

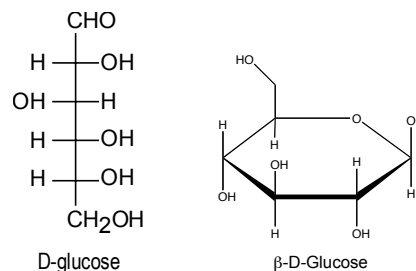
Chem 250

"Deluxe" Answer Key Evening Exam 2v1

This exam is composed of **40** questions.

As discussed in the course syllabus, honesty and integrity are absolute essentials for this class. In fairness to others, dishonest behavior will be dealt with to the full extent of University regulations.

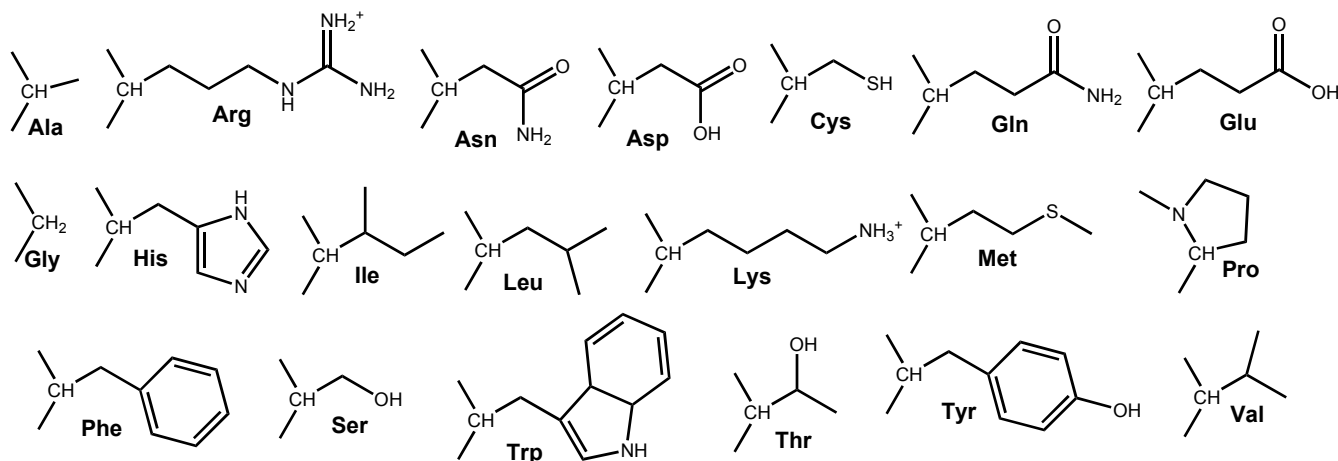
I hereby state that all answers on this exam are my own and that I have neither gained unfairly from others nor have I assisted others in obtaining an unfair advantage on this exam.



