Exam 1 Test Prep

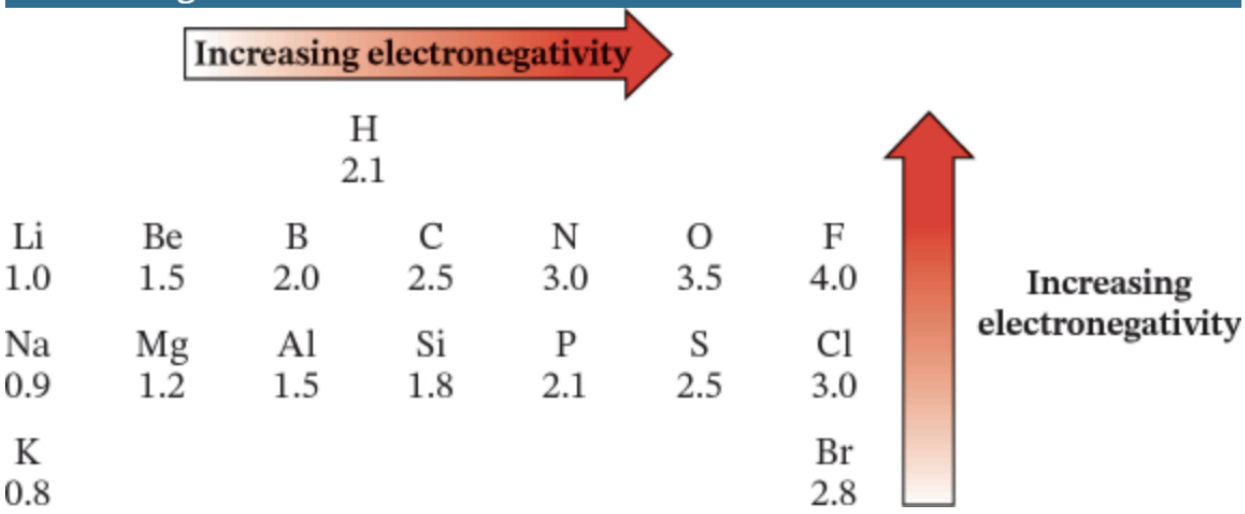
Concepts to Understand:

- Electronegativity
- Converting Condensed, Bond-line, and Dashed
- Formal Charge
- Constitutional Isomers
- Hybridization
- Functional Groups
- Degree of Substitution
- Intermolecular Forces
- Acids and Bases

Electronegativity

TABLE 1.1

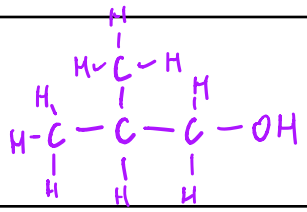
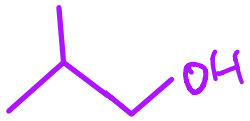
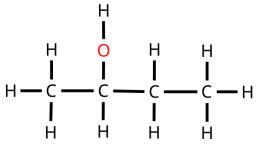
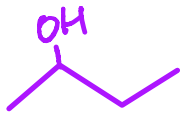
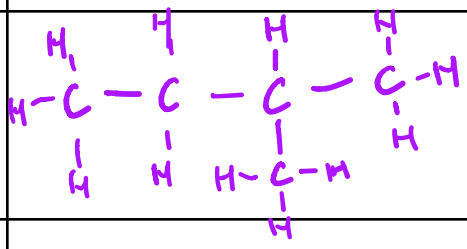
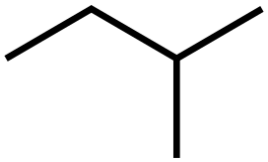
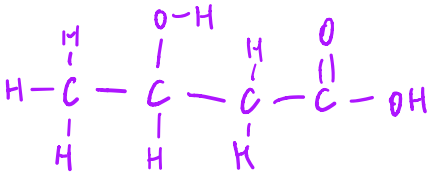
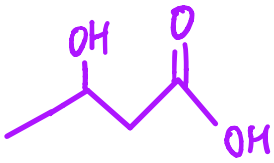
Electronegativities of Some of the Elements



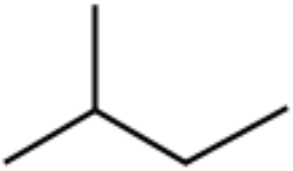
More electronegative atoms can stabilize a negative charge

