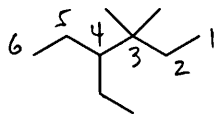
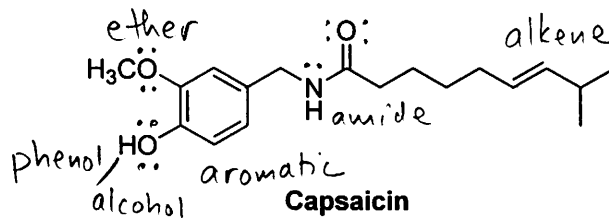


1. Select the correct name of this molecule.



B

- a. 3-ethyl-4,4-dimethylhexane
 b. 4-ethyl-3,3-dimethylhexane
 c. 3,3-dimethyl-4-ethylhexane
 d. 2-methyl-2,3-diethylpentane
 e. 2,3-diethyl-2-methylpentane
2. Capsaicin is one of the substances in chili peppers that is responsible for their "heat". Select the functional group that is **not** present in capsaicin.




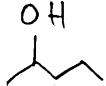

B

- a. Amide
 b. Ester
 c. Alkene
 d. Aromatic ring
 e. All of these groups are present in capsaicin
3. In the structure of capsaicin shown in #2, the lone pairs are not explicitly drawn, but all atoms are neutral. How many lone pairs of electrons are there in the structure?

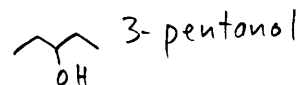
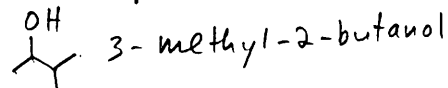
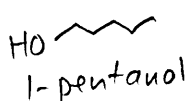
D

- a. 4
 b. 5
 c. 6
 d. 7
 e. Enough
4. 2-Pentanol (Pentan-2-ol) is a member of a set of constitutional isomers. Which of these molecules is **not** a constitutional isomer of 2-pentanol?

E

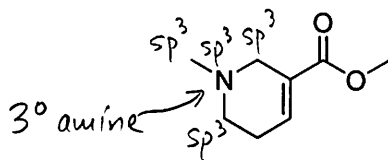
- a. 2-methyl-2-butanol 
 b. 1-pentanol 
 c. 3-methyl-2-butanol 
 d. 3-pentanol
 e. All of these molecules are constitutional isomers of 2-pentanol.

All are $C_5H_{12}O$



5. Arecoline is a natural product called an alkaloid. It is found in the fruit of the areca palm and is used as a veterinary drug to control worms in animals. In the structure of arecoline shown here, lone pairs of electrons are not explicitly drawn, but all atoms are neutral.

C



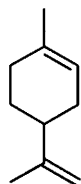
Arecoline

Which of the following statements about arecoline is **false**?

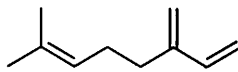
- a. Arecoline contains a tertiary amine. T
 b. The C-N σ bonds in arecoline are formed by the overlap of sp^3 orbitals on carbon and nitrogen. T
 False c. A resonance structure may be drawn for arecoline that places a formal positive charge on nitrogen. X sp^3 C's on either side
 d. There are 13 hydrogen atoms in arecoline. T
 e. More than one of the statements above (a, b, c, d) is false.

6. Termites are not very nice in many ways. In addition to eating wood and destroying structures, certain termites use a chemical defense mechanism called a *fontanellar gun*, where a termite sprays an enemy insect with a toxic mixture of these three compounds:

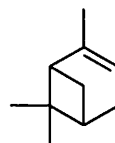
B



Limonene



Myrcene



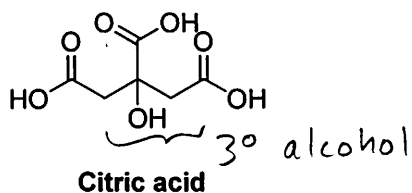
Pinene

Each of these compounds contains one or more carbon-carbon double bonds. What is the percentage of s character for the hybrid orbitals on a carbon involved in a double bond?

- a. 25%
 b. 33.3%
 c. 50%
 d. 66.7%
 e. 75%

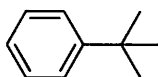
sp^2 hybridized, so 1 part s,
2 parts p
thus 33.3%

7. Which statement about the compounds in question 6 is **true**?
- B
- Two of the compounds are constitutional isomers of each other, but the third is not.
 - All three compounds are constitutional isomers of each other.
 - The three compounds are *not* constitutional isomers of each other.
 - There is not enough information to answer the question.
8. Citric acid is a compound that occurs naturally in citrus fruits. It is also an important metabolic intermediate in all aerobic organisms (organisms that can survive in an oxygenated environment).



