Chemistry 234-101
Exam 3 – Version A

Summer 2019 Dr. J. Osbourn

Instructions: Answer the first 18 questions of this exam using the bubble sheet attached to the end of this exam booklet. You may detach this sheet if you wish. Answer the remaining questions directly on this exam. Show all work and provide complete explanations.

The Periodic Table

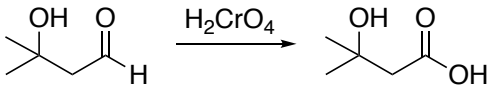
IA																	VIIIA
1 H 1.01	2 IIA											13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.1	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	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	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	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	56 Ba 137.3	57 La* 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	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	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac^ (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (264)	108 Hs (265)	109 Mt (268)	110 Ds (271)	111 Rg (272)							

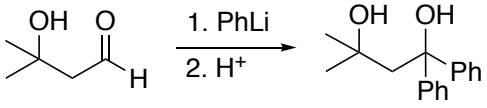
*	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
^	90 Th 232.0	91 Pa (231)	92 U 238.0	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

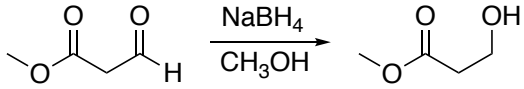
Multiple-Choice

Choose the best answer for each of the following questions. Record each answer on the attached bubble sheet. **Ensure you completely bubble in your answers**. *(2 points each)*

1. Which one of the following requires the use of a protecting group to carry out the desired transformation?

a. 

b. 

c. 

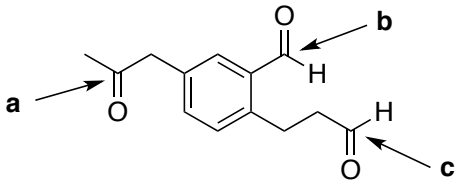
d. All of these require a protecting group

e. None of these require a protecting group

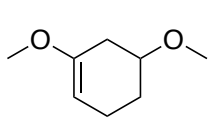
2. Which statement regarding the Fischer esterification is **false**?

   a. The reaction can be catalyzed by adding acid.
   b. The reaction can be driven to completion by removing water as it is formed.
   c. The reaction can be driven to completion by adding a large excess of one reagent.
   d. The reaction is an equilibrium process
   e. None of the above statements are false.

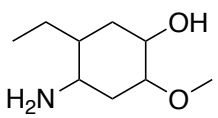
3. Which one of the indicated carbonyls is the most reactive toward a nucleophile?



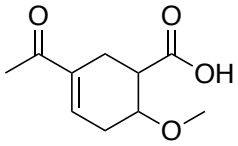
4. Which compound below will be the most water soluble?



a.

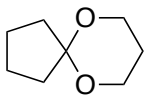


b.

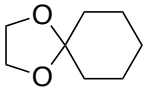


c.

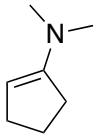
5. Which one of the following has/have cyclopentanone as a hydrolysis (H^+, H_2O) product?



a



b



c

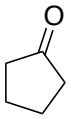
A and C

d

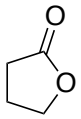
A, B, and C

e

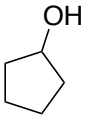
6. Rank the following from lowest boiling point to highest boiling point.



I



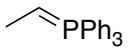
II



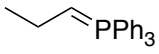
III

a. I < II < III
b. II < I < III
c. I < III < II
d. III < I < II
e. III < II < I

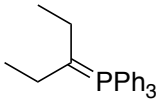
7. What ylide will produce 3-ethyl-3-hexene upon reaction with 3-pentanone?



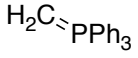
a.



b.