Signature

PERIODIC TABLE OF THE ELEMENTS

| 1A | 2A | 3B | 4B | 5B | 6B | 7B | 8B | 8B | 8B | 1B | 2B | 3A | 4A | 5A | 6A | 7A | 8A |
|--------------------------|--------------------------|--------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1 H 1.008 | | | | | | | | | | | | | | | | | 2 He 4.003 |
| 3 Li 6.939 | 4 Be 9.012 | | | | | | | | | | | 5 B 10.81 | 6 C 12.01 | 7 N 14.01 | 8 O 16.00 | 9 F 19.00 | 10 Ne 20.18 |
| 11 Na 22.99 | 12 Mg 24.31 | | | | | | | | | | | 13 Al 26.98 | 14 Si 28.09 | 15 P 30.97 | 16 S 32.07 | 17 Cl 35.45 | 18 Ar 39.95 |
| 19 K 39.10 | 20 Ca 40.08 | 21 Sc 44.96 | 22 Ti 47.90 | 23 V 50.94 | 24 Cr 52.00 | 25 Mn 54.94 | 26 Fe 55.85 | 27 Co 58.93 | 28 Ni 58.71 | 29 Cu 63.55 | 30 Zn 65.39 | 31 Ga 69.72 | 32 Ge 72.61 | 33 As 74.92 | 34 Se 78.96 | 35 Br 79.90 | 36 Kr 83.80 |
| 37 Rb 85.47 | 38 Sr 87.62 | 39 Y 88.91 | 40 Zr 91.22 | 41 Nb 92.91 | 42 Mo 95.94 | 43 Tc (99) | 44 Ru 101.1 | 45 Rh 102.9 | 46 Pd 106.4 | 47 Ag 107.9 | 48 Cd 112.4 | 49 In 114.8 | 50 Sn 118.7 | 51 Sb 121.8 | 52 Te 127.6 | 53 I 126.9 | 54 Xe 131.3 |
| 55 Cs 132.9 | 56 Ba 137.3 | 57 La 138.9 | 72 Hf 178.5 | 73 Ta 181.0 | 74 W 183.8 | 75 Re 186.2 | 76 Os 190.2 | 77 Ir 192.2 | 78 Pt 195.1 | 79 Au 197.0 | 80 Hg 200.6 | 81 Tl 204.4 | 82 Pb 207.2 | 83 Bi 209.0 | 84 Po (209) | 85 At (210) | 86 Rn (222) |
| 87 Fr (223) | 88 Ra 226.0 | 89 Ac 227.0 | 104 Unq (261) | 105 Unp (262) | 106 Unh (263) | 107 Uns (262) | 108 Uno (265) | 109 Une (266) | | | | | | | | | |



1. (2 points) Propanoic acid and methyl acetate are constitutional isomers and both are liquids at room temperature. Which has the lower boiling point?

1) propanoic acid 2) methyl acetate 3) they have the same boiling point

(2) methyl acetate – the carboxylic acid can form very stable interactions with itself? Methyl acetate is an ester (Chptr 18)

2. Which listing below correctly orders the boiling points of the indicated molecules?

1) 1-butanol > propanoic acid > diethyl ether

2) propanoic acid > diethyl ether > 1-butanol

3) propanoic acid > 1-butanol > diethyl ether

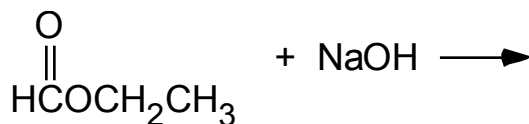
4) diethyl ether > propanoic acid > 1-butanol

5) 1-butanol > diethyl ether > propanoic acid

think about what H-bonding opportunities are available for each. How can that molecule interact with another of itself?

(3) acid > alcohol > ether (all have about the same MW) (Chptr 18)

3. (2 points) The products of the following reaction are:



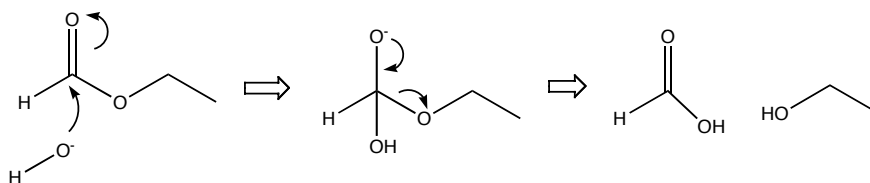
1) sodium propanoate and water

2) sodium acetate and formaldehyde

3) methane and sodium acetate

4) ethanol and sodium formate

5) none of the above



(4) hydrolysis of an ester Chapter 19, p 480 / Quiz 2

4. (2 points) Which of the following is expected to have the lowest melting point?

1) CH₃(CH₂)₂₀COOH

2) CH₃(CH₂)₁₂COOH

3) it is not possible to predict

(2) shorter chain leads to less van der Waals interactions OWL 18.4a / Quiz 2

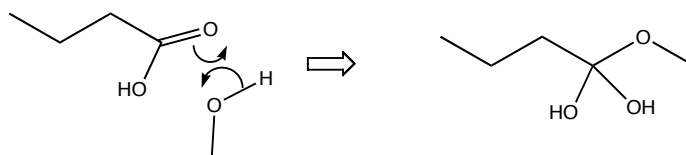
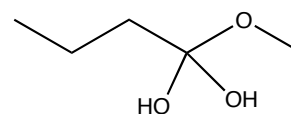
5. (2 points) Glycolipids contain what characteristic head group?

