

Last

First

MI

Chemistry 234
Exam 3

Fall 2017

Dr. J. Osbourn

Instructions: The first 24 questions of this exam should be answered on the provided Scantron. You must use a pencil for filling in the Scantron sheet. Ensure all erasures are complete. Any questions left blank will be marked incorrect. Answer the remaining questions on the exam itself. Show all work and provide complete explanations.

Please write your name on:

- **The first page (Exam Cover Page)**
- **The second page (Grading Page)**
- **The Scantron Sheet** – Circle your Last Name

Please bubble in your WVU Student ID Number on your Scantron sheet.

The Periodic Table

																		18 VIII A																											
1 IA																		2 He																											
1 H 1.01																		13 III A		14 IVA		15 VA		16 VIA		17 VIIA		4.00																	
3 Li 6.94																		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																		13 Al 26.98		14 Si 28.09		15 P 30.97		16 S 32.07		17 Cl 35.45		18 Ar 39.95																	
12 Mg 24.31																		26.98		28.09		30.97		32.07		35.45		39.95																	
19 K 39.1																		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													
20 Ca 40.08																		27 Co 58.93		28 Ni 58.69		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																		43 Tc (98)		44 Ru 101.07		45 Rh 102.91		46 Pd 106.42		47 Ag 107.87		48 Cd 112.41		49 In 114.82		50 Sn 118.71		51 Sb 121.76		52 Te 127.6		53 I 126.9		54 Xe 131.29					
55 Cs 132.9																		73 Os 186.2		74 Ir 192.2		75 Pt 195.1		76 Au 197.0		77 Hg 200.6		78 Tl 204.4		79 Pb 207.2		80 Bi 209		81 Po (209)		82 At (210)		83 Rn (222)							
87 Fr (223)																		107 Bh (264)		108 Hs (265)		109 Mt (268)		110 Ds (271)		111 Rg (272)																			
88 Ra (226)																		106 Sg (263)		107 Bh (264)		108 Hs (265)		109 Mt (268)		110 Ds (271)		111 Rg (272)																	
89 Ac^ (227)																		105 Db (262)		106 Sg (263)		107 Bh (264)		108 Hs (265)		109 Mt (268)		110 Ds (271)		111 Rg (272)															
104 Rf (261)																		103 U 238.0		104 Np (237)		105 Pu (244)		106 Am (243)		107 Cm (247)		108 Bk (247)		109 Cf (251)		110 Es (252)		111 Fm (257)		112 Md (258)		113 No (259)		114 Lr (260)					
105 Db (262)																		102 Th 232.0		103 Pa (231)		104 U 238.0		105 Np (237)		106 Pu (244)		107 Am (243)		108 Cm (247)		109 Bk (247)		110 Cf (251)		111 Es (252)		112 Fm (257)		113 Md (258)		114 No (259)		115 Lr (260)	
106 Sg (263)																		101 Th 232.0		102 Pa (231)		103 U 238.0		104 Np (237)		105 Pu (244)		106 Am (243)		107 Cm (247)		108 Bk (247)		109 Cf (251)		110 Es (252)		111 Fm (257)		112 Md (258)		113 No (259)		114 Lr (260)	
107 Bh (264)																		100 Th 232.0		101 Pa (231)		102 U 238.0		103 Np (237)		104 Pu (244)		105 Am (243)		106 Cm (247)		107 Bk (247)		108 Cf (251)		109 Es (252)		110 Fm (257)		111 Md (258)		112 No (259)		113 Lr (260)	
108 Hs (265)																		99 Th 232.0		100 Pa (231)		101 U 238.0		102 Np (237)		103 Pu (244)		104 Am (243)		105 Cm (247)		106 Bk (247)		107 Cf (251)		108 Es (252)		109 Fm (257)		110 Md (258)		111 No (259)		112 Lr (260)	
