There are 22 multiple choice questions, each worth 3 points (66 points total). In order to receive credit for an answer, you must (i) put the letter of the correct response in the space shown on the right side of the page, and (ii) circle the letter of the correct response. The remaining questions are worth the values indicated. Total points on this exam is 100 points. There is a 2 hour time limit for this exam. Good luck!

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

1) Unsaturated fatty acids have lower melting points than saturated fatty acids because
   A) they have more hydrogen atoms.
   B) the cis double bonds give them an irregular shape.
   C) the trans double bonds give them an irregular shape.
   D) they have fewer hydrogen atoms.
   E) their molecules fit closely together.

   1) B

2) Which part of a soap is responsible for its ability to dissolve fats and oily dirt?
   A) the carboxylate
   B) the hydrophobic end
   C) the ionized oxygen
   D) the hyrophilic end
   E) the carbonyl group

   2) B

3) A glycosidic bond between two monosaccharides can also be classified as a(n)
   A) ester bond.
   B) achiral bond.
   C) hemiacetal bond.
   D) diether bond.
   E) alcohol bond.

   3) D

4) One difference between D-glucose and L-glucose is
   A) it is not possible to make L-glucose.
   B) L-glucose has a 5-membered ring, and D-glucose has a 6-membered ring.
   C) only D-glucose is found in disaccharides and polysaccharides.
   D) L-glucose cannot form a closed structure.
   E) the open-chain form of L-glucose does not exist.

   4) C

5) Which of the following is found in vinegar?
   A) nitric acid
   B) methanoic acid
   C) butanoic acid
   D) propanoic acid
   E) ethanoic acid

   5) E

6) What is the common name for ethanoic acid?
   A) stearic acid
   B) citric acid
   C) acetic acid
   D) butyric acid
   E) formic acid

   6) C
7) What happens to the water solubility of carboxylic acids as the carbon chain length increases?
A) It increases.  B) It stays the same.  C) It decreases.

8) What kind of intermolecular bonding occurs between carboxylic acids?
A) covalent bonding  B) hydrogen bonding  C) ionic bonding
D) charge-transfer bonding  E) nonpolar bonding (London Dispersion Forces)

9) What is the name of this compound (an ester)?

\[
\text{CH}_3\text{C} - \text{O} - \text{CH}_2\text{CH}_3
\]

A) ethyl acetate  B) diethyl ester  C) 2-ether-2-butanone
D) ethyl methyl ester  E) ethyl methanoate

10) The common name of the compound

\[
\text{CH}_3\text{CH}_2\text{CH}_2\text{C} - \text{OH}
\]

A) acetic acid.  B) propionic acid.  C) butyric acid.
D) butanoic acid.  E) propanoic acid.

11) What is the name of the structure formed (it is essentially a droplet of oil with charges on the surface) when a soap coats an oily particle to make it water soluble?
A) lipid  B) dimer  C) micelle  D) cluster  E) liposome

12) In the L- isomer of a Fischer projection of a monosaccharide, the –OH group on the chiral carbon furthest from the carbonyl group is written
A) on the left of the top chiral carbon.
B) on the right of the bottom chiral carbon.
C) on the left of the middle chiral carbon.
D) on the right of the top chiral carbon.
E) on the left of the bottom chiral carbon.

13) Which carboxylic acid in the list below is an aromatic carboxylic acid?
A) citric acid  B) benzoic acid  C) benzene
D) butyric acid  E) acetic acid
14) What is the irritating acid found in ant and bee stings?  
A) stearic acid  
B) citric acid  
C) formic acid  
D) acetic acid  
E) butyric acid  

15) A carboxylic acid is prepared from an aldehyde by  
A) hydrogenation.  
B) reduction.  
C) neutralization.  
D) oxidation.  
E) hydrolysis.  