- 1) sphingosines 2) phosphates 3) cholesterol
 4) steroids 5) carbohydrates

(5) Chptr 21 Hint: Glyco = "sweet" = sugar (similarly glycolysis is the break down of sugars)

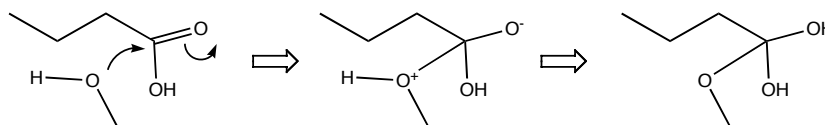
6. (2 points) Which two reactants would lead to the Fischer esterification reaction intermediate shown at right?

- 1) butanoic acid and methanol
 2) butanal and formic acid
 3) 1-butanone and formic acid
 4) pentanoic ester and water
 5) none of the above



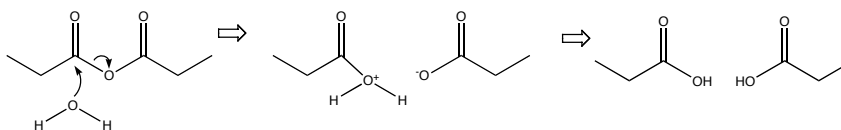
(1) OWL 18.5e / Quiz 2

You might have remembered that Fischer esterifications involve an attack by an alcohol on a carboxylic acid, but if you didn't, the other reactions won't lead to intermediates of this sort. An alternative view of the above is:



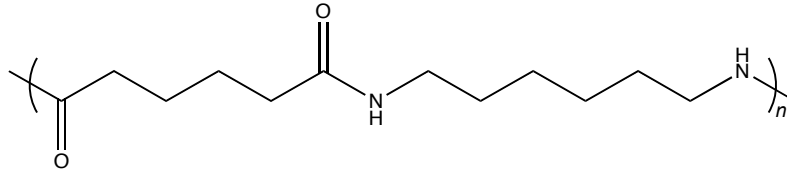
7. (2 points) Hydrolysis of propyl anhydride is represented by which reaction below?

- 1)
- 2)
- 3)
- 4)



(1) Chptr 19

8. (2 points) Nylon-66, shown below, is an example of what kind of polymer?



- 1) polyester 2) polycarbonate 3) polyamide 4) polyacrylate

(3) (Chptr 19) Amide linkage:  **poly-amide**

9. (2 points) In one complete cycle of the acyl carrier protein, how many carbons are added to the growing fatty acyl chain?

- 1) 1 2) 2 3) 3 4) 4 5) 8

(2) (Chapter 29)

10. (2 points) The synthesis of one molecule of glucose requires how many molecules of acetyl-CoA?

- 1) 1 2) 2 3) 3 4) 4 5) 8

(3) (Chapter 29) In drafting this question, I was going on the simple notion that acetyl-CoA carries 2-carbon units and that glucose has 6 carbons – easy math. But it turns out it's a bit more complicated. Hence everyone got full credit for any answer(!). This will NOT be on the extra credit quiz.

11. (2 points) The reactions of gluconeogenesis are simply the reactions of glycolysis run in reverse

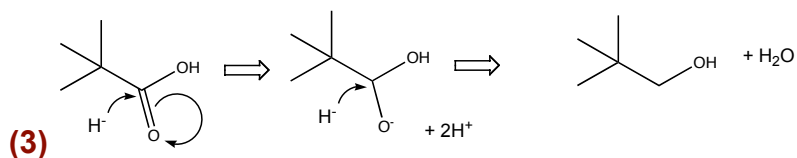
- 1) True 2) False

(2) False (OWL 29.2) Perhaps the primary “key concept” we talked about in this section!

