Name: Answer Key
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

1 IA												13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1 H 1.01	2 IIA																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)

Please do not rip off this cover sheet

Name: _____
Last First MI

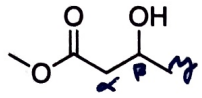
Grading Page (Exam 3):

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

Multiple Choice

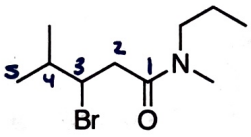
Choose the one best answer for each of the following questions. Bubble your answer in on the provided Scantron sheet. Additionally, circle or write your answer directly on the exam so that you can check your answers once the key is posted.

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



a. Methyl β-hydroxybutyrate
b. Methyl γ-hydroxybuterate
c. β-hydroxymethoxybuterate
d. γ-hydroxymethoxybuteric acid
e. None of these are correct

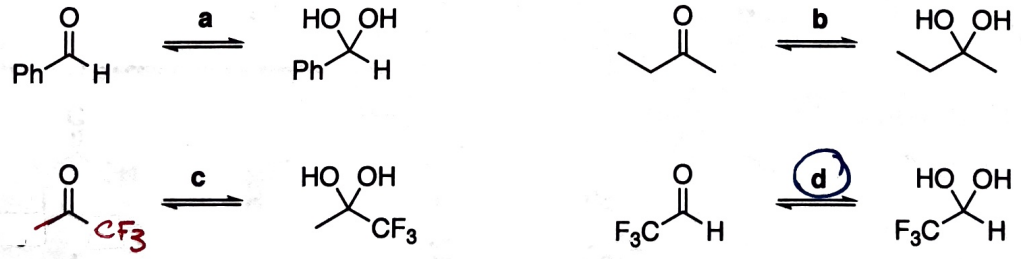
2. What is the correct IUPAC name for the compound shown below? (c)



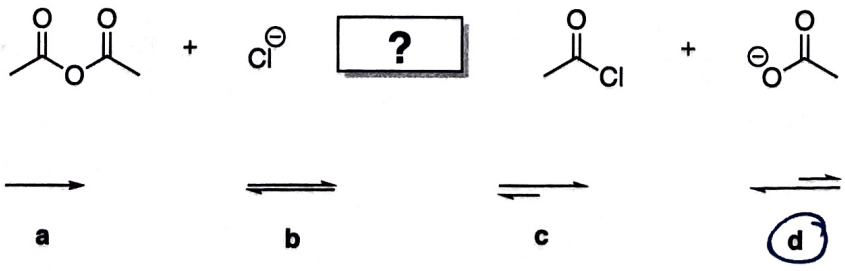
N-methyl 4-methyl } N,4-dimethyl
N-propyl 3-bromo

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

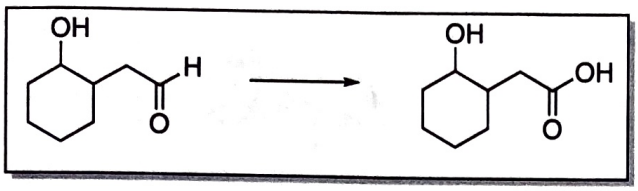
3. Which reaction below would you expect to lie furthest to the right (i.e. which reaction has the most stable gem-diol and least stable carbonyl)? (d)



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

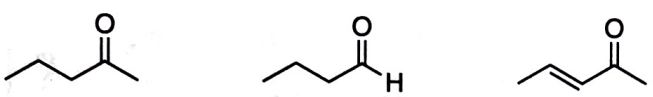


5. Which set of reagents should be used to successfully carry out the following transformation? (b)



a	b	c	d
$Na_2Cr_2O_7$ H_2SO_4	1. TMSCl, Base 2. CrO_3, H^+ 3. TBAF (F^-)	1. TMSCl, Base 2. $LiAlH_4$ 3. H_2O 4. TBAF (F^-)	1. $HOCH_2CH_2OH$, H^+ 2. CrO_3, H^+ 3. H^+, H_2O

