FINAL EXAM Name_____
CHEM 160A December 19, 2003

1) (4 points) Draw linolenic acid ($18.3\Delta^{9,12,15}$).

2) (4 points) Why are triacylglycerols better for long-term storage of energy than glycogen is?
   a) Triacylglycerols exclude water, so they take up less room than glycogen.
   b) Triacylglycerols can be stored in fat cells, whereas glycogen must be stored in muscle or liver cells.
   c) There is more energy available per carbon atom in triacylglycerols than in glycogen.
   d) a and b
   e) a and c
   f) all of the above

3) (4 points) Why is glycogen better as a quick source of energy than triacylglycerols are?
   a) Humans have enzymes that break down glycogen, but we do not have enzymes that break down triacylglycerols.
   b) The glucose in glycogen is more easily accessible than are the fatty acids in triacylglycerols.
   c) The carbons in glycogen are more oxidized than those in triacylglycerols, so there is more energy available per carbon molecule in glycogen.

4) (4 points) Why is fat a solid at room temperature, while vegetable oil is a liquid at room temperature?
   a) Fat is made of triacylglycerols, whereas oil is not.
   b) The triacylglycerols in fat contain only saturated fatty acids, whereas the triacylglycerols in vegetable oil contain only unsaturated fatty acids.
   c) The triacylglycerols in fat contain fewer unsaturated fatty acids than the triacylglycerols in vegetable oil do.
   d) The triacylglycerols in fat contain more unsaturated fatty acids than the triacylglycerols in vegetable oil do.

5) (4 points) Why wouldn't triacylglycerols make good membranes?
   a) Triacylglycerols are too large to make lipid bilayers.
   b) Triacylglycerols have no polar region to interact with water.
   c) Triacylglycerols become hydrolyzed upon exposure to water.

6) (4 points) Salts of fatty acids, in aqueous solutions, form
   a) Triacylglycerols
   b) Diacylglycerols
   c) Micelles
   d) Lipid bilayers

7) (4 points) Phosphodiacylglycerols, in aqueous solutions, form...
   a) Triacylglycerols
   b) Sphingolipids
   c) Micelles
   d) Lipid bilayers

8) For questions a-e, refer to the following structures:

   a) (2 points) Which structure is a triacylglycerol? _____
   b) (2 points) Which structure is a sphingolipid? _____
   c) (2 points) Which structure is a phospholipid? _____
   d) (2 points) Which structure is an eicosanoid? _____
   e) (2 points) Which structure is a steroid? _____

9) (4 points) Steroid hormones and eicosanoids are functionally similar in that…
   a) Both are found in lipid bilayers.
   b) Both are intracellular messengers.
   c) Both are intercellular messengers.
   d) Both contain a steroid nucleus.
   e) All of the above.

10) (4 points) Steroid hormones and eicosanoids differ in that
   a) Eicosanoids do not contain the steroid nucleus.
   b) Eicosanoids are made from arachadonic acid, whereas steroid hormones are made from chlosterol.
   c) Eicosanoids are local messengers, whereas steroid hormones are long-distance messengers.
   d) All of the above.

11) (4 points) Vitamin D...
   a) is formed by a non-enzymatic reaction in the body
   b) is made from cholesterol
   c) maintains healthy bones
   d) prevents breast cancer an prostate cancer
   e) all of the above

Use the following information to answer questions 11-14:
Two different species of bacteria have been isolated from two very different environments: one, a hot spring with an average water temperature of 40°C, and the other a glacial lake with an average water temperature of -4°C.

12) (4 points) Which of the two bacterial species would be expected to have more unsaturated fatty acids in its membrane lipids?
   a) The hot spring bacteria
   b) The glacial lake bacteria

13) (4 points) At 27°C, which species would have a more fluid membrane?
   a) The hot spring bacteria
   b) The glacial lake bacteria

14) (4 points) Why does the glacial lake bacteria contain cholesterol in its membrane?
   a) To increase membrane fluidity.
   b) To decrease membrane fluidity.
   c) To increase the production of lipid intracellular signaling molecules.
   d) To stabilize membrane proteins.
   e) To increase the membranes' permeability to water.