109 Mt (268)																		98 Th 232.0		99 Pa (231)		100 U 238.0		101 Np (237)		102 Pu (244)		103 Am (243)		104 Cm (247)		105 Bk (247)		106 Cf (251)		107 Es (252)		108 Fm (257)		109 Md (258)		110 No (259)		111 Lr (260)	
110 Ds (271)																		97 Th 232.0		98 Pa (231)		99 U 238.0		100 Np (237)		101 Pu (244)		102 Am (243)		103 Cm (247)		104 Bk (247)		105 Cf (251)		106 Es (252)		107 Fm (257)		108 Md (258)		109 No (259)		110 Lr (260)	
111 Rg (272)																		96 Th 232.0		97 Pa (231)		98 U 238.0		99 Np (237)		100 Pu (244)		101 Am (243)		102 Cm (247)		103 Bk (247)		104 Cf (251)		105 Es (252)		106 Fm (257)		107 Md (258)		108 No (259)		109 Lr (260)	
112 Og (284)																		95 Th 232.0		96 Pa (231)		97 U 238.0		98 Np (237)		99 Pu (244)		100 Am (243)		101 Cm (247)		102 Bk (247)		103 Cf (251)		104 Es (252)		105 Fm (257)		106 Md (258)		107 No (259)		108 Lr (260)	
113 Ug (286)																		94 Th 232.0		95 Pa (231)		96 U 238.0		97 Np (237)		98 Pu (244)		99 Am (243)		100 Cm (247)		101 Bk (247)		102 Cf (251)		103 Es (252)		104 Fm (257)		105 Md (258)		106 No (259)		107 Lr (260)	
114 Ts (288)																		93 Th 232.0		94 Pa (231)		95 U 238.0		96 Np (237)		97 Pu (244)		98 Am (243)		99 Cm (247)		100 Bk (247)		101 Cf (251)		102 Es (252)		103 Fm (257)		104 Md (258)		105 No (259)		106 Lr (260)	
115 Og (294)																		92 Th 232.0		93 Pa (231)		94 U 238.0		95 Np (237)		96 Pu (244)		97 Am (243)		98 Cm (247)		99 Bk (247)		100 Cf (251)		101 Es (252)		102 Fm (257)		103 Md (258)		104 No (259)		105 Lr (260)	
116 Lv (293)																		91 Th 232.0		92 Pa (231)		93 U 238.0		94 Np (237)		95 Pu (244)		96 Am (243)		97 Cm (247)		98 Bk (247)		99 Cf (251)		100 Es (252)		101 Fm (257)		102 Md (258)		103 No (259)		104 Lr (260)	
117 Ts (294)																		90 Th 232.0		91 Pa (231)		92 U 238.0		93 Np (237)		94 Pu (244)		95 Am (243)		96 Cm (247)		97 Bk (247)		98 Cf (251)		99 Es (252)		100 Fm (257)		101 Md (258)		102 No (259)		103 Lr (260)	
118 Og (294)																		89 Th 232.0		90 Pa (231)		91 U 238.0		92 Np (237)		93 Pu (244)		94 Am (243)		95 Cm (247)		96 Bk (247)		97 Cf (251)		98 Es (252)		99 Fm (257)		100 Md (258)		101 No (259)		102 Lr (260)	
119 Ug (296)																		88 Th 232.0		89 Pa (231)		90 U 238.0		91 Np (237)		92 Pu (244)		93 Am (243)		94 Cm (247)		95 Bk (247)		96 Cf (251)		97 Es (252)		98 Fm (257)		99 Md (258)		100 No (259)		101 Lr (260)	
120 Lv (293)																		87 Th 232.0		88 Pa (231)		89 U 238.0		90 Np (237)		91 Pu (244)		92 Am (243)		93 Cm (247)		94 Bk (247)		95 Cf (251)		96 Es (252)		97 Fm (257)		98 Md (258)		99 No (259)		100 Lr (260)	
121 Ts (294)																		86 Th 232.0		87 Pa (231)		88 U 238.0		89 Np (237)		90 Pu (244)		91 Am (243)		92 Cm (247)		93 Bk (247)		94 Cf (251)		95 Es (252)		96 Fm (257)		97 Md (258)		98 No (259)		99 Lr (260)	
122 Og (294)																		85 Th 232.0		86 Pa (231)		87 U 238.0		88 Np (237)		89 Pu (244)		90 Am (243)		91 Cm (247)		92 Bk (247)		93 Cf (251)		94 Es (252)		95 Fm (257)		96 Md (258)		97 No (259)		98 Lr (260)	