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

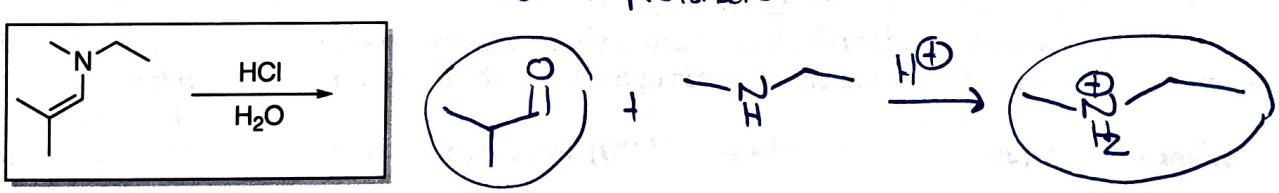


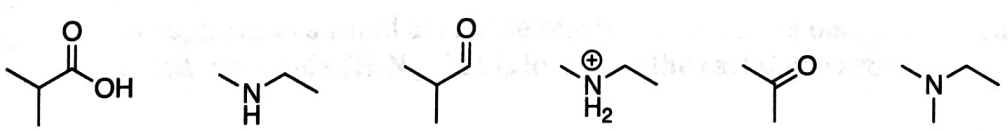
I II III

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

II < I < III

7. Assuming one full equivalent of HCl is used, what are the expected organic products from the following enamine hydrolysis? (c) 4 will protonate N

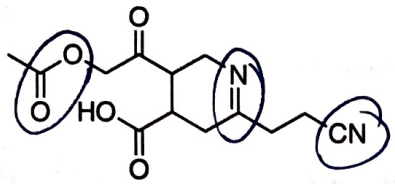




I II III IV V VI

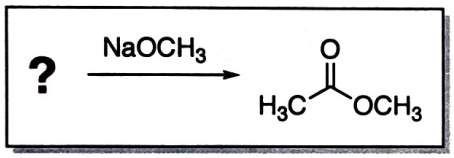
a. I and II
b. I and IV
c. III and IV
d. II and III
e. V and VI

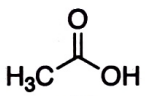
8. How many hydrolyzable functional groups are present in the following molecule? (b)



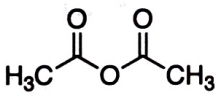
a. Two
b. Three
c. Four
d. Five
e. Six

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

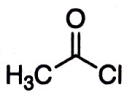




a



b



c

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)

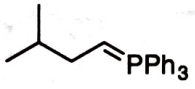
a. The penicillin can hydrolyze the amide bonds that make up the bacterial cell wall.
b. The toxicity of the β-lactam, which interrupts the ribosome processing in the bacterial cell.
c. The strained β-lactam reacts with the transpeptidase enzyme, which prevents it from synthesizing bacterial cell walls.
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)

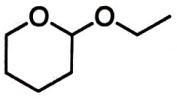
(a) Acetaldehyde dehydrogenase
b. Alcohol dehydrogenase
c. Acetate synthase
d. Acetic acid dehydrogenase
e. None of the above

Structure Matching

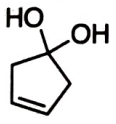
For questions 13-17, pick the term from the term bank that identifies each structure below. You can only use each term once. *Note that some answers may require you to bubble in more than one letter.* ***Record each answer on your Scranton sheet!***

13. 

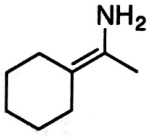
e

14. 

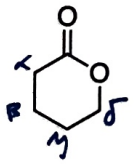
be

15. 

c

16. 

ac

17. 

