

Name: Answer Key

Last

First

MI

Chemistry 233 Exam 1

Spring 2017

Dr. J. Osbourn

Instructions: The first 14 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. Any question with multiple answers selected 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	1 H 1.01	2 IIA											13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA	
	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*	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^	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)

Exams will be returned by placing them alphabetically on the table at the front of Clark 101. Your grade will not be visible as it is on the second page. If, however, you have a privacy concern, check the box below and your exams will be held back so that you can pick them up privately.

Hold Back My Exams

Please do not rip off this cover sheet

Name: _____
Last First MI

Grading Page (Exam 1):

Page	Points Possible	Points Earned
Multiple Choice (3-5)	28	
6	16	
7	22	
8	12	
9	22	
TOTAL	100	

Multiple Choice

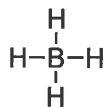
Choose the one best answer for each of the following questions. Using a pencil, record this answer on the provided Scantron sheet. (2 points each)

1. What is the hybridization of the indicated atom in the structure below?



- a. sp
- b. s
- c. sp^2
- d. p
- e. sp^3

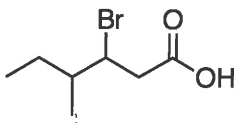
2. What is the formal charge on **boron** in the compound below?



Group 3 - 4 bonds - 0 l.p.e⁻ = -1

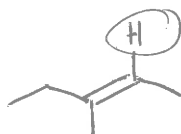
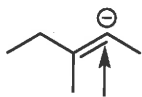
- a. Neutral (0)
- b. +1
- c. -1

3. What is the condensed formula for the structure below?



- a. $CH_3CH_2(CH_3)CHBrCH_2COOH$
- b. $CH_3CH_2CH(CH_3)CHBrCH_2COOH$
- c. $CH_3(CH_2)_2(CH_3)CHBrCH_2COOH$
- d. None of the above

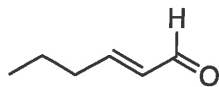
4. How many hydrogen atoms are present on the indicated carbon atom?



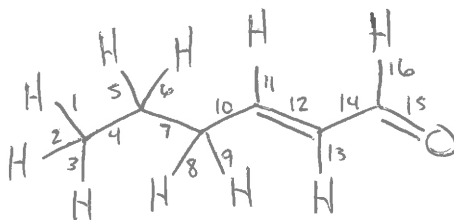
\oplus takes the place of this H

- a. Zero
- b. One
- c. Two
- d. Three

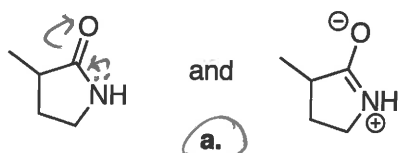
5. How many σ -bonds are present in the structure below?



- a. Two
- b. Five
- c. Seven
- d. Fourteen
- e. Sixteen**

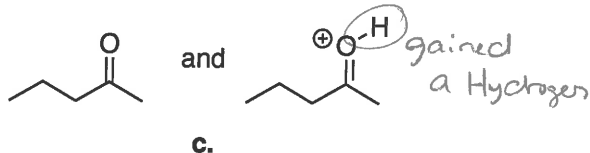


6. Which of the following pairs of structures represent resonance structures?



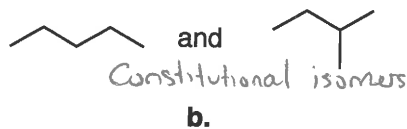
and

a.

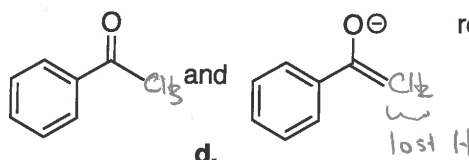


and

c.



b.



d.

more than one of the pairs represent resonance structures

e.

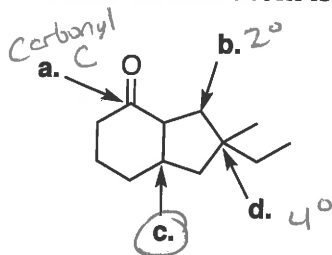
7. Rank the three compounds shown below in order of increasing boiling point.



