

# 20F-CHEM14C-1 Assessment

CHRISTINA KILKEARY

TOTAL POINTS

**99 / 103**

QUESTION 1

1 1a 3 / 5

- ✓ - 1 pts Wrong number of atoms in longest conjugated chain
  - 1 pts Wrong number of sp<sup>2</sup> hybridized atoms
  - 1 pts Wrong number number of hydrogens
  - 1 pts Listed a nonexistent functional group
- ✓ - 1 pts Didn't list a present functional group
  - 0 pts correct

QUESTION 2

2 1b 5 / 5

- 1 pts Wrong number of atoms in longest conjugated chain
  - 1 pts Wrong number of sp<sup>2</sup> hybridized atoms
  - 1 pts Wrong number number of hydrogens
  - 1 pts Listed a nonexistent functional group
  - 1 pts Didn't list a present functional group
- ✓ - 0 pts Correct

QUESTION 3

3 1c 5 / 5

- 1 pts Wrong number of atoms in longest conjugated chain
  - 1 pts Wrong number of sp<sup>2</sup> hybridized atoms
  - 1 pts Wrong number of hydrogens
  - 1 pts Listed a nonexistent functional group
  - 1 pts Didn't list a present functional group
- ✓ - 0 pts Correct

QUESTION 4

4 1d 4 / 5

- 1 pts Wrong number of atoms in longest conjugated chain
  - 1 pts Wrong number of sp<sup>2</sup> hybridized atoms

- 1 pts Wrong number of hydrogens
- 1 pts Listed a nonexistent functional group
- ✓ - 1 pts Didn't list a present functional group
  - 0 pts Correct

QUESTION 5

5 2 16 / 16

- ✓ - 0 pts Click here to replace this description.
  - 2 pts counting pi electrons wrong
  - 4 pts counting pi electrons wrong (\*2)
  - 2 pts getting wrong aromaticity
  - 4 pts getting wrong aromaticity (\*2)
  - 8 pts counting pi electrons wrong (\*4)

QUESTION 6

6 3 3 / 4

- + 4 pts Correct requirements (adjacent and parallel p-orbitals, alternating double bonds, overlapping p-orbitals, at least 3 p-orbitals)
- ✓ - 1 pts 1 incorrect/missing
  - 2 pts 2 incorrect/missing
  - 2 pts 3 incorrect/missing
  - 3 pts More than 3 incorrect/missing more than 3
  - 4 pts No answer/none

QUESTION 7

7 4 8 / 8

- ✓ - 0 pts Correct
  - 8 pts Incorrect
  - 1 pts wrong charge
  - 6 pts one step correct
  - 7 pts one step correct but charge is wrong
  - 3 pts three steps correct but charge is wrong
  - 5 pts two steps are correct but charge is wrong
  - 2 pts three steps correct
  - 2 pts one wrong resonance

- **1 pts** wrong hydrogen number
- **1 pts** where is your hydroxyl group?

QUESTION 8

8 **5a** 5 / 5

- ✓ - **0 pts** Correct
- **2 pts** R or achiral or wrong answer
- **3 pts** Wrong drawing (wrong stereochemistry/achiral)
- **1 pts** Drawing partially wrong (wrote S instead of SH)

QUESTION 9

9 **5b** 5 / 5

- ✓ - **0 pts** Correct
- **1 pts** A or B wrong
- **2 pts** Both A and B wrong
- **1 pts** One stereocenter wrong
- **3 pts** Both stereocenters wrong
- **1 pts** Minor error in drawing

QUESTION 10

10 **5c** 5 / 5

- ✓ - **0 pts** Correct
- **1 pts** One wrong
- **2 pts** Two wrong
- **3 pts** Three wrong
- **4 pts** All four wrong
- **1 pts** Any wrong stereocenter on drawing
- **1 pts** Minor issue with drawing

QUESTION 11

11 **6a** 8.5 / 8.5

- ✓ - **0 pts** Correct
- **1 pts** Minor mistake
- **4 pts** Intermediate mistake
- **6 pts** Major Mistake
- **8.5 pts** Completely wrong

QUESTION 12

12 **6b** 8.5 / 8.5

- ✓ - **0 pts** Correct

- **1 pts** Minor Error
- **4 pts** Intermediate Error
- **6 pts** Major Error
- **8.5 pts** Completely Wrong

