

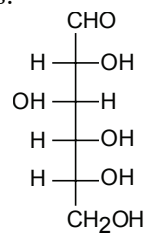
Chem 250

Answer Key Evening Exam 2v1

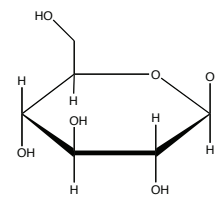
This exam is composed of **40 multiple choice** plus **4 short answer** questions.

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.



D-glucose

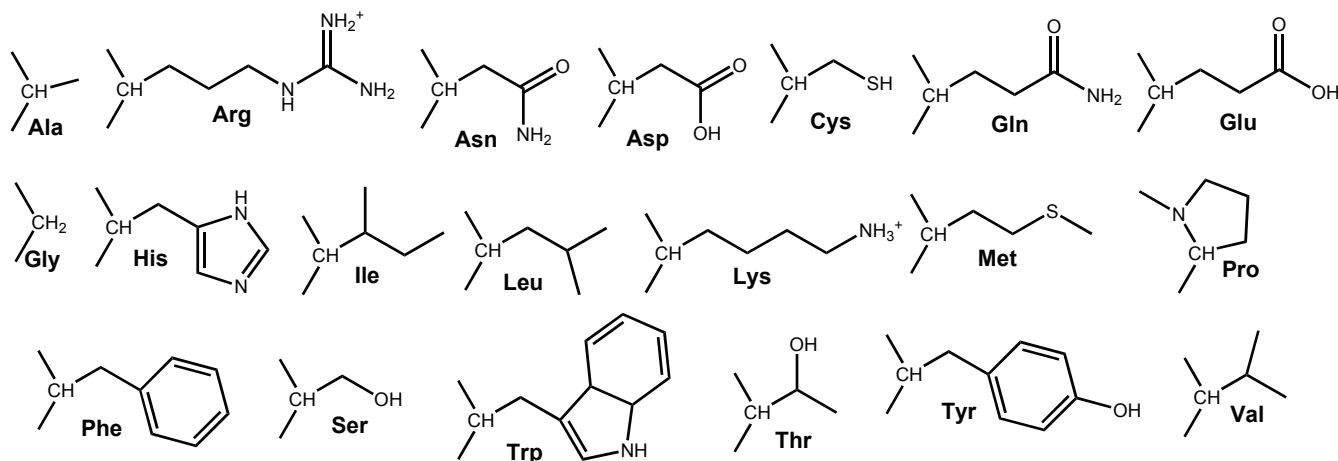


β-D-Glucose

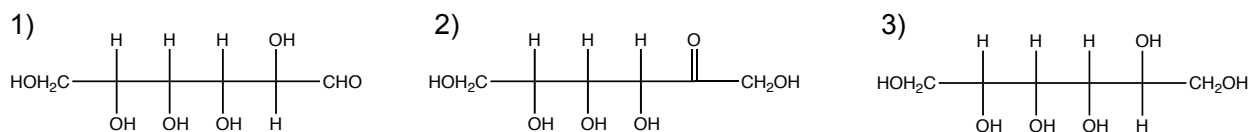
Signature

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)									



For questions 1 to 2, consider the following (for each question, answer (4) if “none of the above” applies):



