CHEM 3311 **Hour Exam #1** **Name**_____
Dr. Minger **June 11, 2019**

Circle your recitation section: 111 112 113 114 115 116

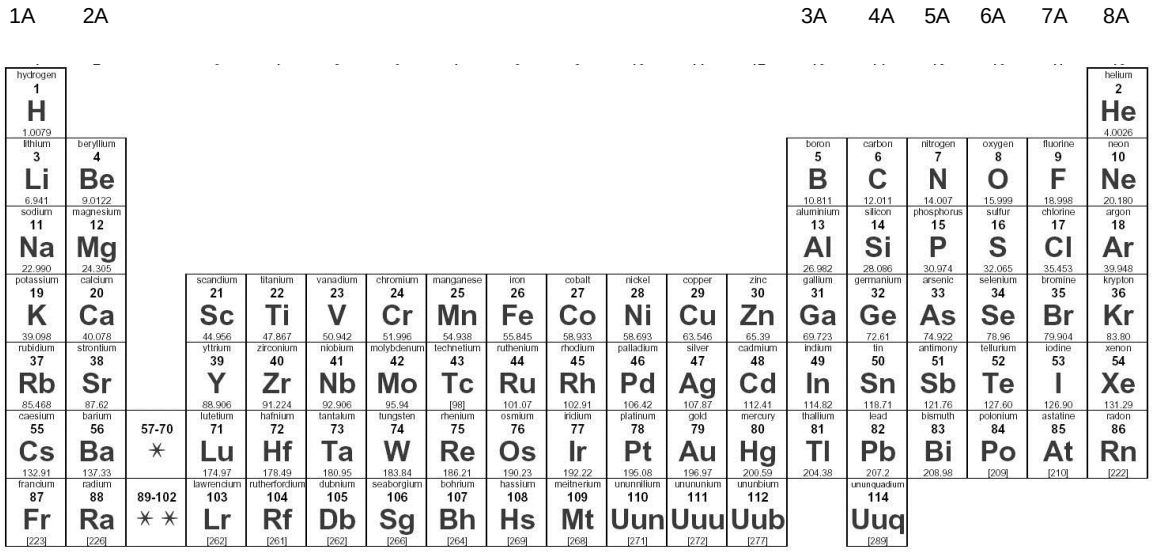
121 122 123 124 125 126

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.

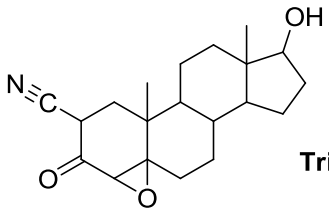
_____
Signature

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.



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.

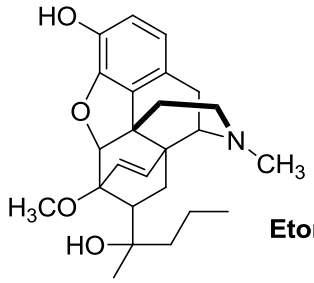
1. Trilostane is a molecule used to treat Cushing's syndrome, a disease related to unusually high levels of compounds called glucocorticoids. Select the functional group that is NOT present in the structure of trilostane.



Trilostane

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

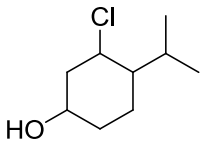
2. Etorphine is a powerful analgesic that is incorporated into tranquilizer darts and used by veterinarians to sedate very large animals. Which functional group is present in the structure of etorphine?



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.

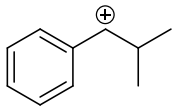


a. *sec*-butyl
b. *tert*-butyl
c. isobutyl
d. isopropyl
e. neopentyl

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

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

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

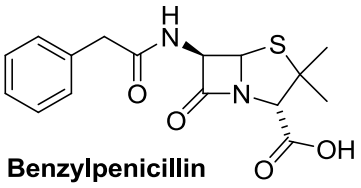


a. *sp*
b. sp^2
c. sp^3
d. The benzylic carbon is not hybridized

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

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

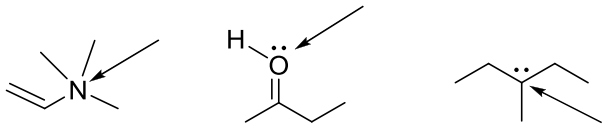
7. Benzylpenicillin is a member of the important penicillin family of antibiotics. Select the true statement about the structure of benzylpenicillin.