QUESTION 13

13 **7a** 10 / 10

- ✓ - **0 pts** Correct
- **5 pts** set 1 wrong
- **5 pts** set 2 wrong Correct: DBAC/ CBAD

QUESTION 14

14 **7b** 10 / 10

- **5 pts** set 1 wrong.
- **5 pts** set 2 wrong. Correct: DABC/ CABD
- ✓ - **0 pts** Correct

QUESTION 15

15 **bonus** 3 / 3

- ✓ - **0 pts** Correct drawing of H bonds, correct base pair (GC)
- **1.5 pts** Incorrect H bonds
- **1.5 pts** Incorrect interaction
- **3 pts** No answer

### Periodic Table of the Elements

1 IA 1A		2 IIA 2A												3 IIIA 3A	4 IVA 4A	5 VA 5A	6 VIA 6A	7 VIIA 7A	8 VIIIA 8A				
1 H Hydrogen 1.008		3 Li Lithium 6.941	4 Be Beryllium 9.012															5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180
11 Na Sodium 22.990	12 Mg Magnesium 24.305			3 III B 3B	4 IV B 4B	5 V B 5B	6 VI B 6B	7 VII B 7B	8 VIII 8	9 VIII 9	10 VIII 10	11 IB 1B	12 IIB 2B	13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.065	17 Cl Chlorine 35.453	18 Ar Argon 39.948				
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.88	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.631	33 As Arsenic 74.922	34 Se Selenium 78.971	35 Br Bromine 79.904	36 Kr Krypton 84.238						
37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.94	43 Tc Technetium 98.906	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.905	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.414	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.757	52 Te Tellurium 127.6	53 I Iodine 126.905	54 Xe Xenon 131.29						
55 Cs Cesium 132.905	56 Ba Barium 137.327	57-71 Lanthanide Series	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.85	75 Re Rhenium 186.207	76 Os Osmium 192.22	77 Ir Iridium 192.222	78 Pt Platinum 195.08	79 Au Gold 196.967	80 Hg Mercury 200.59	81 Tl Thallium 204.383	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium [209]	85 At Astatine [210]	86 Rn Radon [222]						
87 Fr Francium [223]	88 Ra Radium [226]	89-103 Actinide Series	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [263]	107 Bh Bohrium [264]	108 Hs Hassium [265]	109 Mt Meitnerium [266]	110 Ds Darmstadtium [271]	111 Rg Roentgenium [272]	112 Cn Copernicium [285]	113 Nh Nihonium [286]	114 Fl Flerovium [289]	115 Mc Moscovium [288]	116 Lv Livermorium [293]	117 Ts Tennessine [294]	118 Og Oganesson [294]						
		57 La Lanthanum 138.905	58 Ce Cerium 140.12	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.24	61 Pm Promethium [145]	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.50	67 Ho Holmium 164.930	68 Er Erbium 167.259	69 Tm Thulium 168.934	70 Yb Ytterbium 173.054	71 Lu Lutetium 174.967							
		89 Ac Actinium [227]	90 Th Thorium 232.038	91 Pa Protactinium [231]	92 U Uranium 238.029	93 Np Neptunium [237]	94 Pu Plutonium [244]	95 Am Americium [243]	96 Cm Curium [247]	97 Bk Berkelium [247]	98 Cf Californium [251]	99 Es Einsteinium [252]	100 Fm Fermium [257]	101 Md Mendelevium [258]	102 No Nobelium [259]	103 Lr Lawrencium [260]							

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x *Christina Killkeary*

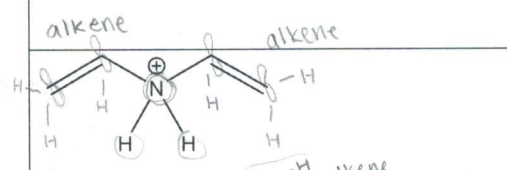
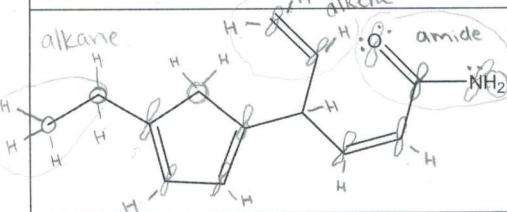
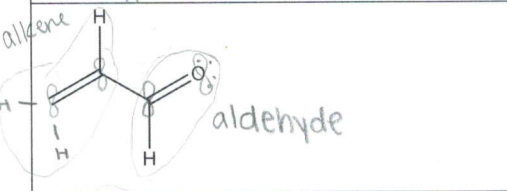
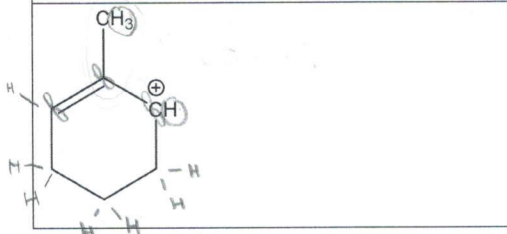
Name: Christina Killkeary  
Date: 9 November 2020