123 Lv (293)																		84 Th 232.0		85 Pa (231)		86 U 238.0		87 Np (237)		88 Pu (244)		89 Am (243)		90 Cm (247)		91 Bk (247)		92 Cf (251)		93 Es (252)		94 Fm (257)		95 Md (258)		96 No (259)		97 Lr (260)	
124 Ts (294)																		83 Th 232.0		84 Pa (231)		85 U 238.0		86 Np (237)		87 Pu (244)		88 Am (243)		89 Cm (247)		90 Bk (247)		91 Cf (251)		92 Es (252)		93 Fm (257)		94 Md (258)		95 No (259)		96 Lr (260)	
125 Og (294)																		82 Th 232.0		83 Pa (231)		84 U 238.0		85 Np (237)		86 Pu (244)		87 Am (243)		88 Cm (247)		89 Bk (247)		90 Cf (251)		91 Es (252)		92 Fm (257)		93 Md (258)		94 No (259)		95 Lr (260)	
126 Lv (293)																		81 Th 232.0		82 Pa (231)		83 U 238.0		84 Np (237)		85 Pu (244)		86 Am (243)		87 Cm (247)		88 Bk (247)		89 Cf (251)		90 Es (252)		91 Fm (257)		92 Md (258)		93 No (259)		94 Lr (260)	
127 Ts (294)																		80 Th 232.0		81 Pa (231)		82 U 238.0		83 Np (237)		84 Pu (244)		85 Am (243)		86 Cm (247)		87 Bk (247)		88 Cf (251)		89 Es (252)		90 Fm (257)		91 Md (258)		92 No (259)		93 Lr (260)	
128 Og (294)																		79 Th 232.0		80 Pa (231)		81 U 238.0		82 Np (237)		83 Pu (244)		84 Am (243)		85 Cm (247)		86 Bk (247)		87 Cf (251)		88 Es (252)		89 Fm (257)		90 Md (258)		91 No (259)		92 Lr (260)	
129 Lv (293)																		78 Th 232.0		79 Pa (231)		80 U 238.0		81 Np (237)		82 Pu (244)		83 Am (243)		84 Cm (247)		85 Bk (247)		86 Cf (251)		87 Es (252)		88 Fm (257)		89 Md (258)		90 No (259)		91 Lr (260)	
130 Ts (294)																		77 Th 232.0		78 Pa (231)		79 U 238.0		80 Np (237)		81 Pu (244)		82 Am (243)		83 Cm (247)		84 Bk (247)		85 Cf (251)		86 Es (252)		87 Fm (257)		88 Md (258)		89 No (259)		90 Lr (260)	
131 Og (294)																		76 Th 232.0		77 Pa (231)		78 U 238.0		79 Np (237)		80 Pu (244)		81 Am (243)		82 Cm (247)		83 Bk (247)		84 Cf (251)		85 Es (252)		86 Fm (257)		87 Md (258)		88 No (259)		89 Lr (260)	
132 Lv (293)																		75 Th 232.0		76 Pa (231)		77 U 238.0		78 Np (237)		79 Pu (244)		80 Am (243)		81 Cm (247)		82 Bk (247)		83 Cf (251)		84 Es (252)		85 Fm (257)		86 Md (258)		87 No (259)		88 Lr (260)	
133 Ts (294)																		74 Th 232.0		75 Pa (231)		76 U 238.0		77 Np (237)		78 Pu (244)		79 Am (243)		80 Cm (247)		81 Bk (247)		82 Cf (251)		83 Es (252)		84 Fm (257)		85 Md (258)		86 No (259)		87 Lr (260)	
134 Og (294)																		73 Th 232.0		74 Pa (231)		75 U 238.0		76 Np (237)		77 Pu (244)		78 Am (243)		79 Cm (247)		80 Bk (247)		81 Cf (251)		82 Es (252)		83 Fm (257)		84 Md (258)		85 No (259)		86 Lr (260)	
135 Lv (293)																		72 Th 232.0		73 Pa (231)		74 U 238.0		75 Np (237)		76 Pu (244)		77 Am (243)		78 Cm (247)		79 Bk (247)		80 Cf (251)		81 Es (252)		82 Fm (257)		83 Md (258)		84 No (259)		85 Lr (260)	
136 Ts (294)																		71 Th 232.0		72 Pa (231)		73 U 238.0		74 Np (237)		75 Pu (244)		76 Am (243)		77 Cm (247)		78 Bk (247)		79 Cf (251)		80 Es (252)		81 Fm (257)		82 Md (258)		83 No (259)		84 Lr (260)	
137 Og (294)																		70 Th 232.0		71 Pa (231)		72 U 238.0		73 Np (237)		74 Pu (244)		75																	

