

Part I – Short Answer

Choose a letter to fill in the blanks. Use choices as many times as you wish. Only one choice is needed per blank.

1. (3 points each) First set – functional groups

- | | |
|----------|---------------------------------------|
| A. ether | D. amine |
| B. ester | E. alcohol |
| C. amide | F. NONE of these fits the description |

__F__ contains a C=C double bond

__F__ is an acid

__D__ does not contain the element oxygen

__B__ can have a pleasant smell, such as wintergreen, pear, or banana

__D__ was one of the awful smells of the 8 ton 45-foot dead whale

2. (3 points each) Second set – plastics.

- | | |
|---------|---------------------------------------|
| A. PVC | E. PP |
| B. PS | F. NONE of these fits the description |
| C. HDPE | G. ALL of these fit the description |
| D. LDPE | |

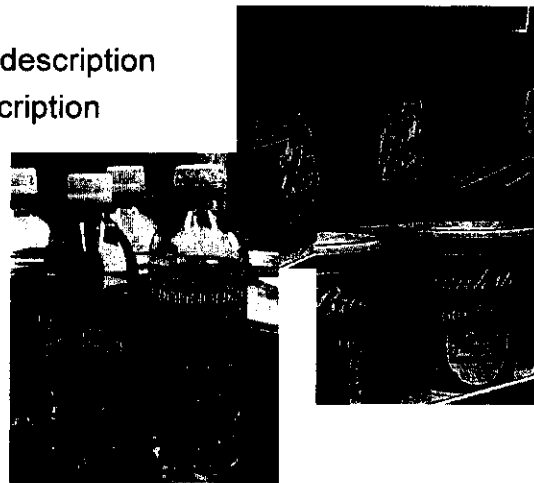
__G__ is an addition polymer

__A__ should not be burned (produces toxic fumes)

__C__ used for Tide containers and milk jugs

__E__ stable to fat/oil, and is used for yogurt

__F__ used for clear plastic water bottles



Part II – Acids, bases, this n’ that

1. (5 points) Write the balanced chemical equation for the reaction of sulfuric acid and ammonium hydroxide. (No partial credit)

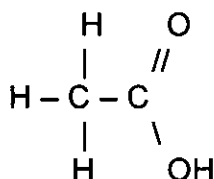


2. (4 points) What acid and base react to produce the salt calcium nitrate?

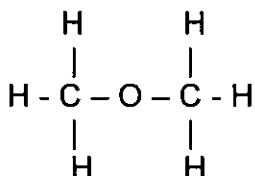
Chemical formula of acid: HNO_3

Chemical formula of base: $\text{Ca}(\text{OH})_2$

3. a. (3 points) Draw the structural formula for acetic acid (also called ethanoic acid). Show all bonds and atoms.



b. (4 points) Draw the structural formula for any one isomer of ethanol (also called ethyl alcohol). Show all bonds and atoms.

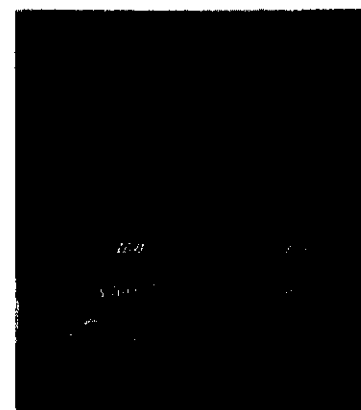


4. (12 points) Compare acetic acid with ethanol. Complete the table with Y for Yes or N for No.

	ethanol (Y/N)	acetic acid (Y/N)
Can react with another compound to form an ester.	Y	Y
Can react with another compound to form an amide.	N	Y
Can react with another compound to form a polymer.	N	N

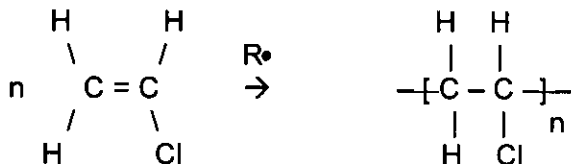
5. (3 points) Vinegar is a dilute solution of acetic acid. Identify the plastic used as a container for vinegar.

HDPE LDPE PVC PETE

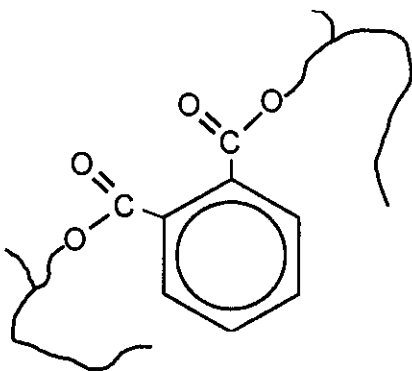


Part III – Polyvinyl Chloride

1. (5 points) Write the balanced chemical equation for n molecules of vinyl chloride polymerizing to form polyvinyl chloride. Use structural formulas and include a catalyst.