12. (2 points) The reaction of 2,2-dimethylpropanoic acid and LiAlH_4 in water yields:

- 1) CO_2 and 2,2-dimethylbutanoic acid
- 2) CO_2 and 2,2-dimethylethanoic acid
- 3) water and 2,2-dimethyl-1-propanol
- 4) water and 2,2-dimethyl-1-propanal
- 5) nothing. No reaction occurs.

Remember that LiAlH_4 is a reductant or H^- donor. The only thing that can be readily reduced is the $\text{C}=\text{O}$ double bond. You can simply add to H^- across the double bond, or you can think about attack by H^-



OWL 18.5d / Quiz 2

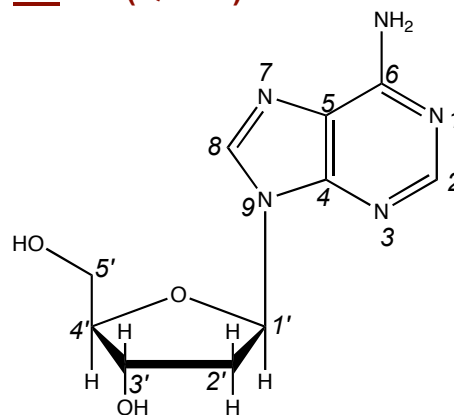
13. (2 points) Which of the following is/are Ketose(s)?

- 1) $\begin{array}{c} \text{CHO} \\ | \\ \text{CHOH} \\ | \\ \text{CH}_2\text{OH} \end{array}$ 2) $\begin{array}{c} \text{CH}_2\text{OH} \\ | \\ \text{CO} \\ | \\ \text{CH}_2\text{OH} \end{array}$ 3) Both 4) Neither

**(2) The second one is. see p 494 and OWL 20.1b
Aldehyde → Ketose. Look for the one with the ketone (Quiz 2)**

14. (2 points) In adenosine, shown at right, which of the following sugar centers are chiral (note that the sugar atoms are labeled n' , while the base atoms are labeled n).

- 1) $1', 2', 3', 4',$ and $5'$
- 2) $1', 2', 3', 4',$ and $5'$
- 3) $1', 3', 4',$ and $5'$
- 4) $1', 2', 3',$ and $4'$
- 5) $1', 3',$ and $4'$



(5) Chptr 20 and Gen Chem

Identify where C's are. Then remember to fill in H's to complete C's octet. Then ask, are there 4 *different* atoms connected to each C? Yes, for only $1', 3',$ and $4'$.

15. (2 points) Which of the following atoms in adenosine are sp^2 hybridized?

1) 1', 2', 3', 4', and 5'

2) 1', 2', 3', and 4'

3) 1 through 8

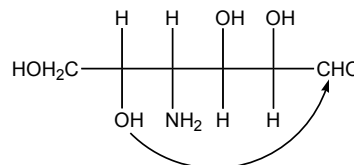
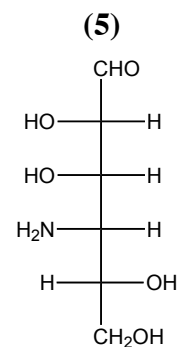
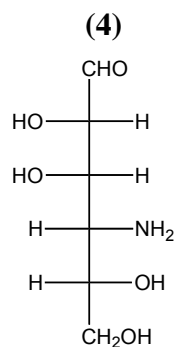
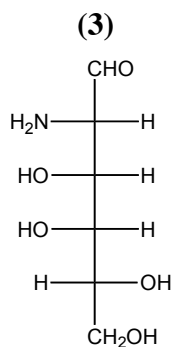
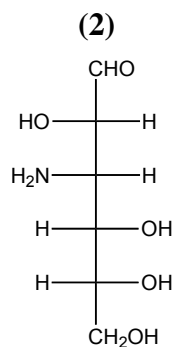
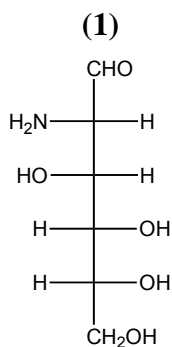
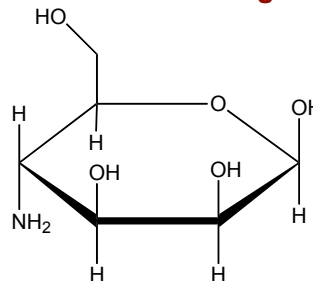
4) 1 through 9

5) 1 through 9 and 5'

(4) Chptr 20 and Gen Chem

From the last question, you hopefully figured out that the sugar carbons all have four atoms attached. Therefore they are all sp^3 . Remember that the ring has resonance forms and that we talked about how the entire ring is flat.