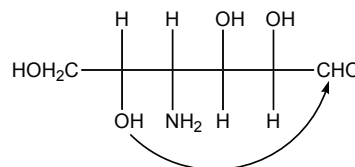
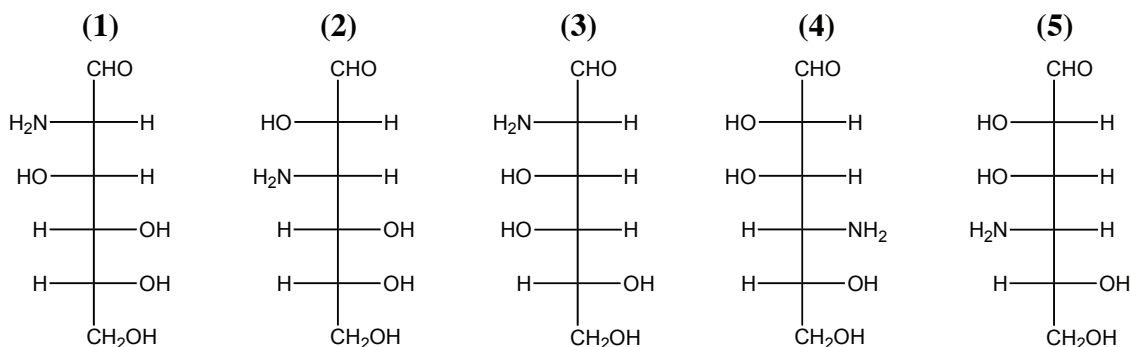
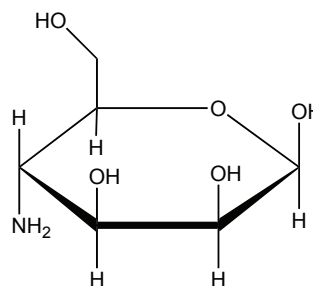
1. (2 points) Which of the above cyclizes to a sugar with a 6-membered ring?

(1) Attack is at the aldehyde (Ch 20)

2. (2 points) Which of the above is incapable of forming a cyclic sugar?

(3) This contains neither an aldehyde nor a ketone, thus no attack (Ch 20)

3. (2 points) Which Fischer representation below shows the linear form of the cyclic sugar shown at right?

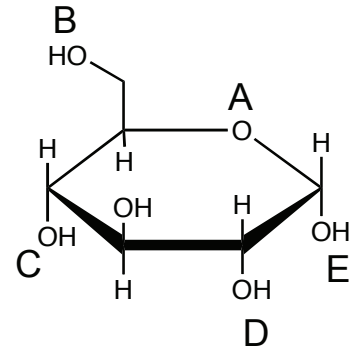


(4) Chapter 20 (p 499) / Quiz 2

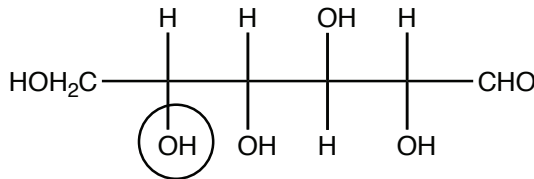
4. (2 points) Consider the sugar at right. Which oxygen becomes the aldehyde oxygen in the linear form of the sugar?

1) A 2) B 3) C 4) D 5) E

(5) Chapter 20



5. (2 points) The circled oxygen in the linear form below corresponds to which oxygen in the circular form at right?



1) A 2) B 3) C 4) D 5) E

(1) Chapter 20

6. (2 points) Which of the following is/are ketose(s)?

1) HO-CH₂-CH(OH)-CHO 2) HO-CH₂-CH(OH)-CH₂-OH
 3) HO-CH₂-CO-CH₂-OH 4) (1) and (2)
 5) none of the above

(3) The third one (only) contains a ketone. see p 494 and OWL 20.1b

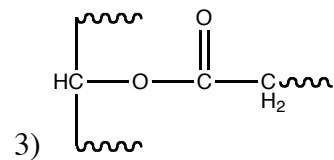
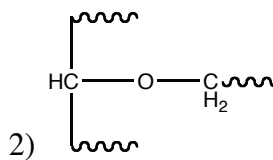
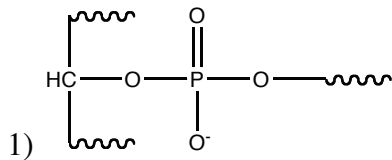
Ketose → Ketone. Look for the one with the ketone (Ch 20)

7. (2 points) Glycolipids contain what characteristic head group?