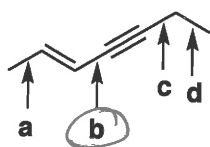
- a. A,B,C
- b. B,C,A**
- c. C,A,B
- d. A,C,B

$B < C < A$

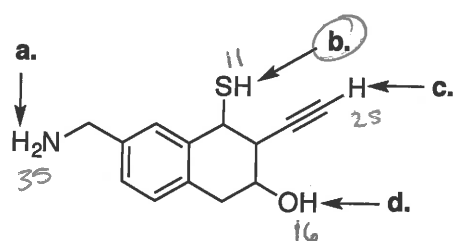
8. Which carbon atom is tertiary?



9. Which one of the indicated C-C single bonds is the shortest?

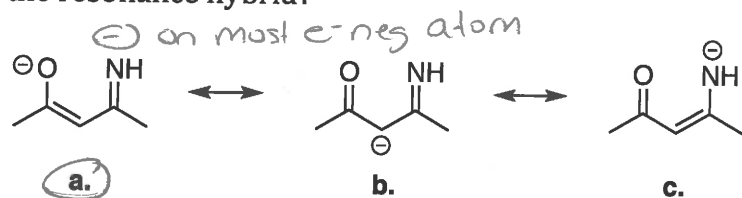


10. Consider the compound shown below. Which one of the indicated hydrogen atoms is the most acidic?

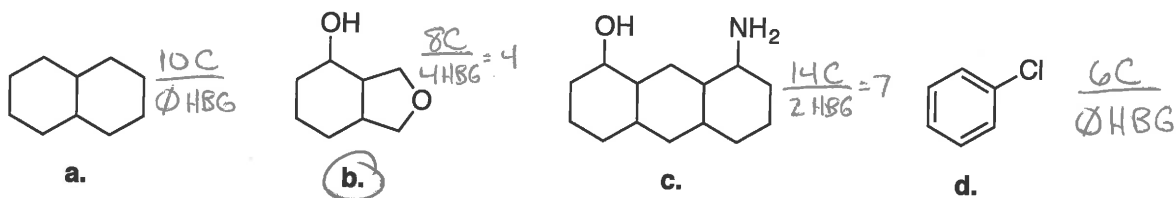


Do not need to know pKa's to answer this Q.

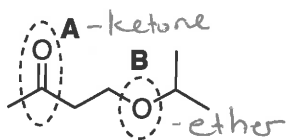
11. Consider the three resonance structures shown below. Which would be the major contributor to the resonance hybrid?



12. Which one of the compound shown below would you expect to be the most water-soluble?



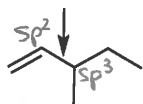
13. What are the identities of the two indicated functional groups?



Carbonyl is a broad class that includes the ketone

- a. A = carbonyl; B = ester
- b. A = ester; B = ether
- c. A = ketone; B = ether**
- d. A = amide; B = ketone
- e. A = ketone; B = ester