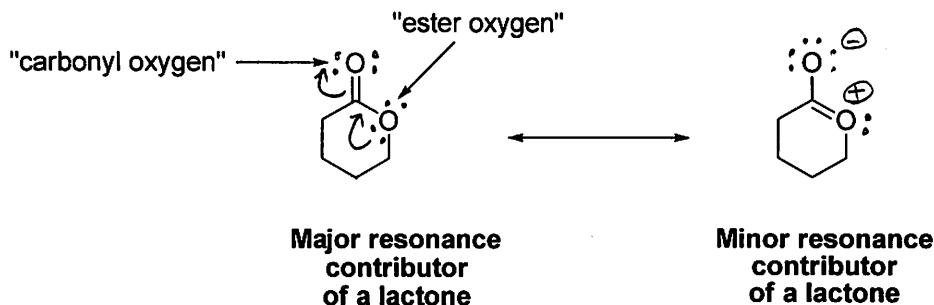
Select the correct statement about the structure of citric acid.

- Citric acid contains a tertiary alcohol.
 - There is an anhydride functional group in citric acid. *No*
 - There is an ester functional group in citric acid. *No*
 - The only functional groups contained in citric acid are carboxylic acids. *No - there is an alcohol*
 - Citric acid contains a C-C π bond. *No*
9. The common name for the group attached to this benzene ring is



- C
- isopropyl
 - sec-butyl
 - tert-butyl
 - isobutyl
 - neobutyl

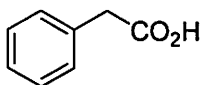
10. One of the functional groups we discussed in class was an ester. Esters can occur as cyclic structures called *lactones*.



In the structures above, lone pairs are not explicitly drawn. In the major resonance contributor, all atoms are neutral. Which of the following correctly describes the formal charges in the minor resonance contributor shown above?

	Ester oxygen	Carbonyl oxygen	Carbonyl carbon
A	+	-	0
B	-	+	0
C	0	-	+
D	0	+	-
E	None of the answer choices A-D is correct.		

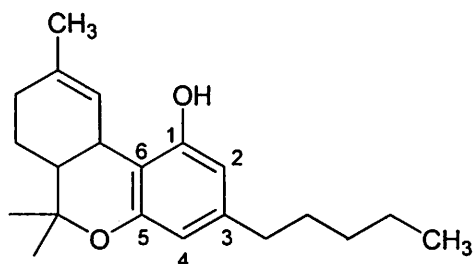
11. Which of these functional groups is contained in this structure?



- a. Alcohol
- b. Aldehyde
- c. Amine
- d. Carboxylic acid
- e. None of these

12. Tetrahydrocannabinol (THC) is a compound you saw in class. Some of the carbon atoms are numbered in the structure for reference. Lone pairs are not explicitly drawn, but all atoms are neutral.

B



Tetrahydrocannabinol

According to valence bond theory, what orbitals are overlapping to form the σ bond between C1 and C6?

- a. sp and sp
- b. sp^2 and sp^2
- c. sp^3 and sp^3
- d. p and p

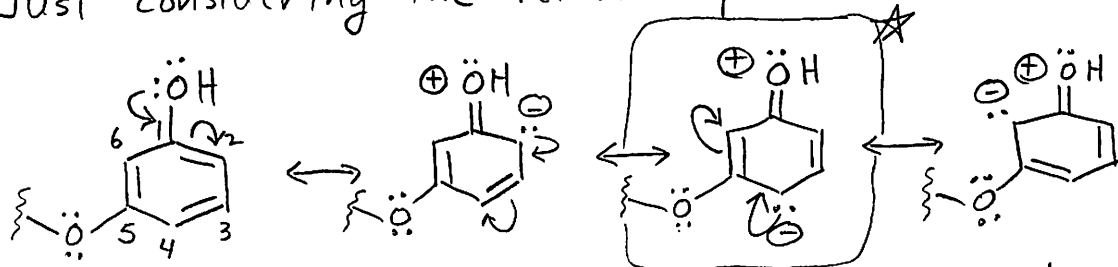
13. Although the structure shown in #12 is the major resonance contributor of tetrahydrocannabinol, the molecule can be represented with several other resonance contributors. All these contributors involve the delocalization of electrons into the aromatic ring from the O in the OH group or from the O in the ether functional group. Which of the following accurately describes one of the acceptable minor contributors?

