1. Organic chemistry is most broadly defined as
   A) the chemistry of living systems.
   B) the chemistry of substances produced by living systems.
   C) the chemistry of the compounds of carbon.
   D) the chemistry of the non-metallic compounds.

2. Approximately what percentage of known compounds are classified as organic compounds?
   A) \( \approx 95\% \)
   B) \( \approx 70\% \)
   C) \( \approx 40\% \)
   D) \( \approx 20\% \)

3. The most unique property of carbon is its ability to
   A) form four bonds.
   B) bond to oxygen.
   C) bond to nitrogen.
   D) bond to carbon.

4. An organic compound is best defined as
   A) a compound containing carbon.
   B) a compound of carbon and hydrogen.
   C) a compound produced by a living organism.
   D) a compound that is NOT produced in a laboratory.

5. The first organic compound to be synthesized in a chemist's laboratory was
   A) cholesterol.
   B) chlorophyll.
   C) urea.
   D) benzene.

6. The element whose atoms have a unique ability to bond to each other and to other kinds of atoms is ________.
   A) sodium
   B) carbon
   C) sulfur
   D) nitrogen

7. The unique aspect of a saturated hydrocarbon is that it must contain
   A) only carbon and hydrogen.
   B) only single bonds.
   C) single and double bonds.
   D) single, double and triple bonds.
8. The simplest alkane is
   A) monane.
   B) ethane.
   C) methane.
   D) propane.

9. What is the name of the compound with a formula CH₃CH₂CH₃?
   A) methane
   B) ethane
   C) propane
   D) butane

10. A compound containing only carbon and hydrogen and which has only single bonds between atoms is classified as an
    A) alkane.
    B) alkene.
    C) alkyne.
    D) aromatic.

11. What is the name of the compound with a formula CH₃CH₃?
    A) methane
    B) ethane
    C) propane
    D) butane

12. What is the name of the compound with a formula CH₃CH₂CH₂CH₃?
    A) methane
    B) ethane
    C) propane
    D) butane

13. Which of the following is NOT a reason for the great variety of organic molecules?
    A) The ability of carbon to form chains
    B) Carbon atoms can form more than four bonds.
    C) Isomerism
    D) Carbon forms bonds with a variety of elements, including H, O, N, Cl and Br.

14. Alkanes are often called
    A) unsaturated hydrocarbons.
    B) saturated hydrocarbons.
    C) carbohydrates.
    D) saturated fats.

15. Compounds with the same number and kinds of atoms but with different structures are known as
    A) homologs.
    B) isotopes.
C) isomers.
D) allotropes.

16. The formula for hexane is
   A) C₆H₆.
   B) C₆H₁₂.
   C) C₆H₁₄.
   D) C₆H₁₀.

17. Which of the following alkanes will have the highest boiling point?
   A) CH₄
   B) C₃H₈
   C) C₈H₁₈
   D) C₂₀H₄₂

18. A compound that contains only carbon and hydrogen is a(n)
   A) alcohol.
   B) carbohydrate.
   C) homolog.
   D) hydrocarbon.

19. Acetylene is
   A) CH₄.
   B) C₂H₆.
   C) C₂H₄.
   D) C₂H₂.

20. Acetylene is an
   A) alkane.
   B) alkene.
   C) alkyne.
   D) aromatic compound.

21. The hydrocarbon that is used in torches along with oxygen to produce very hot flames for cutting and welding is
   A) ethylene.
   B) methane.
   C) propane.
   D) acetylene.

22. Organic compounds that contain a benzene ring or possess certain properties similar to those of benzene are called ________ compounds.
   A) alkaloid
   B) acidic
   C) aromatic
   D) saturated
23. Chlorinated hydrocarbons, such as carbon tetrachloride $\text{CCl}_4$, make good dry cleaning solvents because
   A) they dissolve in water.
   B) they dissolve water insoluble stains, like grease and oil.
   C) they are not liquids at room temperature.
   D) they cause no significant health problems.