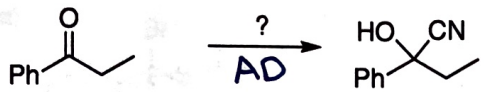
b

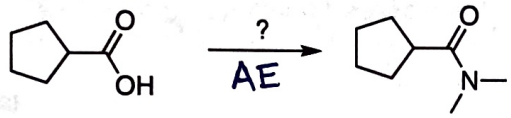
Terms

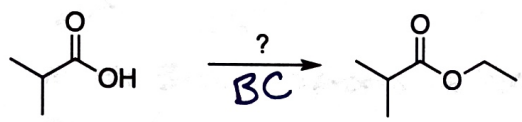
a. hemiacetal
b. δ-lactone
c. hydrate
d. imine
e. ylide
ab. Schiff base
ac. enamine
ad. ε-lactam
ae. nitrile
bc. δ-lactam
bd. phosphonium
be. acetal
abc. ε-lactone
abd. oxaphosphetane
abe. gemol

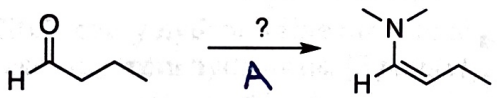
Reagent Bank

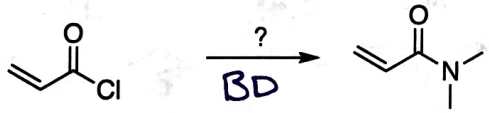
For questions 18-24, select the appropriate reagent from the reagent bank to accomplish each transformation shown below. You can only use each reagent once. *Note that some answers may require you to bubble in more than one letter.* ***Record each answer on your Scranton sheet!***

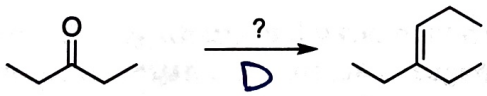
18. 

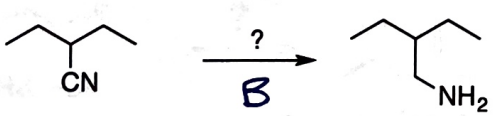
19. 

20. 

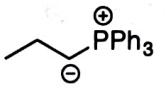
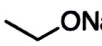
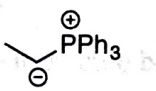
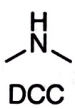
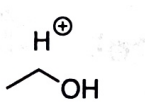
21. 

22. 

23. 

24. 

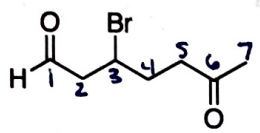
Reagent Bank

 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.

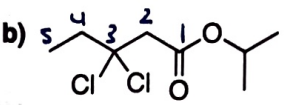
(12) 25. Provide the IUPAC name or structure for each compound shown below. *(3 points each)*

a)



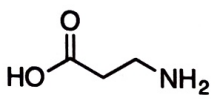
3-bromo-6-oxoheptanal (+1) (+1) (+1)

b)



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

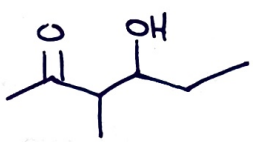
c)



IUPAC: 3-aminopropanoic acid (+1)

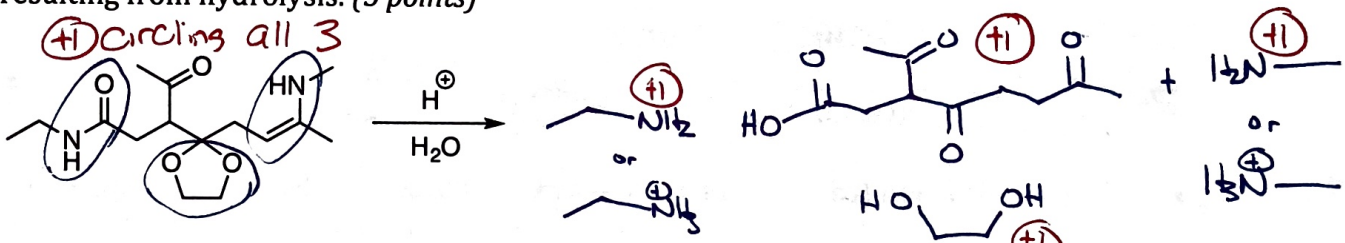
Common: β-aminopropionic acid (+1) (+1)

