

CHEM 3311 (Luca) First Hour Exam – Feb 13th 2018

Your Name: _____

Student ID: _____

Recitation (Check one):

- Monday 8am - Mori
- Monday 9am - Carey
- Monday 10am - Carey
- Monday 11am - Carey
- Tue 8am - Park
- Tue 11am - Carey
- Tue 2pm - Carey

Question	Points
1	
2	
3	
4	
5	
Total	

This is a closed-book exam. The use of notes and cell phones will not be allowed during the exam. You may use models sets totally dismantled brought in a clear ziplock bag. Use the backs of the pages for scratch work. If your final answer is not clearly specified, you will lose points.

1 H 1.0079																	2 He 4.0026	
3 Li 6.941	4 Be 9.0122											5 B 10.811	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180	
11 Na 22.990	12 Mg 24.305											13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.06	17 Cl 35.453	18 Ar 39.948	
19 K 39.098	20 Ca 40.078	21 Sc 44.956	22 Ti 47.88	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.845	27 Co 58.933	28 Ni 58.693	29 Cu 63.546	30 Zn 65.38	31 Ga 69.723	32 Ge 72.61	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.80	
37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.94	43 Tc 98	44 Ru 101.07	45 Rh 101.07	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 126.90	54 Xe 131.29	
55 Cs 132.91	56 Ba 137.33	57-70 * Lr	71 Lu 174.967	72 Hf 178.49	73 Ta 180.948	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po 209	85 At 210	86 Rn 222
87 Fr 223	88 Ra 226	89-102 ** Lr	103 Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uun	111 Uuu	112 Uub						

* Lanthanide series	57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm 144.91	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04
** Actinide series	89 Ac 227	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	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

pKa Values

HI	-10	CH ₃ COOH	4.7	ArOH	10	H ₂	35
HBr	-8	HN ₃	4.7	RSH	10-12	NH ₃	36
HCl	-6	H ₂ S	7.0	H ₂ O	15.7	H ₂ C=CH ₂	45
H ₃ O ⁺	-1.7	NH ₄ ⁺	9.3	ROH (R=alkyl)	16-18	CH ₄	60
HF	3.2	HCN	9.4	HC≡CH	26		

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1. (20 points total)

a. What is the least acidic compound of the compounds below? Explain your answer. (4 points)

- i. CF_3COOH
- ii. CH_3COOH
- iii. CH_2FCOOH

b. Which one of the compounds has the lowest pK_a ? Explain your answer. (4 points)

c. Draw the structures for each of the conjugate bases of the acids in 1a. (6 points)

d. What is the least basic of the conjugate bases from question 1c? Explain your answer (6 points)

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2. Give an example of molecules that meet **all** of the following requirements. For each of the examples, indicate hybridization **at all carbon** atoms (15 points total).
- Draw a molecule with 5 carbon atoms, one degree of unsaturation and one ketone functional group (5 points):

 - Draw a molecule with more than 10 carbon atoms, only two sp-hybridized carbon atoms and only two nitriles (5 points):

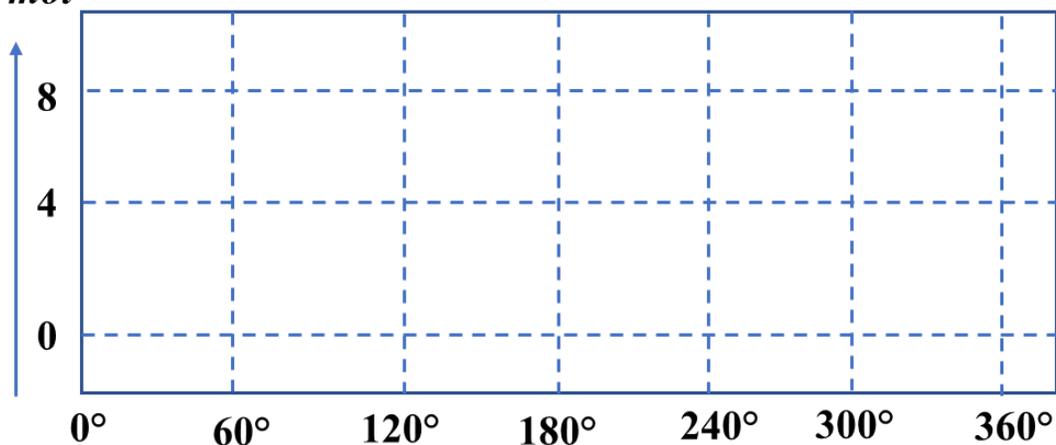
 - Draw a molecule with an ether, a ester functional group, and one sp² carbon atom (5 points):