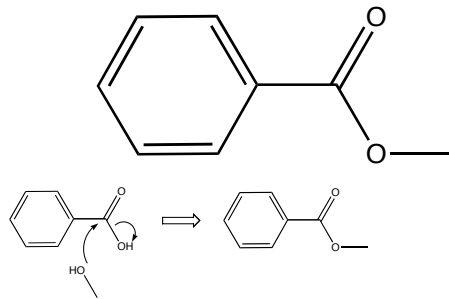
16. (2 points) Which Fischer representation below shows the linear form of the cyclic sugar shown at right?



(4) Chapter 20 (p 499) / Quiz 2

17. (2 points) From what parent molecules can the molecule at right be synthesized?

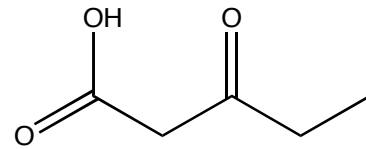
- 1) toluene and methyl acetate
- 2) benzoic acid and methanol
- 3) benzene and acetic acid
- 4) acetic acid and phenol



(2) - (Chptr 18)

18. (2 points) Heating the molecule at right yields which products?

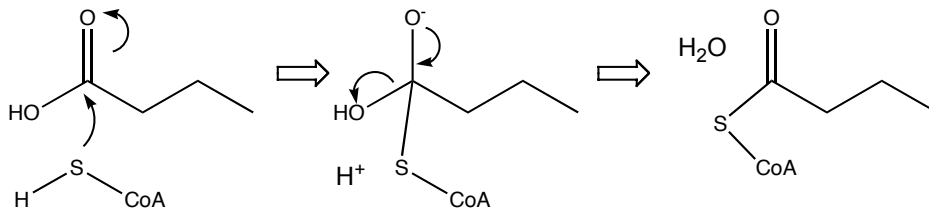
- 1) propanoic acid and carbon dioxide
- 2) acetic acid and propanoic acid
- 3) butanoic anhydride
- 4) 2-butanone and carbon dioxide
- 5) no reaction occurs



(4) decarboxylation of β -ketoacid (Chptr 18). There is a nice presentation of this on p. 468 of the text, using almost exactly this molecule.

19. (2 points) In metabolism, CoA-SH usually reacts directly with

- | | | |
|---------------------|-----------|-------------|
| 1) anhydrides | 2) esters | 3) alcohols |
| 4) carboxylic acids | 5) water | |



(4) (Chapter 27) This is what CoA-SH does for a living – key concept!

20. (2 points) In NAD and FAD the adenosine diphosphate functional group serves what purpose?
- 1) It is a “handle” to help it bind to enzyme active sites
 - 2) It accepts a phosphate from reactants to dephosphorylate them
 - 3) Hydrolysis of the diphosphate helps to drive reactions
 - 4) It helps to bind and position the reactants
 - 5) It plays no role. You can remove it and what remains still functions

(1) (Chapter 27) - a unifying concept for NAD, NADP, FAD

21. (2 points) In the Citric Acid cycle, malate reacts with NAD^+ . In this reaction, malate:
- 1) isomerizes
 - 2) is phosphorylated
 - 3) is dephosphorylated
 - 4) is reduced
 - 5) is oxidized

(5) (Chapter 27) – NAD^+ is an oxidant – key concept!

