

Name _____

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

- 1) How many unpaired electrons would you expect for the square planar complex, $[\text{Ni}(\text{CN})_4]^{2-}$? (CN^- is a strong field ligand.)

A) 8 B) 0 C) 6 D) 2 E) 4

Answer: B

- 2) Which compound will have the largest dipole moment?

A) 1, 1, 2, 2-tetrabromoethylene B) *cis*-1, 2-dichloroethylene
C) *trans*-1, 2-dichloroethylene D) 1, 1, 2, 2-tetrachloroethylene

Answer: B

- 3) Which one of the amino acids below is not chiral?

A) glycine B) alanine C) valine D) aspartic acid

Answer: A

- 4) Which of the following species can exhibit geometric isomerism?

A) $[\text{Cr}(\text{en})\text{Cl}_2\text{Br}_2]^-$
B) $[\text{Pt}(\text{NH}_3)(\text{en})\text{Cl}]^+$
C) $[\text{CrNO}_2(\text{CN})_5]^{2-}$
D) $[\text{Co}(\text{en})_2\text{ClBr}]^+$
E) $[\text{Pt}(\text{NH}_3)_3\text{Cl}_3]^-$

Answer: A

- 5) A concentration cell consists of two Ni / Ni^{2+} electrodes. The electrolyte in half-cell A is 0.50 M and the electrolyte in half-cell B is 0.0025 M. Which combination below correctly pairs the anode and the cell voltage?

A) A, + 0.14 B) B, + 0.14 C) A, + 0.068 D) B, + 0.068 E) A, - 0.068

Answer: D

- 6) Which of the following statements about *cis-trans* isomers is not correct?

A) In the *cis*- isomer, the groups of interest are on the same side of the double bond.
B) Conversion between *cis*- and *trans*- isomers occurs by rotation around the double bond.
C) There are no *cis-trans* isomers in alkynes.
D) In the *trans*- isomer, the groups of interest are on opposite sides across the double bond.

Answer: B

- 7) What is the name of the product formed by the reaction of propanoic acid with ethanol?

A) ethyl propanoate B) ethylpropylketone C) pentyl ester D) pentanone

Answer: A

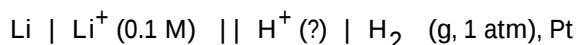
- 8) Which statement regarding ligands is correct?
- A) Positive ions make good ligands.
 - B) All ligands are negative ions.
 - C) Only one atom of the ligand can bond to the metal.
 - D) The atom bonding to the metal is positively polarized.
 - E) All ligands are Lewis bases.

Answer: E

- 9) Mercury is toxic to the body, in part, because Hg^{2+} interferes with
- A) digestion.
 - B) antioxidant activity.
 - C) sulfur containing enzymes.
 - D) transport of electrons across the blood-brain barrier.
 - E) oxygen uptake.

Answer: C

- 10) What should be the pH of a solution in the cathode half-cell if the following voltaic cell is to have $E_{\text{cell}} = 3.000 \text{ V}$?



- A) 0.040 B) 0.0668 C) 0.116 D) 2.351 E) 1.676

Answer: E

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

Answer: E

- 12) Which of the following complexes is diamagnetic?
- A) $[\text{Zn}(\text{NH}_3)_4]^{2+}$ B) $[\text{FeBr}_6]^{2-}$ C) $[\text{FeF}_6]^{3-}$ D) $[\text{Mn}(\text{CN})_6]^{3-}$

Answer: A

- 13) Which of the following statements is incorrect?
- A) Iron, cobalt and nickel display ferromagnetism in addition to paramagnetism.
 - B) Copper, silver and gold dissolve in aqueous acid to form +1 cations and $\text{H}_2 (\text{g})$.
 - C) Manganese exhibits a variety of oxidation states from +2 to +7.
 - D) Dichromate ion, $\text{Cr}_2\text{O}_7^{2-}$, is a good oxidizing agent in acidic solution.

Answer: B

- 14) Which of the following complex ions is colorless?
- A) $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ B) $[\text{Mn}(\text{CN})_6]^{3-}$ C) $[\text{Ag}(\text{NH}_3)_2]^+$ D) $[\text{CrCl}_3(\text{H}_2\text{O})_3]$

Answer: C

15) Which of the following is not considered to be a transition metal?

- A) La B) Pb C) Au D) Ni E) Sc

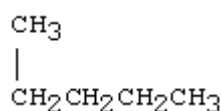
Answer: B

16) Which statement is incorrect?

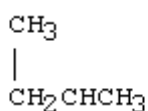
- A) A "high spin" complex results from a strong field ligand.
B) The spectrochemical series orders the ligands according to their abilities to split the d-orbital energy level.
C) Crystal field theory views the bond between the central atom or ion and the ligands as largely electrostatic.
D) Paramagnetic species contain unpaired electrons.
E) The splitting of the energies of the d orbitals results from different interactions between the d orbitals and the ligands.

Answer: A

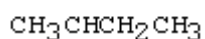
17) Which of the structures below are identical?