Please do not rip off this cover sheet

Name: _____
Last First MI

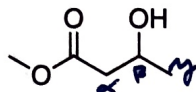
Grading Page (Exam 3):

Page	Points Possible	Points Earned
Multiple Choice (3-7)	44 + 4 bonus	
8	28	
9	28	
TOTAL	100 (+4)	

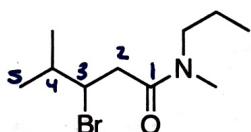
Multiple Choice

Choose the one best answer for each of the following questions. Bubble your answer in on the provided Scantron sheet. Additionally, circle or write your answer directly on the exam so that you can check your answers once the key is posted.

1. What is the common name for the ~~acid chloride~~ ^{ester} shown below? (a)

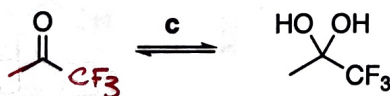
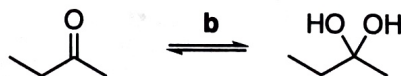
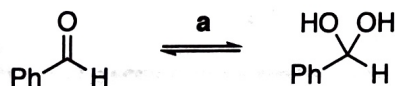


- (a) Methyl β -hydroxybutyrate
 b. Methyl γ -hydroxybutyrate
 c. β -hydroxymethoxybutyrate
 d. γ -hydroxymethoxybutyric acid
 e. None of these are correct
2. What is the correct IUPAC name for the compound shown below? (c)

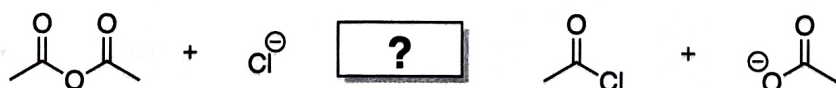


N-methyl 4-methyl } N,4-dimethyl
 N-propyl 3-bromo

- a. N-methyl-N-propyl-3-bromo-4-methylpentanamide
 b. N,3-dimethyl-N-propyl-3-bromopentanamide
 (c) 3-bromo-N,4-dimethyl-N-propylpentanamide
 d. 3-bromo-N-methyl-4-methyl-N-propylpentanamide
 e. (methylpropylamino)-3-bromo-4-methylpentanamide
3. Which reaction below would you expect to lie furthest to the right (i.e. which reaction has the most stable gem-diol and least stable carbonyl)? (d)



4. Consider the reaction shown below. Which arrow best describes the direction of the reaction equilibrium? (d)



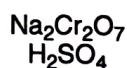
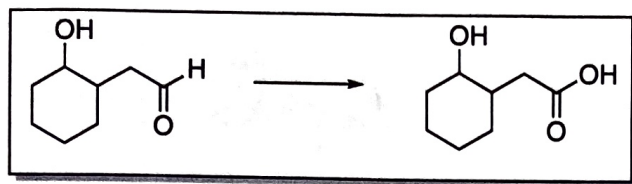
a.

b.

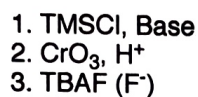
c.

(d)

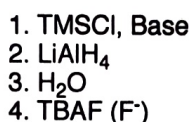
5. Which set of reagents should be used to successfully carry out the following transformation? (b)



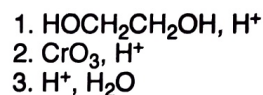
a



b

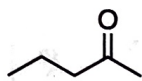


c

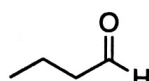


d

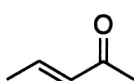
6. Rank the carbonyl compounds below in order of increasing stability. (d)



I

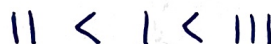


II

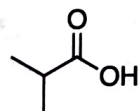
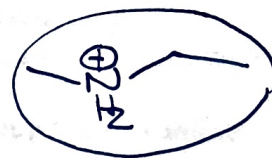
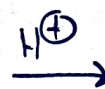
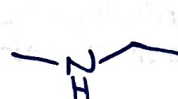
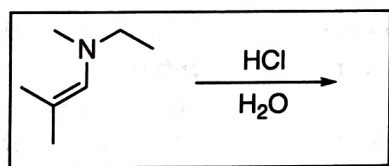