22. (2 points) The negatively charged molecule carbonylcyanide-*p*-trifluoromethoxyphenylhydrazone (FCCP) binds to H^+ ions in the mitochondrial intermembrane space and transports them across the inner membrane to the matrix. FCCP thus is toxic because it:
- 1) prevents electron flow to dioxygen
 - 2) leads to the build up of lactic acid
 - 3) prevents synthesis of ATP via the proton translocating ATPase
 - 4) leads to excess protonation of acetyl-CoA
 - 5) inhibits phosphorylation of glucose

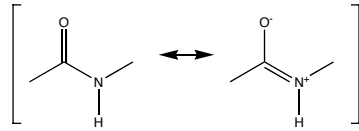
(3) (OWL 27.6) – H^+ gradient drives ATP synthesis in respiration – a key concept!

23. (2 points) Which listing below contains only hydrophobic amino acids?
- | | |
|------------------------|-----------------------|
| 1) Met, Asn, Asp, Lys) | 2) Met, Asn, Pro, Leu |
| 3) Arg, Glu, Asp, Lys | 4) Arg, Glu, Val, Phe |
| 5) Ile, Leu, Val, Phe | |

(5) Chptr 22– look at the side chains (front page of exam). Nonpolar groups aren't charged and can't hydrogen bond – key concept!

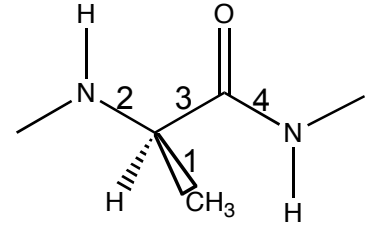
24. (2 points) In the amino acid linkage shown at right, which bonds have a high energy cost for rotation?

1) 1 2) 2 3) 3 4) 4

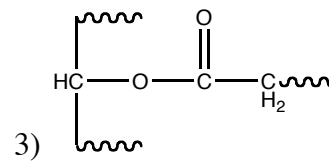
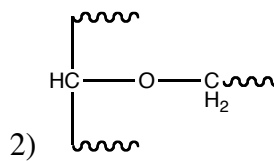
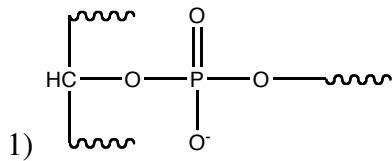


- a key concept!

(4) Remember the resonance structure (Chptr 22)

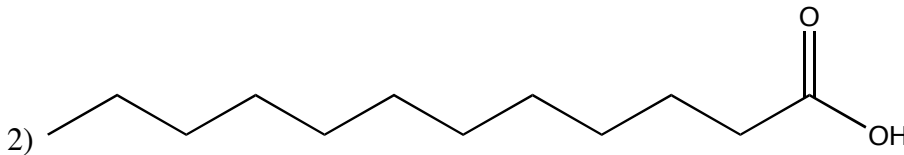
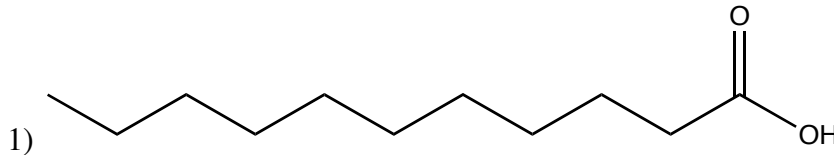


25. (2 points) Which of the following is a structure typically *not* seen in the complex lipids we have seen?



(2) Chptr 21 – see p. 529

26. (2 points) Which fatty acid below is not of natural origin?



3) Neither are of natural origin
4) Both are of natural origin

(1) – 11 carbons – even number (Chptr21) – key concept.

Do you remember why?

27. Ounce for ounce, which provide lower energy yields, both in conventional combustion and in cellular metabolism

1) carbohydrates 2) fats

(1) Fats are more reduced and so yield more energy in oxidation to CO₂ (Chapter 28)

28. (2 points) ATP is often hydrolyzed in order to drive unfavorable reactions. Another important and very common role for ATP that does not involve hydrolysis is:
- 1) reduction of carboxylic acids
 - 2) phosphorylation of alcohols
 - 3) oxidation of alcohols
 - 4) oxidation of primary amines
 - 5) cyclization of sugars

(2) Chptr 28 – Remember we talked about two key roles for ATP?