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

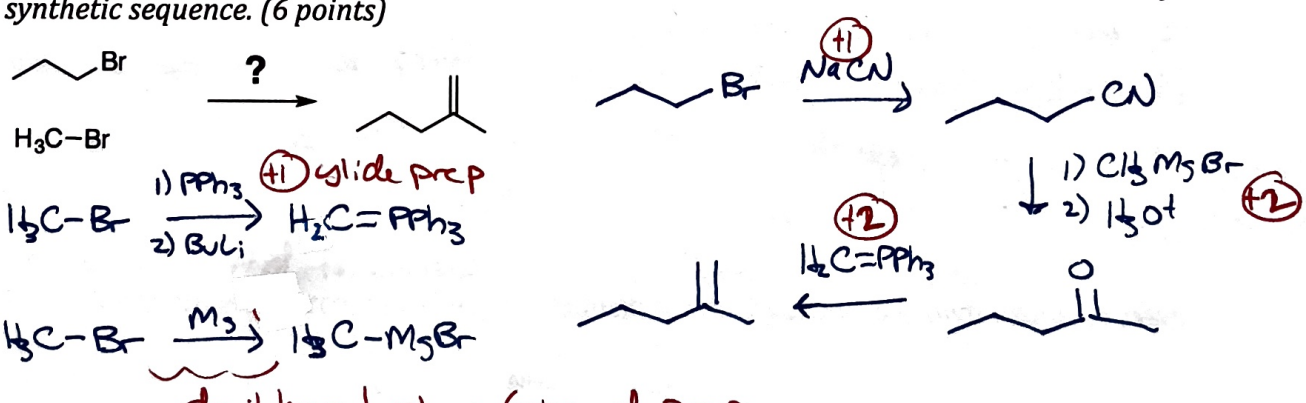


(+3)

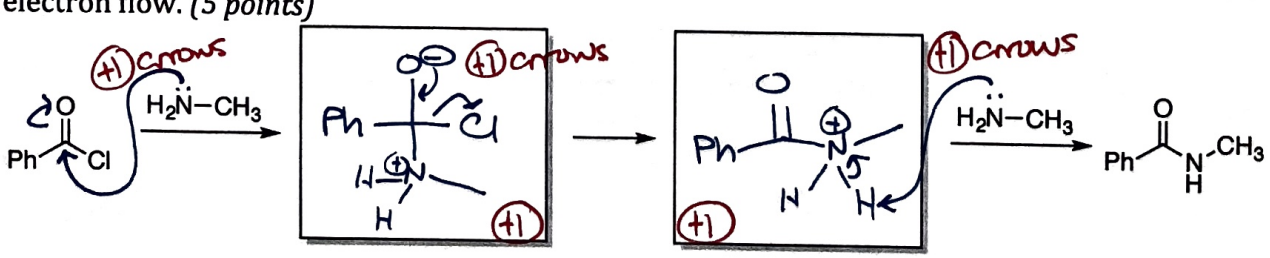
(5) 26. Circle every hydrolyzable functional group in the molecule below then draw all of the products resulting from hydrolysis. *(5 points)*



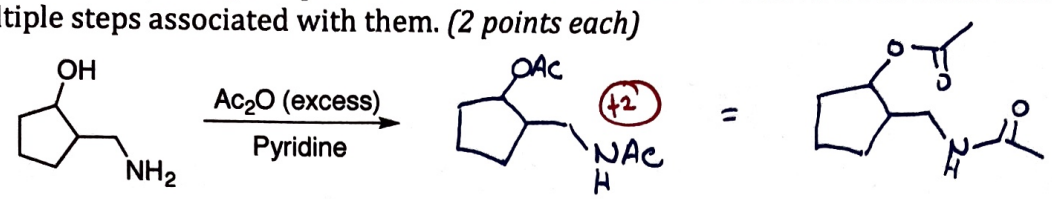
(6) 27. Provide a synthesis of the compound shown below using the provided starting materials and any other organic or inorganic reagents. *Hint: You should have a ketone at some point in your synthetic sequence. (6 points)*

