

CHEM 3311
Dr. Minger

Hour Exam #1
June 11, 2019

Name Key

Circle your recitation section: 111 112 113 114 115 116
121 122 123 124 125 126

Sign the Honor Code pledge:

I pledge that on my honor, as a University of Colorado at Boulder student, I have neither given nor received unauthorized assistance on this exam.

Signature

General Instructions: There are 7 pages of questions plus this cover sheet. Be sure you have them all. Read each question carefully so that you know exactly what is being asked and what you need to write or draw. **DO NOT USE COLORED INK.** Your work on scratch pages will not be graded, so be sure everything you want graded is written on the exam itself.

1A 2A

3A 4A 5A 6A 7A 8A

hydrogen 1 H 1.00794																	helium 2 He 4.002602				
lithium 3 Li 6.941	beryllium 4 Be 9.0122															boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180
potassium 19 K 39.098	calcium 20 Ca 40.078	scandium 21 Sc 44.956	titanium 22 Ti 47.887	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.38	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selecnium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80				
rubidium 37 Rb 85.468	strontium 38 Sr 87.62	yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.94	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	paladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.61	iodine 53 I 126.90	xenon 54 Xe 131.29				
cesium 55 Cs 132.91	barium 56 Ba 137.33	* 57-70 Lu 174.97	hafnium 72 Hf 178.49	tantalum 73 Ta 180.95	wolfram 74 W 183.84	rhenium 75 Re 186.21	osmium 76 Os 190.23	iridium 77 Ir 192.22	platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	thallium 81 Tl 204.38	lead 82 Pb 207.2	bismuth 83 Bi 208.98	polonium 84 Po [209]	astatine 85 At [210]	radon 86 Rn [222]				
francium 87 Fr [223]	radium 88 Ra [226]	* 89-102 Lr [261]	rutherfordium 104 Rf [261]	dubnium 105 Db [262]	seaborgium 106 Sg [266]	bohrium 107 Bh [264]	hassium 108 Hs [265]	meitnerium 109 Mt [268]	darmstadtium 110 Uun [271]	roentgenium 111 Uuu [272]	copernicium 112 Uub [273]	tennessine 114 Uuq [289]									

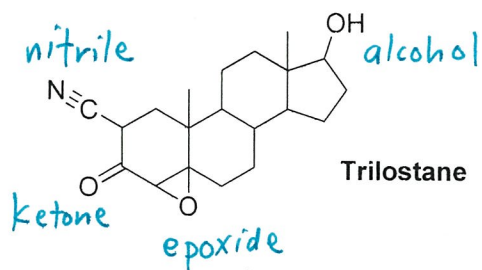
* Lanthanide series

lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04
actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]

* Actinide series

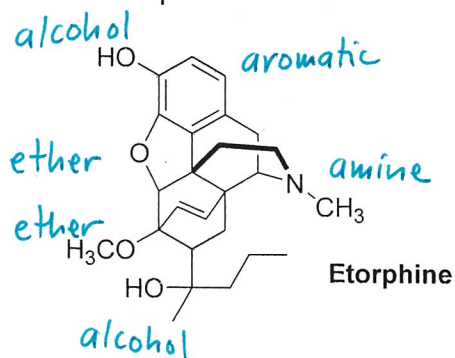
Multiple choice. Each of the following multiple choice questions (1-10) is worth 5 points and has only one correct answer. Select the best answer for each question and bubble it in on your Scantron.

1. Trilostane is a molecule used to treat Cushing's syndrome, a disease related to unusually high levels of compounds called glucocorticoids. Select the functional group that is NOT present in the structure of trilostane.



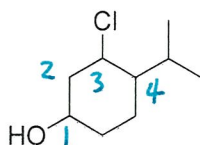
- a. alcohol
b. aldehyde
c. epoxide
d. ketone
e. nitrile

2. Etorphine is a powerful analgesic that is incorporated into tranquilizer darts and used by veterinarians to sedate very large animals. Which functional group is present in the structure of etorphine?



- a. alkyl halide
b. amine
c. anhydride
d. ester
e. nitro

3. Select the common name for the alkyl group attached to the ring in this structure.

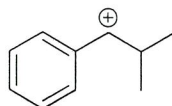


- D
- a. *sec*-butyl
 - b. *tert*-butyl
 - c. isobutyl
 - d. isopropyl
 - e. neopentyl

4. In the previous question, what is the locator number/locant for the ring carbon to which the chlorine atom is attached?

- C
- a. 1
 - b. 2
 - c. 3
 - d. 4
 - e. 5

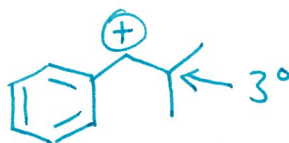
5. In this structure, what is the hybridization of the benzylic carbon?