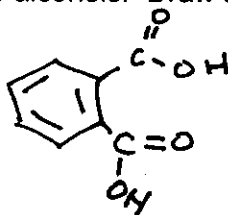
2. Here is a schematic representation of DEHP, di-(2-ethylhexyl) phthalate.



a. (3 points) The benzene ring is one functional group present in the molecule. Name the other.

ester

b. (3 points) DEHP can be synthesized from a "double" carboxylic acid and two alcohols. Draw a structural formula for the double acid.

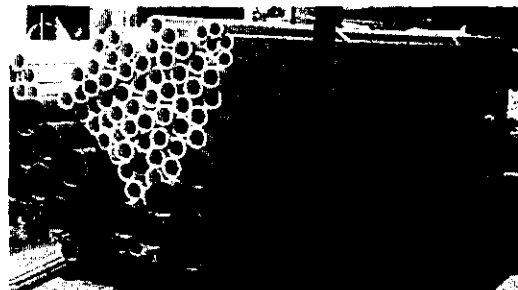


c. (4 points) Here is a photo of PVC pipe. Does it contain DEHP?

YES Explain (<20 words):

NO

No. DEHP is added to soften PVC. This pipe is rigid!



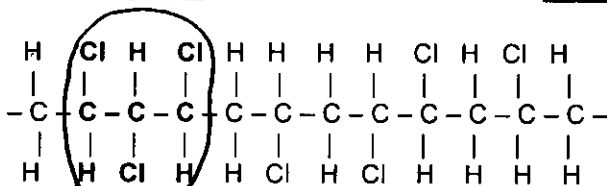
d. (3 points) The plasticizer DEHP is controversial because it is linked to a particular health concern. The concern is NOT cancer. What is it?

Several answers possible. Male reproductive organ changes.

Male abdominal obesity and/or insulin resistance (these were from the readings handed out)

Also accept: It can leach out during blood transfusions +1 point.

3. (4 points) Here is a segment of PVC. It has an error. Circle it.

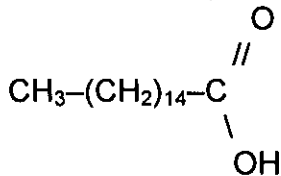


Error: A vinyl chloride monomer contains only 1 Cl atom. Two Cls can be next to each other in the chain, but it is not possible to have 3 chlorine atoms in a row.

Part IV – Peanut Oil

Peanut oil is characterized by the fatty acids that are part of the fat molecules, as shown by this slide from lecture.

1. (3 points) Palmitic acid (see slide) is a saturated fatty acid with 16 carbons. Draw the structural formula (condensed is fine).



2. (5 points) Peanut oil is not composed of fatty acid molecules.

Rather, the peanut oil molecules contain the ____ ester ____ functional group.

These peanut oil molecules are formed which molecules?
____ glycerin (glycerol) and 3 fatty acids ____.

3. (12 points) Peanut oil slowly goes rancid on exposure to oxygen. Mark with an X the statements that are True.

- X Oxygen is more soluble in peanut oil than in water
- Oxygen reacts with the saturated fatty acids that are part of peanut oil
- X Fats and oils that are slightly rancid are safe to eat (and cook with)
- Beef fat is more likely to go rancid than peanut oil.

4. (4 points) According to the slide, peanut oil is about 17% saturated fat. The other 83% is unsaturated. Unsaturated fats are either polyunsaturated or monounsaturated. Explain how the molecular structures of these two fats differ.

Polyunsaturated fats ____ contain more than one C=C _____

In contrast ...

Monounsaturated fats ____ only contain one C=C _____

Peanut oil

10% palmitic acid
2% stearic acid
+ 5% other saturated
~17 % saturated fat



Low level of saturation



Part V – Peanut Oil – Hydrogenated!

1. (4 points) Food manufacturers hydrogenate oils and use them in a variety of foods. Give two reasons.

Reason #1 Extends the shelf life (or less likely to go rancid)

Reason #2 Cheaper to use vegetable oils than butter.

Also possible: makes a 'spreadable' product that the oil doesn't separate out

Not possible: tastes better

2. (4 points) You have an oil and fully hydrogenate it. Will it contain any trans fats?