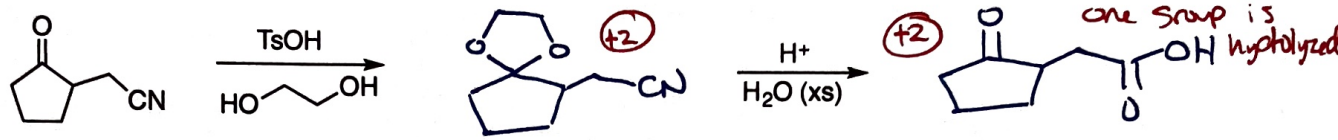


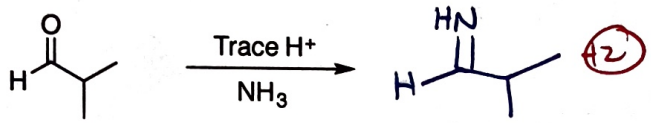
(5) 28. Provide the missing intermediates for the reaction below. Then draw in curved arrows to show electron flow. *(5 points)*

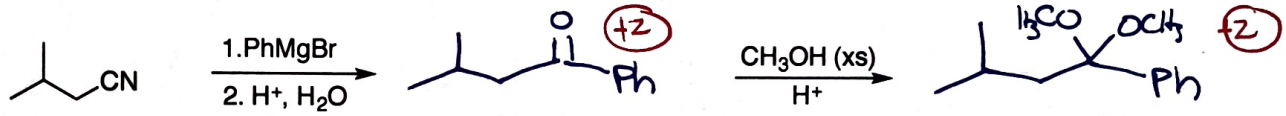


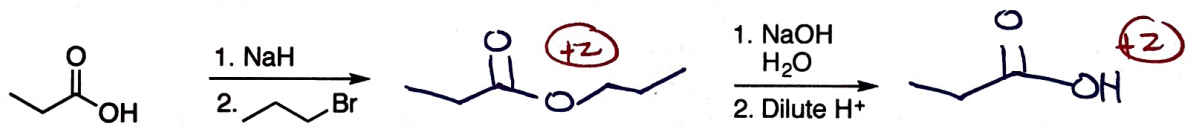
(16) 29. Predict the major organic product for each reaction shown below. Note: Some reactions have multiple steps associated with them. *(2 points each)*

a. 

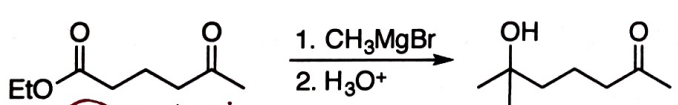
b. 

c. 

d. 

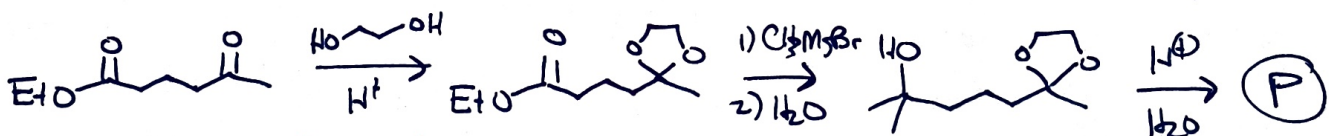
e. 

(4) 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)*



(+2) explaining problem
The Grignard reagent would react with both the ester and the ketone (undesired)

(+2) Solution
Ketone should be protected



* Not required to draw out full synthetic sequence

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