

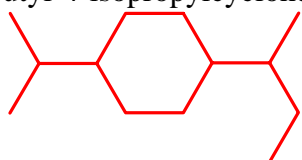
The test consists of six pages. Print your name legibly on each page now. A seventh page contains approximate pK values for some acids. You can tear this page off and use as scratch paper. **If something is not clear, raise your hand and ask!**

Page	Points
1	<u>16</u>
2	<u>17</u>
3	<u>24</u>
4	<u>16</u>
5	<u>14</u>
6	<u>13</u>
Total	<u>100</u>

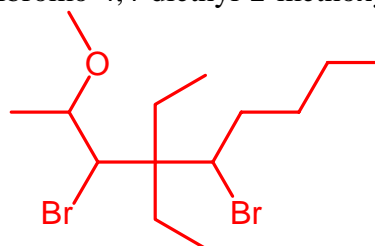
Points

- (4) 1. Draw the structure of each of the following alkanes (condensed, line, or combination): **2 pts each structure. 1 pt minor mistake.**

(a) 1-sec-butyl-4-isopropylcyclohexane



(b) 3,5-dibromo-4,4-diethyl-2-methoxynonane

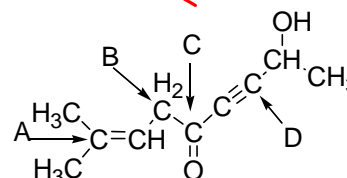


- (4) 2. In the structure at the right, identify the **hybridization** of the sigma bonds to each of the carbon atoms specified by a letter.

1 pt each

A: sp² B: sp³

C: sp² D: sp

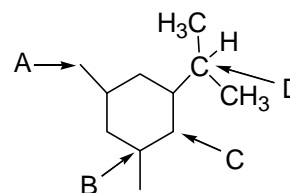


- (4) 3. In the structure at the right, identify whether each of the specified carbon atoms is a **primary**, **secondary**, or **tertiary** carbon.

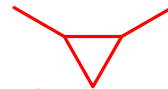
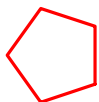
1 pt each

A: primary B: tertiary

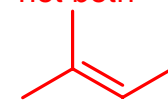
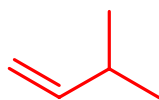
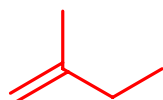
C: secondary D: tertiary



- (4) 4. Draw four **structural isomers** of the compound C₅H₁₀. **any 4, 1 pt each stereochemistry not needed**



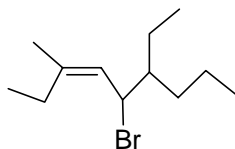
cis or trans,
not both



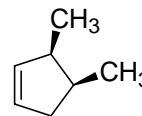
cis or trans,
not both

- (4) 5 Name the following compounds, including a *cis* or *trans* designation if necessary.
2 pts each. 1 pt for minor mistake.

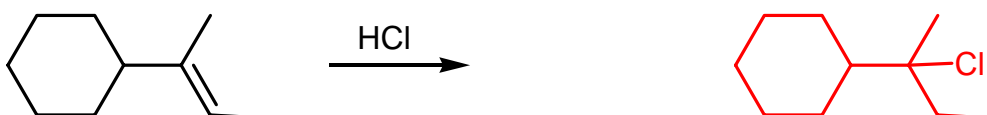
(a)



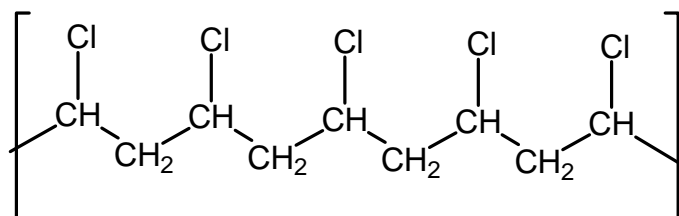
(b)

Name: cis-5-bromo-6-ethyl-2-methyl-3-noneneName: cis-3,4-dimethylcyclopentene

- (2) 6. Draw the structure of the major product of the following addition reaction:



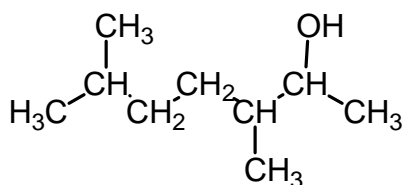
- (3) 7. Name the following addition polymer, and draw the structure of the monomer which polymerizes to form it. 1 pt name, 2 pts structure

Polymer Name: polyvinyl chloride

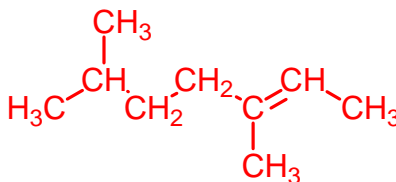
Monomer Structure:



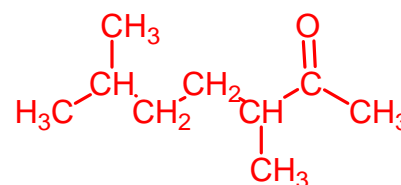
- (8) 8. Draw the **Saytzeff dehydration product** and the **oxidation product** of the following alcohol. Give the **IUPAC name** for each product. 2 pts each structure, 2 pts name, pt minor error.



Dehydration Product:

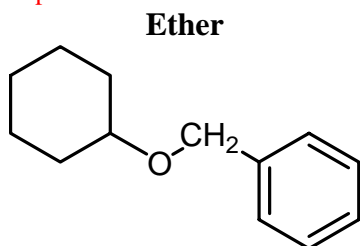
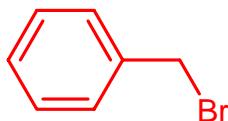
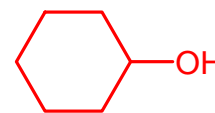
Name: 3,6-dimethyl-2-heptene
(okay if cis or trans is in name)

Oxidation Product

Name: 3,6-dimethyl-2-heptanone

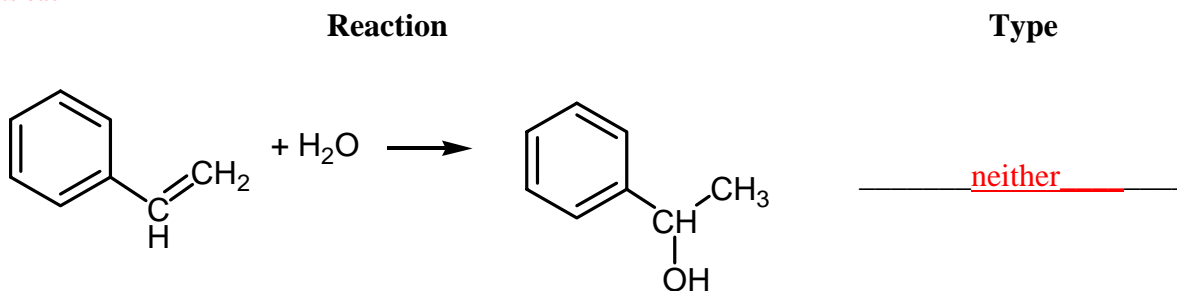
- (4) 9. The following ether can be synthesized by the Williamson synthesis from an alkyl bromide and an alcohol. Draw the structure of both the alkyl bromide and the alcohol that would be used.

2 pts each

**Alkyl Bromide****Alcohol**

- (4) 10. Identify the each of following reactions as an **oxidation**, a **reduction**, or **neither**.

2 pts each



- (2) 11. Tollen's reagent will oxidize aldehydes but not alcohols. What is the **oxidizing** agent in Tollen's reagent, and what product is produced as a positive test for aldehydes?

1 pt each

Oxidizing agent:**Ag⁺****Product:****Ag (or silver mirror)**

- (8) 12. Give the IUPAC name of the following carboxylic acids: 2 pts each

Common Name**IUPAC Name****Common Name****IUPAC Name**

malonic acid

propanedioic acid

isobutyric acid

2-methylpropanoic acid

adipic acid

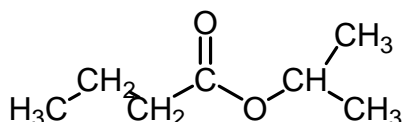
hexanedioic acid

acetic acid

ethanoic acid

- (6) 13. Give the **common name** of the following ester, and the **common names** of the acid and alcohol from which it is made.

