

**Chem 220 - Final Exam**

**Name** \_\_\_\_\_

**Section** \_\_\_\_\_

1. (28) Use the compounds below to answer the following:

Acyl Halides	Alcohols	Aldehydes	
Alkanes		Alkenes	Acid anhydrides
	Amides		Amines (specify 1°, 2°, 3° or 4°)
Aromatic compounds	Carboxylic Acids	Esters	
Ethers	Halogenated hydrocarbons		
Ketones	Thiols		

- Which of the above contain hydroxyl groups?
- Which of the above are carboxylic acid derivatives?
- Using the designation R draw the functional group for an aldehyde.
- CFCs belong to which of the above groups?
- List three of the above that form hydrogen bonds when pure?
- Testosterone is a(n) \_\_\_\_\_.
- Which of the above has the general formula  $C_nH_{2n+2}$ ?
- Which of the above is ionic?

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2.(10) As you did for lab, draw a flowchart for the separation of benzoic acid and phenol. Include in the flow chart the chemical species present at each step.

3. (4) Which of the following compounds are constitutional isomers? (Circle)

Cyclohexane hexane methylcyclopentane 1,1,2-trimethylcyclopropane

4. (9) Each of the following statements **incorrectly** describes some aspect of benzene's structure. Write a corrected version of each statement.

a) Benzene exists as a ring of alternating double and single bonds.

b) The most stable conformation of the benzene ring is the chair form.

c) All the carbon atoms of benzene are *sp* hybridized.

5.(13) Menthol, an alcohol, has a cool and refreshing feeling when rubbed on the skin, it is used in cosmetics, shaving lotions, cough drops and nasal sprays.

a) The IUPAC name for menthol is 2-isopropyl-5-methyl-cyclohexan-1-ol. Draw menthol:

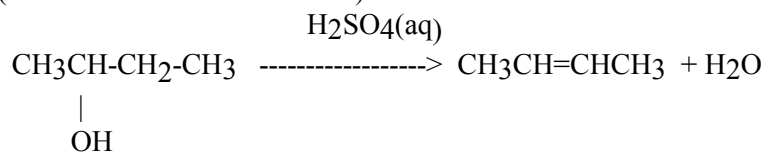
b) Menthol is the most stable stereoisomer of 2-isopropyl-5-methyl-cyclohexan-1-ol. Given this information, draw the most stable conformation of menthol. Is the hydroxyl group cis or trans to the isopropyl group?

c) Menthol has an LD<sub>50</sub> of 3180 mg/kg when administered to rats orally? If a cough drop contained 10 mg of menthol per drop, and we assume that menthol has the same toxicity in humans. How many menthol tablets would a 150 lb. (68 kg) person have to take in order to reach the LD<sub>50</sub> dose? (if you do not have a calculator you may just show the set-up for the problem and give an approximate answer)

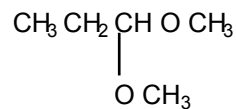
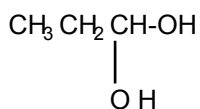
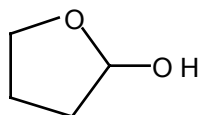
6. (6) Draw (S)-2-pentanol using both a perspective view (wedges and dotted lines) and a Fischer projection.

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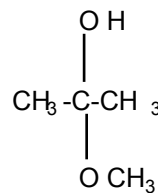
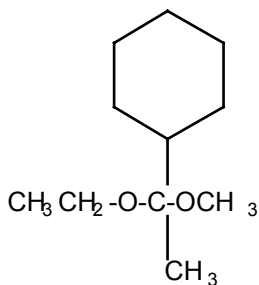
7. (9) Write a sequence of steps describing the mechanism of the acid-catalyzed dehydration of 2-butanol (overall reaction shown below).



8. (5) Identify each of the following compounds as a hemiacetal, hemiketal, acetal, ketal or hydrate.



\_\_\_\_\_



\_\_\_\_\_

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9. (4) Rank the compound below in order of decreasing acidity.

Benzene    benzoic acid    benzyl alcohol    phenol

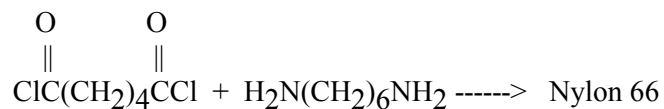
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Most acidic

\_\_\_\_\_

Least acidic

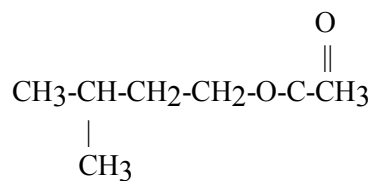
10. (4) Nylon 66 is the trade name for a polymer made from adipoyl chloride and 1,6-hexanediamine. Draw the repeating unit of this polymer.



11.(10) Explain, using resonance, why cyclohexylamine has a  $\text{pK}_b$  of 3.34 and aniline has a  $\text{pK}_b$  of 9.37. (Don't just draw the structures you must also explain)

12. (6) Give a simple chemical test that you would use in lab to differentiate between 1-pentanol and pentanal, be sure to denote how you would determine a positive reaction and which compound will give a positive test.

13. (14) An ester that contributes to the characteristic odor of bananas is:



(3) What is the name of this compound? \_\_\_\_\_

(5) You know two different reactions that would produce this product. Write the complete equation for one of these reactions. Do not write the names of the reactants, write the equation using formulas.