B

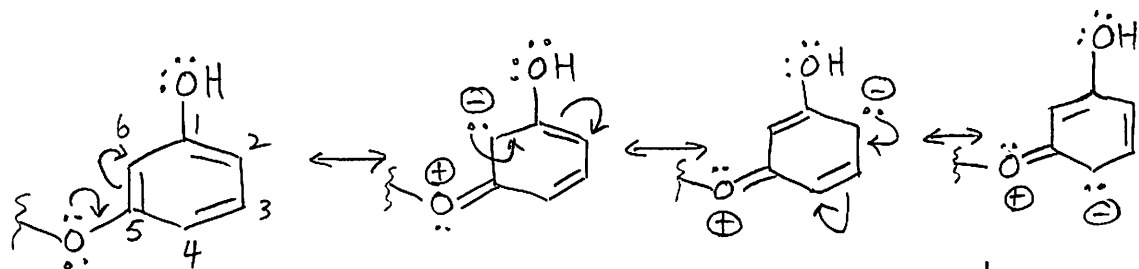
	Ether oxygen	OH oxygen	C1	C2	C3	C4	C5	C6
<input checked="" type="checkbox"/> A	+	0	-	0	0	0	0	0
<input checked="" type="checkbox"/> B	0	+	0	0	0	-	0	0
<input checked="" type="checkbox"/> C	+	0	0	0	-	0	0	0
<input checked="" type="checkbox"/> D	0	+	0	0	0	0	-	0
<input checked="" type="checkbox"/> E	None of the answer choices A-D represents an acceptable minor resonance contributor.							

Explanation →

12. Just considering the relevant part of the structure:



Delocalizing e^- from the OH oxygen puts a lone pair and negative charge at C2, C4 or C6, and a \oplus on the OH oxygen.



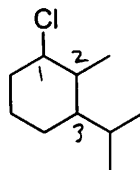
Delocalizing e^- from the ether O puts a lone pair and negative charge at C2, C4 or C6, and a \oplus on the ether oxygen.

In either case, the lone pair/ \ominus can't end up at C1, C3 or C5.

★ is answer choice B.

14. Which of the choices is the correct common name for this compound?
(Note that it's a common name, not an official IUPAC name, because we're using the common name for the isopropyl group.)

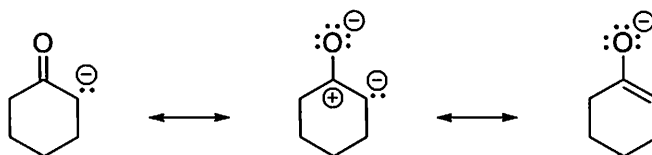
A



- a. 1-chloro-3-isopropyl-2-methylcyclohexane
 b. 1-chloro-2-methyl-3-isopropylcyclohexane
 c. 3-chloro-1-isopropyl-2-methylcyclohexane
 d. 1-isopropyl-2-methyl-3-chlorocyclohexane
 e. 3-chloro-2-methyl-1-isopropylcyclohexane

15. Select the *most minor* (least important) resonance contributor. All lone pairs are shown in all structures.

B



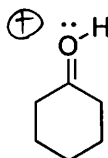
A

(B) Carbon lacks octet;
 Separation of charge; formal
 charges not minimized

- a. A
 b. B
 c. C
 d. A and C
 e. All structures are equivalent

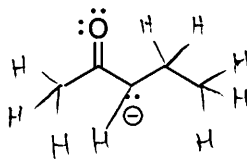
16. What is the formal charge on oxygen in this structure? All lone pairs of electrons are shown.

B



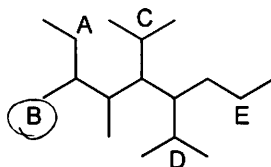
- a. 0
 b. +1
 c. -1
 d. +2
 e. -2

17. How many hydrogen atoms are there in this structure?



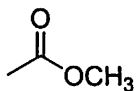
- C
- a. 7
 - b. 8
 - c. 9
 - d. 10
 - e. Some other number