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

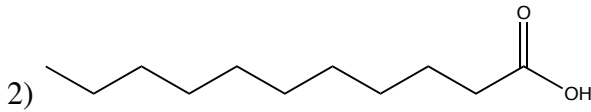
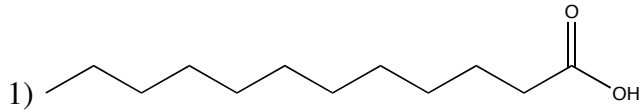
(2) Chptr 21 Hint: Glyco = "sweet" = sugar (similarly glycolysis is the break down of sugars)

8. (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

9. (2 points) Which fatty acid below is not of natural origin?



3) Neither are of natural origin

4) Both are of natural origin

(2) – 11 carbons – even number (Chptr21) – key concept.

Do you remember why?

10. (2 points) Partial hydrogenation of fats refers to:

1) hydrolytic cleavage of one of the fatty acids away from the triglyceride

2) oxidation of some, but not all, of the alkyl chain single bonds

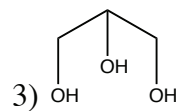
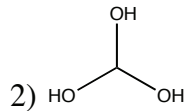
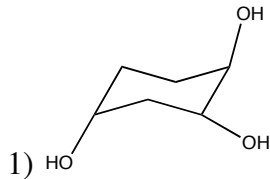
3) reduction of some, but not all, of the alkyl chain double bonds

4) attack on one of the chains by CoA-SH

5) removal of 2 carbons from one of the fatty acyl chains

(3) OWL 21.3 “Hydrogenase” – adds hydrogens across a double bond, though in this context, it’s usually not an enzymatic reaction

11. (2 points) Triglycerides are based on which chemical framework?



(3) (Chptr 21)

12. (2 points) In metabolism, CoA-SH usually reacts directly with

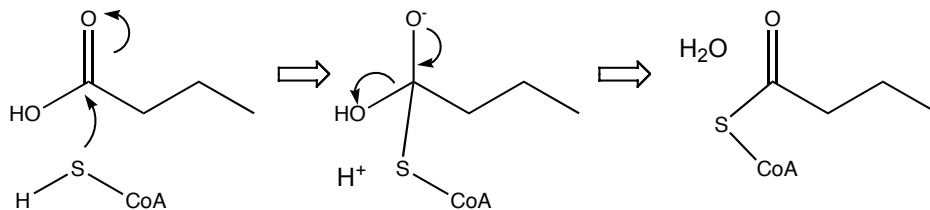
1) alcohols

2) esters

3) anhydrides

4) carboxylic acids

5) water



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

13. (2 points) In NAD and FAD the adenosine diphosphate functional group serves what purpose?

- 1) Hydrolysis of the diphosphate helps to drive reactions
- 2) It accepts a phosphate from reactants to dephosphorylate them
- 3) It is a “handle” to help it bind to enzyme active sites
- 4) It helps to bind and position the reactants
- 5) It plays no role. You can remove it and what remains still functions

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

14. (2 points) In the Citric Acid cycle, succinate reacts with FAD. In this reaction, succinate:

- 1) isomerizes
- 2) is phosphorylated
- 3) is dephosphorylated
- 4) is oxidized
- 5) is reduced

(4) (Chapter 27) - FAD is an oxidant – key concept!

15. (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) leads to excess protonation of acetyl-CoA
- 4) prevents synthesis of ATP via the proton translocating ATPase
- 5) inhibits phosphorylation of glucose

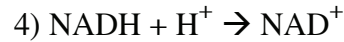
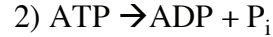
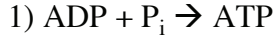
(4) (OWL 27.6) – H⁺ gradient drives ATP synthesis in respiration – a key concept!

