

Chemistry 234-101

Exam 3 – Version B

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.

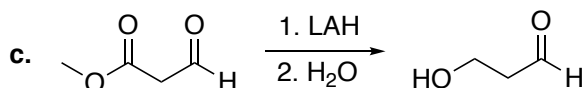
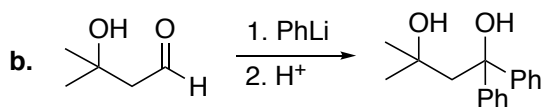
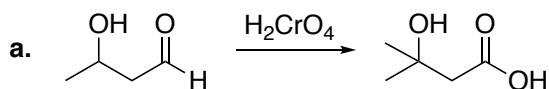
The Periodic Table

1A	1	2											13	14	15	16	17	VIII A	2
	H																		He
	1.01																		4.00
	3	4											5	6	7	8	9	10	
	Li	Be											B	C	N	O	F	Ne	
	6.94	9.01											10.81	12.01	14.01	16.00	19.00	20.18	
	11	12	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
	Na	Mg											Al	Si	P	S	Cl	Ar	
	22.99	24.31											26.98	28.09	30.97	32.07	35.45	39.95	
	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr	
	39.1	40.08	44.96	47.88	50.94	52.00	54.94	55.85	58.93	58.69	63.55	65.39	69.72	72.61	74.92	78.96	79.90	83.80	
	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	
	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe	
	85.47	87.62	88.91	91.22	92.91	95.94	(98)	101.07	102.91	106.42	107.87	112.41	114.82	118.71	121.76	127.6	126.9	131.29	
	55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	
	Cs	Ba	La*	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn	
	132.9	137.3	138.9	178.5	180.9	183.9	186.2	190.2	192.2	195.1	197.0	200.6	204.4	207.2	209	(209)	(210)	(222)	
	87	88	89	104	105	106	107	108	109	110	111								
	Fr	Ra	Ac^	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg								
	(223)	(226)	(227)	(261)	(262)	(263)	(264)	(265)	(268)	(271)	(272)								
	58	59	60	61	62	63	64	65	66	67	68	69	70	71					
	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu					
	140.1	140.9	144.2	(145)	150.4	152.0	157.3	158.9	162.5	164.9	167.3	168.9	173.0	175.0					
	90	91	92	93	94	95	96	97	98	99	100	101	102	103					
	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr					
	232.0	(231)	238.0	(237)	(244)	(243)	(247)	(247)	(251)	(252)	(257)	(258)	(259)	(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?



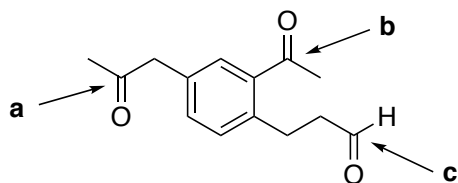
d. All of these require a protecting group

e. None of these require a protecting group

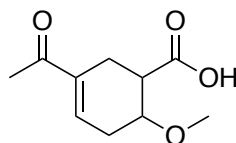
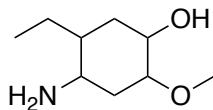
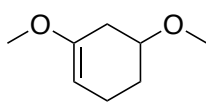
2. Which statement regarding the Fischer esterification is **false**?

- The reaction can be catalyzed by adding acid.
- The reaction can be driven to completion by removing water as it is formed.
- The reaction can be driven to completion by adding a large excess of both reagents.
- The reaction is an equilibrium process
- None of the above statements are false.

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



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

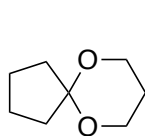


a.

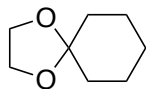
b.

c.

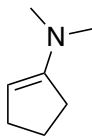
5. Which one of the following has/have cyclohexanone as a hydrolysis (H^+ , H_2O) product?



a



b



c

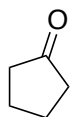
A and C

d

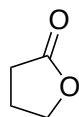
A and B

e

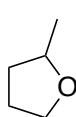
6. Rank the following from lowest boiling point to highest boiling point.



I



II



III

a. $\text{I} < \text{II} < \text{III}$

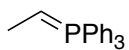
b. $\text{II} < \text{I} < \text{III}$

c. $\text{I} < \text{III} < \text{II}$

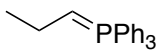
d. $\text{III} < \text{I} < \text{II}$

e. $\text{III} < \text{II} < \text{I}$

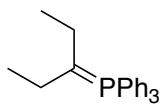
7. What ylide will produce 2-methyl-2-butene upon reaction with 2-propanone?



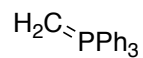
a.



b.



