

Name: Answer Key  
 Last First MI

**Chemistry 233-001/002  
 Exam 1 - Version Green**

Fall 2018

Dr. J. Osbourn

**Instructions:** The first 13 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																18 VIIIA	
1 <b>H</b> 1.01											13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	2 <b>He</b> 4.00	
3 <b>Li</b> 6.94	4 <b>Be</b> 9.01											5 <b>B</b> 10.81	6 <b>C</b> 12.01	7 <b>N</b> 14.01	8 <b>O</b> 16.00	9 <b>F</b> 19.00	10 <b>Ne</b> 20.18
11 <b>Na</b> 22.99	12 <b>Mg</b> 24.31	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIII B	10	11 IB	12 IIB	13 <b>Al</b> 26.98	14 <b>Si</b> 28.09	15 <b>P</b> 30.97	16 <b>S</b> 32.07	17 <b>Cl</b> 35.45	18 <b>Ar</b> 39.95
19 <b>K</b> 39.1	20 <b>Ca</b> 40.08	21 <b>Sc</b> 44.96	22 <b>Ti</b> 47.88	23 <b>V</b> 50.94	24 <b>Cr</b> 52.00	25 <b>Mn</b> 54.94	26 <b>Fe</b> 55.85	27 <b>Co</b> 58.93	28 <b>Ni</b> 58.69	29 <b>Cu</b> 63.55	30 <b>Zn</b> 65.39	31 <b>Ga</b> 69.72	32 <b>Ge</b> 72.61	33 <b>As</b> 74.92	34 <b>Se</b> 78.96	35 <b>Br</b> 79.90	36 <b>Kr</b> 83.80
37 <b>Rb</b> 85.47	38 <b>Sr</b> 87.62	39 <b>Y</b> 88.91	40 <b>Zr</b> 91.22	41 <b>Nb</b> 92.91	42 <b>Mo</b> 95.94	43 <b>Tc</b> (98)	44 <b>Ru</b> 101.07	45 <b>Rh</b> 102.91	46 <b>Pd</b> 106.42	47 <b>Ag</b> 107.87	48 <b>Cd</b> 112.41	49 <b>In</b> 114.82	50 <b>Sn</b> 118.71	51 <b>Sb</b> 121.76	52 <b>Te</b> 127.6	53 <b>I</b> 126.9	54 <b>Xe</b> 131.29
55 <b>Cs</b> 132.9	56 <b>Ba</b> 137.3	57 <b>La*</b> 138.9	72 <b>Hf</b> 178.5	73 <b>Ta</b> 180.9	74 <b>W</b> 183.9	75 <b>Re</b> 186.2	76 <b>Os</b> 190.2	77 <b>Ir</b> 192.2	78 <b>Pt</b> 195.1	79 <b>Au</b> 197.0	80 <b>Hg</b> 200.6	81 <b>Tl</b> 204.4	82 <b>Pb</b> 207.2	83 <b>Bi</b> 209	84 <b>Po</b> (209)	85 <b>At</b> (210)	86 <b>Rn</b> (222)
87 <b>Fr</b> (223)	88 <b>Ra</b> (226)	89 <b>Ac^</b> (227)	104 <b>Rf</b> (261)	105 <b>Db</b> (262)	106 <b>Sg</b> (263)	107 <b>Bh</b> (264)	108 <b>Hs</b> (265)	109 <b>Mt</b> (268)	110 <b>Ds</b> (271)	111 <b>Rg</b> (272)							

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

Exams will be returned by placing them alphabetically on a table in the Chemistry Learning Center. 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 all of 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\***

*Green*

Name: \_\_\_\_\_  
Last First MI

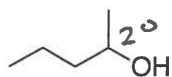
Grading Page (Exam 1):

Page	Points Possible	Points Earned
Multiple Choice (3-5)	26	
6	21	
7	26	
8	27	
<b>TOTAL</b>	<b>100</b>	

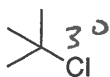
### Multiple Choice

Choose the one best answer for each of the following questions. Using a pencil, record each answer on the provided Scantron sheet. You should also circle each answer directly on the exam.  
(2 points each)

1. Structure I contains a \_\_\_\_ alcohol and structure II contains a \_\_\_\_ chloride.

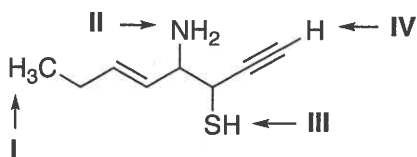


structure I

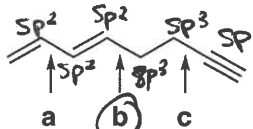


structure II

- tertiary, quaternary
  - secondary, tertiary
  - primary, tertiary
  - secondary, primary
  - secondary, quaternary
2. Rank the following protons from least acidic to most acidic.

