C) Zn^{2+} D) Co^{2+}

Answer: C

20) Using the following sequence of reactions, determine the order of reducing agents (strongest to weakest)



- A) $\text{A} > \text{C} > \text{B}$ B) $\text{A} > \text{B} > \text{C}$ C) $\text{C}^+ > \text{B}^+ > \text{A}^+$ D) $\text{B} > \text{C} > \text{A}$

Answer: A

21) For the reaction $2 \text{Al(s)} + 3 \text{Co}^{2+}(\text{aq}) \rightarrow 2 \text{Al}^{3+}(\text{aq}) + 3 \text{Co(s)}$, ΔG° is -799 kJ. What is E° for a standard cell based on this reaction?

- A) +2.76 V B) +1.38 V C) +8.28 V D) +4.14 V

Answer: B

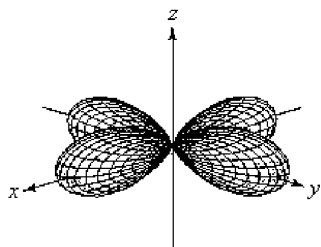
- 22) $\text{O}_2(\text{g}) + 4 \text{H}^+(\text{aq}) + 4 \text{e}^- \rightarrow 2 \text{H}_2\text{O}(\text{l})$ $E^\circ = +1.23 \text{ V}$
 $\text{Pb}^{2+}(\text{aq}) + 2 \text{e}^- \rightarrow \text{Pb(s)}$ $E^\circ = -0.13 \text{ V}$
 $2 \text{H}_2\text{O}(\text{l}) + 2 \text{e}^- \rightarrow \text{H}_2(\text{g}) + 2 \text{OH}^-(\text{aq})$ $E^\circ = -0.83 \text{ V}$

Based on the half-reactions above, electrolysis of an aqueous solution of $\text{Pb}(\text{NO}_3)_2$ is expected to produce.

- A) H_2 at the cathode and Pb at the anode. B) Pb at the cathode and O_2 at the anode.
C) O_2 at the cathode and Pb at the anode. D) Pb at the cathode and H_2 at the anode.

Answer: B

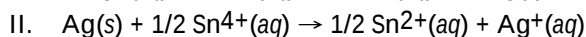
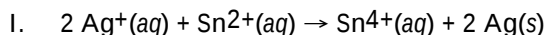
- 23) For the fourth-shell orbital shown below, what are the principal quantum number, n , and the angular momentum quantum number, l ?



- A) $n = 4$ and $l = 1$ B) $n = 4$ and $l = 0$ C) $n = 4$ and $l = 2$ D) $n = 4$ and $l = 3$

Answer: C

- 24) What is the relationship between the standard cell potentials, E° , for the following two galvanic cell reactions?



- A) $E^\circ(\text{I}) = E^\circ(\text{II})$ B) $E^\circ(\text{I}) = 2E^\circ(\text{II})$ C) $E^\circ(\text{I}) = -E^\circ(\text{II})$ D) $E^\circ(\text{I}) = -2E^\circ(\text{II})$

Answer: C

- 25) How many unpaired electrons are present in the high spin form of the $[\text{CoF}_6]^{3-}$ complex and what metal orbitals are used in bonding?

A) 0 unpaired electrons and $3d$, $4s$, and $4p$ orbitals to give d^2sp^3

B) 4 unpaired electrons and $3d$, $4s$, and $4p$ orbitals to give d^2sp^3

C) 0 unpaired electrons and $4s$, $4p$ and $4d$ orbitals to give sp^3d^2

D) 4 unpaired electrons and $4s$, $4p$ and $4d$ orbitals to give sp^3d^2

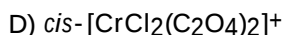
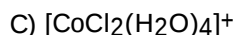
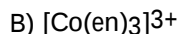
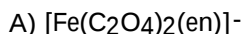
Answer: D

- 26) The equilibrium constant, K , can be calculated from

- A) E . B) E° . C) either E° or E . D) neither E° nor E .

Answer: B

- 27) Which complex can not exist as enantiomers?



Answer: C

- 28) What is the coordination number of copper in the $[\text{Cu}(\text{en})_2(\text{H}_2\text{O})_2]^{2+}$ complex?

A) 0

B) 2

C) 4

D) 6

E) none of these

Answer: D

- 29) Doubling all the coefficients in the equation for the cell reaction

A) doubles ΔG° , but does not change E° .

B) doubles E° , but does not change ΔG° .

C) doubles both E° and ΔG° .

D) does not change E° or ΔG° .

Answer: A

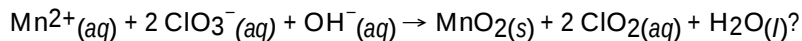
- 30) $\text{Ag}^+(\text{aq}) + \text{e}^- \rightarrow \text{Ag}(\text{s}) \quad E^\circ = +0.800 \text{ V}$
 $\text{AgBr}(\text{s}) + \text{e}^- \rightarrow \text{Ag}(\text{s}) + \text{Br}^-(\text{aq}) \quad E^\circ = +0.071 \text{ V}$
 $\text{Br}_2(\text{l}) + 2 \text{e}^- \rightarrow 2 \text{Br}^-(\text{aq}) \quad E^\circ = +1.066 \text{ V}$

Use some of the data above to calculate K_{sp} at 25°C for AgBr .