III

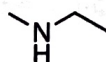
- a. $\text{I} < \text{II} < \text{III}$
b. $\text{III} < \text{II} < \text{I}$
c. $\text{I} < \text{III} < \text{II}$
d. $\text{II} < \text{I} < \text{III}$
e. $\text{III} < \text{I} < \text{II}$



7. Assuming one full equivalent of HCl is used, what are the expected organic products from the following enamine hydrolysis? (c) *will protonate N*



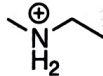
I



II



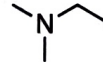
III



IV



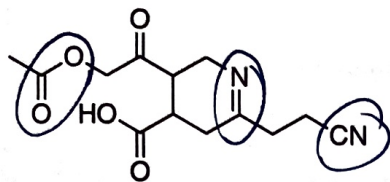
V



VI

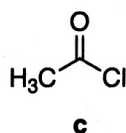
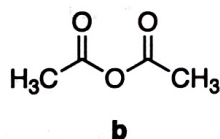
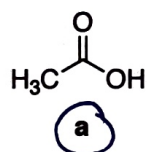
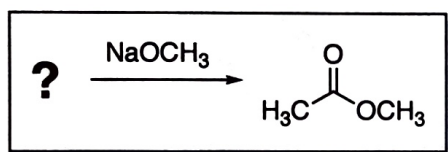
- a. I and II
b. I and IV
c. III and IV
d. II and III
e. V and VI

8. How many hydrolyzable functional groups are present in the following molecule? (b)



- a. Two
- ☒ b. Three
- c. Four
- d. Five
- e. Six

9. Which starting material below will **not** give an ester upon treating with NaOCH_3 ? (a)



All of these will
give the ester
product
d

None of these
will give the
ester product
e

10. Which statement below correctly describes the driving force behind the amide hydrolysis under basic conditions (NaOH , H_2O)? (e)

- a. This reaction is driven by adding a large excess of water.
- b. This reaction proceeds because the amide is more stable than the carboxylic acid.
- c. Adding dilute acid at the end of the reaction protonates the amine byproduct giving a stable amine salt.
- d. This reaction is driven by the hydroxide (OH^-) being a better leaving group than an amide (H_2N^-).
- ☒ e. The driving force is a rapid acid base reaction that occurs between the carboxylic acid that is formed and the amide (H_2N^-) that is lost from the carbonyl carbon.

Bonus Questions (11 & 12)

11. What gives the penicillin antibiotics their activity against Gram-positive bacteria? (c)

- a. The penicillin can hydrolyze the amide bonds that make up the bacterial cell wall.
- b. The toxicity of the β -lactam, which interrupts the ribosome processing in the bacterial cell.
- ☒ c. The strained β -lactam reacts with the transpeptidase enzyme, which prevents it from synthesizing bacterial cell walls.
- d. The β -lactam makes the antibiotic bacteriostatic and prevents the reproduction of bacterial cells.
- e. Penicillin reacts with the bacterial cell wall material causing the cell wall to burst.

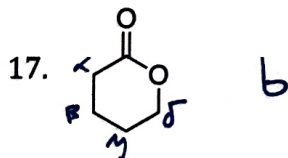
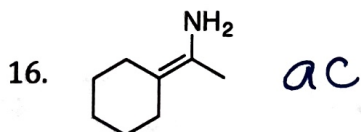
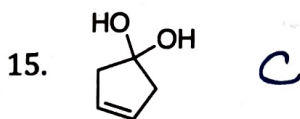
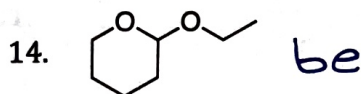
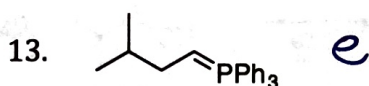
12. During alcohol metabolism in the body, what enzyme is responsible for converting acetaldehyde to acetic acid? (a)

- a. Acetaldehyde dehydrogenase
- b. Alcohol dehydrogenase
- c. Acetate synthase
- d. Acetic acid dehydrogenase
- e. None of the above

Structure Matching

For questions 13-17, pick the term from the term bank that identifies each structure below. You can only use each term once. *Note that some answers may require you to bubble in more than one letter.*

Record each answer on your Scranton sheet!