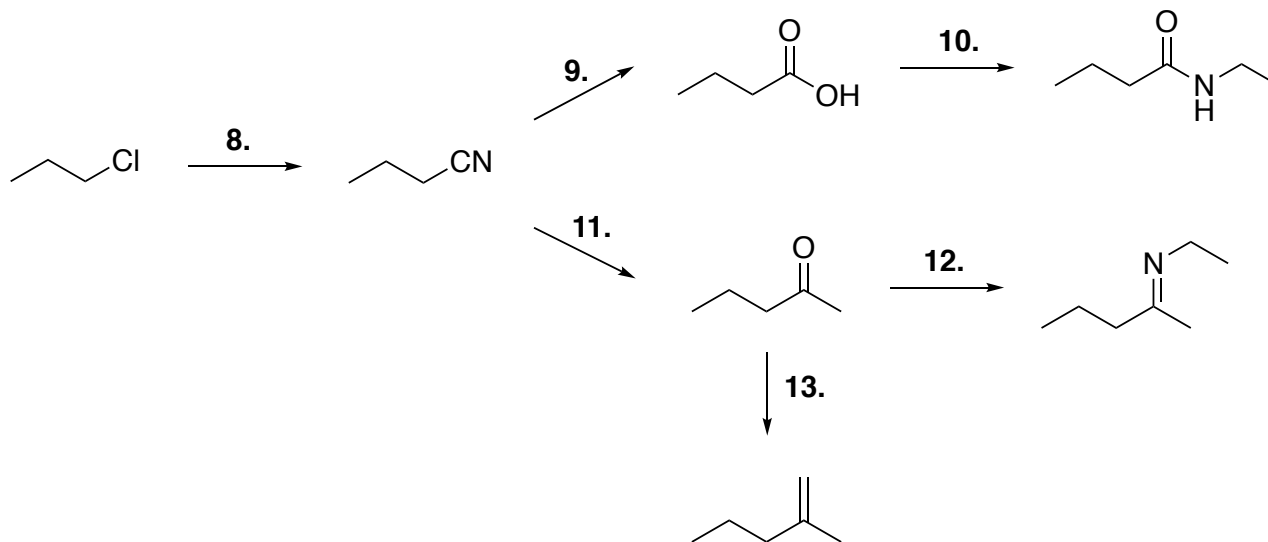
c.



d.

Reagent Matching

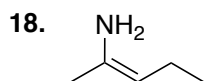
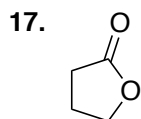
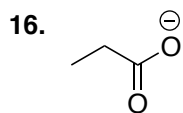
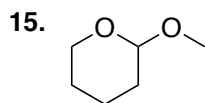
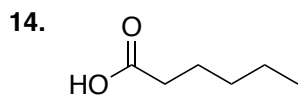
Use the reagent bank to select the best reagent for each transformation in the synthetic scheme shown below. You may only use each reagent once. *Bubble these answers in on your bubble sheet for credit.* (2 points each)



Reagent Bank				
<chem>NaCN</chem> a	<chem>CCNH2</chem> b	1. PCC 2. <chem>CH3Li</chem> c	1. <chem>CH3MgBr</chem> 2. H^+ , <chem>H2O</chem> d	1. <chem>H2C=CHLi</chem> 2. Dilute H^+ e
<chem>CCNH2</chem> DCC ab	<chem>H2C=PPh3</chem> ac	1. <chem>BH3·THF</chem> 2. H^+ , <chem>H2O</chem> ad	H^+ <chem>HOCH3</chem> ae	<chem>H2CrO4</chem> bc
<chem>CCNHNa</chem> bd	1. LAH 2. Dilute H^+ be	H^+ <chem>H2O</chem> cd	H^+ <chem>CCNH2</chem> ce	<chem>HCN</chem> 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)*

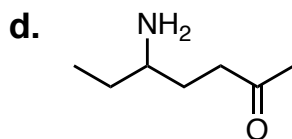
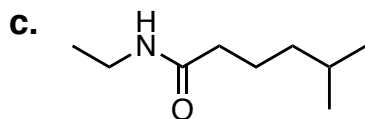
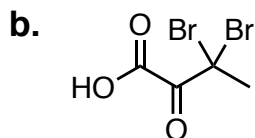
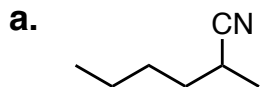


Term Bank	
a.	δ -lactone
b.	carboxylate
c.	acetal
d.	γ -lactam
e.	hemiacetal
ab.	alkoxide
ac.	imine
ad.	butyric acid
ae.	ylide
bc.	carboxide
bd.	valeric acid
be.	γ -lactone
cd.	enamine
ce.	δ -lactam
de.	caproic acid

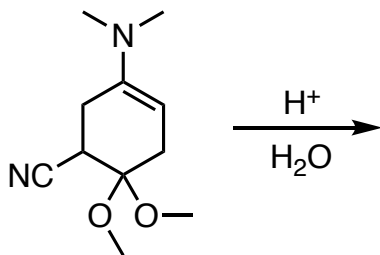
Completion Section

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

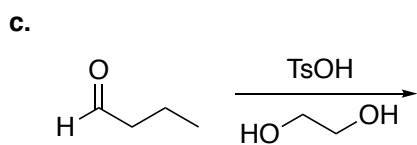
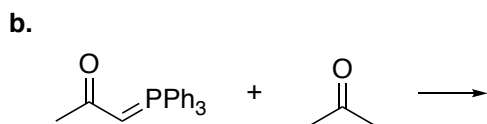
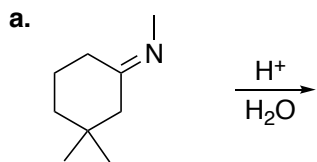
19. Provide IUPAC systematic names for each compound shown below. (3 points each)