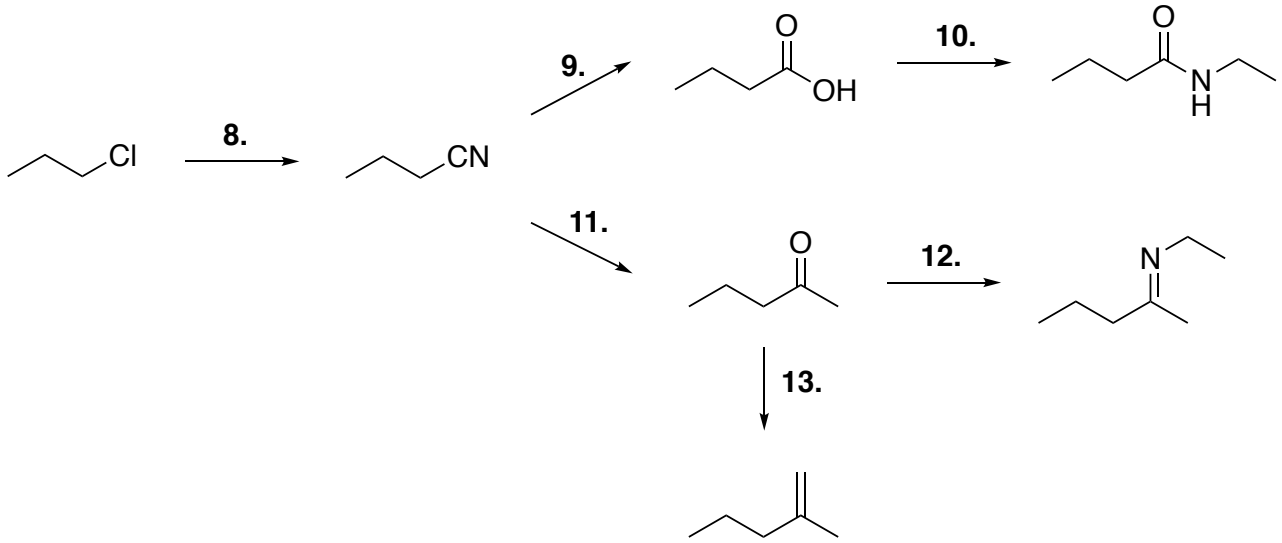
c.



d.

Reagent Matching

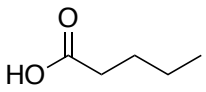
Use the reagent bank to select the best reagent for each transformation in the synthetic scheme shown below. You may only use each reagent once. *Bubble these answers in on your bubble sheet for credit. (2 points each)*

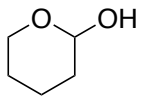


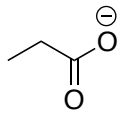
Reagent Bank				
NHNa **a**	1. LAH 2. Dilute H^+ **b**	H^+ H_2O **c**	H^+ NH_2 **d**	HCN **e**
NaCN **ab**	NH_2 **ac**	1. PCC 2. CH_3Li **ad**	1. CH_3MgBr 2. H^+, H_2O **ae**	1. $H_2C{=}CHLi$ 2. Dilute H^+ **bc**
NH_2 DCC **bd**	$H_2C{=}PPh_3$ **be**	1. $BH_3{\bullet}THF$ 2. H^+, H_2O **cd**	H^+ $HOCH_3$ **ce**	H_2CrO_4 **de**

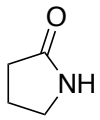
Structure Matching

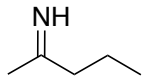
Match each structure shown below with the appropriate term from the term bank. *Bubble these answers in on your bubble sheet for credit. (2 points each)*

14. 

15. 

16. 

17. 

18. 

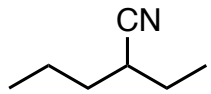
Term Bank	
a.	δ-lactone
b.	carboxylate
c.	acetal
d.	γ-lactam
e.	hemiacetal
ab.	alkoxide
ac.	imine
ad.	butyric acid
ae.	ylide
bc.	carboxide
bd.	valeric acid
be.	γ-lactone
cd.	enamine
ce.	δ-lactam
de.	caproic acid

Completion Section

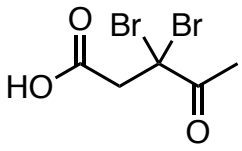
Answer the remaining questions directly on the exam itself. Please write neatly and **darkly** as your answers will be scanned for grading.