24. The compound with the formula, $\text{CHCl}_3$, was used as an anesthetic in earlier times, but has been found to have some serious side effects. The compound is called
   A) methyl chloride.
   B) methylene chloride.
   C) chloroform.
   D) carbon tetrachloride.

25. When carbon tetrachloride reacts with hot water it produces phosgene ($\text{COCl}_2$). Phosgene was used in poison-gas warfare in World War I. Based upon this chemistry, carbon tetrachloride is no longer used in
   A) fire extinguishers.
   B) anesthetics.
   C) chemical reactions.
   D) toilet bowl cleaners.

26. CFCs have been widely used in
   A) refrigerators.
   B) pesticides.
   C) toasters.
   D) gasoline.

27. In representing the general formula of various functional groups, the symbol $R$ stands for
   A) a halogen atom.
   B) a ring.
   C) an aromatic group.
   D) an alkyl group.

28. In organic chemistry, compounds are generally classified by
   A) state.
   B) functional group.
   C) color.
   D) odor.

29. The parts of organic molecules that give compounds characteristic chemical and physical properties are known as
   A) alkyl groups.
   B) aromatic groups.
   C) functional groups.
   D) hydrocarbon groups.

30. Alcohols are characterized by which functional group?
A) hydroxyl
B) carboxyl
C) halide
D) ester

31. The formula of methanol is
   A) COH.
   B) CHOH.
   C) CH₂OH.
   D) CH₃OH.

32. Methanol is an important solvent. It is also an important starting material for the synthesis of other molecules. Most methanol today is obtained from the
   A) destructive distillation of wood.
   B) reaction of carbon monoxide and hydrogen at high temperature and pressure.
   C) fermentation of corn.
   D) decomposition of animal waste.

33. The intoxicating alcohol in "alcoholic" beverages is
   A) ethanol.
   B) methanol.
   C) propanol.
   D) a mixture of the above

34. A bottle of rum is labelled as "80 proof." The percentage of ethanol by volume in this alcoholic beverage is
   A) 8%.
   B) 40%.
   C) 80%.
   D) 160%.

35. Distillation of fermented grain "beer" yields 95% ethanol. What is the proof of this "grain alcohol?"
   A) 47.5
   B) 95
   C) 190
   D) 200

36. Excessive ingestion of ethanol over a long period may cause which of the following?
   A) physiological addiction
   B) memory loss
   C) deterioration of the liver
   D) all of the above

37. Ethanol acts as a mild
   A) stimulant.
   B) depressant.
   C) hallucinogen.
D) narcotic.

38. What is the percent alcohol by volume in a beverage that is 36 proof?
   A) 3.6%
   B) 18%
   C) 36%
   D) 72%

39. Which substance causes fetal alcohol syndrome?
   A) CH₃OH
   B) CH₃CH₂OH
   C) CH₃CHOHCH₃
   D) CH₃OCH₃

40. Citronellol, C₁₀H₁₉OH, is a constituent of rose and germanium oils. It is used in perfumery. Chemically, citronellol is an
   A) alcohol.
   B) acid.
   C) alkane.
   D) amine.

41. The main ingredient in most antifreezes is
   A) ethanol.
   B) ethylene glycol.
   C) glycerol.
   D) gasoline.

42. Glycerol is an alcohol with ________ hydroxyl groups
   A) one
   B) two
   C) three
   D) four

43. Which of the following statements about industrial grade ethanol and the ethanol used in alcoholic beverages is NOT correct?
   A) Industrial grade ethanol is made by reacting ethylene with water, while ethanol used in beverages is made by fermentation.
   B) Industrial grade ethanol carries no federal excise tax, while ethanol used in beverages is taxed.
   C) Industrial grade ethanol and ethanol used in beverages have different molecular structures.
   D) Noxious substances are added to industrial grade ethanol so it is not safe to drink.

44. Compounds with a hydroxyl group attached directly to a benzene ring are called
   A) alcohols.
   B) aromatic hydrocarbons.
   C) ethers.
D) phenols.