16) Photosynthesis uses ______ as an energy source.  
A) oxygen  
B) carbon dioxide  
C) glucose  
D) chlorophyll  
E) sunlight  

17) Galactose can be prepared by the enzymatic hydrolysis of which sugar listed below?  
A) lactose.  
B) sucrose.  
C) glucose.  
D) maltose.  
E) erythrose.  

18) Which of these functional groups is likely to give a sour taste to a food?  
A) ester  
B) thiol  
C) ketone  
D) ether  
E) carboxylic acid  

19) The carbon cycle includes the breakdown of carbohydrates to carbon dioxide in the body. Water is also produced. This process is referred to as what?  
A) respiration.  
B) photosynthesis.  
C) reduction  
D) anabolism.  
E) mutarotation.  

20) The products of the saponification (hydrolysis performed in base, such as NaOH) of a fat are  
A) salts of fatty acids.  
B) salts of fatty acids and glycerol.  
C) phospholipids.  
D) the esters of fatty acids.  
E) fatty acids and glycerol.  

21) Cellulose is not digestible by humans because it contains glucose units linked by  ______-glycosidic bonds.  
A) β-1,2  
B) α-1,6  
C) α-1,4  
D) α-1,2  
E) β-1,4
22) Cellobiose, which is composed of two glucose molecules, is a
   A) polysaccharide.
   B) phosphosaccharide.
   C) monosaccharide.
   D) trisaccharide.
   E) disaccharide.
23 (12) Give correct names for the following compounds. IUPAC names are preferred, but not required, especially if the compound has a common name if it is a carbohydrate or aromatic-type of compound (2 point each).

- Pectanal
- Hexadecanoic acid
- D-Galactose (it's a common sugar)
- B-D-glucose
- 5-Nitro-2,3-hexanedioic acid

24 (8) (i) Acetic acid reacts with 2-butanol to form an ester. Show structures for acetic acid, 2-butanol (2 pts each) and for the ester produced (1 pt). What is the name of this ester (1 pt).

\[
\text{C-C-OH} + \text{C-C-C-C-C} \rightarrow \text{C-C-C-C-C-C}
\]

sec-butyl acetate

(ii) You desire to hydrolyze ethyl benzoate (for 1 pt I will give you its structure, if you do not know it) yielding acid and alcohol portions. Show the final products (1 pt each) when using acid and base hydrolysis reactions.

Hydrolysis products in acid (1 pt ea):

- \(\text{C-C-OH}\)
- \(\text{C-C-OH}\)

Hydrolysis products in base (1 pt ea):

- \(\text{C-C-OH}\)
- \(\text{C-C-OH}\)
25 (4) Draw structures for an (i) L-aldotetrose and for a (ii) D-ketopentose using the Fischer projection model (1 pt ea). Draw the Fischer projection for (iii) D-glucose and for (iv) D-fructose (1 pt ea),

(i) \[ \text{C}_6\text{H}_{12}\text{O}_6 \]
(ii) \[ \text{C}_6\text{H}_{12}\text{O}_6 \]
(iii) \[ \text{C}_6\text{H}_{12}\text{O}_6 \]
(iv) \[ \text{C}_6\text{H}_{12}\text{O}_6 \]

26 (6) Show chemical structures for each of the following compounds.

β-maltose (a disaccharide)

2-hydroxybutyric acid

Triacylglyceride

Isopropyl acetate (an ester)

Any chiral molecule

27 (4) Each of the following chemicals has about the same molar mass, but have different boiling points. Predict the correct order for increasing boiling points (4 pts):

(i) Butane, (ii) 1-propanol, and (iii) propanal, (iv) isobutane (2-methylpropane)

\[ \text{Isobutane} < \text{Butane} < \text{Propanal} < \text{1-Propanol} \]

Lowest \( \text{IV} \) \(< \text{I} \) \(< \text{III} \) \(< \text{II} \) : Highest

(Key: London Dispersion Forces \(<\) dipole-dipole \(<\) H-bonds in molecules)