19. Provide IUPAC systematic names for each compound shown below. *(3 points each)*

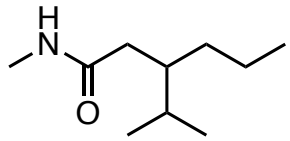
a.



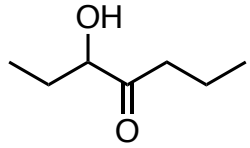
b.



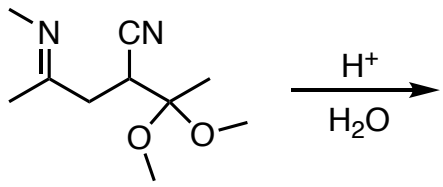
c.



d.

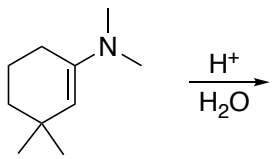


20. Draw all of the products that will result if the following compound is subjected to hydrolysis conditions. *(3 points)*

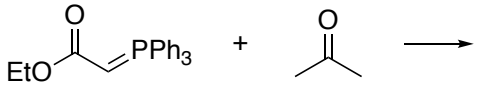


21. Predict the major product(s) for each of the following reactions. You do not need to include stereochemistry. *(2 points each)*

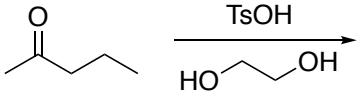
a.



b.



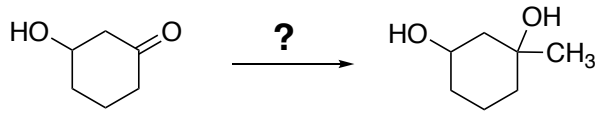
c.



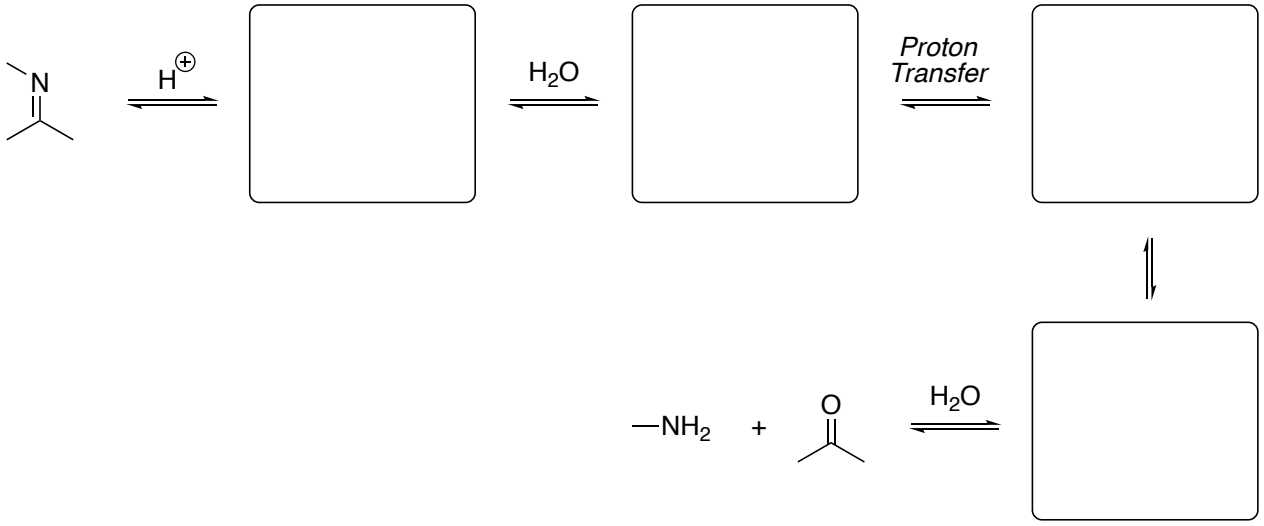
d.

e.