45. A phenol has a(n) ________ group attached to a benzene ring.
   A) amino
   B) carbonyl
   C) carboxyl
   D) hydroxyl

46. Compounds that have two alkyl groups attached to an oxygen atom are called
   A) alcohols.
   B) phenols.
   C) esters.
   D) ethers.

47. Methyl tert-butyl ether (MTBE, CH₃OC(CH₃)₃) has been used as a gasoline additive.
   MTBE is an example of an ether with the general structure
   A) ROR.
   B) ROH.
   C) ROR'.
   D) R'OH.

48. Diethyl ether is the most important of the ethers. It is an example of an ether with the
   general structure
   A) ROR.
   B) ROH.
   C) ROR'.
   D) R'OH.

49. The general formula for a ketone is
   A) ROR'.
   B) RCOOH.
   C) RCOR'.
   D) RCOOR'.

50. The simplest aldehyde is
   A) acetaldehyde.
   B) formaldehyde.
   C) benzaldehyde.
   D) unaldehyde.

51. The functional group of the organic acids is the
   A) hydroxyl group.
   B) amine group.
   C) carbonyl group.
   D) carboxyl group.

52. When a bee stings, one of the compounds it injects is
   A) acetic acid.
   B) butyric acid.
   C) formic acid.
   D) hydrochloric acid.

53. One of the primary ingredients in vinegar is
   A) acetic acid.
   B) butyric acid.
   C) formic acid.
   D) hydrochloric acid.

54. The simplest carboxylic acid is commonly known as
   A) acetic acid.
   B) butyric acid.
   C) formic acid.
   D) propionic acid.

55. One of the compounds that is present in rancid butter and body odor is
   A) acetic acid.
   B) butyric acid.
   C) benzaldehyde.
   D) formaldehyde.

56. Vinegar is a solution of _______ in water.
   A) acetic acid
   B) butyric acid
   C) formic acid
   D) propionic acid

57. Many of the flavors isolated from foods are
   A) carboxylic acids.
   B) esters.
   C) alcohols.
   D) ketones.
58. An analgesic is a substance that acts as a(n)
   A) fever reducer.
   B) disinfectant.
   C) anesthetic.
   D) pain reliever.

59. This substance used as an analgesic was first isolated from willow bark.
   A) benzene
   B) acetic acid
   C) salicylic acid
   D) ethanol

60. This substance is an ester of the phenol group of salicylic acid with acetic acid and is commonly called
   A) aspirin.
   B) Maalox.
   C) Milk of Magnesia.
   D) Tylenol.

61. Esters are often used as
   A) anesthetics.
   B) disinfectants.
   C) fragrances.
   D) insecticides.

62. Amines are derivatives of
   A) ammonia.
   B) methane.
   C) water.
   D) amino acids.

63. Amino acids are multifunctional compounds that contain
   A) carboxyl and amine groups.
   B) carboxyl and amide groups.
   C) ester and amine groups.
   D) aldehyde and amide groups.

64. Amino acids are the "building blocks" of
   A) carbohydrates.
   B) fats.
   C) proteins.
   D) vitamins.

65. The substructures that distinguish plant and animal cells are
   A) ribosomes.
   B) nuclei.
   C) mitochondria.
   D) chloroplasts.
66. In cells, protein synthesis occurs on the
   A) nucleus.  
   B) mitochondria.  
   C) ribosomes.  
   D) cytoplasm.

67. In cells, primary energy production occurs in the
   A) mitochondria.  
   B) nucleus.  
   C) ribosomes.  
   D) cell membrane.

68. Cell nutrients and waste must pass through the cell
   A) membrane.  
   B) nucleus.  
   C) ribosomes.  
   D) chloroplasts.

69. Chloroplasts in plants convert
   A) light energy into heat energy.  
   B) light energy into electrical energy.  
   C) light energy into chemical energy.  
   D) heat energy into chemical energy.