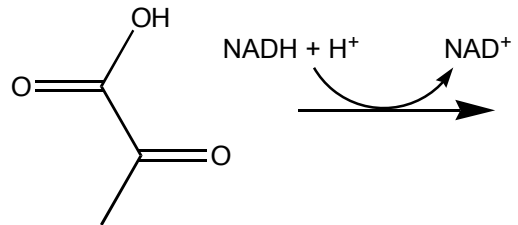
29. (2 points) What force is most dominant in driving a protein from an ensemble unfolded of states to a compact globular structure?
- 1) hydrogen bonding
 - 2) hydrophobic collapse
 - 3) disulfide bonding
 - 4) formation of helices
 - 5) electrostatic attraction between charged amino acid side chains

(2) Chptr 22 – This is a key concept in protein folding. Oil/water et al.

30. (2 points) Which structural element(s) can stabilize polar groups in the interior of a protein (choose the best answer)?
- 1) alpha helices
 - 2) beta sheets
 - 3) quaternary structure
 - 4) disulfide bonds
 - 5) alpha helices and beta sheets

(5) Chptr 22 – This was *the* key concept of secondary structure talked about in class!

31. (2 points) In one of the reactions of glycolysis, pyruvate reacts with NADH. What is the structure of the product?



- (1) (2) (3) (4)

(3) NADH carries out reductions (but only one) (Chptr 28). There are two double bonds that could be reduced, but one is in a carboxylic acid and so is “happier.”

32. (2 bonus points) What is the course number of this class?

1) 250

2) 111

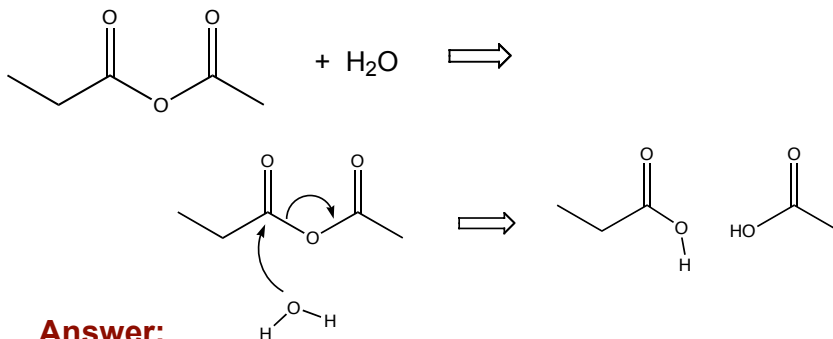
3) 496

4) 728

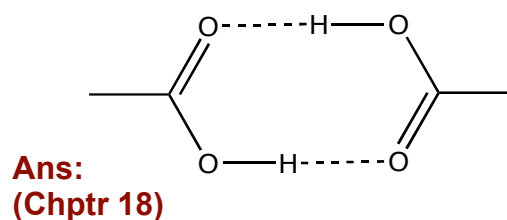
(1)

**** Answer questions 32-39 directly on this sheet, in the spaces provided ****

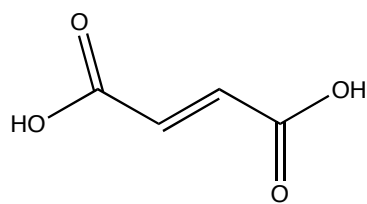
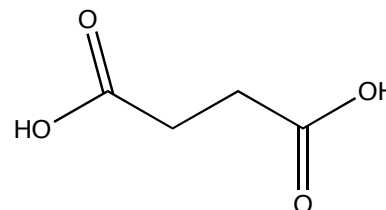
33. (5 points) Draw the structural formula for the major organic product of the reaction below:



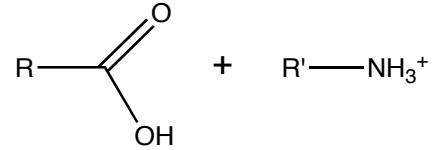
34. (5 points) Draw a structural formula for the dimer formed when two molecules of acetic acid (ethanoic acid) interact by hydrogen bonding.