Structures

Condensed to Dash to bond line practice:

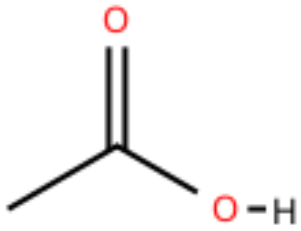
$(CH_3)_2CHCH_2OH$		
$CH_3CH(OH)CH_2CH_3$		
$CH_3CH_2CH(CH_3)CH_3$		
$CH_3CH(OH)CH_2COOH$		

What would be the condensed formula for the following compound?



A. $CH_3CH(CH_3)CH_2CH_2$
B. $CH_3CH_2CH_2CH_3$
C. $CH(CH_3)CH_2CH_2CH_3$
D. $CH_3CH(CH_3)CH_2CH_3$
E. $CH_3CH_3(CH_3)CH_2CH_3$

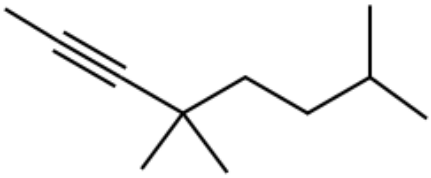
What would be the condensed formula for the following compound?



A. $(CH_3)_2CCOOH$
B. CH_3COOCH_3
C. CH_3COOH
D. CH_3CHOOH
E. CH_2COOH

What is the correct bond-line structure of this compound?

$CH_3CC(CH_2)_3C(CH_3)_3$

A.


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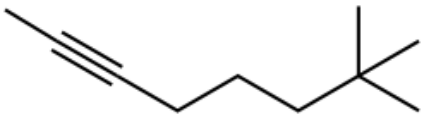
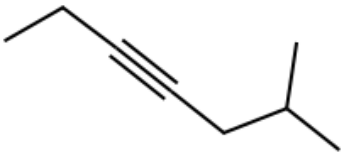
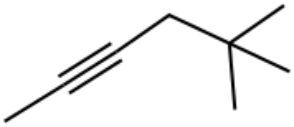
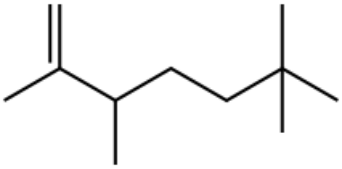


C.


D.


E.


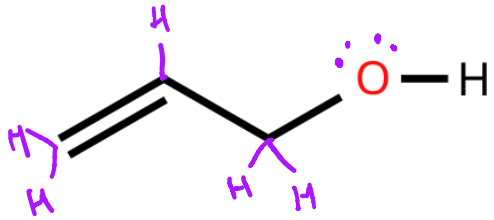
Formal Charge

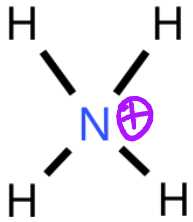
Draw all hydrogens, lone pairs, and formal charges (if applicable)

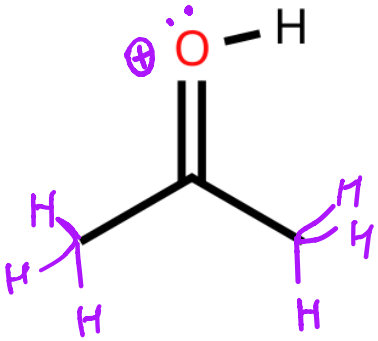
Remember your formal charge calculations:

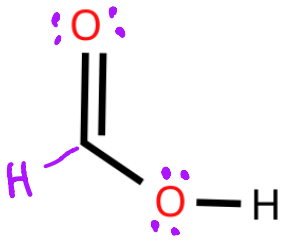
$$FC = V - N - \frac{B}{2}$$

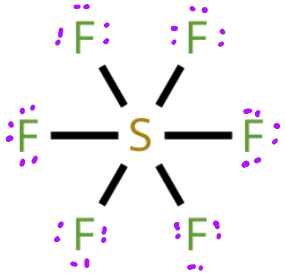
FC = formal charge
V = number of valence electrons
N = number of nonbonding valence electrons
B = total number of electrons shared in bonds