70. Which of the following elements is NOT found in carbohydrates?
   A) carbon  
   B) hydrogen  
   C) oxygen  
   D) nitrogen

71. Which of the following is a monosaccharide?
   A) glucose  
   B) starch  
   C) sucrose  
   D) lactose

72. Which of the following serves as dietary fiber?
   A) starch  
   B) galactose  
   C) cellulose  
   D) fructose

73. Which of the following is a polysaccharide?
   A) glucose  
   B) fructose  
   C) starch  
   D) galactose
74. The monomer unit in both starch and cellulose is _______.
   A) glucose  
   B) galactose  
   C) fructose  
   D) sucrose

75. Animal starch is called _______.
   A) amylose  
   B) amyllopectin  
   C) cellulose  
   D) glycogen

76. An example of a disaccharide is
   A) sucrose.  
   B) galactose.  
   C) dextrose.  
   D) fructose.

77. The name carbohydrate reflects
   A) the ratio of carbon to hydrogen in the molecule.  
   B) the ratio of carbonyl groups to total carbon content.  
   C) the ratio of carbon to the combined ratio of "hydrogen to oxygen."  
   D) the ratio of carbon to oxygen.

78. Which of the following polymers is NOT made by plants?
   A) amyllopectin  
   B) amylose  
   C) cellulose  
   D) glycogen

79. Unsaturated fats are often liquids called
   A) hydrogenated fats.  
   B) oils.  
   C) triglycerides.  
   D) glycerol.

80. What functional group(s) are contained in an amino acid?
   A) –NH₂  
   B) –C=O  
   C) –COOH  
   D) both –NH₂ and –COOH

81. What is a zwitterion?
   A) a compound that carries two positively charged atoms  
   B) a compound that carries two negatively charged atoms  
   C) a compound that carries either two positively charged atoms or two negatively charged atoms
D) a compound that carries one positively charged atom and one negatively charged atom

82. Which of the following statements about essential amino acids is NOT correct?
   A) Essential amino acids cannot be synthesized by the human body.
   B) Essential amino acids cannot be incorporated into protein.
   C) Essential amino acids must be part of the diet.
   D) Some amino acids are essential for infants and children, but not for adults.

83. Proteins are
   A) polyamides.
   B) polyesters.
   C) polysaccharides.
   D) polyacids.

84. The ________ structure of a protein is its amino acid sequence.
   A) primary
   B) secondary
   C) tertiary
   D) quaternary

85. Which of the following involves a covalent bond?
   A) dispersion forces
   B) disulfide linkages
   C) hydrogen bonding
   D) salt bridges

86. Enzymes are
   A) catalysts.
   B) structural material.
   C) genetic material.
   D) nucleic acids.

87. The class of compounds that serve as the source of information and control in living systems are
   A) amino acids.
   B) carbohydrates.
   C) nucleic acids.
   D) proteins.

88. RNA is found primarily in the cell
   A) nucleus.
   B) ribosomes.
   C) mitochondria.
   D) RNA is found throughout the cell.

89. The sugar in the nucleotides of DNA is
A) glucose.  
B) sucrose.  
C) ribose.  
D) deoxyribose.

90. The sugar in the nucleotides of RNA is  
A) glucose.  
B) sucrose.  
C) ribose.  
D) deoxyribose.

91. The information in DNA and RNA is carried by the  
A) phosphate bonds.  
B) sugar molecules.  
C) length of the nucleic acid chain.  
D) base sequence.

92. Watson and Crick proposed that DNA exists as a(n)  
A) alpha helix.  
B) double helix.  
C) beta sheet.  
D) pleated sheet.

93. Base pairing in DNA occurs through  
A) covalent bonds between complementary bases on nucleic acid chains.  
B) hydrogen bonds between complementary bases on nucleic acid chains.  
C) salt bonds between complementary bases on nucleic acid chains.  
D) an interaction that is not well understood.

94. DNA is found primarily in the cell  
A) nucleus.  
B) ribosomes.  
C) mitochondria.  
D) DNA is found throughout the cell.

95. Human body cells have ________ chromosomes.  
A) 20  
B) 23  
C) 46  
D) 53

96. Which of the following bases is found in RNA but not in DNA?  
A) adenine  
B) cytosine  
C) guanine  
D) uracil