15) (4 points) Which of these properties distinguish enzymes from other catalysts?
   a) Enzymes lower the energy of activation of a reaction.
   b) Enzymes become denatured at high temerature.
   c) Enzymes speed up a reaction.
   d) Enzymes are not consumed in the reaction they catalyze
   e) All of the above.

16) (8 points) Sketch energy diagrams for a reaction with and without a catalyst. Label all parts of the diagram.

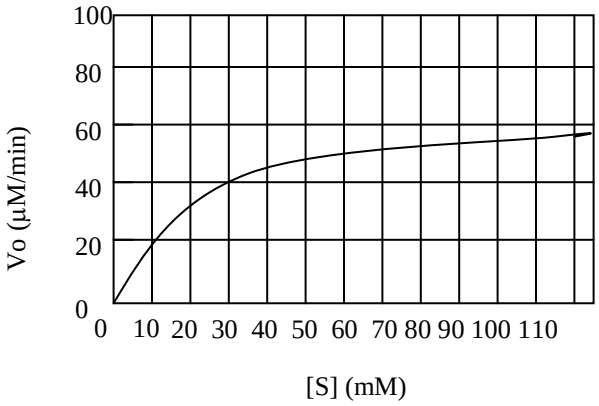
17) (3 points) In some enzymes, components other than amino acid residues are necessary for activity. These components are called _____. In such enzymes, the complete, active enzyme is called a(n) _____, and the enzyme without its additional components is called a(n) _____.

18) (4 points) For the situations described below, use the following symbols to indicate whether V_{max} will increase (↑), decrease (↓), or remain constant (=).

a) After [S] has been doubled: _____
b) In the presence of a mixed inhibitor: _____
c) In the presence of a competitive inhibitor: _____
d) In the presence of an uncompetitive inhibitor: _____
e) After the enzyme concentration has been doubled: _____

19) (1 point) The relatively small portion of an enzyme that is involved in substrate binding is known as the _____. (2 words)

For questions 20 an 21, refer to the Michaelis-Menten Plot below. This graph depicts the effects of increasing substrate concentration ([S]) on the initial rate of a reaction. The concentration of enzyme in this experiment was held constant at 0.1 μM.

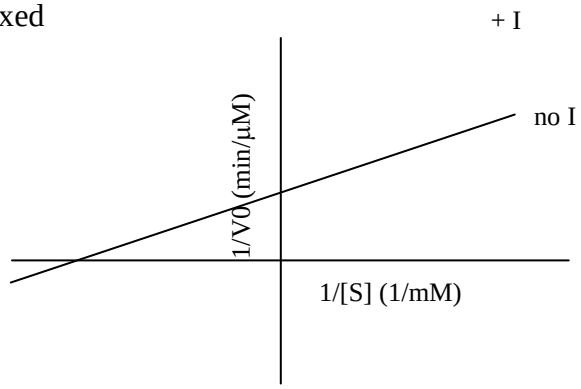


20) (4 points) What is the approximate K_m of this enzyme with this substrate?
a) 60 μM/min
b) 30 μM/min
c) 16 μM/min
d) 16 mM

21) (4 points) What is the approximate k_{cat} of this enzyme with this substrate?
a) 60 μM/min
b) 600 min^{-1}
c) 60 min^{-1}
d) 6.0 min^{-1}

22) (4 points) The Lineweaver-Burk Graph below depicts an enzyme in the absence and presence of its inhibitor (I). What type of inhibitor is this?

a) competitive
b) uncompetitive
c) mixed



23) (6 points) Draw D-glucose in its linear form.

24) (6 point) Mannose is an epimer of glucose at C2. Draw β-D-mannose.

25) (10 points) Draw sucrose (α-D-glucopyranose-(1-2)β-D-fructofuranose).

26) (4 points) Which of these polysaccharides would be degraded the fastest by the enzyme amylase?
   a) Cellulose
   b) Amylose
   c) Glycogen
   d) Amylopectin

27) (4 points) Structurally, what are the <u>similarities</u> between cellulose and amylose?
   a) They both contain $\beta 1 \rightarrow 4$ linkages.
   b) They both contain $\alpha 1 \rightarrow 4$ linkages.
   c) They both contain $1 \rightarrow 4$ linkages.
   d) They both contain glucose monomers.
   e) a and d
   f) c and d