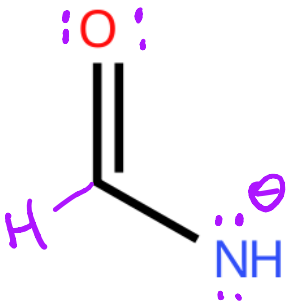


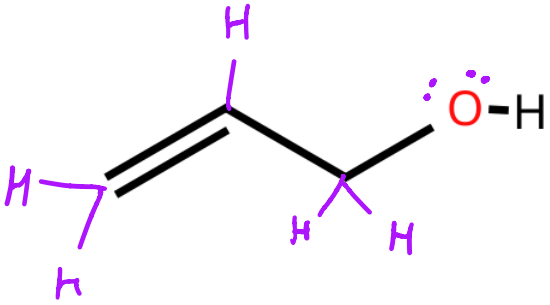






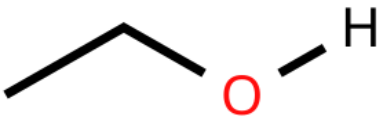




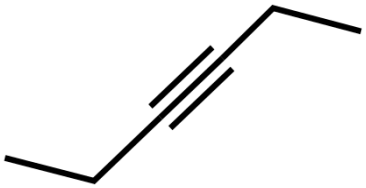


Constitutional Isomers

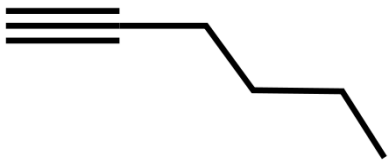
Identify the compounds as constitutional isomers, the same compound, or different:

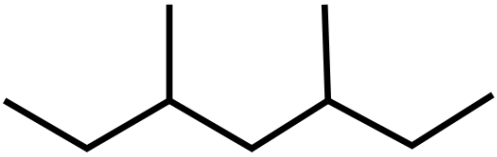


Const. isomers

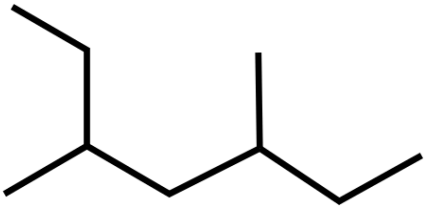


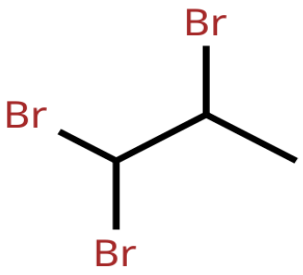
const. isomers



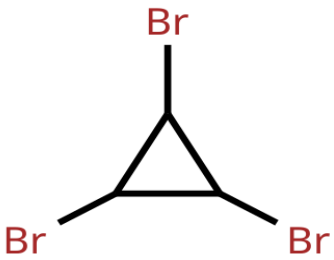


same



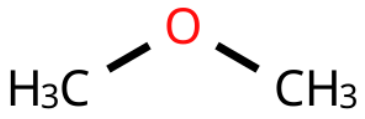


different

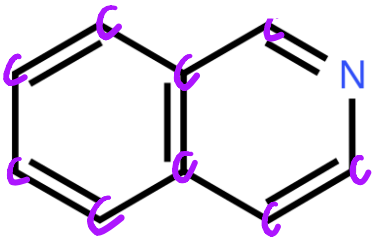


Hybridization

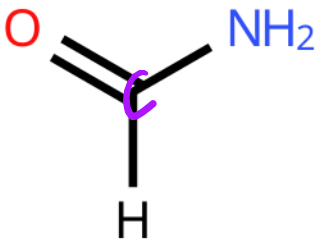
How many Carbons, Pi, and Sigma bonds are in the following structures?