16. (2 points) The purpose of glycogen in the human body is

- | | |
|-----------------------|---------------------|
| 1) storage of glucose | 2) storage of fats |
| 3) bone structure | 4) tissue structure |
| 5) none of the above | |

(1) (Chapter 29 & 20)

17. (2 points) In respiration, a H^+ gradient across the mitochondrial membrane is used to drive the following unfavorable reaction:



5) β oxidation of fatty acids

(1) (Chptr 27)

18. 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 CO_2 (Chapter 28)

19. (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

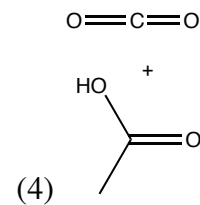
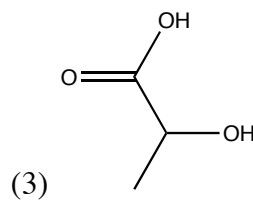
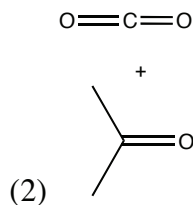
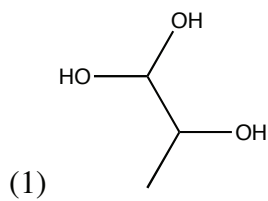
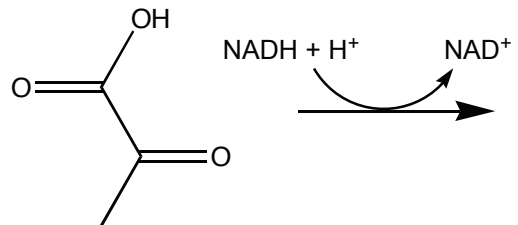
3) oxidation of alcohols

4) oxidation of primary amines

5) cyclization of sugars

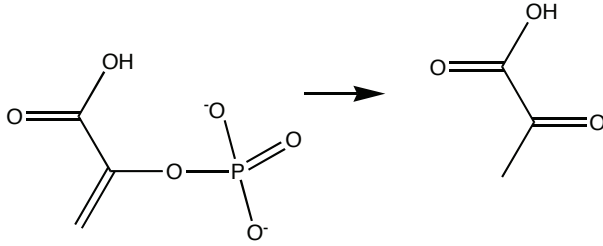
(2) Chptr 28 – Remember we talked about two key roles for ATP?

20. (2 points) In one of the reactions of glycolysis, pyruvate reacts with NADH. What is the structure of the product?



(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.”

21. (2 points) The last step in glycolysis is the following

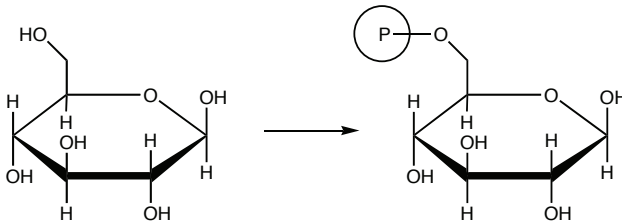


Which of the following enzymes catalyzes this reaction?

- | | |
|----------------------------|----------------------------|
| 1) aldolase | 2) phosphoglycerate mutase |
| 3) hexokinase | 4) pyruvate kinase |
| 5) phosphohexose isomerase | |

(4) looking backward, this phosphorylates, so it must be a kinase. Substrate not a hexose. Remember that enzymes catalyze reactions in both directions. (Ch 28)

22. (2 points) In one of the reactions of glycolysis, glucose is phosphorylated:

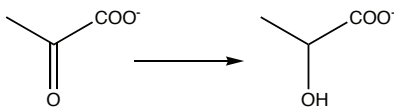


Which common metabolite is another reactant in this process?

- | | | | | |
|---------------|---------|--------|--------|-------------|
| 1) Coenzyme A | 2) NADH | 3) FAD | 4) ATP | 5) Pyruvate |
|---------------|---------|--------|--------|-------------|

(4) (Chptr 28)

23. (2 points) In one of the reactions of glycolysis, pyruvate is converted to lactate:



Which common metabolite is another reactant in this process?