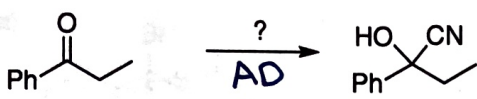
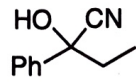
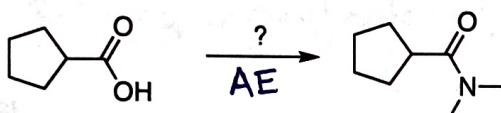
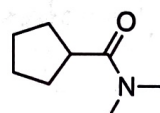
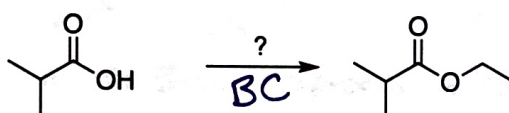
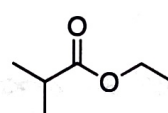
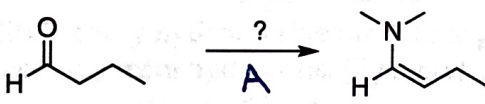
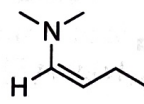
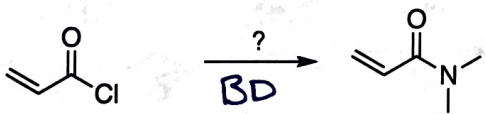
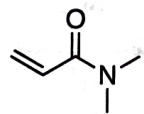
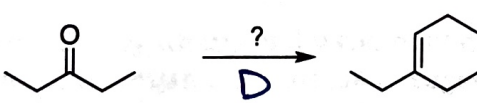
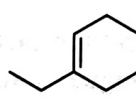
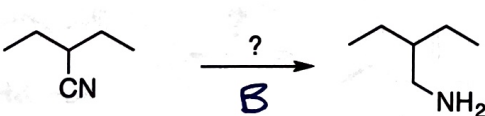
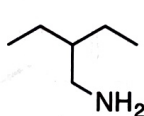


Terms


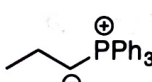
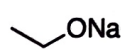
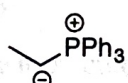




- a. hemiacetal
- b. δ -lactone
- c. hydrate
- d. imine
- e. ylide
- ab. Schiff base
- ac. enamine
- ad. ϵ -lactam
- ae. nitrile
- bc. δ -lactam
- bd. phosphonium
- be. acetal
- abc. ϵ -lactone
- abd. oxaphosphetane
- abe. gemol

Reagent Bank

For questions 18-24, select the appropriate reagent from the reagent bank to accomplish each transformation shown below. You can only use each reagent once. *Note that some answers may require you to bubble in more than one letter. Record each answer on your Scranton sheet!*

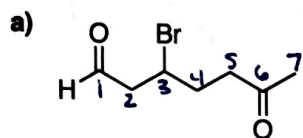
18.  $\xrightarrow{\text{AD}}$ 
19.  $\xrightarrow{\text{AE}}$ 
20.  $\xrightarrow{\text{BC}}$ 
21.  $\xrightarrow{\text{A}}$ 
22.  $\xrightarrow{\text{BD}}$ 
23.  $\xrightarrow{\text{D}}$ 
24.  $\xrightarrow{\text{B}}$ 

Reagent Bank

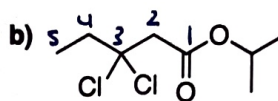
 Trace H^+ A	1. LiAlH_4 2. H_2O B	H^+ H_2O C
 D	NaBH_4 CH_3OH E	 AB
 AC	NaCN HCl AD	 DCC AE
 BC	 (2 equiv.) BD	NaCN CH_3MgBr BE
NH_3 Pyridine CD	POCl_3 CE	 DE

Completion Section: Answer the remaining questions on the exam itself. Read the questions carefully and provide complete explanations.