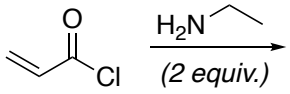
22. Show the steps necessary to prepare the following product from the given starting material and any other organic or inorganic reagents. *(6 points)*



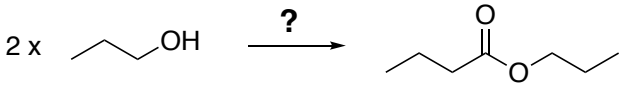
23. The mechanism for imine hydrolysis is shown below. Provide the missing intermediates and draw in curved arrows to show electron flow. *(8 points)*



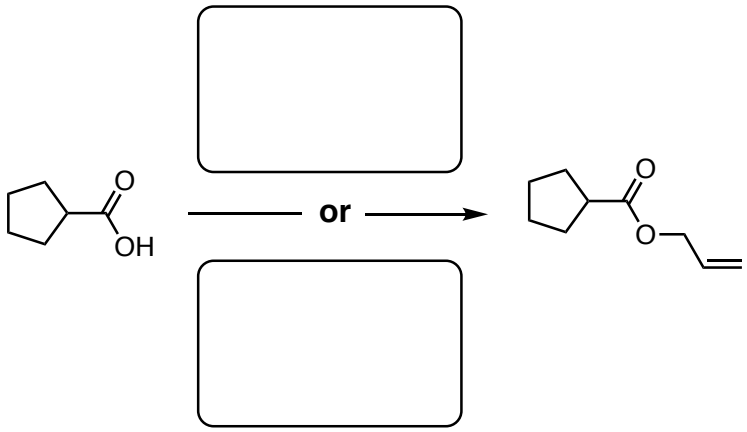
24. Draw the product and complete electron pushing mechanism for the following reaction. *(6 points)*



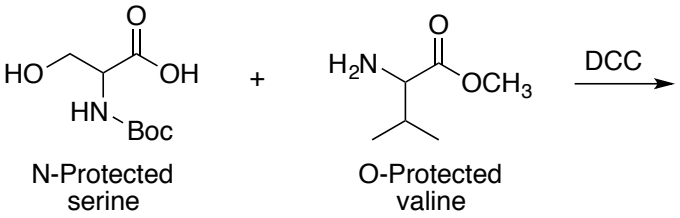
25. Design a synthesis of the following product using the provided starting materials and any other organic or inorganic reagents. *(5 points)*



26. Provide two different sets of conditions (reagents) that can be used to prepare the following ester from the carboxylic acid. *(4 points)*



27. Below are the structures of serine (N-protected with a Boc group) and valine (O-protected as a methyl ester). Show the dipeptide fragment that results from a DCC coupling reaction. *(3 points)*

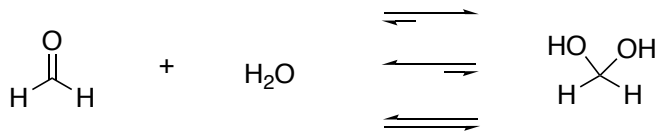


N-Protected serine

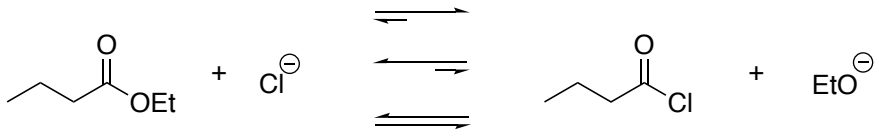
O-Protected valine

28. For each reaction below, circle the equilibrium arrows that best represent the directionality of the reaction. *(1 point each)*

a.



b.



c.