

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

1) Which of these metals is not a transition element?

- A) Hg B) Zr C) Os D) Mo E) Pb

Answer: E

2) Which of the following has the largest atomic radius?

- A) Ti B) Hf C) Ir D) Mn

Answer: B

3) Which of the following statements is incorrect?

- A) Scandium metal is chemically very reactive.
B) Cr^{6+} electrolysis requires more electricity than generally required for other metals.
C) Scandium metal is relatively abundant but not widely used.
D) Vanadium metal is relatively abundant in the Earth's crust.
E) Since the Group IA and IB elements all have only one valence electron, they exhibit similar chemical properties.

Answer: E

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

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

Answer: B

5) What is the ground state electron configuration of Ni^{2+} ?

- A) $[\text{Ar}] 4s^2 3d^6$ B) $[\text{Ar}] 4s^2 4d^6$ C) $[\text{Ar}] 3d^8$ D) $[\text{Ar}] 3d^{10}$ E) $[\text{Ar}] 4d^8$

Answer: C

6) Which of the following acids will react with Au?

- A) HNO_3
B) HCl
C) a mixture of HCl and HNO_3
D) H_2SO_4
E) H_3PO_4

Answer: C

7) Which of the following features a covalent bond?

- A) KCl B) $\text{Sr}(\text{NO}_3)_2$ C) Hg_2Cl_2 D) MgBr_2 E) CaCl_3

Answer: C

8) Mercury is toxic to the body, in part, because Hg^{2+} interferes with

- A) sulfur containing enzymes.
B) digestion.
C) oxygen uptake.
D) antioxidant activity.
E) transport of electrons across the blood-brain barrier.

Answer: A

9) Which of the following could not be a ligand?

- A) CN^- B) NH_3 C) H_2O D) Br^- E) Co^{2+}

Answer: E

10) What is the coordination number of chromium in $[\text{Cr}(\text{en})(\text{ox})_2]^-$?

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

Answer: E

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

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

Answer: A

12) Which number incorrectly states how many of the given ligand (or chelating agent) could be found in an octahedral complex?

- A) $\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$ 3
B) $^-\text{OOC}\text{COO}^-$ 3
C) EDTA 1
D) $\text{NH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ 3
E) NO_2^- 6

Answer: D

13) Which statement regarding ligands is correct?

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

Answer: C

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

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

Answer: C

15) Name the following compound: $[\text{Cr}(\text{NH}_3)_2(\text{en})\text{Cl}_2]\text{Cl}$

- A) diammineethylenediaminodichlorochromium (III) chloride
B) trichlorodiamminoethylenediaminechromate (III)
C) diammineethylenediaminetrichlorochromium (III)
D) chromium (III) diammineethylenediamine trichloride
E) diamminedichloroethylenediaminechromium (III) chloride

Answer: E

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

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

Answer: B

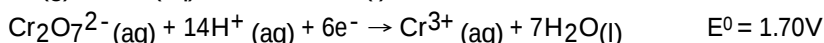
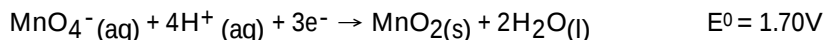
- 17) The complex ion $[\text{Ni}(\text{Br})_4]^{2-}$ is found to have two unpaired electrons. Use crystal field theory to deduce what geometry is consistent with this observation. (Br^- is a weak field ligand.)
- A) square planar
 - B) linear
 - C) tetrahedral
 - D) octahedral
 - E) none of these

Answer: C

- 18) Which statement is not true regarding optical isomerism?
- A) Optical isomers are mirror images of each other.
 - B) Two optical isomers of $[\text{Co}(\text{en})_3]^{3+}$ exist.
 - C) Optical isomers are not superimposable.
 - 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

- 19) Base on following equation. Which one is strongest oxidizing agent?



- A) $\text{MnO}_2(\text{s})$
- B) $\text{Cr}_2\text{O}_7^{2-} (\text{aq})$
- C) $\text{MnO}_4^- (\text{aq})$
- D) $\text{Cr}^{3+} (\text{aq})$
- E) $\text{O}_2(\text{g})$

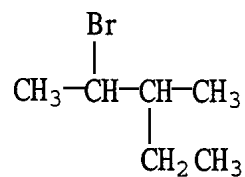
Answer: C

- 20) At one time, a triangular prism was considered as a possible geometric structure for coordination number 6. Assuming that ethylenediamine (en) molecules can link only to adjacent coordination sites, determine the number of possible geometric and/or optical isomers of $[\text{Co}(\text{en})_3]^{3+}$ based on the triangular prism structure.