# Assessment (Nov 9<sup>th</sup>)

Chem14C-Fall 2020  
Prof. Castillo

Name: Christina Kilkeary  
ID: 605416454

- 1- For **each** of the following molecules (20 points)
  - a) indicate how many atom(s) are in the longest conjugated chain, and
  - b) indicate the total number  $sp^2$  hybridized atom(s)
  - c) number of hydrogen atoms
  - d) functional groups

Structure	Atoms in the longest conjugated chain	$sp^2$ hybridized atom(s)	number of hydrogens	Functional groups
	2	4	8	alkene none
	5	11	17	amide alkane alkene
	4	4	4	aldehyde alkene
	3	3	11	none

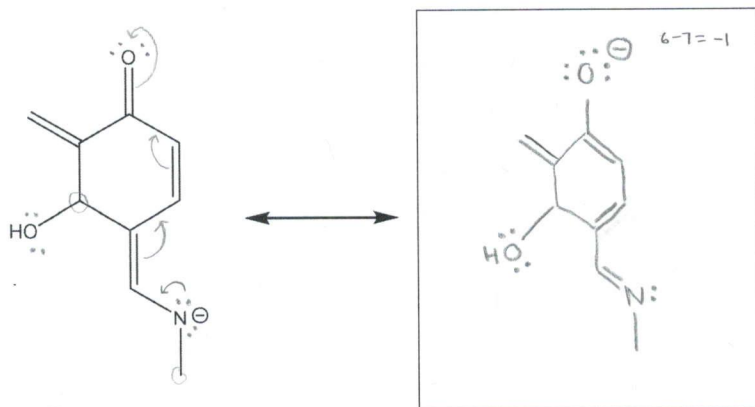
2- For each following molecule, indicate whether it is aromatic or not. Circle the correct answer. Also indicate the number of pi electrons in each molecule below. (16 points)

$4n+2=10 \checkmark$	$4n+2=6 \checkmark$	$4n+2=10 \checkmark$	$4n+2 \neq 8 \times$
Aromatic?	Aromatic?	Aromatic?	Aromatic?
<u>Yes</u> / No	<u>Yes</u> / No	<u>Yes</u> / No	Yes / <u>No</u>
# of $\pi$ electrons	# of $\pi$ electrons	# of $\pi$ electrons	# of $\pi$ electrons
10	6	10	8

3- Which of the following are requirements for resonance? (Check all that apply) (4 points)

<input checked="" type="checkbox"/> Adjacent p-orbitals <input checked="" type="checkbox"/> Parallel p-orbitals <input checked="" type="checkbox"/> Alternating double bonds	<input type="checkbox"/> $4n$ pi electrons <input checked="" type="checkbox"/> Overlapping p-orbitals <input type="checkbox"/> $4n+2$ pi electrons ← aromaticity <input checked="" type="checkbox"/> At least 3 orbitals
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4- Draw the best resonance contributor for the structure below. (8 points)



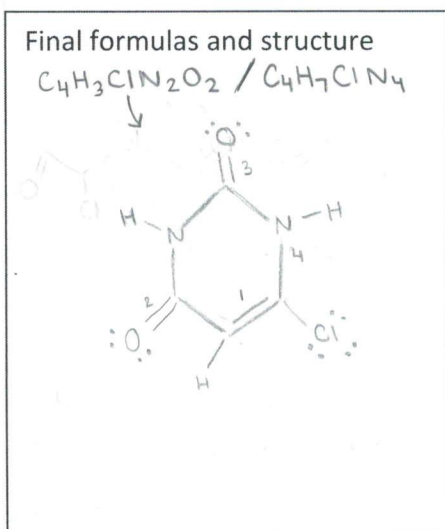
put negative charge on oxygen  $\rightarrow$  more electronegative