2 pts each

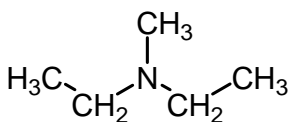
Common NamesEster: isopropyl butyrateAcid: butyric acidAlcohol: isopropyl alcohol

- (4) 14. Nylon 6,6 is a condensation polymer of two compounds. Give the names of the two compounds (IUPAC or common) which react to form nylon.

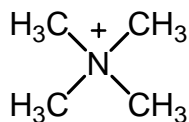
2 pts each

adipic acid (or hexanedioic acid) and 1,6-hexanediamine (or 1,6-diaminohexane)

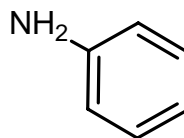
- (4) 15. Classify the following amines as **primary**, **secondary**, **tertiary**, or **quaternary**:



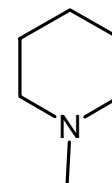
tertiary



Quaternary



primary

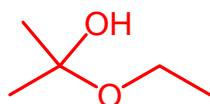


tertiary

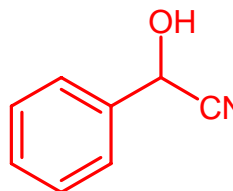
- (4) 16. Draw the structures of the following:

2 pts each

The **hemiketal** formed between **ethanol** and **propanone**:



The **cyanohydrin product** formed between **HCN** and **benzaldehyde**:



- (4) 17 Using the pK values from the last page, determine whether the following acid-base reactions:

1 pt each

A. Favor products in a greater than 10:1 ratio.

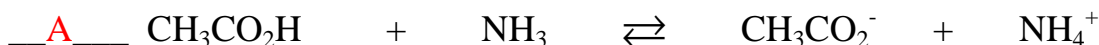
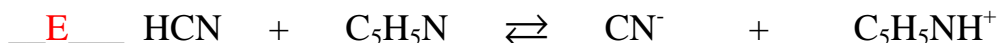
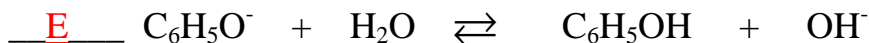
B. Favor products in a less than 10:1 ratio.

C. Form approximately equal amounts of reactants and products.

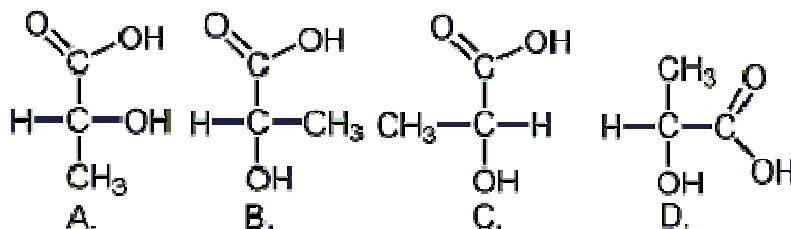
D. Favor reactants in a less than 10:1 ratio.

E. Favor reactants in a greater than 10:1 ratio.

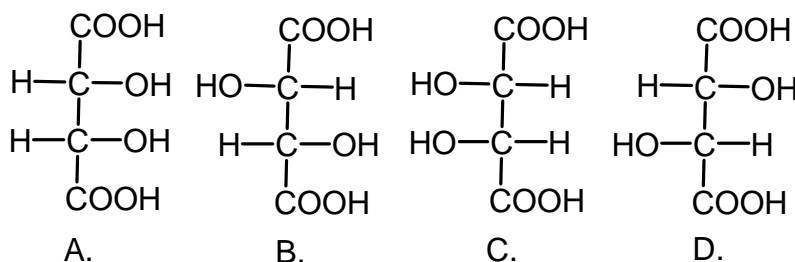
(Put the appropriate letter in the blank to the left of the reaction.)



- (3) 18. Following are different Fischer projection formulas of lactic acid. Indicate the relationship between the structure pairs—whether they represent **enantiomers** or **the same compound**.