- A) two optical and no geometric isomers
- B) no optical and two geometric isomers
- C) two optical and two geometric isomers
- D) one optical and one geometric isomers

Answer: B

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

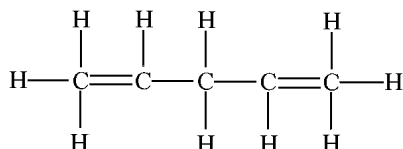


- A) 3-methyl-4-bromopentane
- B) 2-ethyl-3-bromobutane
- C) 2-bromo-3-methylpentane
- D) 4-bromo-3-methylpentane
- E) 2-bromo-3-ethylbutane

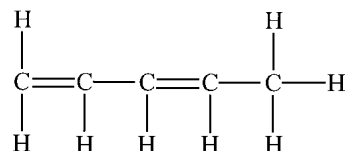
Answer: C

22) Which of the following is an example of a conjugated molecule?

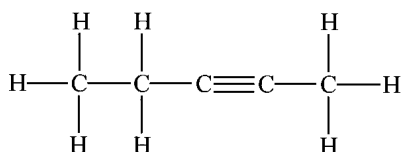
A)



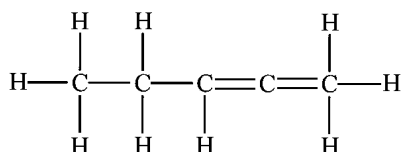
B)



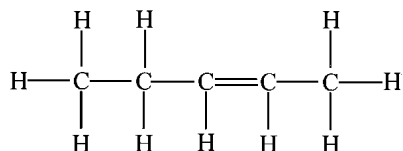
C)



D)

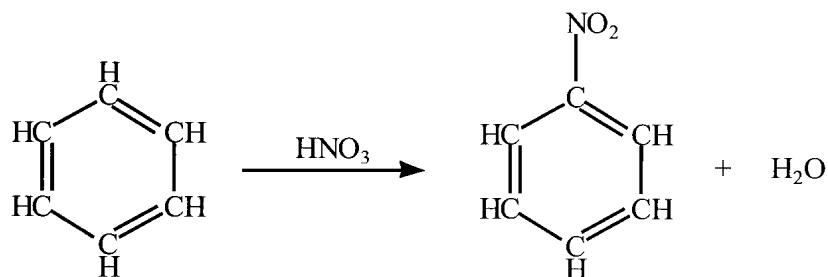


E)



Answer: B

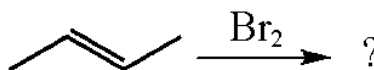
23) The following reaction is an example of



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

Answer: A

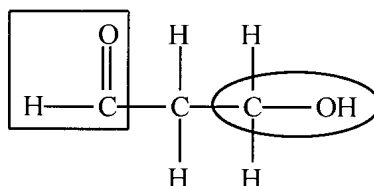
24) Indicate the organic product of the following reaction.



- A) 1-bromoethylethane
- B) 1,2-dibromobutane
- C) 2,2-dibromobutane
- D) 2,3-dibromobutane
- E) 2-methylpropane

Answer: D

25) Name the functional groups in the following molecule (circle first and the square second).



- A) alcohol, aldehyde
- B) alcohol, ester
- C) alcohol, amide
- D) alcohol, ketone
- E) aldehyde, carboxylic acid

Answer: A

26) Which of the following amino acids has an acidic side chain?

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

Answer: A

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

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

Answer: E

28) Which type of electromagnetic radiation interacts primarily with the π electrons in a molecule?

- A) X-ray
- B) microwave
- C) IR
- D) UV
- E) radio-TV

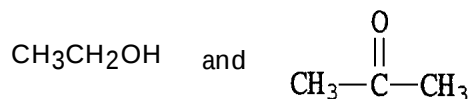
Answer: D

29) Which of the following bonds requires more energy to stretch?