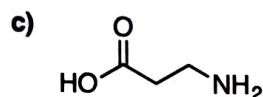
25. Provide the IUPAC name or structure for each compound shown below. (3 points each)



3-bromo-6-oxoheptanal
(+1) (+1) (+1)



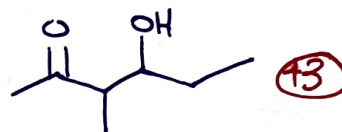
isopropyl 3,3-dichloropentanoate
(+1) (+1) (+1)



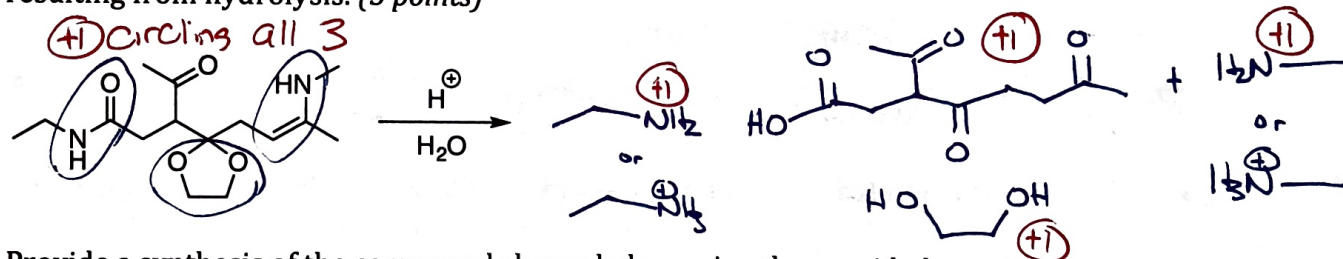
IUPAC: 3-aminopropanoic acid (+1)

Common: β-aminopropionic acid (+1)

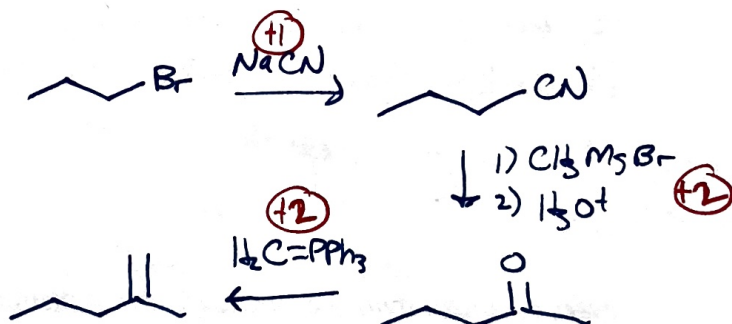
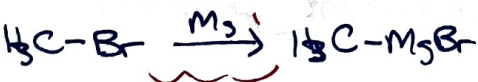
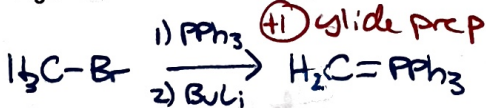
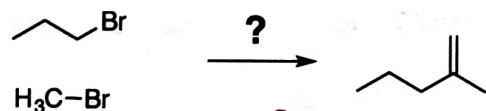
d) 4-hydroxy-3-methyl-2-hexanone



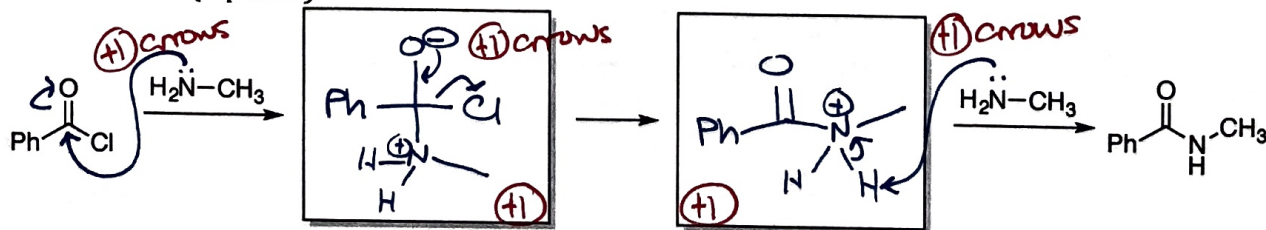
26. Circle every hydrolyzable functional group in the molecule below then draw all of the products resulting from hydrolysis. (5 points)