5- Identify the stereochemistry configuration and draw the enantiomer of each molecule (15 points)

Structure	Configuration	Enantiomer
	S	
	a <u>S</u> b <u>R</u>	
	a <u>R</u> b <u>R</u> c <u>S</u> d <u>R</u>	

6- Find all possible molecular formulas for the following mass spectrometry data, draw at least one reasonable structure inside the boxes from one of the formulas (17 points)

a- m/z: 146.0 (100.0%), 147.0 (4.3%), 148.0 (32.2%)



146 is even so even # of N

$\frac{4.3\%}{1.1\%} = 3.9 \rightarrow 4 \text{ Carbons}$

32.2%  $\rightarrow$  1 chlorine

$146 - (4 \cdot 12) - 35 = 63 \text{ amu of NOH}$

N	O	amu left	Formula
0	3	15	$C_4H_{15}O_3Cl$ X
0	4	-1	X
2	0	35	X
2	2	3	$C_4H_3ClN_2O_2$ ✓
4	0	7	$C_4H_7ClN_4$ ✓

if N=0;  
max H is  $8+0+2=10$

if N=2  
max H is 12

if N=4  
max H is 14

# of pi ring in structure

$$C - \frac{H}{2} - \frac{X}{2} + \frac{N}{2} + 1 =$$

$$4 - 1.5 - .5 + 1 + 1 = 4 \rightarrow 3 \text{ pi } 1 \text{ ring}$$

$$4 - 3.5 - .5 + 2 + 1 = 3$$

b- m/z: 142.0 (100.0%), 143.0 (7.1%), 144.0 (8.2%)

$$142 - (2 \cdot 32) = 78 \text{ amu} \quad \text{Sulfur}$$

142 even so even # of N

$$\frac{7.1}{1.1} = 6.5 \rightarrow \text{6 or 7 Carbons}$$

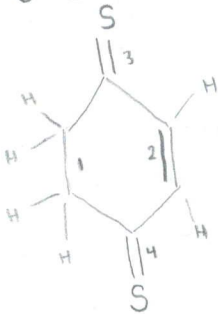
8.2%  $\rightarrow$  2 sulfurs

$\frac{12}{1}$	$\frac{14}{0}$	$\frac{16}{0}$	max H	amu left	formula
1	0	0	14	6	$C_6H_6S_2$ ✓
			16	-6	X

$$C - \frac{H}{2} - \frac{X}{2} + \frac{N}{2} + 1 =$$

$$6 - 3 - 0 + 0 + 1 = \boxed{4} \text{ rings and pi bonds combined}$$

Final formulas and structure

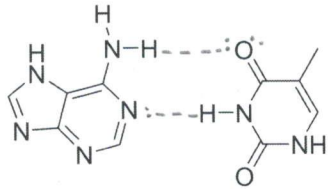


7- For **each set** of molecules, rank the structures by the correct order using the assigned letter for each structure (20 points)

Set	Option A	Option B	Option C	Option D
1	d-d 	d-d Br 	d-d 	LDF 
2	H bond 	large molecules have higher boiling points H bond 	LDF 	NH <sub>2</sub> H bond 
Water solubility			Boiling point	
Set 1:	D, A, B, C least most		Set 1: D, A, B, C lowest highest	
Set 2:	C, B, A, D least most		Set 2: C, A, B, D lowest highest	

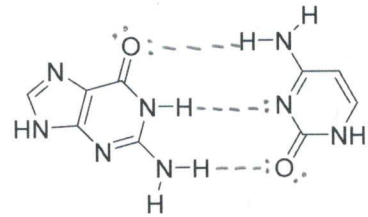
**Bonus question:** The nucleic acid of DNA is comprised of four nucleobases that bind in pairs. Guanine (G) binds with cytosine (C). Adenine (A) binds with thymine (T). Within a DNA helix, complementary strands are held together via hydrogen bonding interactions between nucleobase pairs. (3 points)

- a) The structures for base pairs guanine and cytosine and are shown alongside adenine and thymine. Draw in all relevant lone pairs for hydrogen bonding and used dashed lines to indicate where hydrogen bonds form.



adenine

thymine



guanine

cytosine

- b) Which base pair has a stronger interaction?

Guanine and cytosine have a stronger interaction because they can hydrogen bond at 3 points compared to adenine and thymine's 2 points of hydrogen bonding.