Name: _____

3. Draw the Newman Projection structures for 2-methylbutane, looking down the bond between carbons 2 and carbon 3 (as in the IUPAC naming). **Start with a dihedral angle between methyl groups of 0°** and draw other Newman Projections in increments of 60° **keeping the front atom stationary while rotating the one in the back clockwise** (7 points). For each of the conformations you draw, determine the interactions involved in between substituents. Indicate these interactions in the rectangles below (7 points). Consult the table and add up the energy of the interactions. Plot each energy level (for each of the conformations) and create a conformational energy diagram in the graph given (6 points). Interactions not shown in the table below are assumed to be negligible. (20 points total)

Interaction	Energy (kcal/mol)
H/H eclipsed	1
Me/H eclipsed	1.15
Me/Me Eclipsed	3.6
Me/Me gauche	0.67

Kcal/mol



Interactions

Interactions

Interactions

Interactions

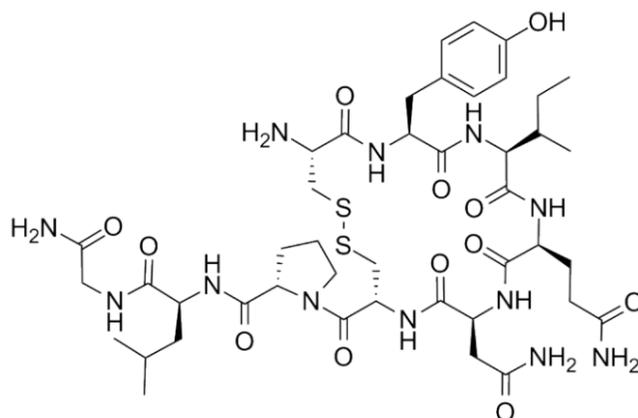
Interactions

Interactions

Interactions

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4. Oxytocin has been identified as the molecule responsible triggering feelings of love in our neural pathways. Its chemical structure is shown below. After carefully reviewing the structural features (functional groups) of this molecule, please answer the following questions: (25 points total)

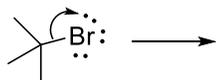


- a. How many degrees of unsaturation does this molecule have? (4 points)
- b. How many primary amide bonds can you identify in this structure? (**place a circle around them**) (4 points)
- c. How many π bonds does this molecule have? (4 points)
- d. How many sp -hybridized carbon atoms does this molecule have? (4 points)
- e. Assume you ingested oxytocin. Your stomach has a pH of 1.6 and the phenol group on oxytocin has a pK_a of 10. Knowing that only deprotonated oxytocin is absorbed by your intestine, what is the ratio of deprotonated oxytocin to protonated oxytocin in your stomach? (4 points)
- f. Based on your calculation at point e, how much of a 100-mg dose would be active? (5 points)

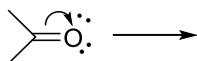
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5. Write out the structures of products for the following reactions. Clearly indicate charges and lone pairs on the atoms of your molecules and ions. (20 points total)

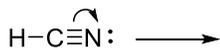
a. (3p)



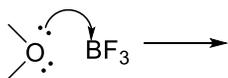
b. (3p)



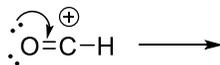
c. (3p)



d. (3p)



e. (3p)



f. (5p)

