Name Key

Chem 150 - Fall 2015
Exam II

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1. Label each of the carbon and nitrogen atoms in the molecule shown below as have having either a *tetrahedral* (**Tet**), *trigonal planar* (**Trig**) or *linear* (**Lin**) geometry.

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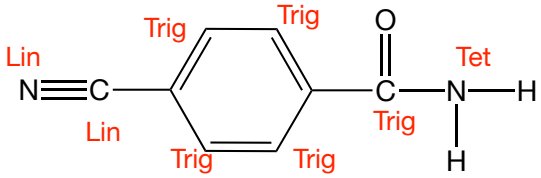

2. Cross out the molecule(s) that are unlikely to exist

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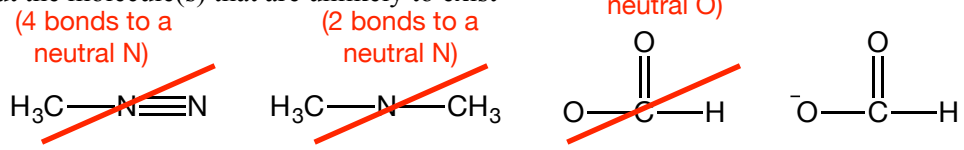

3. Classify each of the following molecules based on the functional group, if any, that they contain, for example, *alkane, alcohol, amine etc.*

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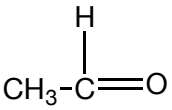
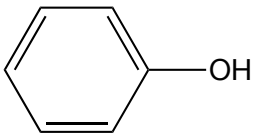
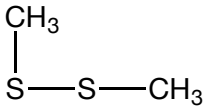


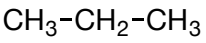
Aldehyde



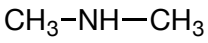
Phenol



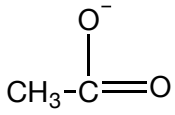
Disulfide



Alkane



Amine



Carboxylate Ion

4. Name each of the following molecules.

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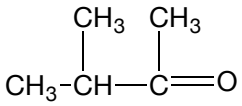
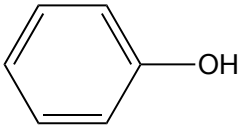
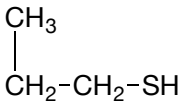


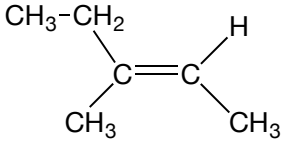
3-methyl-2butanone



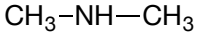
phenol



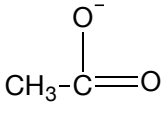
1-propanethiol



trans 3-methyl-2-pentene

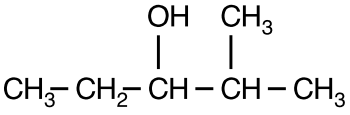
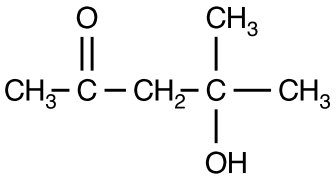
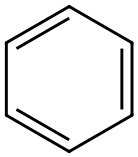


dimethylamine



ethanoate ion
(acetate ion)

5. From the molecules below

a. Pick one that can undergo a *dehydrogenation reaction* with NAD^+ to produce a carbonyl and use it to write a balanced chemical equation for this reaction. Be sure to include all of the possible products.

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b. Name the organic reactants and products in this reaction.

6. Draw structural formulas for the following named molecules.

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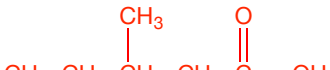
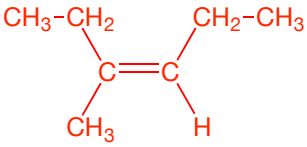
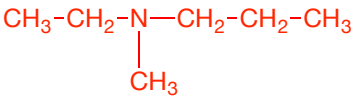
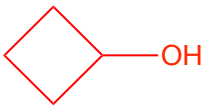
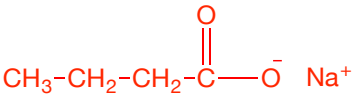
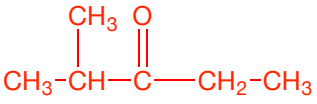
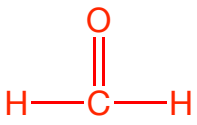
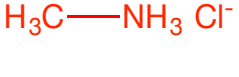
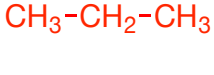
 3-methylpentanoic acid	 *cis* 3-methyl-3-hexene	 *N*-ethyl *N*-methyl propylamine
 cyclobutanol	 sodium 3-methylbutanoate	 2-methyl-3-pentanone
 methanal	 methylammonium chloride	 propane