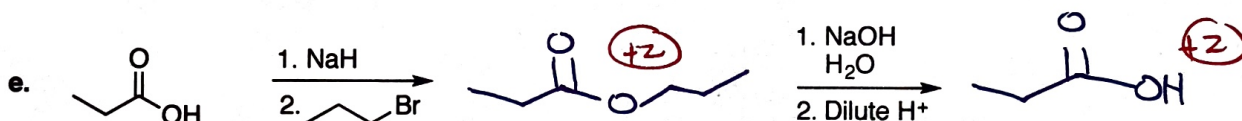
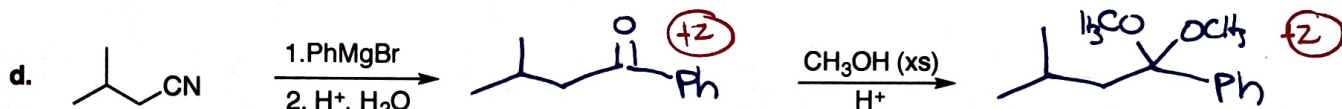
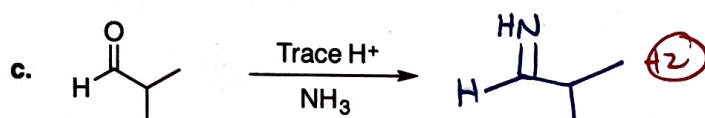
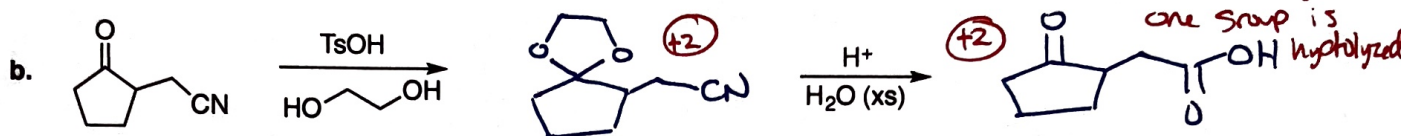
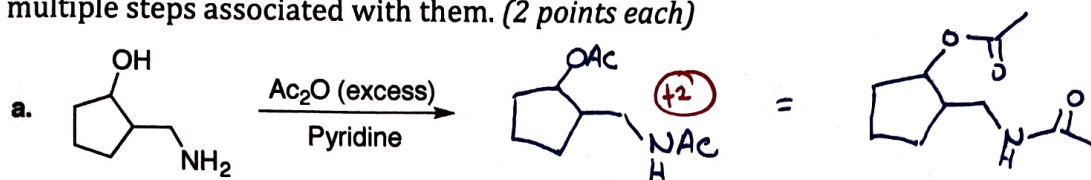
27. Provide a synthesis of the compound shown below using the provided starting materials and any other organic or inorganic reagents. Hint: You should have a ketone at some point in your synthetic sequence. (6 points)



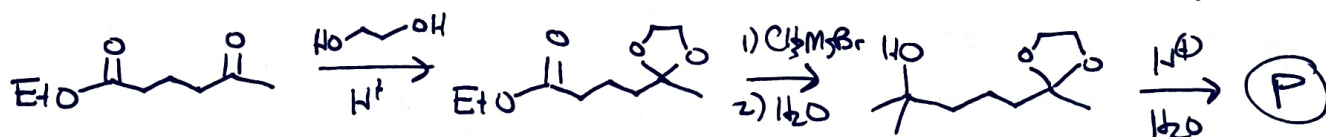
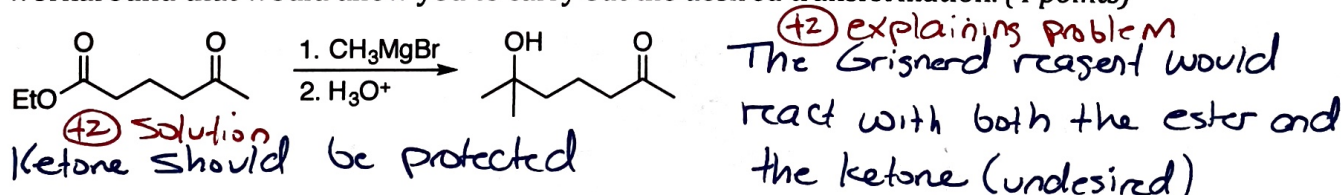
28. Provide the missing intermediates for the reaction below. Then draw in curved arrows to show electron flow. (5 points)



29. Predict the major organic product for each reaction shown below. Note: Some reactions have multiple steps associated with them. (2 points each)



30. The reaction shown below does not work as written. Explain what the problem is and design a workaround that would allow you to carry out the desired transformation. (4 points)



* Not required to draw out full synthetic sequence

31. Provide a complete electron pushing mechanism for the hydrolysis shown below. (8 points)