2 carbons
0 pi bonds
8 sigma bonds

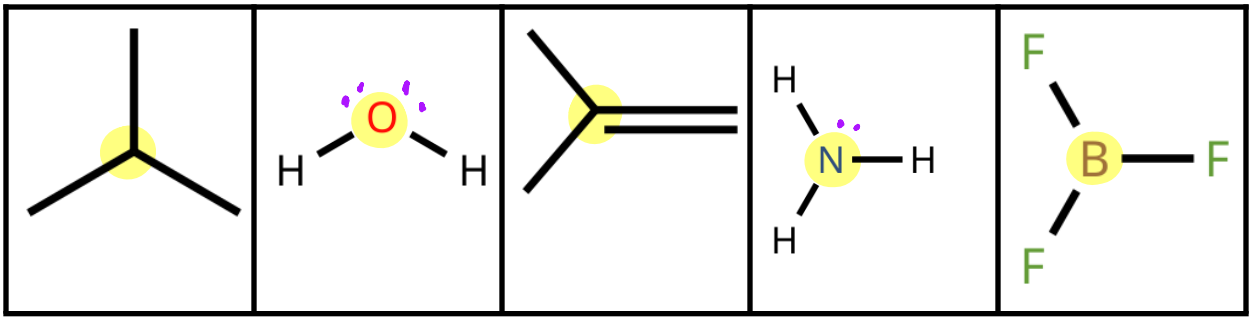


9 carbons
5 pi bonds
18 sigma bonds



1 carbon
1 pi bond
5 sigma bonds

Identify the hybridization of the central atom:



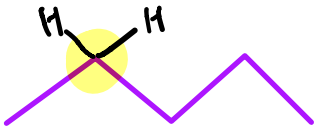
sp^3 sp^3 sp^2 sp^3 sp^2

Carbon atoms have a face-to-face overlap AND a side-to-side overlap of orbitals, what kind of bond(s) and how many bonds were created?

- a sigma bond and a pi bond
- double-bonded carbons

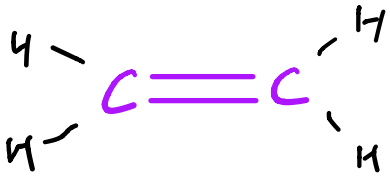
What is the hybridization of the highlighted atom?

$CH_3CH_2CH_2CH_2CH_3$



sp^3 109.5°

CH_2CH_2

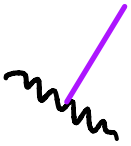
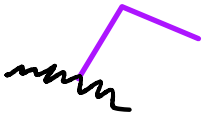
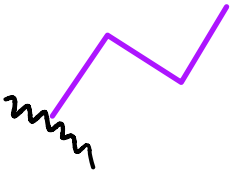
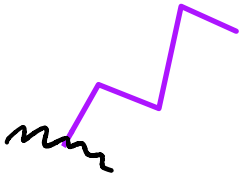
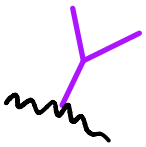
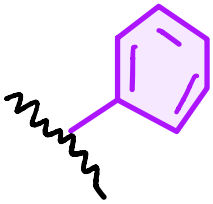
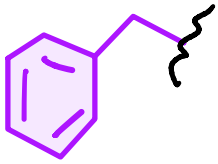
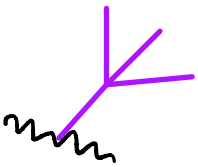


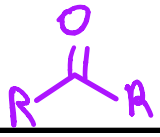
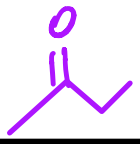
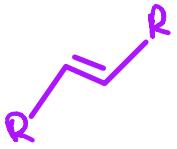
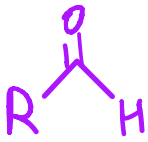
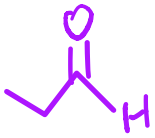
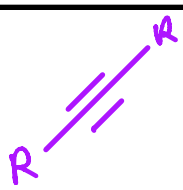
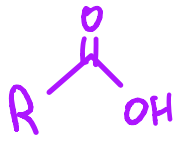
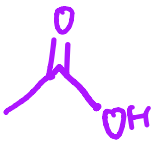
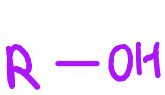
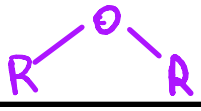
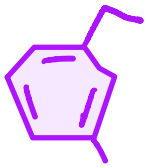
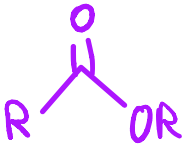
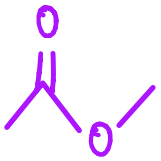
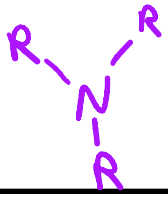
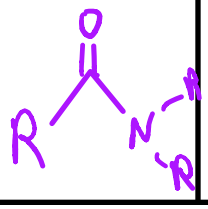
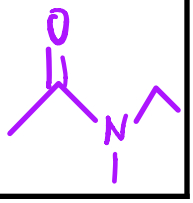
sp^2 120°