7. Propane is a gas at room temperature and pressure and is used as a fuel for cooking and heating while ethanol is a liquid at room temperature and pressure and is used as a fuel when mixed with gasoline and as an intoxicant when imbibed

   a. Draw the structural formulas for

      i. propane: $CH_3-CH_2-CH_3$

      ii. ethanol: CH_3-CH_2-OH

   b. Using complete sentences, describe at the molecular level why ethanol is a liquid at room temperature and pressure when propane is a gas. (Use complete sentences.)

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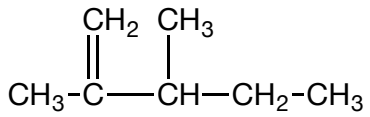
Ethanol is a liquid at room temperature while propane is a gas because ethanol has a substantially higher boiling point than propane. It is the strength of the non-covalent intermolecular interactions that influences boiling points so this observation indicates that ethanol has stronger intermolecular interactions than propane. Enumerating these interactions, because both molecules are about the same size, they will have very similar dispersion interactions. The presence of the electronegative oxygen indicates that ethanol will also have dipole/dipole interactions. Ethanol also has hydrogen bonding donor and two acceptor sites, so it can also participate in hydrogen bonding interactions.

   c. Energy is released from these fuels by having them undergo combustion with oxygen to produce carbon dioxide and water. Write a balanced chemical equation for the complete combustion of both propane and ethanol.

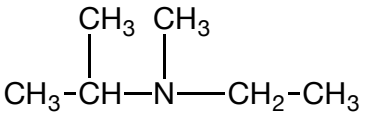
      i. propane: $CH_3-CH_2-CH_3$ (C_3H_8) + 5 O_2 ⟶ 3 CO_2 + 4 H_2O

      ii. ethanol: CH_3-CH_2-OH (C_2H_6O) + 3 O_2 ⟶ 2 CO_2 + 3 H_2O

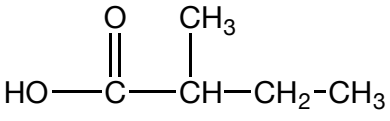
8. Given the structural formulas for the three molecules shown below,



A. 2,3-dimethyl-1-pentene



B. *N*-ethyl *N*-methyl isopropylamine



C. 2-methylbutanoic acid

   a. Provide names for each of the compounds.

   b. Using the lettered labels, arrange the molecules in the order of their melting points, from low to high.

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A < **B** < **C**

   c. Using the lettered labels, arrange the molecules in the order of their solubilities in water, from low to high.

A < **B** < **C**

9. Below each structure shown, draw and name the structures for the products when these molecules are completely reduced.

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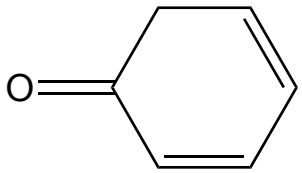
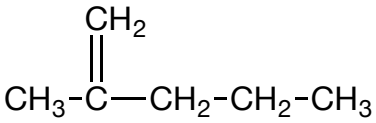
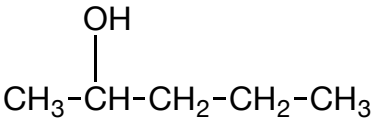
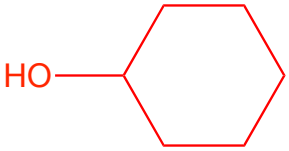
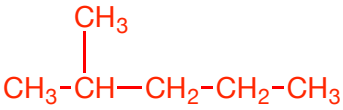
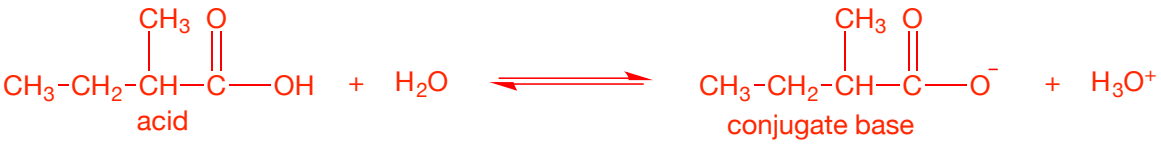
		
 cyclohexanol	 2-methylpentane	no change 2-pentanol

10. Using structural formulas, write the balanced chemical equation for the ionization of each of the following molecules when placed in water and indicate whether the *pH* will be =, >, or < 7. Also, name the conjugate base or conjugate acid.