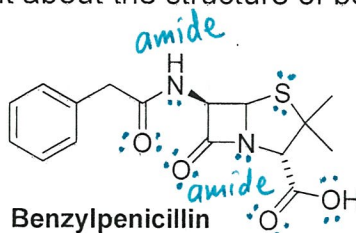
- B
- a. *sp*
 - b. *sp*²
 - c. *sp*³
 - d. The benzylic carbon is not hybridized

6. In the structure in the preceding question, how many tertiary carbons are there?

- B
- a. 0
 - b. 1
 - c. 2
 - d. 3
 - e. More than 3

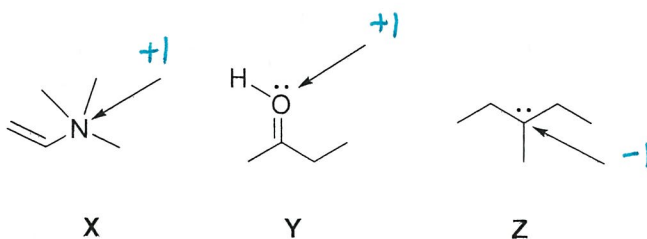


7. Benzylpenicillin is a member of the important penicillin family of antibiotics. Select the true statement about the structure of benzylpenicillin.



- C
- a. All the rings in benzylpenicillin are aromatic. *No - only the ring on the left*
- b. Benzylpenicillin does not contain any heteroatoms. *O, N, S are heteroatoms*
- c. There are two amide functional groups in benzylpenicillin.
- d. In the structure shown, a carboxylic acid functional group is coming forward (out of the plane). *It is going behind the plane*
- e. There is a total of ten lone pairs not explicitly shown in the structure. *There are 12*

8. In the three structures shown (X, Y and Z), all lone pairs are included but nonzero formal charges are not explicitly shown. Select the answer choice that correctly states the formal charge on the atom indicated with the arrow in each structure.



- B
- | | | | |
|-------------------------------------|-------|-------|-------|
| a. | X: +1 | Y: +1 | Z: +1 |
| <input checked="" type="radio"/> b. | X: +1 | Y: +1 | Z: -1 |
| c. | X: -1 | Y: +1 | Z: +1 |
| d. | X: 0 | Y: 0 | Z: 0 |
| e. | X: +1 | Y: -1 | Z: +1 |

9. How many p orbitals are there in the valence shell of a carbonyl carbon?

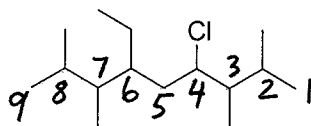
- B
- a. 0
- b. 1
- c. 2
- d. 3
- e. 4

sp² hybridized

Valence shell:

sp² sp² sp² p

10. When this compound is named properly according to IUPAC rules, which of the following choices will NOT appear in the name?



A

- a. 6-chloro
- b. ethyl
- c. tetramethyl
- d. nonane
- e. All of these choices will appear in the IUPAC name of the compound

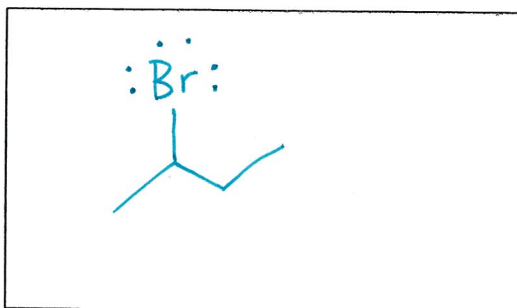
Free response. Provide the requested drawings or other information for the remaining questions.

11. Draw the requested molecules in the boxes provided and circle the correct choice underneath each name to classify the compound. (10 pts)

Sec-butyl bromide

Classify this alkyl halide
(circle one):

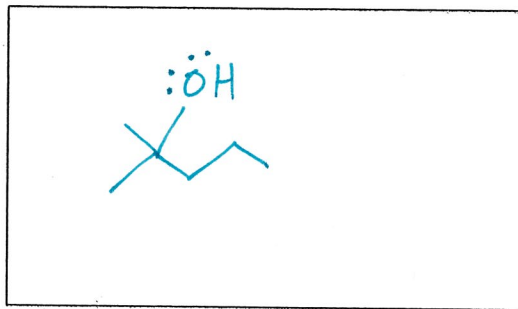
1° 2° 3°



**2-methylpentan-2-ol
(2-methyl-2-pentanol)**

Classify this alcohol
(circle one):

1° 2° 3°



12. Indicate the orbitals that are overlapping to create each of the indicated bonds according to valence bond theory. The carbon atoms are numbered for reference. (10 pts)