- A) C=O (amide)
- B) O-H (alcohol)
- C) C=O (ester)
- D) C-H (alkyl)
- E) C-H (aromatic)

Answer: B

30) Which type of spectroscopy would be most useful in distinguishing the following pair of compounds?



- A) IR
- B) MS
- C) NMR
- D) UV-Vis
- E) Microwave

Answer: A

31) Which type of electromagnetic radiation stretches and bends chemical bonds in a molecule?

- A) IR
- B) X-ray
- C) radio-TV
- D) microwave
- E) UV

Answer: A

32) Which type of electromagnetic radiation changes nuclear spin states?

- A) UV
- B) Radio-TV
- C) Microwave
- D) X-ray
- E) IR

Answer: B

33) Which type of electromagnetic radiation generally involves the greatest energy changes?

- A) radio-TV
- B) visible
- C) UV
- D) IR
- E) microwave

Answer: C

34) What is the energy, in kJ/mol, associated with infrared radiation of 1740 cm^{-1} ?

(Planck's constant : $6.626 \times 10^{-34}\text{ J}\cdot\text{s}$; light speed : 3×10^{10})

- A) $4.64 \times 10^{-8}\text{ kJ/mol}$
- B) 658 kJ/mol
- C) 464 kJ/mol
- D) 20.8 kJ/mol
- E) 72.3 kJ/mol

Answer: D

35) Which of the following techniques could be used to distinguish between 1,3-pentadiene and pentane?

- A) NMR spectroscopy
- B) UV spectroscopy
- C) IR spectroscopy
- D) both A and B
- E) all of the above

Answer: E

36) How do drugs exhibit biological activity?

- A) They hydrolyze the fats and oils in abnormal cells to make metal salts of fatty acids.
- B) They interact with specific enzymes and block or change the shape of the active site of the receptor.
- C) They react with abnormal cells in the body and form Lewis acids by electrophilic aromatic substitution.
- D) They mimic the action of a specific enzyme, increasing the availability of the receptors.
- E) They stimulate the cells to perform acid-base reactions.

Answer: B

37) The S_N2 reaction mechanism results in

- A) rearrangement of the molecule to a more stable alkane.
- B) formation of an alkene functional group.
- C) preparation of an alcohol.
- D) replacement of a group on a molecule with a nucleophile.
- E) regeneration of the aromatic ring.

Answer: D

38) Aldehydes differ from ketones in that

- A) the carbonyl is located at the end of the carbon chain.
- B) the reactivity of the ketone is much greater than that of the aldehyde.
- C) the mass of the aldehyde is always greater than the ketone.
- D) they are more oxidized than ketones.
- E) they contain two oxygens.

Answer: A

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

- A) purine base
- B) pentose sugar
- C) glyceral
- D) phosphate group

Answer: C

40) Which of the following is the formula of an alkane?

- A) C₆H₁₂
- B) C₃H₆
- C) C₃H₁₀
- D) C₆H₁₀
- E) C₃H₈

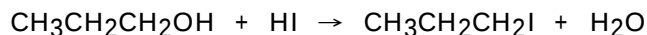
Answer: E

41) An organic molecule absorbs light with a wavelength of 500 nm. What color would you expect the compound to be?

- A) blue
- B) red
- C) blue-green
- D) orange
- E) yellow

Answer: B

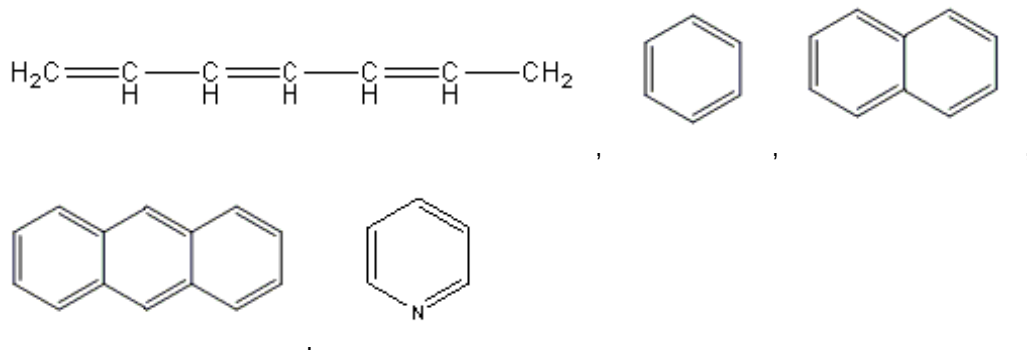
42) The reaction of 11.0g 1-propanol with excess HI produces how many grams of water?