(4) In class we discussed LeChatelier's Principle with respect to increasing the yield of reactions to form an ester. Give an example of a way to increase the yield of the ester formation reaction, using LeChatelier's principle.

(2) Name one property that a compound must have in order to be effective as a scent or aroma.

14.(5) Rank the following compounds in order of increasing boiling points (B.P.):

butyl alcohol    methyl acetate    sodium butanoate    pentane    propionic acid

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

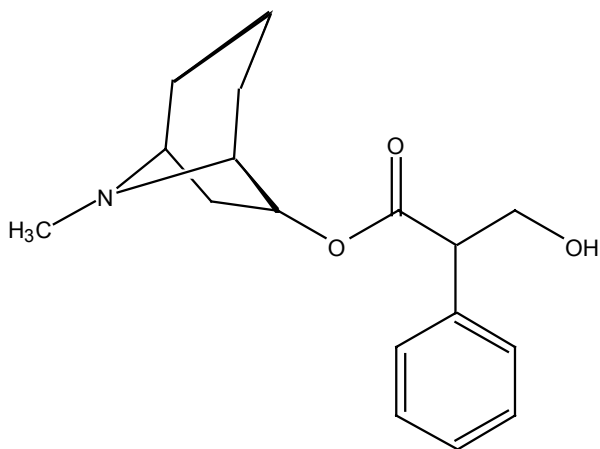
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\_\_\_\_\_

Lowest Boiling Point

Highest Boiling Point

15. (13) a) Circle the functional groups in the following molecule. Identify clearly what class of organic compound this functional group defines [For example: you would circle a double bond and denote that it defines an alkene]



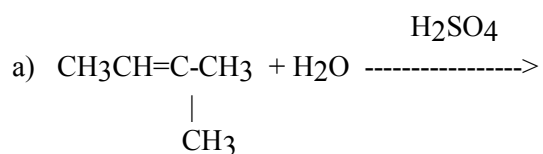
- b) The compound shown above is hyoscyamine. It is a drug used to relax smooth muscle spasm. It is dispensed in a timed-release capsule as hyoscyamine sulfate. What reaction was done by the drug company to form hyoscyamine sulfate (just name the reaction). Why would they want to dispense the drug in this form?
- c) Hyoscyamine is a derivative of a tropane alkaloid. What is an alkaloid?
16. (6) Parnate, a monoamine oxidase inhibitor, is used in the treatment of major depressive episodes. One theory for the cause of depression is that depression is caused by a functional decrease in either norepinephrine or dopamine. Why would a monoamine oxidase inhibitor be used to treat depression.

- b) The chemical name for Parnate is  $\pm$ -trans-2-phenylcyclopropylamine sulfate. What does the  $\pm$  mean?

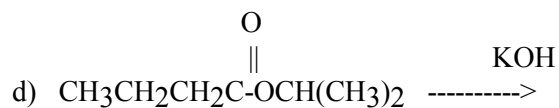
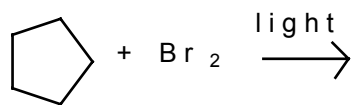
17. (9) Outline the sequence of reactions that will convert toluene to N-methylbenzylamine.

18. (5) Heroin is a derivative of morphine, where the hydroxyl groups on morphine are converted to esters. A 3 mg dose of heroin is equivalent to a 10 mg dose of morphine in its analgesic effect. Explain why heroin is more potent than morphine (include in your answer why the conversion causes the change).

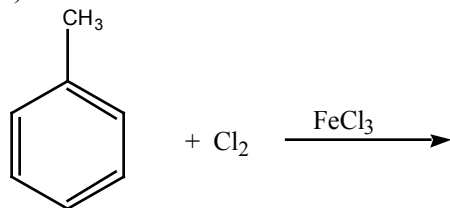
19. (40) Give the products for **ten (10)** of the following reactions. Do only ten if you do more than ten reactions only the first ten will be graded:



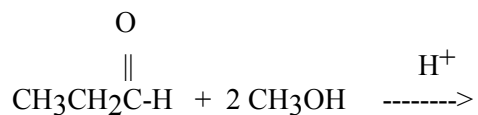
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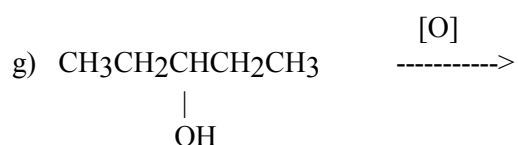
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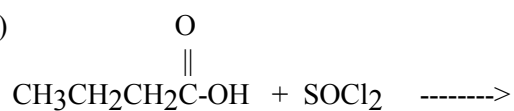
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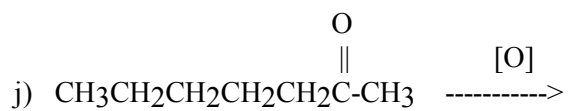
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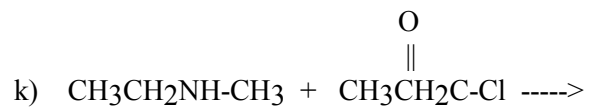
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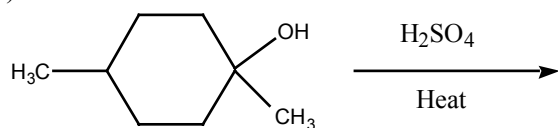
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k)



l)



m)



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