a. 2-methylbutanoic acid, *pH* < 7, name of conjugate 2-methylbutanoate ion



b. dimethyl amine, *pH* > 7, name of conjugate dimethyl ammonium ion

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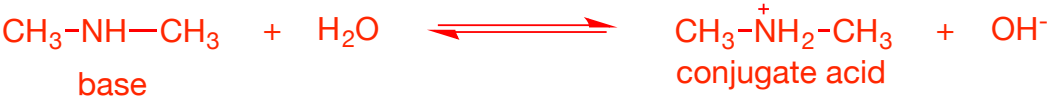

11. Draw the structures of butylamine and ethyl dimethylamine

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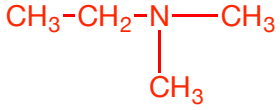
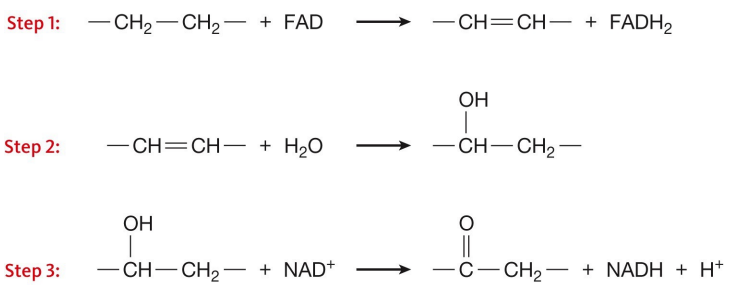
(hydrogen bond donors and acceptor)	(no hydrogen bond donors)
 butyl amine	 *N*-ethyl dimethylamine

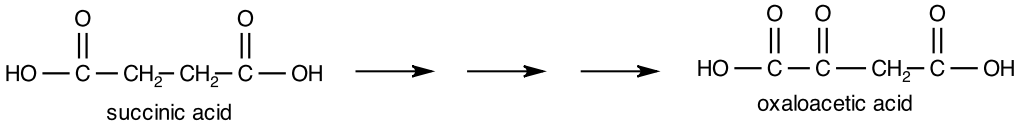
a. Which is predicted to have the higher boiling point? butyl amine

b. Which is predicted to have the higher so solubility in water? both will be soluble

12. In class we discussed that the following sequence of three reactions is common to a number of metabolic pathways,



For example, this sequence is used in citric acid (Krebs) cycle,



Write balanced chemical equations for each of reactions in this pathway and indicate whether multiple isomers can form. (If so, you only need to include one isomer in your chemical equation.)

a. Multiple isomers? (Yes/No)
Step 1:

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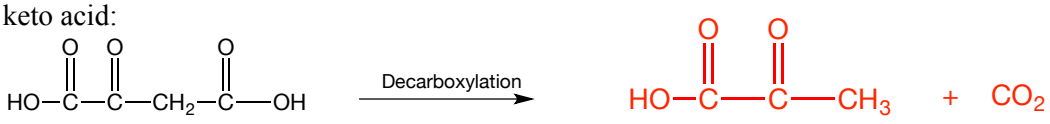
b. Multiple isomers? (Yes/No)
Step 2:

c. Multiple isomers? (Yes/No)
Step 3:

13. Complete the following reaction equations

a. Oxaloacetic acid is a β-keto acid. Complete the reactions equation for the decarboxylation of a β-keto acid:



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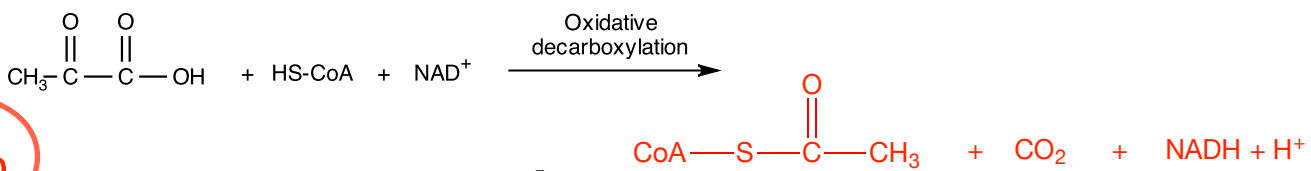
b. Pyruvic acid is a α-keto acid. Complete the reaction equation for the oxidative decarboxylation of α-keto acid.



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