14. What type of orbital overlap is present in the indicated bond?

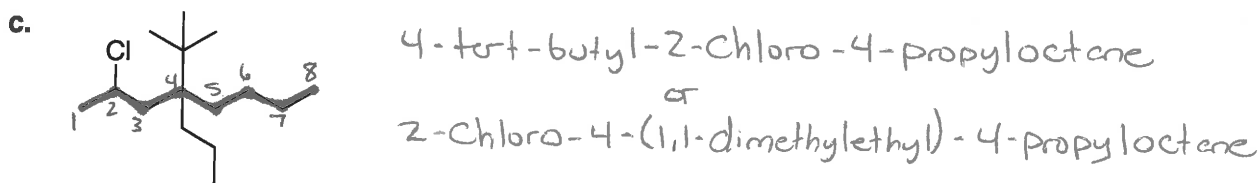
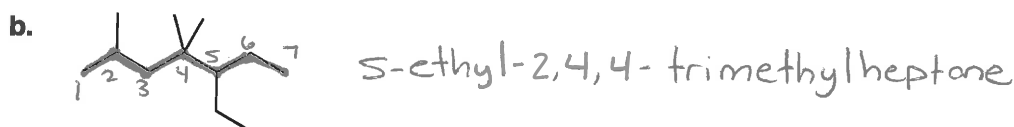
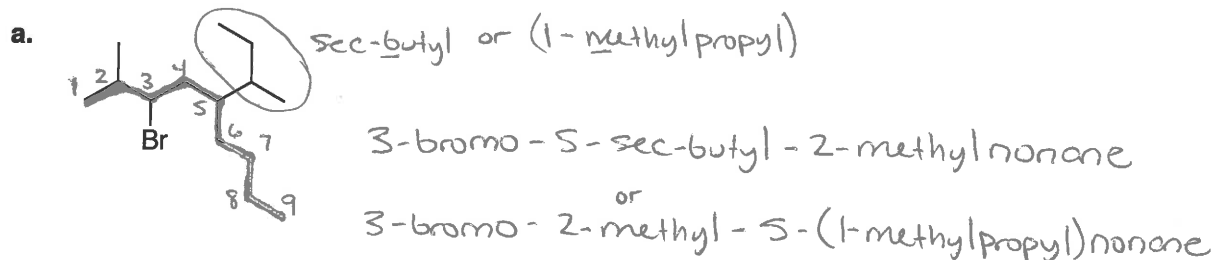


- a. Csp^3-Csp^3
- b. Csp^2-Csp^2
- c. Csp^2-Csp^2 and $Cp-Cp$
- d. Csp^2-Csp^3**
- e. Csp^2-Csp^3 and $Cp-Cp$

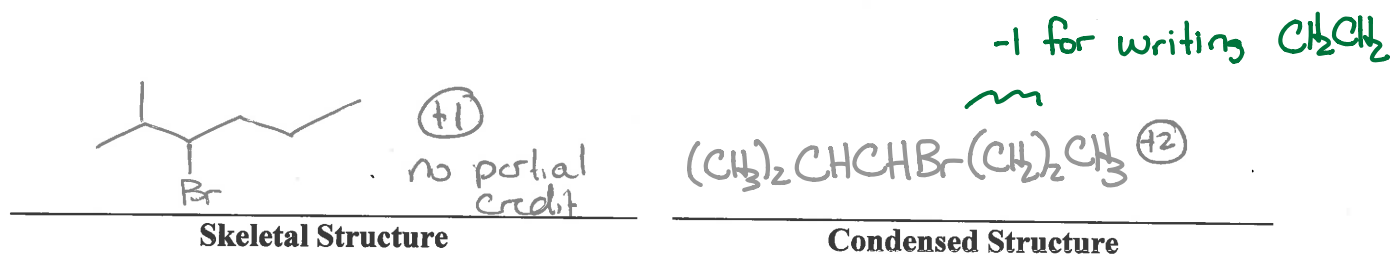
Completion Section

Answer the remaining questions in the spaces provided. Show all work and provide complete explanations.

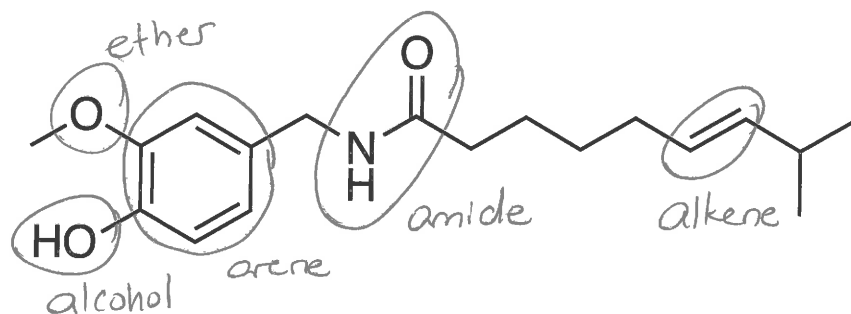
15. Provide IUPAC systematic names for each of the following compounds. (3 points each)