Functional Groups

I highly recommend making flashcards with their chemical formula, structure, and relative pKa values (excluding alkyl groups)

Alkyl Functional Groups

Methyl		Ethyl	
Propyl		Butyl	
Isopropyl		Phenyl	
Benzyl		Tert-butyl	

Alkyl Halide			Nitrile		
Alkane			Ketone		
Alkene			Aldehyde		
Alkyne			Carboxylic Acid		
Alcohol			Ether		
Aromatic/ Arene/ Benzene			Ester		
Amine			Amide		

Intermolecular Forces

Factors that affect bp/mp:

The more ___branching___ in a structure, the ___lower___ the boiling point

Intermolecular forces:

___longer___ carbon chain; ___higher___ the bp

More ___H -___ bonding; higher bp

The more ___branching___ in a structure, the ___higher___ the melting point

When a molecule can stack easily the melting point is___high___

1. D
2. F
3. A
4. B
5. E
6. C

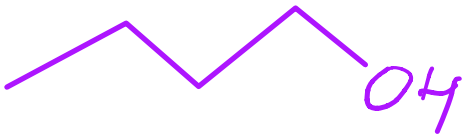
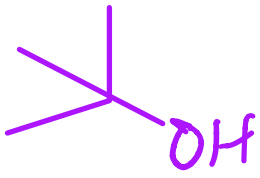
A	Ion-Dipole
B	Hydrogen Bonding
C	London Dispersion
D	Ionic Bonds (crystal)
E	Dipole-Dipole
F	Covalent Bonding

Move intermolecular forces ↓

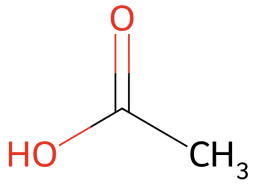
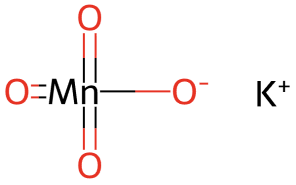
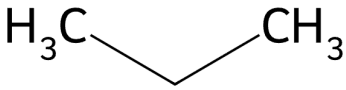
Why would an ether have a lower boiling point than an alcohol?

	
~~• London forces~~ ~~• dipole~~	~~• London forces~~ ~~• Dipole~~ • H-bonding

Which compound has the higher melting point and boiling point, why?

$CH_3(CH_2)_3OH$ 	$(CH_3)_3COH$ 
• high boiling point • long carbon chain	• high melting point - lots of branching

Identify all intermolecular forces in the compounds below and star their strongest one:

		
• London dispersion • H-bonding ★ • Dipole-dipole	• Ionic bonding ★ • Ion-dipole	• London dispersion ★

Acids/Bases

Bronsted Lowry Acid: H^+ donor

Bronsted Lowry Base: H^+ acceptor

Lewis Acid: e^- pair acceptor

Lewis Base: e^- pair donor

What does the acronym ARIO mean? What is it looking at?

A tom

R esonance

I nduction

O rbitals

The stability of a conj. acid / base to determine basicity/acidity

Identify the Nucleophile and Electrophile in the following acid/base reaction:

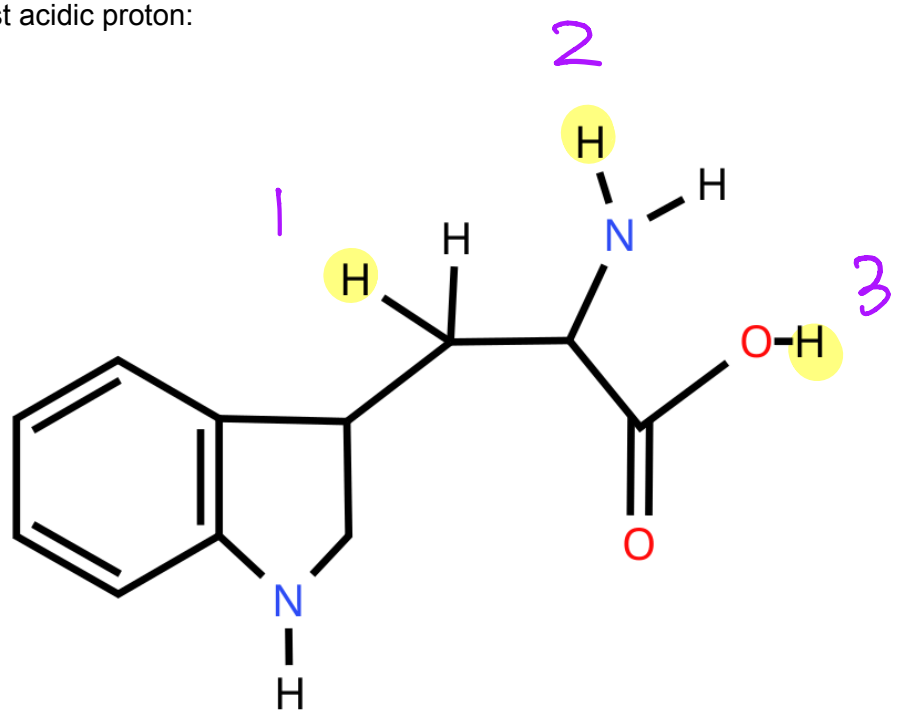
$NH_2^-(aq) + H_2O(l) \rightarrow NH_3(aq) + OH^-(aq)$

Nuc⁻ Elec⁺

Would the reaction above favor the products or reactants?

Products

Identify the most acidic proton:

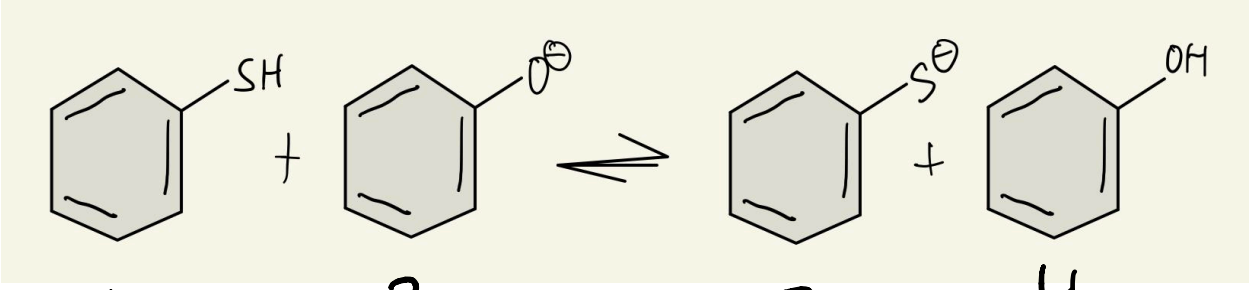


3, most acidic

2, mid

1, least

Predict the equilibrium and identify the most acidic compound:



Right side. Compound 1 most acidic

Would $CH_2ClCH_2CO_2H$ or $CH_3CH_2CO_2H$ be a stronger acid? Why?

↑

This one - because its conj. base is stabilized (weakened) by inductive effects of Cl

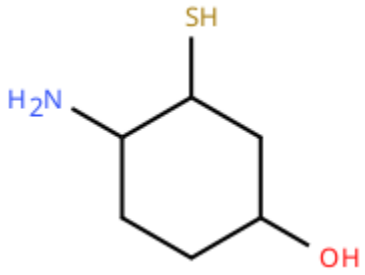
You are given compounds with a pKa of 25, 44, and 51. What kind of molecule would you expect these to be (respectively)?

A. Alkane, Alkene, Alkyne
B. Ether, Alkyne, Alcohol
C. Alkyne, Alkene, Alkane
D. Carboxylic Acid, Alcohol, Ether
E. Nitrile, Ester, Alkyne

What is the pKa range of an alcohol?

A. 16-18
B. 26-29
C. 1-3
D. 10
E. 45-50

Which regions of this compound will be more acidic?



A. Sulfur > Oxygen > Nitrogen
B. Oxygen > Nitrogen > Sulfur
C. Nitrogen > Oxygen> Sulfur
D. Sulfur > Oxygen and Nitrogen
E. Sulfur and Oxygen > Nitrogen