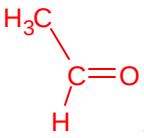
Chem 130: Chemistry for Funeral Services
Problem Set 8: Due 3/28/06

Name: **KEY** Date:

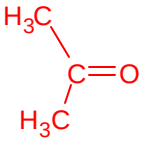
Each question is worth one point. Show your work wherever calculations are required.

1. What is the characteristic functional group of aldehydes and ketones? How is a ketone different from an aldehyde? Use structural formulas in your answer.

Aldehydes and ketones have a carbonyl group. Aldehydes have at least one hydrogen connected to the carbonyl carbon. Ketones only have carbons attached to the carbonyl carbon.



Sample aldehyde



Sample ketone

2. Describe the reaction of formaldehyde with ammonia. What is urotropin? Why does formaldehyde demand increase when there is an advanced state of decomposition?

Six formaldehyde molecules react with four ammonia molecules to form urotropin. Urotropen is a molecule that has several open and connected ring structures with bonds between methylene groups (CH_2) and nitrogen. Formaldehyde demand increases in with an advanced state of decomposition because there is more free nitrogen to react with the formaldehyde.

3. What happens to formaldehyde in basic solutions? Draw the structural equation. What is the name of this reaction? Why is it important to buffer formaldehyde solutions?

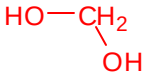
In basic solutions the Cannizzaro reaction occurs. This reaction describes the auto-oxidation/reduction reaction that can happen with aldehydes. For formaldehyde, 2 Formaldehyde molecules gives 1 Formic Acid molecule (oxidation product) and 1 Methanol molecule (reduction product). It is important to buffer formaldehyde solutions to keep conditions basic enough to avoid the formation of paraformaldehyde (the polymerization product that happens in acid solutions) but not so basic as to have the Cannizzaro reaction occur.

4. What is paraformaldehyde and how is it formed? How is paraformaldehyde formation minimized in embalming fluids?

Paraformaldehyde is the polymerization product of formaldehyde reacting with itself to form long chains of [CH_2O] units. This reaction happens in somewhat acidic solutions. Its formation is minimized by using buffers to keep the formaldehyde solution slightly basic.

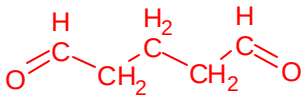
5. Describe an aqueous solution of formaldehyde. What is the solubility limit for formaldehyde in water? What structure does formaldehyde typically have in water?

An aqueous solution of formaldehyde can contain up to 37% formaldehyde gas (by weight). In solution, it tends to be in the form of the dihydroxy alcohol methylene glycol.



6. Draw the structure of a dialdehyde important in embalming. Why is it important in embalming?

Gluteraldehyde is a dialdehyde that is an alternate molecule to use embalming. It has the preservative ability of formaldehyde (with a different cross-linking mechanism that gives a softer tissue structure). It is also a good sterilant.



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7. What is a common use for ketones in embalming fluids? Give one example of a molecule used in this way.

Ketones are commonly used as solvents. Acetone (dimethyl ketone or propanone) can be used as an external solvent.

8. What is the characteristic functional group for a carboxylic acid? Describe how to name simple carboxylic acids. How are carboxylic acids important for embalming?

RCOOH To name a carboxylic acid, count the number of carbons and use the alkane root for than number of carbons then add "oic" as the ending. For example CH_3COOH has two carbons and so is derived from ethane. It's name is ethanoic acid. The common name is acetic acid.

9. Give the general structure for and describe a common use of each of the following in the embalming process.

Type of molecule	Common Structure	Typical use in Embalming
Dicarboxylic acids	RCOOH | RCOOH	The neutralization salts of these compounds are often used as precipitating anticoagulants. They tend to form insoluble salts with calcium ions. The insoluble salts precipitate. In doing so, they remove the calcium ions that help initiate blood clotting. This makes them anticoagulants.
Chelates	EDTA (full structure available in text book)	These compounds "wrap around" and bind calcium (and other) ions without precipitating. As such they are considered "sequestering agents" because they "hide" or sequester the calcium ions without precipitating. Since they also bind calcium ions, they are also considered to be anticoagulants.
Hydroxy Acids	RCOOH | H C –OH | RCOOH	These compounds are also used as sequestering anticoagulants because they bind calcium ions without precipitating (so they are soluble in water). Some bacteria can attack some of these products and produce molecules that promote blood-clotting. If such bacteria are present, hydroxy acids can actually promote blood clotting.

10. What is an ester? How are esters formed (the common reaction)? How are esters used in embalming? Give two examples of commonly encountered esters and give their structures (hint: see Table 17-4).

An ester is the product of an alcohol and a carboxylic acid reaction. (Resulting in an RCOOR structure.) Esters tend to be fragrant so they are often used as masking agents. Several possible structures possible. See Table 17-4.