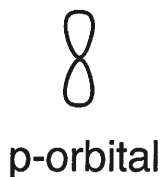


- $I < IV < III < II$
  - $IV < I < II < III$
  - $I < II < III < IV$
  - $II < IV < I < III$
  - $I < II < IV < III$
3. Which one of the following single bonds is the longest?



← least s-character

4. What type of hybrid orbital does the following picture represent?



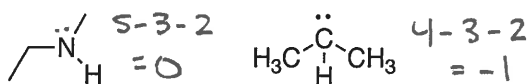
- sp
- sp<sup>2</sup>
- sp<sup>3</sup>
- sp<sup>4</sup>
- p

5. How would you best classify the following reaction?



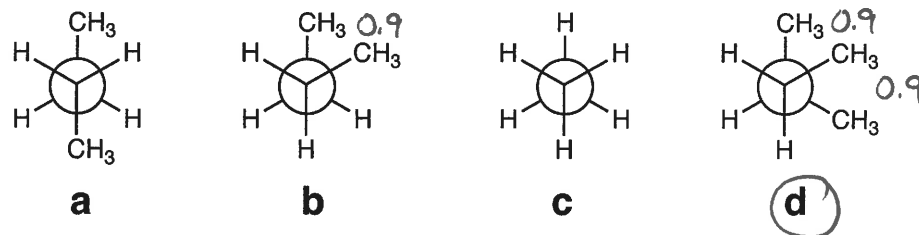
- a.  Bronsted-Lowry Acid/Base  
 b.  Lewis Acid/Base  
 c.  None of the above

6. What is the formal charge on each of the indicated atoms? *Lone pairs have not been drawn in on heteroatoms.*

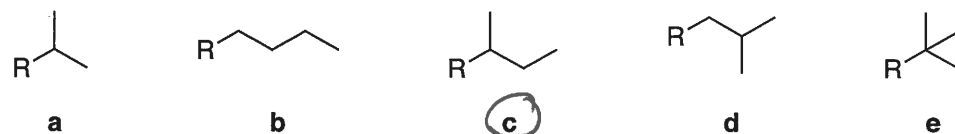


- a.  -1                      +1  
 b.  +1                      -1  
 c.  -1                      -1  
 d.  0                          +1  
 e.  0                          -1

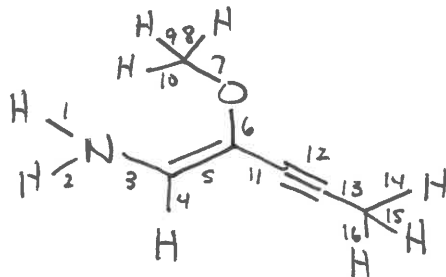
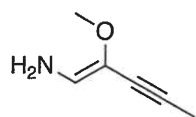
7. Which one of the following conformations is the highest in energy?



8. Which substituent shown below is *sec-butyl*?



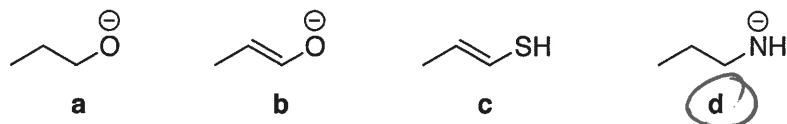
9. How many  $\sigma$ -bonds are in the following molecule? *Hint: draw in the hydrogen.*



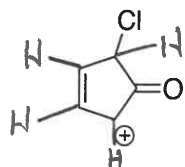
$\Rightarrow \left. \begin{matrix} 1 \sigma\text{-bond} \\ 1 \pi\text{-bond} \end{matrix} \right\}$