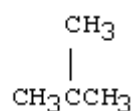
(I)



(II)



(III)



(IV)

A) II, III

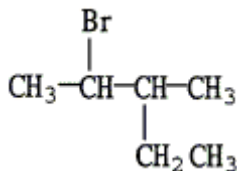
B) III, IV

C) I, II

D) I, IV

Answer: A

18) Name the following compound using the IUPAC nomenclature system.



- A) 2-bromo-3-ethylbutane
B) 2-ethyl-3-bromobutane
C) 3-methyl-4-bromopentane
D) 4-bromo-3-methylpentane
E) 2-bromo-3-methylpentane

Answer: E

19) Which one of the following is the formula for a ketone?

- A) CH_3CHO B) CH_3OCH_3 C) CH_3COCH_3 D) CH_3COOH

Answer: C

20) Which of the following is a coordination compound?

- A) $[\text{CoCl}(\text{NH}_3)_5]\text{Cl}_2$
- B) $[\text{CoCl}(\text{NH}_3)_5]^{2+}$
- C) CoCl_2
- D) NaCl
- E) NH_3

Answer: A

21) What is the coordination number and oxidation state of the central atom in $[\text{PtCl}_2(\text{en})]$?

- A) 2 0
- B) 4 0
- C) 3 0
- D) 2 -2
- E) 4 +2

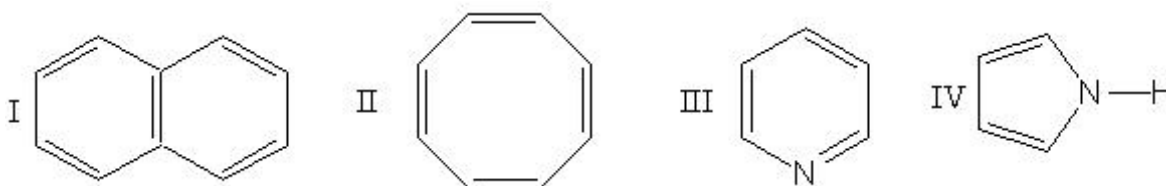
Answer: E

22) Which of the following elements would have five unpaired electrons in atomic form?

- A) Co
- B) Cr
- C) Fe
- D) V
- E) Mn

Answer: E

23) Which of the following compound is aliphatic?



- A) I
- B) II
- C) III
- D) IV

Answer: B

24) Which functional group, in addition to an amine, do all amino acids contain?

- A) an oxyacid
- B) an alcohol
- C) an amide
- D) a carboxylic acid

Answer: D

25) What is the coordination number and oxidation state of the central atom in $[\text{PbEDTA}]^{2-}$?

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

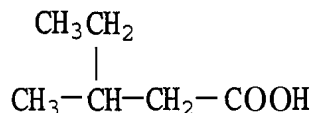
Answer: B

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

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

Answer: A

27) Name the following compound using the IUPAC nomenclature system.



- A) 3-methylpentanoic acid
- B) 2-methylpentanoic acid
- C) 3-ethylpropanoic acid
- D) 3-ethylbutanoic acid
- E) 2-ethylpropanoic acid

Answer: A

28) What does the term "alpha" amino acid mean?

- A) The amino acid contains only one carbon atom.
- B) The amino group attaches to the carbon in the carboxyl group.
- C) The amino acid contains only one carboxylic acid group.
- D) The amino group attaches to the carbon next to the carboxylic acid group.

Answer: D

29) Which of the following is not a constituent of a nucleic acid chain?

- A) purine or pyrimidine base
- B) glycerol
- C) phosphate
- D) pentose sugar

Answer: B

30) Name the following compound: $\text{K}_2 [\text{Cr} (\text{CN})_5 \text{CO}]$

- A) potassium pentacyanocarbonylchromate (III)
- B) dipotassium pentacyanocarbonatochromate (III)
- C) potassium carbonylpentacyanochromium (III)
- D) potassium chromiumcyanidocarbonate
- E) dipotassium chromium cyanidocarbonyl

Answer: A

31) A fat is an example of which functional group?

- A) amide
- B) ester
- C) alkyne
- D) alcohol
- E) carboxylic acid

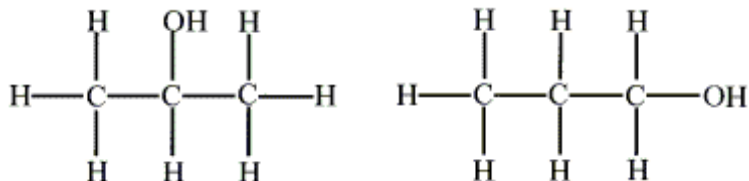
Answer: B

32) Which of the following ions would have three unpaired electrons?

- A) Fe^{2+}
- B) Sc^{3+}
- C) Co^{3+}
- D) Cr^{3+}
- E) Fe^{3+}

Answer: D

- 33) Which of the following spectroscopic methods would be able to easily distinguish between the following molecules?