Benzylpenicillin

a. All the rings in benzylpenicillin are aromatic.
b. Benzylpenicillin does not contain any 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).
e. There is a total of ten lone pairs not explicitly shown in the structure.

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.



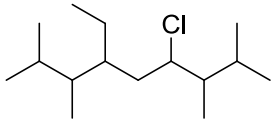
X **Y** **Z**

a.	X: +1	Y: +1	Z: +1
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?

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

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



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):

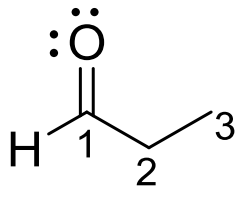
1º 2º 3º

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

Classify this alcohol (circle one):

1º 2º 3º

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: _____ on C1 and _____ on C2

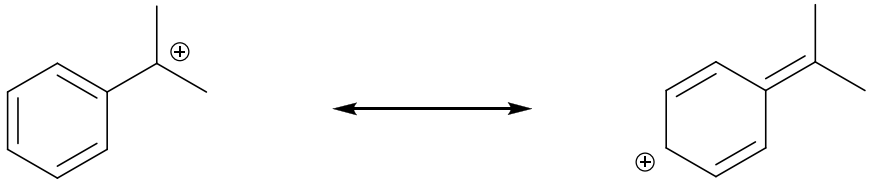
C2 – C3 σ: _____ on C2 and _____ on C3

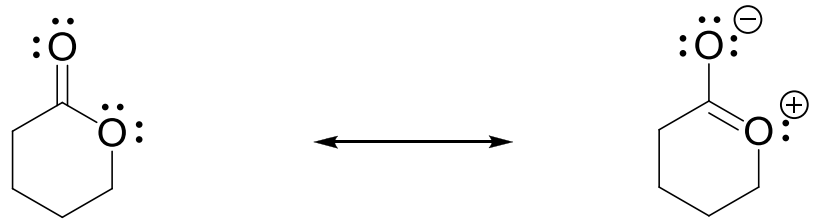
C1 – H σ: _____ on C1 and _____ on H

C1 – O σ: _____ on C1 and _____ on O

C1 – O π: _____ on C1 and _____ 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)

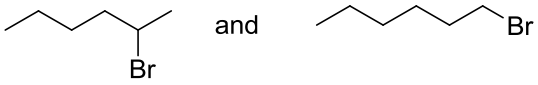




14. State whether each of the following pairs are resonance contributors or constitutional isomers. Circle your answer. (6 pts)

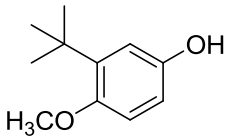
Resonance **Isomers**

Resonance **Isomers**



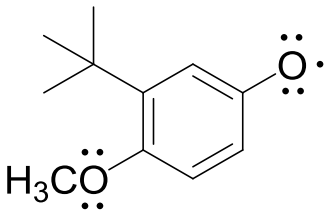
Resonance **Isomers**

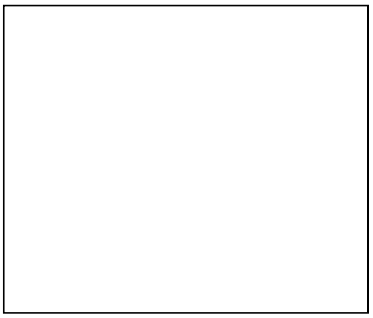
15. A molecule called **BHA** (butylated hydroxyanisole) is used as an antioxidant and food preservative. In the structure below, all atoms are neutral but lone pairs are not explicitly shown. (14 pts)



BHA

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.