- a. 13  
 b. 14  
 c. 15  
 d.  16  
 e. None of the above

10. Which one of the following would you expect to be the strongest base?

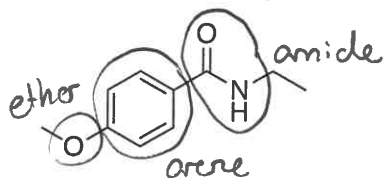


11. How many hydrogens are in the following molecule?



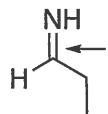
- a. 3
- b. 4
- c. 5
- d. 6
- e. 7

12. What functional groups are present in the following molecule?



- a. arene, ketone, amine
- b. arene, amide, ether
- c. arene, ketone, amine, ether
- d. ether, alkene, amide
- e. alkene, amine, ether, ketone

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

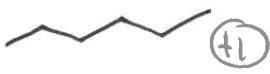


- a.  $Csp^2 - Np$
- b.  $Csp^2 - Ns$
- c.  $Csp^2 - Nsp^2$
- d.  $Csp^2 - Nsp^2$  &  $Cp - Np$
- e. None of the above

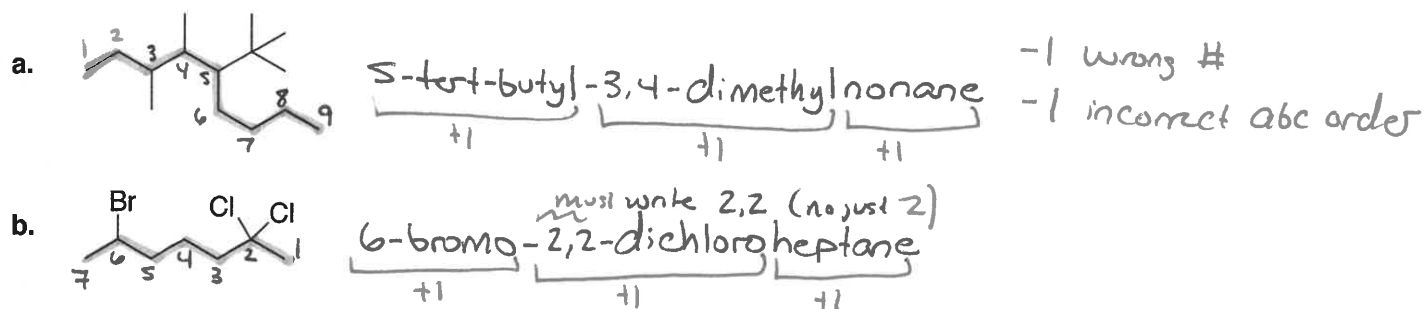
## Completion Section

Answer the remaining questions in the spaces provided.

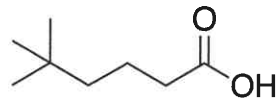
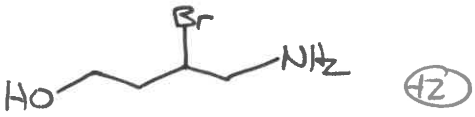
14. Provide the formula ( $C_xH_y$ ), name, and skeletal (bond-line) structure for the straight chain alkane containing 6 carbon atoms. (3 points)

#C	Formula	Name	Skeletal Structure
6	$C_6H_{14}$ (+1)	Hexane (+1)	 (+1)

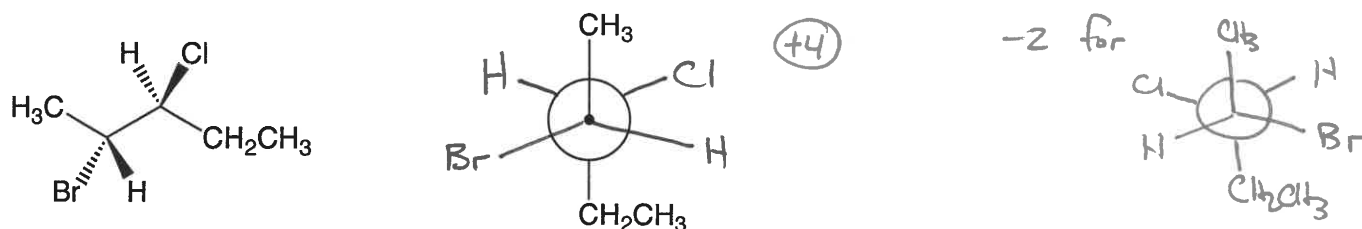
15. Write the IUPAC name for each molecule shown below. (3 points each)