A) UV-Vis

B) IR

C) NMR

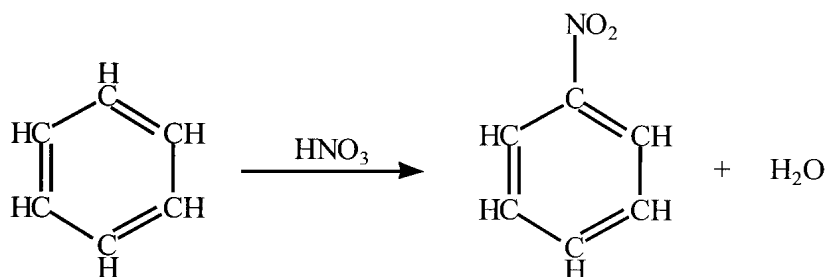
Answer: C

- 34) When gold reacts with aqua regia,

- A) sulfuric acid is used to keep the pH low.
- B) nitrate ion is the reducing agent.
- C) the gold is reduced.
- D) hydrogen ion is the oxidizing agent.
- E) hydrochloric acid furnishes ligands for a soluble complex.

Answer: E

- 35) The following reaction is an example of



- A) addition polymerization.
- B) nucleophilic aromatic substitution.
- C) simple addition.
- D) condensation.
- E) electrophilic aromatic substitution.

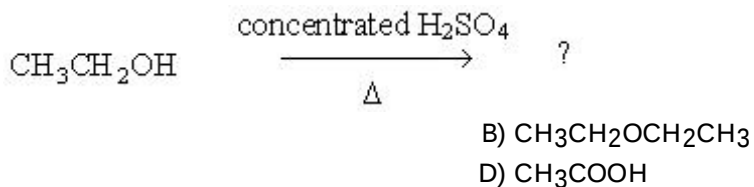
Answer: E

- 36) Aldehydes and ketones are formed from

- A) the addition of nucleophiles to alkenes.
- B) the elimination of alcohols.
- C) the oxidation of alcohols.
- D) the dehydration of alcohols.
- E) the substitution of halides.

Answer: C

- 37) Indicate the organic product of the following reaction.



Answer: A

38) Which of the following would be most likely to form the +3 oxidation state?

- A) Fe B) V C) Ni D) Ca E) Co

Answer: A

39) Calculate the mass defect in the creation of a nucleus of cobalt-59 from the nucleons it contains. The nuclear mass of cobalt-59 is 58.9332 u. Use 1.0073 u as the mass of a proton and 1.0087 u as the mass of a neutron.

- A) 0.5423 u B) 0.0668 u C) 0.5353 u D) 0.4975 u E) 0.5801 u

Answer: A

40) How many geometrical and structural isomers are there of C₄H₈?

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

Answer: D

41) A certain transition metal forms octahedral complexes with either one or five unpaired electrons. How many d electrons are present in this metal ion?

- A) 8 B) 4 C) 6 D) 5 E) 7

Answer: D

42) For transition elements, which of the following occurs as the effective nuclear charge increases?

- A) The atomic radius increases.
B) Both the atomic radius and the density increase.
C) The density decreases.
D) The atomic radius decreases and the density increases.

Answer: D

43) For the following two compounds:

Compound I: [Cr(H₂O)₆]Cl₃ Compound II: [Cr(NH₃)₆]Cl₃

- A) Compound I is violet / Compound II is yellow
B) Compound I is yellow / Compound II is violet
C) Both compounds are all colorless

Answer: A

44) Which of the following amino acids has a basic sidechain?

- A) glutamic acid
B) leucine
C) glycine
D) lysine
E) methionine

Answer: D

45) Which of the following coordination complexes is most stable?

- A) [Ni(NH₃)₆]²⁺ B) NiCl₂ C) [Ni(H₂O)₆]²⁺ D) [NiEDTA]²⁻

Answer: D

46) How many unpaired electrons would you expect to find in the tetrahedral complex [Ni(Cl)₄]²⁻?

- A) 0 B) 1 C) 3 D) 2 E) 5

Answer: D

47) Which element forms +2 ions that are diamagnetic and colorless in solution?

- A) Zn B) V C) Ti D) Cr E) Mn

Answer: A

48) Which of the following compounds catalyzes the conversion of an ester to a carboxylic acid?

- A) Cl_2
B) H_2O
C) ROH (an alcohol)
D) H_2SO_4
E) heat

Answer: D

49) Which statement is not correct concerning enzymes and inorganic catalysts.

- A) Both will speed up the rate of a chemical reaction.
B) Enzymes are more specific than catalysts reacting only with their substrate.
C) Enzymes are larger than most inorganic catalysts.
D) Enzymes are consumed by the reaction while inorganic catalysts do not undergo a chemical change.

Answer: D

50) What type of forces are mainly responsible for stabilizing a protein's tertiary structure?

- A) hydrogen bonds between nearby amino acids
B) disulfide and salt bridges
C) hydrophobic interactions of hydrocarbon side chains
D) all of the above

Answer: D