YES Explain: **NO**. If it is fully hydrogenated, there are no C=C bonds.

NO

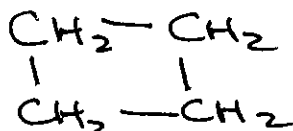
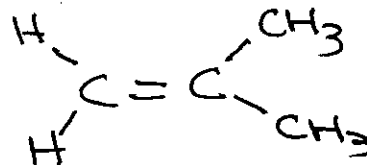
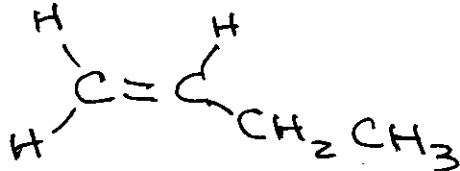
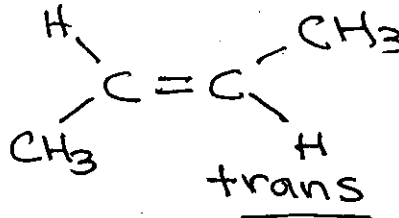
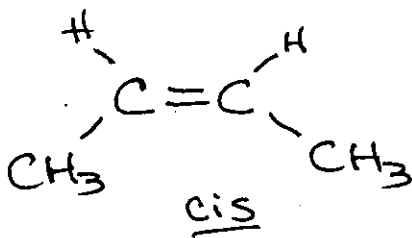
3. (3 points) Two of these molecules are more similar in shape and thus more similar in properties. Circle these two.

cis fatty acid

trans fatty acid

saturated fatty acid

4. (12 points) Draw any 4 isomers of C₄H₈. Carefully show all bonds and atoms.

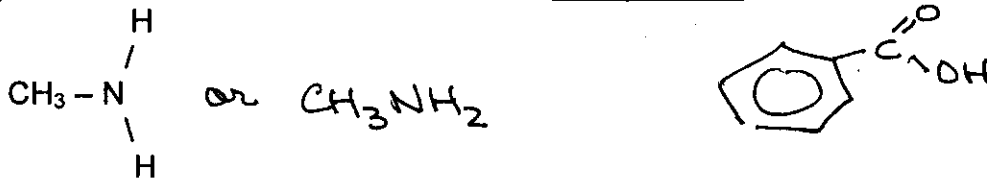


Here are the 5 possibilities:

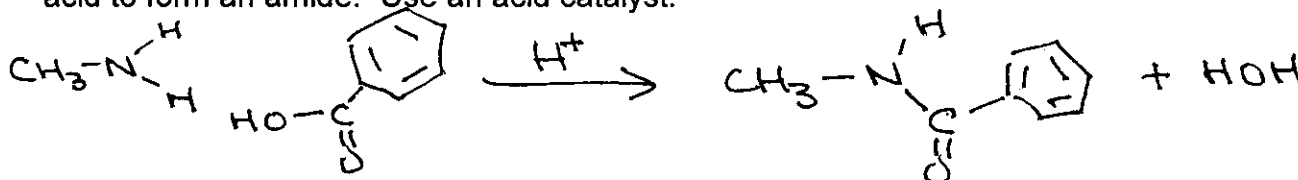
5. (4 points) In the isomers you drew above, label the ones that are cis or trans.

Part VI – Nylons

1. (6 points) Draw two structural formulas, one for methyl amine and one for benzoic acid.



2. (5 points) With structural formulas, show the reaction of methylamine and benzoic acid to form an amide. Use an acid catalyst.

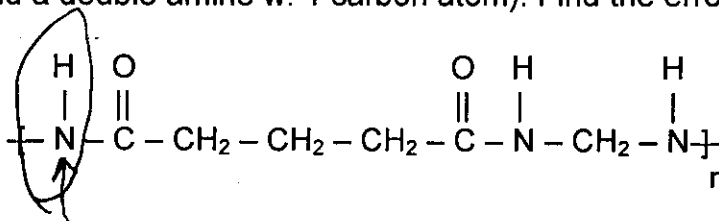


3. (3 points) Can you produce a nylon (a polyamide) using methylamine as one of the monomers?

YES Explain: NO. You need a "double amine" to form a polymer.

NO

4. (3 points) Here is a nylon made from two different monomers (a double acid w. 5 carbon atoms and a double amine w. 1 carbon atom). Find the error and correct it.



Error: The repeating unit has one extra NH in it.

5. (3 points) In the list below, circle the items that nylon is used for.

foam coffee cups

outdoor backpacks

clear beverage bottles

fibers for carpet

bristles in tooth brushes

gallon milk jugs