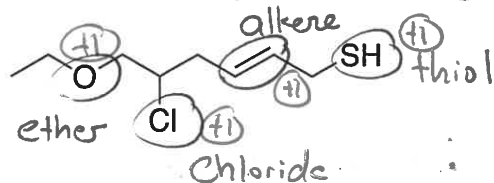
16. For each compound below, complete the table by drawing the missing skeletal or condensed structure. (2 points each)

	Condensed Structure	Skeletal Structure
a	$(CH_3)_3C(CH_2)_3CO_2H$ (+2) or COOH	
b	$HO(CH_2)_2CH(Br)CH_2NH_2$	 (+2)

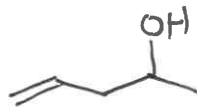
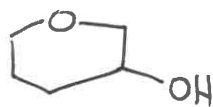
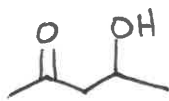
17. Using the template provided, convert the molecule shown below to a Newman projection. (4 pts)



18. Circle and identify the functional groups in the following molecule. (4 points)

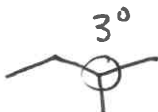


19. Draw a valid uncharged Lewis structure or skeletal structure for a compound with the molecular formula  $C_5H_{10}O_2$ . (4 points) \* Structure will contain one double bond or 1 ring  
A few possibilities:



(+1) for any valid structure

20. Draw two  $C_5H_{12}$  isomers. Then, identify and label one  $2^\circ$  and one  $3^\circ$  carbon on your structures. (4 points)

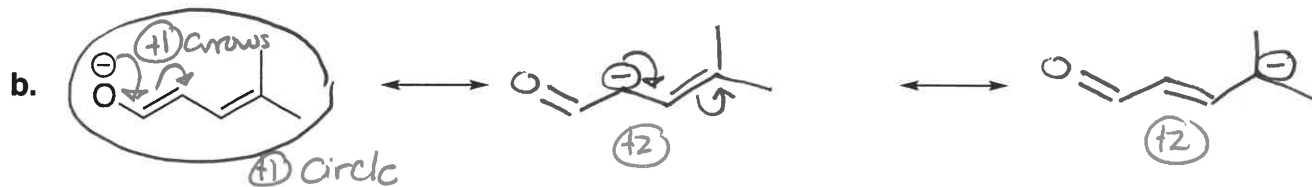
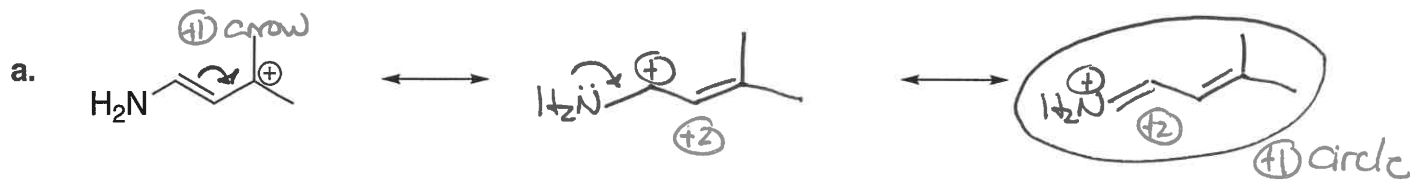