- | | | | | |
|---------------|---------|--------|--------|--------|
| 1) Coenzyme A | 2) NADH | 3) FAD | 4) ATP | 5) ACP |
|---------------|---------|--------|--------|--------|

(2) (Chptr 28)

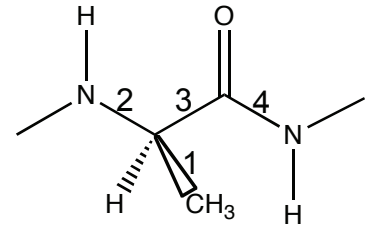
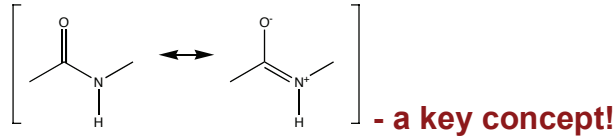
24. (2 points) In one complete cycle of the acyl carrier protein, how many carbons are added to the growing fatty acyl chain?

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

(2) (Chapter 29)

29. (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



(4) Remember the resonance structure (Chptr 22)

30. (2 points) What force is most dominant in driving a protein from an ensemble unfolded of states to a compact globular structure?

1) hydrophobic collapse 2) hydrogen bonding
 3) disulfide bonding 4) formation of helices
 5) electrostatic attraction between charged amino acid side chains

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

31. (2 points) Which structural element(s) can stabilize polar groups in the interior of a protein (choose the best answer)?

1) quaternary structure 2) disulfide bonds
 3) alpha helices 4) beta sheets
 5) alpha helices and beta sheets

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

32. (2 points) A stretch of a protein contains the sequence –Leu-Asn-Ile-Arg-Val-Asp-Ile-Lys-Val-

This stretch most likely lies in

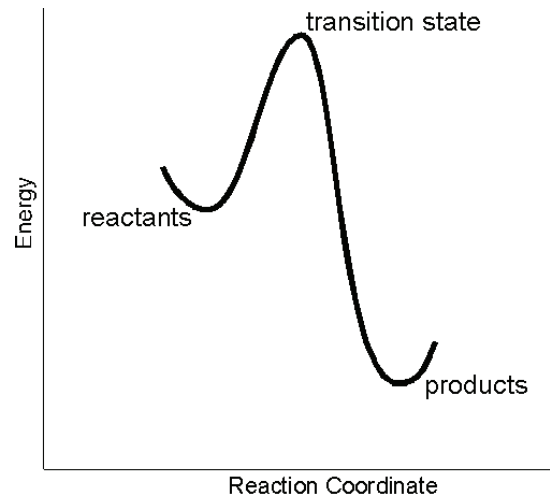
1) in an α -helix in the interior of the folded protein
 2) in an α -helix on the surface of the folded protein
 3) in a β -sheet in the interior of the folded protein
 4) in a β -sheet on the surface of the folded protein
 5) in a turn buried in the interior of the folded protein

(4) it's alternating polar-nonpolar. In a beta-sheet, this puts all of the nonpolar groups on one side and the polar groups on the other (Ch 22).

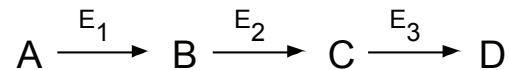
33. (2 points) An enzyme can increase the rate of a reaction by

- 1) raising the energy of the reactants
- 2) lowering the energy of the transition state
- 3) lowering the energy of the products
- 4) raising the temperature of the reactants
- 5) increasing homeopathic vibrations

(2) THE fundamental concept – understand this one! Chptr 23



34. (2 points) In the reaction below, “feedback control” refers to:



- 1) Enzyme E_3 binds to reactant A, preventing its reaction with enzyme E_1
- 2) Enzyme E_3 is redirected to generate product A, rather than product D
- 3) Enzyme E_3 binds to and inhibits enzyme E_1
- 4) Binding of product D to enzyme E_1 inhibits the enzyme
- 5) Binding of intermediate B to enzyme E_3 inhibits the enzyme

(4) Chptr 23.6. Scheme (5) is feed “forward” control and in fact, wouldn’t provide any desired regulation..