16. Draw **3-bromo-2-methylhexane** as a skeletal (bond-line) structure and as a condensed structure. (3 points)

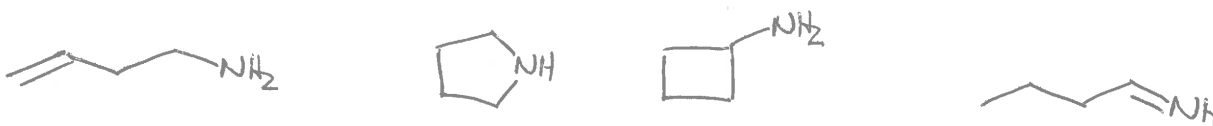


17. Below is the structure of capsaicin, which is the compound that gives chili peppers their "heat". Circle and identify four (4) different functional groups in this compound. (4 points)



+1 for each correctly identified
 -0.5 for each incorrectly identified } up to +4 points

18. Draw a valid uncharged Lewis structure or skeletal structure for a compound with the molecular formula C_4H_9N . Hint: Check octets! (5 points)

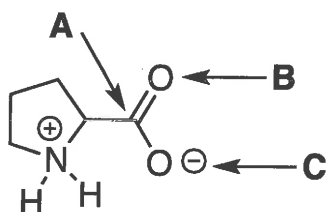


Many other possibilities

* A correct structure will contain either a ring or double bond.

* must include H's on N.

19. Answer the following questions regarding the amino acid proline shown below. (8 points)



a. How many lone pairs of electrons are on oxygen C?

3 lone pairs or 6 lone pair e⁻

b. What is the geometry at carbon A?

trigonal planar

must write electrons for 6 to be accepted

c. In what orbital do the lone pairs on oxygen B reside?

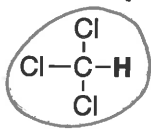
sp²

d. What is the hybridization of the nitrogen?

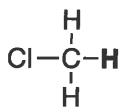
sp³

20. For each pair, circle the molecule that is more acidic and provide a very brief explanation for your choice. (3 points each)

a.



or



(+1)

Inductive effect

(+2)

Cl₃C⁻ is more stable than Cl-CH₂⁻ by the Cl atoms inductively withdrawing e⁻ density

b. H-Cl

or

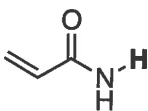


(+1)

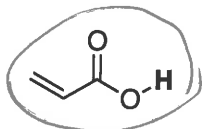
I is larger than Cl

(+2)

c.



or

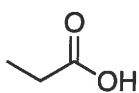


(+1)

O is more e⁻ neg than N

(+2)

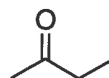
21. For the four compounds shown below, indicate which intermolecular forces are present then rank the compounds in order of increasing boiling point. (7 points)



A



B



C



D

Intermolecular Forces Present:

VDW
D-D (+1)
H-Bonding

VDW (+1)

VDW (+1)
D-D

VDW (+1)

Lowest BP

B

D

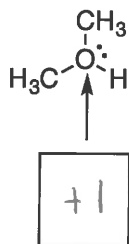
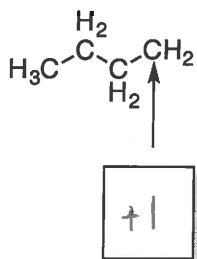
C

A

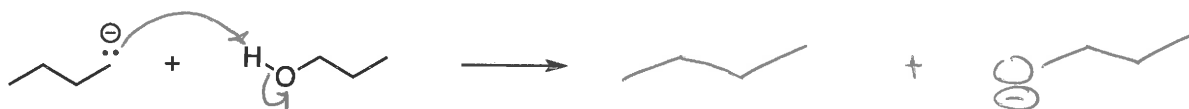
Highest BP

(+3) no partial credit

22. Determine the formal charge for each of the indicated atoms below. All atoms and lone pairs are already drawn in for you. (1 point each)