18. Some of the carbons in this structure are labeled. Which of them is a primary carbon?

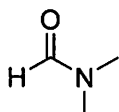


B

19. Which of these compounds is **not** a carboxylic acid derivative?



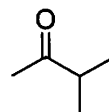
A
ester



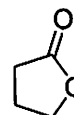
B
amide



C
acid
halide



D
ketone

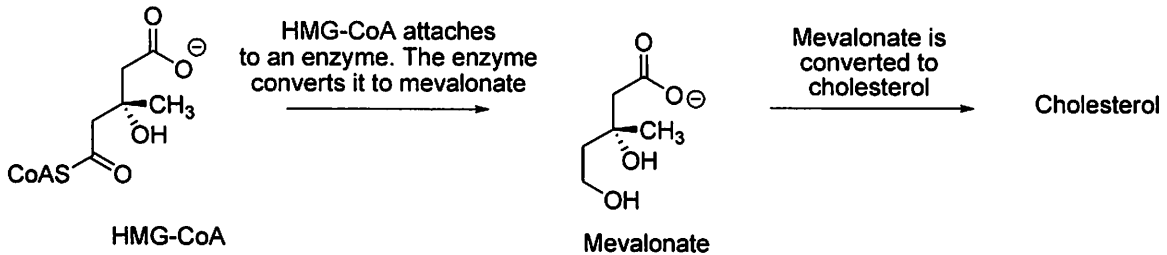


E
ester

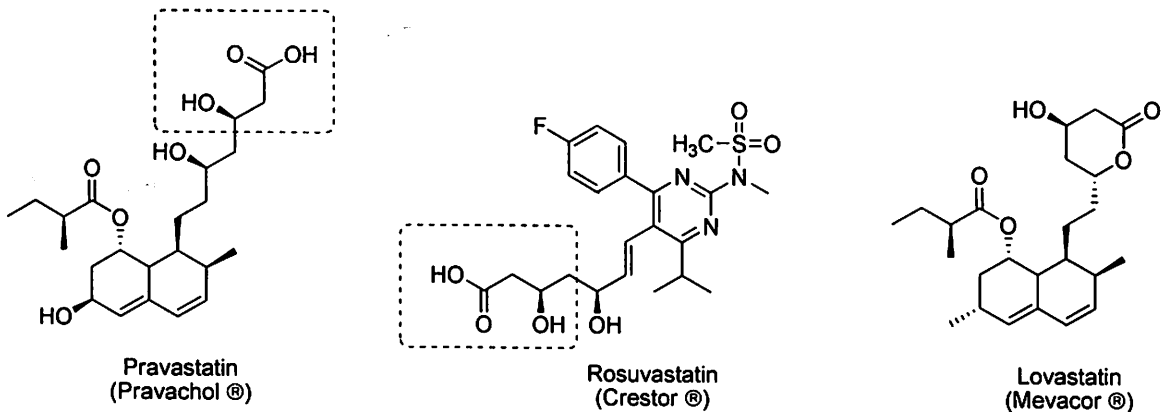
D

20. Statins are a commonly prescribed class of drugs that reduce risk of heart disease by lowering blood cholesterol levels. One of the important steps in cholesterol production in the body is the conversion of a chemical called HMG-CoA to mevalonate. This change is accomplished using an enzyme. HMG-CoA attaches to the enzyme and is converted to mevalonate. Mevalonate is then converted to cholesterol in later steps:

B



Statin drugs work because they mimic part of the structure of HMG-CoA, so they can attach to the enzyme in the way that HMG-CoA would. This blocks HMG-CoA from attaching to the enzyme, which decreases the production of mevalonate and thus prevents the synthesis of cholesterol. Most statin drugs, like Pravastatin and Rosuvastatin (shown below) contain the part of the drug that mimics HMG-CoA (circled with a dashed line). However, in the drug Lovastatin, that portion of the molecule does not appear, yet Lovastatin still works to reduce cholesterol.



Which of the following choices offers the most reasonable explanation for this apparent discrepancy, using information you have heard in lecture?

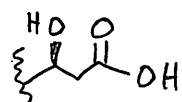
- a. Resonance in Lovastatin allows its atoms to rearrange to fit into the enzyme *No - atoms don't change positions among resonance contributors*
- b. The presence of the cyclic ester (lactone) functional group in Lovastatin
- c. Lovastatin is a constitutional isomer of the other statin drugs *No (see examples above)*
- d. Lovastatin has the same number of sp^2 carbons as the other statin drugs *No (see examples above)*

Explanation \rightarrow

20.

The indicated group of atoms that mimics HMG-CoA

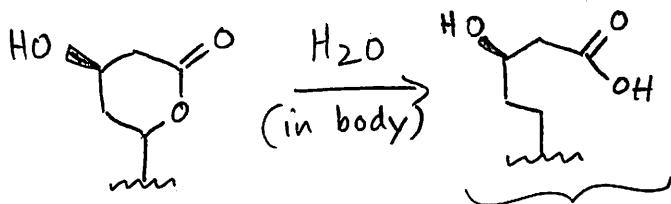
is:



a carboxylic acid with an OH group 2 bonds away.

Although lovastatin lacks this group, it is what is known as a "pro-drug," which means that when it is metabolized it can exert its therapeutic effects.

However, even without knowing that, we recognize that the ester functional group in lovastatin is a carboxylic acid derivative — a compound that when reacted with water becomes a carboxylic acid:



The grouping of atoms that mimics HMG-CoA.

You could also have selected "B" by process of elimination: see reasoning next to each answer choice.