35. (2 points) You are measuring the rate of an enzyme catalyzed reaction. Addition of increasing amounts of substrate restores the reaction rate to only half of its original value. The inhibitor is

- 1) competitive
- 2) noncompetitive
- 3) complementary
- 4) noncomplementary

(2) Chptr 23

36. (2 points) Allostery refers to

- 1) modifications such as phosphorylation, that modulate enzyme activity
- 2) the biosynthesis of different forms of an enzyme in different tissues
- 3) induced fit binding of a substrate in an active site
- 4) binding of a regulatory molecule at an enzyme site different from the active site
- 5) a change in structure of the active site to better fit the bound substrate

(4) (Chptr 23)

37. (2 points) Which amino acid side chain is most likely phosphorylated by ATP by the kinase enzyme? (note you are not expected to know this, but to deduce it from what you've learned in this course)

- 1) Gly 2) Arg 3) Leu 4) Ala 5) Ser

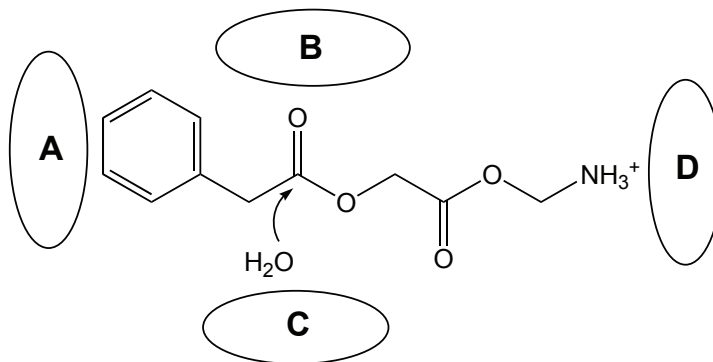
(5) Ser- the hydroxyl is a nucleophile that can attack the phosphoric anhydride in ATP (Chptr 23, 22, and 19)

38. (2 points) Which statement below is most correct?

- 1) Chemical messengers are cells that bind to other cells, injecting chemical signals
- 2) Chemical messengers penetrate cell membranes to bind to proteins inside the cell
- 3) Chemical messengers are ligands that bind to protein receptors on cell membranes
- 4) Chemical messengers react with other messengers to trigger changes in the cell
- 5) Chemical messengers ride bicycles to deliver key messages

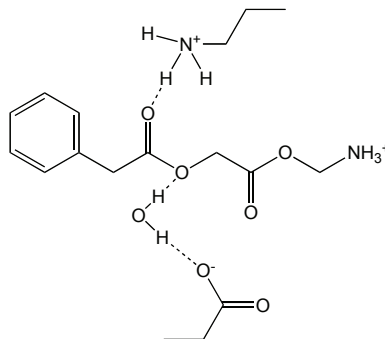
(3) (Chptr 24)

39. (2 points) Consider hydrolysis of the ester shown below.



Placement of which groups where will speed the rate of hydrolysis of the bound molecule?

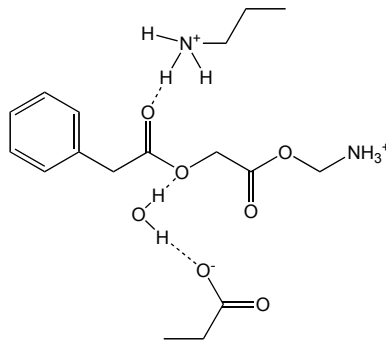
- 1) Phe at B and Glu at C
- 2) Glu at B and Phe at C
- 3) Asp at B and Lys at C
- 4) Lys at B and Asp at C
- 5) none of the above



(4) Chptr 23

40. (2 points) For the same reaction above, substrate specificity is best achieved by placement of which groups where?