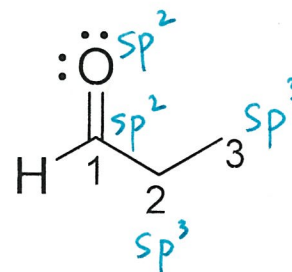
C1 – C2 σ : sp^2 on C1 and sp^3 on C2

C2 – C3 σ : sp^3 on C2 and sp^3 on C3

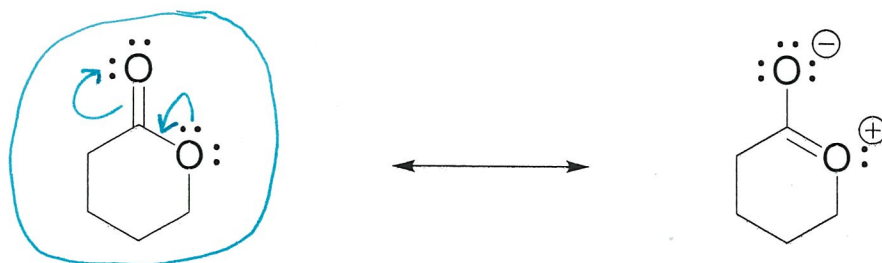
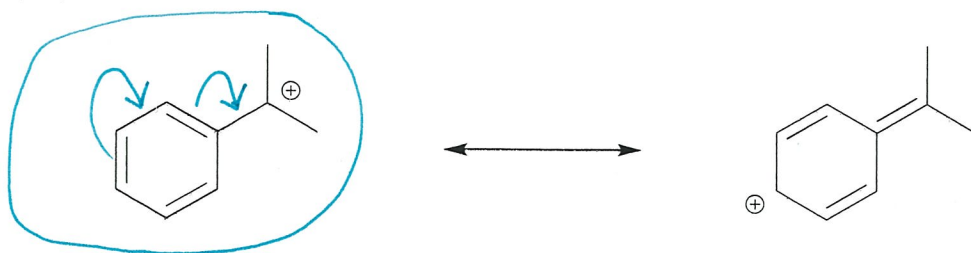
C1 – H σ : sp^2 on C1 and s on H

C1 – O σ : sp^2 on C1 and sp^2 on O

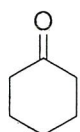
C1 – O π : p on C1 and p on O



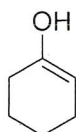
13. For each pair, draw curved arrows on the structure on the left to show how it is related to the structure on the right. Circle the major contributor in each pair. (10 pts)



14. State whether each of the following pairs are resonance contributors or constitutional isomers. Circle your answer. (6 pts)

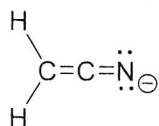


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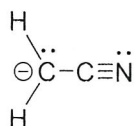


Resonance

Isomers

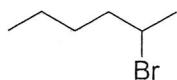


and

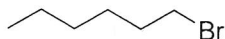


Resonance

Isomers



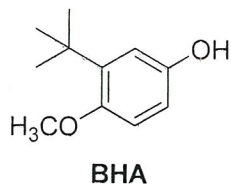
and



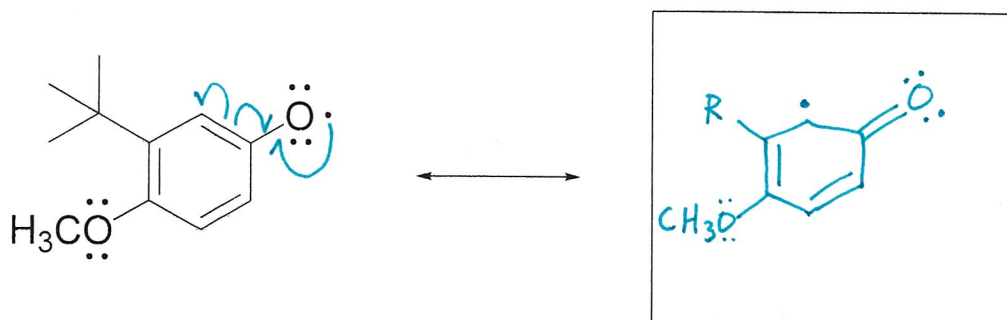
Resonance

Isomers

15. A molecule called **BHA** (butylated hydroxyanisole) is used as an antioxidant and food preservative. In the structure below, all atoms are neutral but lone pairs are not explicitly shown. (14 pts)



- a. In its role as an antioxidant, BHA is converted into the radical shown below. Draw one other resonance contributor that shows the delocalization of the unpaired electron. Draw curved arrows on the original structure to show how it is related to your new structure. You can abbreviate the alkyl group as "R". Include any necessary lone pairs, unpaired electrons, and nonzero formal charges.



- b. If BHA reacts with a base, it is converted to the anion shown below. Draw one other resonance contributor that places the negative charge on a different atom than O. Draw curved arrows on the original structure to show how it is related to your new structure. You can abbreviate the alkyl group as "R". Include any necessary lone pairs, unpaired electrons, and nonzero formal charges.