28) (4 points) Structurally, how does cellulose <u>differ</u> from amylose?
   a) Cellulose is a straight chain, whereas amylose is branched.
   b) Cellulose is a straight chain, whereas amylose is curled into a helix or spiral.
   c) Cellulose contains $\alpha 1 \rightarrow 4$ linkages, whereas amylose contains $\beta 1 \rightarrow 4$ linkages.
   d) Cellulose contains $\beta 1 \rightarrow 4$ linkages, whereas amylose contains $\alpha 1 \rightarrow 4$ linkages.
   e) b and c
   f) b and d

29) (4 points) When a protein is denatured, entropy
   a) increases
   b) decreases
   c) stays the same

30) (4 points) Which of the following structures represents adenine?
   a)

   b)

31) (5 points) Base-pair this molecule with its complementary base, showing all hydrogen bonds.

32) (4 points) Biologically, why is it advantageous for DNA to be stable, but for RNA to be unstable?
   a) RNA must be able to mutate, whereas DNA cannot.
   b) DNA must be able to mutate, whereas RNA cannot.
   c) The information in DNA must be passed to offspring, whereas the information in RNA is only used temporarily.
   d) a and c

33) (4 points) When the ionic strength of a DNA solution is increased, the melting temperature of the DNA
   a) decreases
   b) increases
   c) remains the same

34) (4 points) Draw a Fisher projection of glycine.

35) (4 points) Draw a Fisher projection of L-alanine.

36) (4 points) Why is alanine optically active, while glycine is not?

37) (1 point) Which (one) amino acid allows the least flexibility when found in a protein?

_____

38) (3 points) List three amino acids whose side chains are completely hydrophobic.

a)

b)

c)

39) (4 points) What makes peptide bonds planar?
   a) They hydrogen bond to other peptide bonds in the backbone.
   b) The presence of a carboxylic acid makes them planar.
   c) The amide linkage makes the bond polar.
   d) The C-N bond has a partial double-bond character, due to resonance.

40) (4 points) Which one of the following amino acids would be <u>least</u> likely to interact with the backbone of DNA at physiological pH?
   a) Lysine
   b) Arginine
   c) Histidine

41) (1 point) A single unit within a polymer (for example, a single amino acid within a polypeptide chain) is known as a _____.

42) (4 points) A polypeptide 9 amino acids long is treated with the following reagents. The amino acid sequences of the resulting fragments are listed below. Determine the primary sequence of the polypeptide.

pepsin
   1. tyr-gly-met
   2. ala-met-his
   3. trp-pro-gly

cyanogen bromide
   1. his-tyr-gly-met
   2. trp-pro-gly
   3. ala-met

   a) tyr-gly-met-trp-pro-gly-ala-met-his
   b) trp-pro-gly-ala-met-his-tyr-gly-met
   c) ala-met-his-tyr-gly-met-trp-pro-gly
   d) tyr-gly-met-his-trp-pro-gly-ala

43) (4 points) Use this table to calculate the isoelectric point for Asp-Ser.

Amino Acid	pK_{NH3+}	pK_{COOH}	pK_R
Aspartic Acid	9.90	1.99	3.90
Serine	9.21	2.19	--

a) 2.95
b) 3.05
c) 6.55
d) 7.00
e) 6.90

44) (4 points) How many amino acid residues are needed to make a β turn?
a) 2
b) 4
c) 8
d) 10-11

45) (4 points) How is a β turn stabilized?
a) By one hydrogen bond between the peptide backbone.
b) By many hydrogen bonds between the peptide backbone.
c) By hydrogen bonds, ionic bonds, and hydrophobic interactions
d) By a covalent bond between cysteine side chains.

46) (1 point) What general type of reaction forms water?

_____

47) (4 points) At a pH equal to the pK_a of a weak acid, what can be said about the concentrations of the acid and its conjugate base?
a) There is no base present, only acid.
b) They are equal.
c) There is no relationship between pKa and concentration.

48) (4 points) The pK_a's for the three ionizable groups on tyrosine are: pK_1 (-COOH) = 2.2, pK_2 ($-NH_3^+$) = 9.11, and pK_R = 10.07. In which pH range will this amino acid have the greatest buffering capacity?
a) at all pH's between 2.2 and 10.07
b) at pH's near 7.1
c) at pH's between 9 and 10
d) at pH's near 5.7
e) Amino acids cannot act as buffers