- A) 0.611
- B) 11.0
- C) 3.30
- D) 6.60
- E) 0.183

Answer: C

43) How many compounds are aliphatic in the following list?



A) 1

B) 2

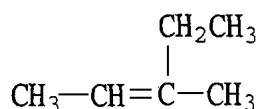
C) 3

D) 4

E) 5

Answer: A

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



A) 2-ethylbutane

B) 3-methyl-2-pentene

C) 3-methyl-3-pentene

D) 2-ethyl-2-butene

E) 2,2-ethyl-2-butene

Answer: B

45) Which of the following species can exhibit geometric isomerism?

A) $[\text{Cr}(\text{en})\text{Cl}_2\text{Br}_2]^-$

B) $[\text{Co}(\text{en})_2\text{ClBr}]^+$

C) $[\text{Pt}(\text{NH}_3)\text{Cl}_3]^-$

D) $[\text{CrNO}_2(\text{CN})_5]^{2-}$

E) $[\text{Pt}(\text{NH}_3)(\text{en})\text{Cl}]^+$

Answer: A

46) Which statement is incorrect?

A) The spectrochemical series orders the ligands according to their abilities to split the d-orbital energy level.

B) Crystal field theory views the bond between the central atom or ion and the ligands as largely electrostatic.

C) Paramagnetic species contain unpaired electrons.

D) The splitting of the energies of the d orbitals results from different interactions between the d orbitals and the ligands.

E) A "high spin" complex results from a strong field ligand.

Answer: E

47) Which is the correct formula for potassium hexacyanoferrate (II)?

- A) $K [Fe(CN)_6]$
- B) $K_6 Fe(CN)_6$
- C) $K_2 [Fe(CN)_6]$
- D) $K [FeCN]_6$
- E) $K_4 [Fe(CN)_6]$

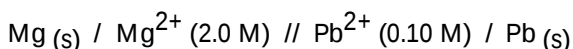
Answer: E

48)

Table 18.1 Selected Standard Electrode Potentials at 25°C

Reaction	E°, V
$Mg^{2+}(aq) + 2e^- \rightarrow Mg(s)$	-2.356
$Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$	-0.440
$Pb^{2+}(aq) + 2e^- \rightarrow Pb(s)$	-0.125
$2H^+(aq) + 2e^- \rightarrow H_2(g)$	0.0
$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$	+0.337
$I_2(s) + 2e^- \rightarrow 2I^-(s)$	+0.535
$Fe^{3+}(aq) + 2e^- \rightarrow Fe^{2+}(aq)$	+0.771
$Ag^+(aq) + e^- \rightarrow Ag(s)$	+0.800
$O_2(g) + 4H^+(aq) + 2e^- \rightarrow 2H_2O$	+1.229
$Cl_2(g) + 2e^- \rightarrow 2Cl^-(aq)$	+1.358
$F_2(g) + 2e^- \rightarrow 2F^-(aq)$	+2.866

(Refer to Table 18.1) Use the Nernst equation to determine E_{cell} at 25°C for the following voltaic cell.



- A) 2.19
- B) 1.23
- C) 2.23
- D) 1.27
- E) 2.27

Answer: A

49) (Refer to Table 18.1) Which is the best oxidizing agent?

- A) Cl_2
- B) Mg^{2+}
- C) Cu^{2+}
- D) F^-
- E) Fe^{3+}

Answer: A

50) In 1998, archaeologists uncover a wooden coffin believed by local residents to be that of an early American colonist. A piece of the coffin is analyzed by radiocarbon dating to determine the actual age of the coffin. The decay rate for carbon-14 in the sample is $12.5 \text{ dis min}^{-1}$ per gram carbon. In what year was the coffin most likely made? (Assume the half-life of carbon-14 is 5730 years and that the decay rate for carbon-14 in living organisms is 15 dis min^{-1} per gram carbon.)

- A) 1945
- B) 1606
- C) 1506
- D) 1774
- E) 1901

Answer: C