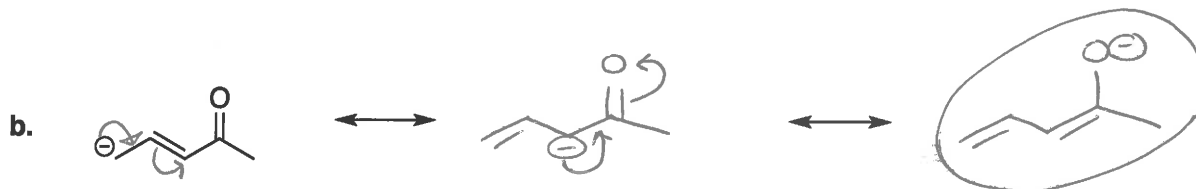


23. For the reaction shown below, draw in curved arrows to show electron flow and predict the products resulting from the reaction. (3 points)

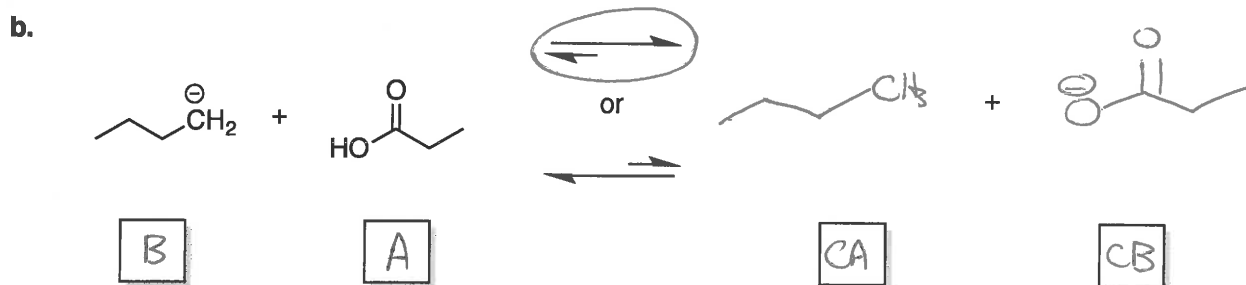
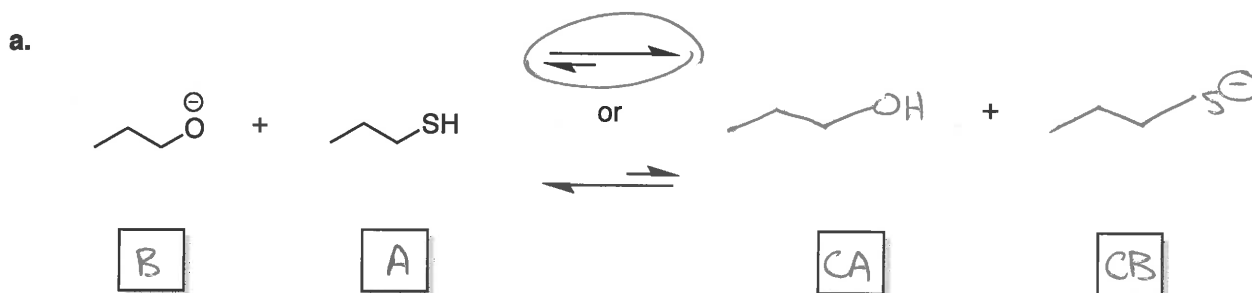


24. For each structure shown below, complete the following: (12 points)

- Draw all relevant resonance structures. (2 pts each structure)
- Use curved arrows to show electron flow. (1 pt)
- Circle the "best" resonance structure (the major contributor to the resonance hybrid). (1 pt)



25. For each acid/base reaction below: 1. Draw the correct products; 2. Label the acid (A), base (B), conjugate acid (CA), and conjugate base (CB); 3. Circle the set of equilibrium arrows that best represents the direction in which the reaction lies. (4 points each)



26. Draw a representative molecule that contains three carbon atoms and a secondary chloride. (2 points)