- A) 6.3×10^{-2} B) 4.9×10^{-13} C) 1.9×10^{-15} D) 2.4×10^{-34}

Answer: B

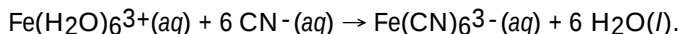
- 31) What is the reduction half reaction for the chemical reaction in a basic solution



- A) $\text{ClO}_3^-(\text{aq}) + 2 \text{H}^+(\text{aq}) + \text{e}^- \rightarrow \text{ClO}_2(\text{aq}) + \text{H}_2\text{O}(\text{l})$
 B) $\text{Mn}^{2+}(\text{aq}) + 2 \text{H}_2\text{O}(\text{l}) \rightarrow \text{MnO}_2(\text{s}) + 4 \text{H}^+(\text{aq}) + 2\text{e}^-$
 C) $\text{ClO}_3^-(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{e}^- \rightarrow \text{ClO}_2(\text{aq}) + 2 \text{OH}^-(\text{aq})$
 D) $\text{Mn}^{2+}(\text{aq}) + 4 \text{OH}^-(\text{aq}) \rightarrow \text{MnO}_2(\text{s}) + 2 \text{H}_2\text{O}(\text{l}) + 2\text{e}^-$

Answer: C

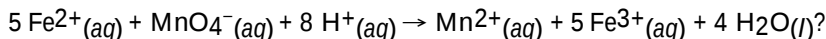
- 32) Identify the Lewis acid that acts as a reactant in the following reaction



- A) H_2O B) Fe^{3+} C) CN^- D) $\text{Fe}(\text{H}_2\text{O})_6^{3+}$

Answer: B

- 33) Which species functions as the oxidizing agent in the following reduction-oxidation reaction:



- A) $\text{Mn}^{2+}(\text{aq})$ B) $\text{MnO}_4^-(\text{aq})$ C) $\text{Fe}^{2+}(\text{aq})$ D) $\text{H}^+(\text{aq})$

Answer: B

- 34) Which statement is not true regarding optical isomerism?

- A) Optical isomers rotate plane polarized light in opposite directions.
 B) Two optical isomers of square planar $[\text{Pt}(\text{en})\text{BrCl}]$ exist.
 C) Optical isomers are mirror images of each other.
 D) Two optical isomers of $[\text{Co}(\text{en})_3]^{3+}$ exist.
 E) Optical isomers are not superimposable.

Answer: B

- 35) What is the coordination number and oxidation state of the central atom in $[\text{CoCl}(\text{NH}_3)_4]^{2+}$?

- A) 6 +2 B) 4 +3 C) 5 +2 D) 1 +2 E) 5 +3

Answer: E

- 36) How many unpaired electrons would you expect for $[\text{Co}(\text{CN})_6]^{3-}$? (CN^- is a strong field ligand.)

- A) 4 B) 5 C) 3 D) 6 E) 0

Answer: E

37) Given the spectrochemical series (increasing λ), $\text{Cl}^- < \text{H}_2\text{O} < \text{NH}_3 < \text{CN}^-$, which of the following species would absorb light of the shortest wavelength?

- A) $[\text{Co}(\text{CN})_6]^{3-}$
- B) $[\text{Co}(\text{NH}_3)_6]^{3+}$
- C) $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$
- D) $[\text{CoCl}_6]^{3-}$
- E) $[\text{Co}(\text{NH}_3)_5\text{Cl}]^{2+}$

Answer: A

38) Which ion has *cis* and *trans* isomers?

- A) $[\text{PtCl}_2(\text{CN})_2]^{2-}$
- B) $[\text{PdCl}_3\text{NH}_3]^-$
- C) $[\text{Pt}(\text{CN})_5\text{NH}_3]^-$
- D) $[\text{Pt}(\text{C}_2\text{O}_4)_2]^{2-}$

Answer: A

39) Which of the following complexes are diamagnetic?

- $[\text{Mn}(\text{CN})_6]^{3-}$ $[\text{Zn}(\text{NH}_3)_4]^{2+}$ $[\text{Fe}(\text{CN})_6]^{4-}$ $[\text{FeF}_6]^{3-}$
- A) $[\text{Zn}(\text{NH}_3)_4]^{2+}$
 - B) $[\text{Zn}(\text{NH}_3)_4]^{2+}$ and $[\text{FeF}_6]^{3-}$
 - C) $[\text{Zn}(\text{NH}_3)_4]^{2+}$ and $[\text{Fe}(\text{CN})_6]^{4-}$
 - D) $[\text{Mn}(\text{CN})_6]^{3-}$, $[\text{Zn}(\text{NH}_3)_4]^{2+}$ and $[\text{Fe}(\text{CN})_6]^{4-}$

Answer: C

40) Which of the following terms can be used to describe an electrochemical cell in which a spontaneous chemical reaction generates an electric current?

- I. an electrolytic cell
 - II. a galvanic cell
 - III. a voltaic cell
- A) only III
 - B) only I
 - C) only II
 - D) II and III

Answer: D