only need to draw two

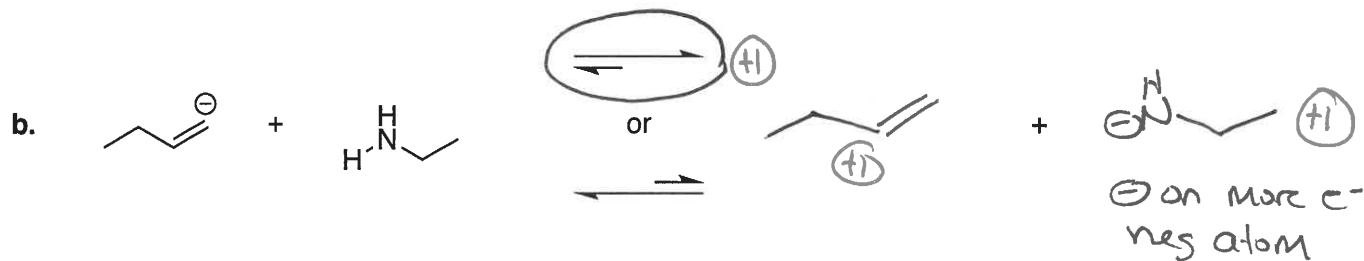
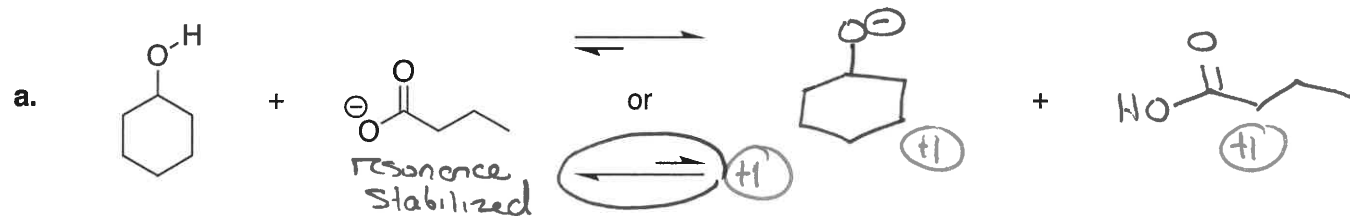
(+2) for two correct isomers (+1) correct  $2^\circ$  (+1) correct  $3^\circ$

21. For each structure shown below, complete the following: (6 points each)

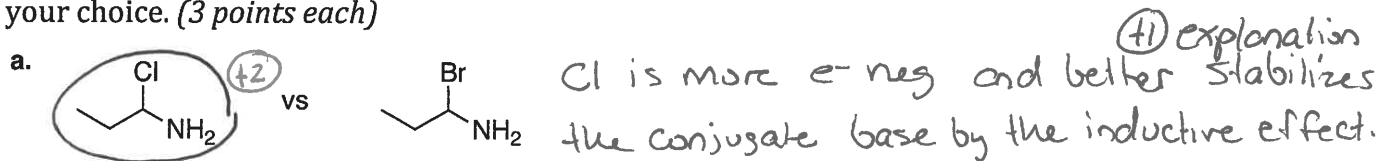
- Draw all relevant resonance structures. (2 pts per structure)
- Use curved arrows to show electron flow. (1 pt)
- Circle the "best" resonance structure (the major contributor to the resonance hybrid). (1 pt)



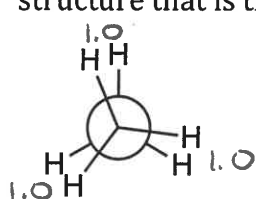
22. For each acid/base reaction below: Draw the correct products and circle the set of equilibrium arrows that best represents the direction in which the reaction lies. (3 points each)



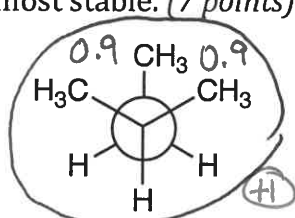
23. For each pair, circle the molecule that is more acidic and provide a very brief explanation for your choice. (3 points each)



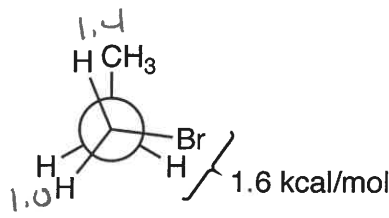
24. Calculate the relative energy (in kcal/mol) for each conformation shown below. Then, circle the structure that is the most stable. (7 points)



3.0 kcal/mol  
(+2)

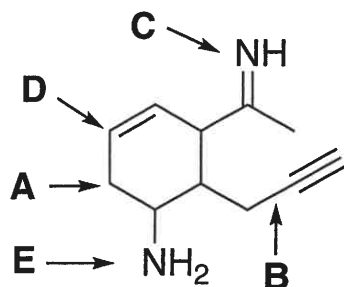


1.8 kcal/mol  
(+2)



4.0 kcal/mol  
(+2)

25. Use the molecule shown below to answer the following questions. (2 points each)



a. What is the geometry at carbon A?

tetrahedral (+2)

b. What is the orbital overlap in bond B?

Csp<sup>3</sup> - Csp (+2)

c. What is the hybridization of nitrogen C?

SP<sup>2</sup> (+2)

d. What is the bond angle at carbon D?

120° (+2)

e. What is the formal charge on nitrogen E?

0 (+2)

26. For each reaction shown below, draw in curved arrows in the reactants to show electron flow and predict the product(s). (2 points each)