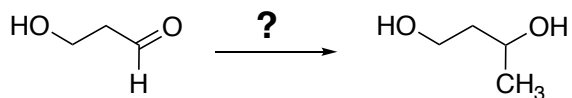
20. Draw all of the products that will result if the following compound is subjected to hydrolysis conditions. (3 points)



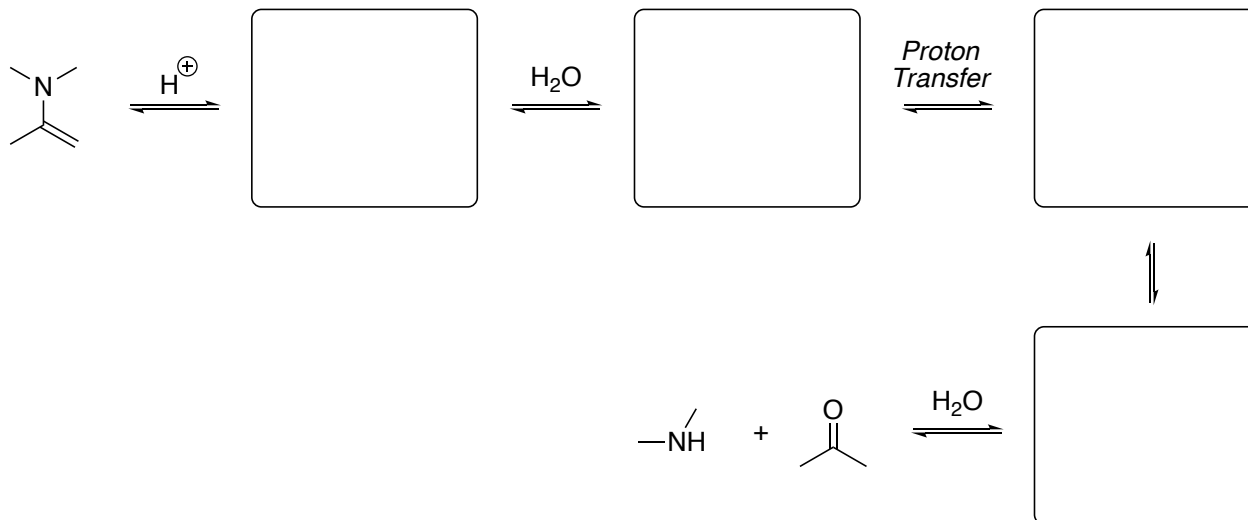
21. Predict the major product(s) for each of the following reactions. You do not need to include stereochemistry. (2 points each)



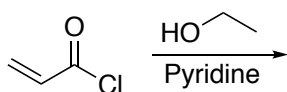
22. Show the steps necessary to prepare the following product from the given starting material and any other organic or inorganic reagents. (6 points)



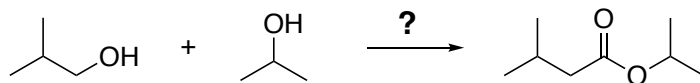
23. The mechanism for enamine hydrolysis is shown below. Provide the missing intermediates and draw in curved arrows to show electron flow. (8 points)



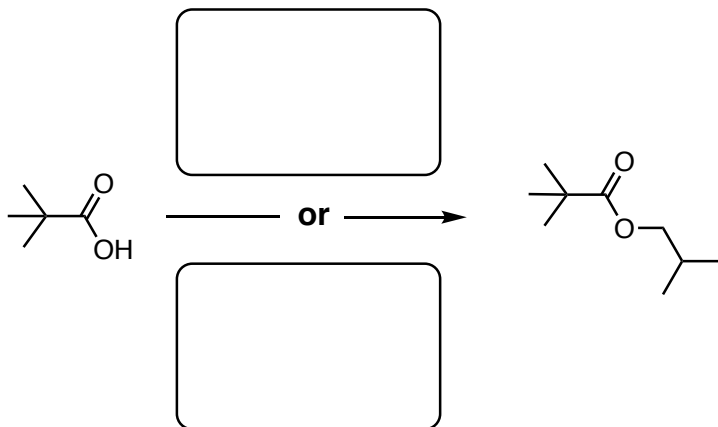
24. Draw the product and complete electron pushing mechanism for the following reaction. (6 points)



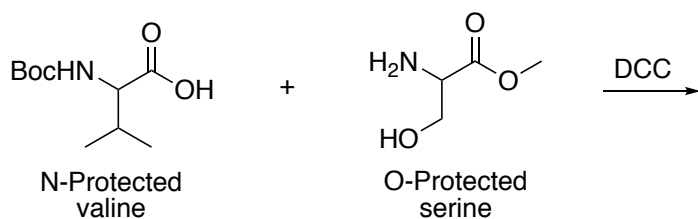
25. Design a synthesis of the following product using the provided starting materials and any other organic or inorganic reagents. (5 points)



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



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