- 1) Phe at B and Glu at C
- 2) Glu at A and Lys at D
- 3) Ile at A and Asp at D
- 4) Ser at B and His at C
- 5) none of the above



(3) Chptr 23

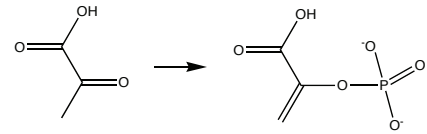
41. (2 bonus points) What is the course number of this class?

- 1) 250
- 2) 111
- 3) 496
- 4) 728

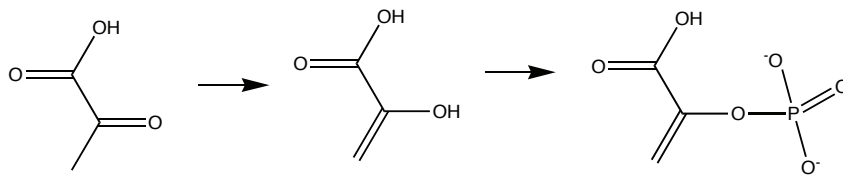
(1)

Short answers * Answer on this sheet. Tear off and turn in this page *

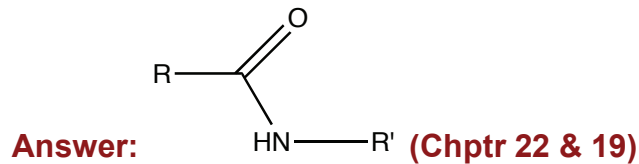
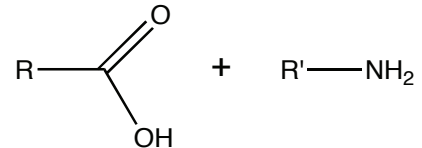
42. (5 points) Consider the reverse of the reaction in question 21. Ketones do not react directly with phosphates, yet that appears to be the end results of this process. Explain how this happens using what you have learned in this class. Hint: something else changes as well...



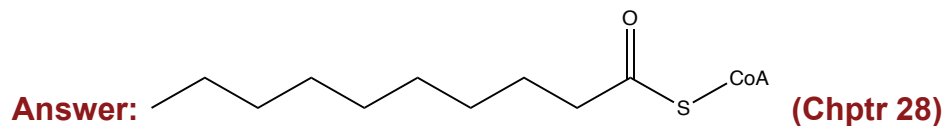
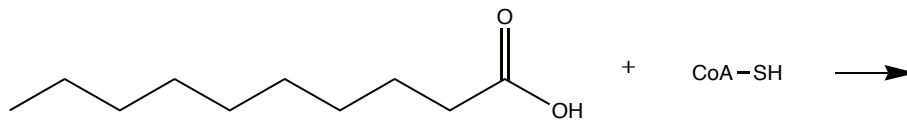
As shown below, dephosphorylation indeed results in an alcohol, but more appropriately, it results in an “enol” (Chptr 17.5) which then isomerizes to a ketone. (Chapter 28)



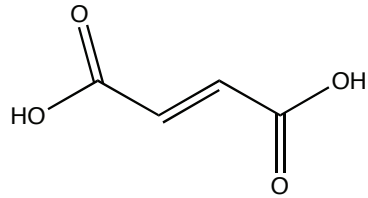
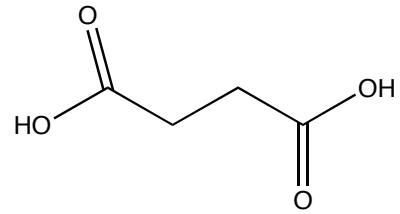
43. (5 points) Draw the product(s) of the following reaction:



44. (5 points) Draw the product of the following reaction:



45. (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)



Answer:

(Chptr 27)