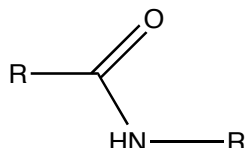


35. (5 points) In the Citric Acid cycle, which is a product of the reaction of succinate (shown at right) with FAD?
(Hint #1: you are not expected to know this from memory, but deduce it from chemistry; Hint #2: there is no decarboxylation)

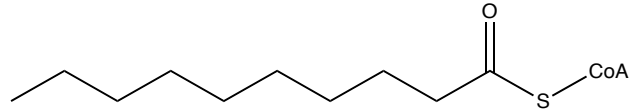


36. (5 points) Draw the product(s) of the following reaction:

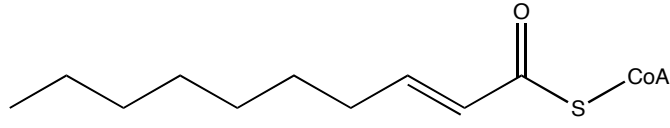


Answer:  (Chptr 22 & 19)

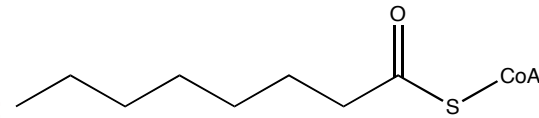
37. (5 points) For the active fatty acid at right,



Draw the structure of the immediate product of reaction with Acyl-CoA dehydrogenase.

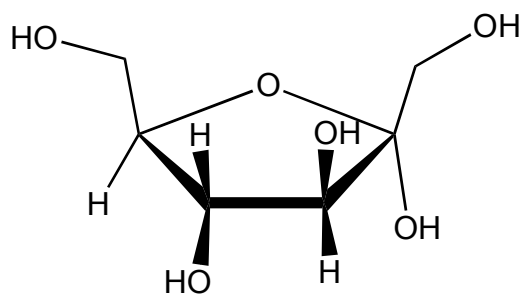
Answer:  (Chptr 29)

38. (5 points) For the same starting fatty acid above, draw the structure of the active fatty acid resulting from one complete round of β -oxidation

Answer:  (2 carbons shorter) (Chptr 28)

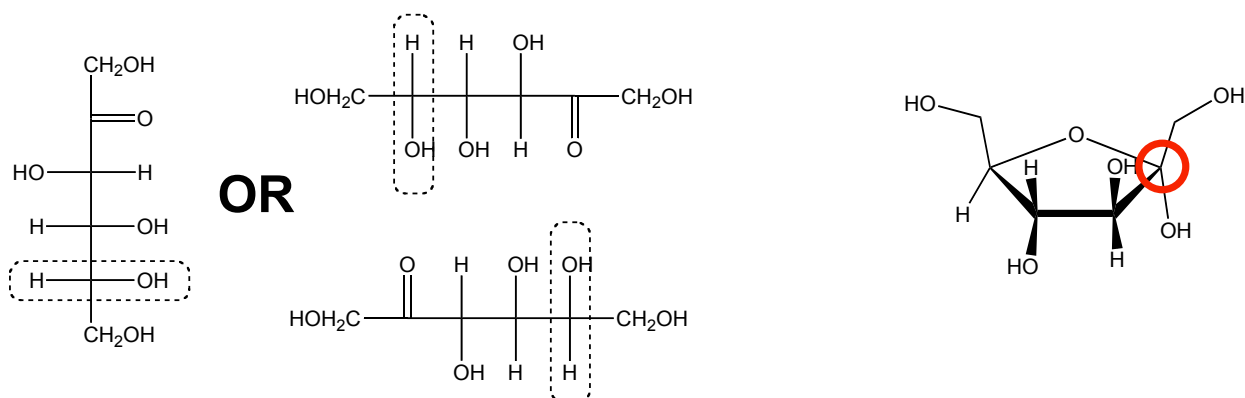
39. (3 points) Circle the anomeric carbon in the sugar at right.

Chapter 20



40. (5 points) Draw the Fischer projection corresponding to the linear form of the molecule shown at right.

Chapter 20



Assigning the stereochemistry of the center in the dashed box is an advanced topic, and so is not graded on this exam.