- (a) Structures B and C enantiomers
- (b) Structures B and D enantiomers
- (c) Structures C and D same compound
- (4) 19. Following are four structures of tartaric acid. Indicate the relationship between the structure pairs below—whether they represent **enantiomers**, **diastereomers**, or **meso structures**.



- (a) Structures A and B diastereomers
- (b) Structures A and C meso compounds
- (c) Structures A and D diastereomers
- (d) Structures B and D enantiomers
- (7) 20. The structure of **prostacyclin** is shown below. This is an eicosanoid produced by the endothelial cells of the blood vessels which inhibits platelet aggregation and blood clotting.

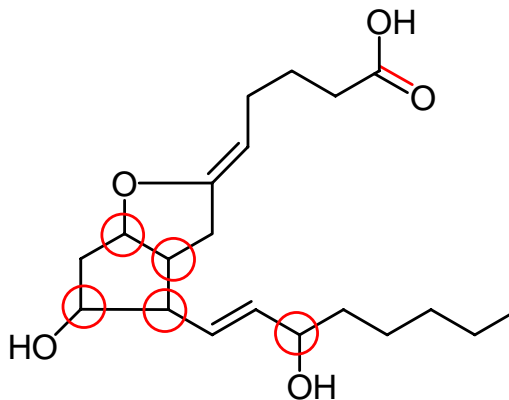
5 pts chiral carbons; 2 pts name

- (a) Circle all the chiral carbons in prostacyclin.

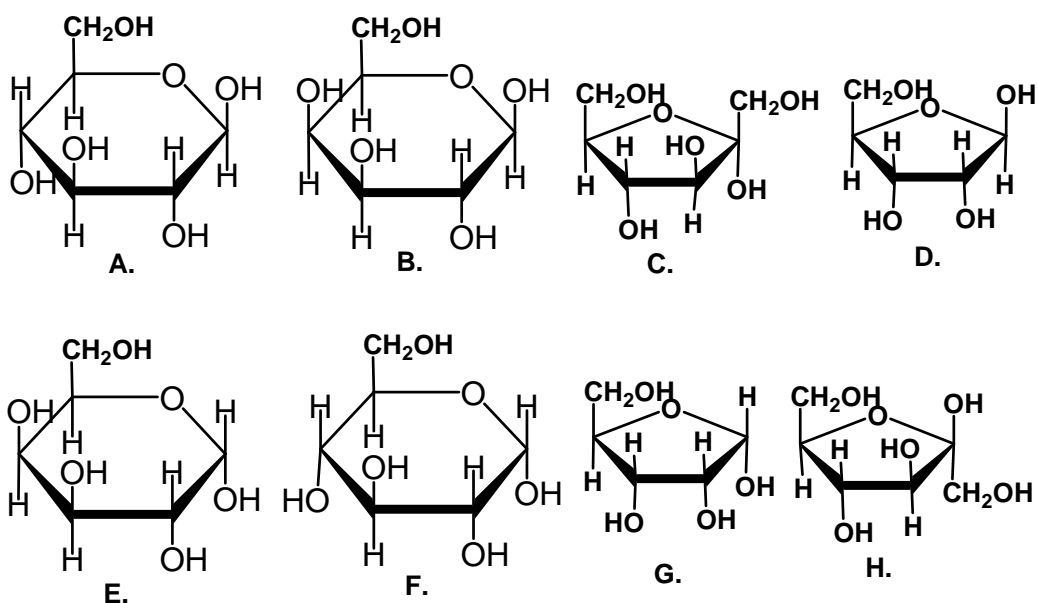
- (b) What is the name of the polyunsaturated fatty acid which is the precursor of prostacyclin?

Arachidonic acid

(or 5,8,11,14-eicosatetraenoic acid)



(9) 21. Following are several monosaccharides drawn in the Haworth projection.



(a) Identify the sugar below by putting the letter corresponding to its structure in the blank next to the name.

1 pt each

E alpha-D-galactopyranose H beta-D-fructofuranose

A beta-D-glucopyranose G alpha-D-ribofuranose

(b) Identify the isomeric relationship between the structure pairs indicated—whether they represent **structural isomers**, **epimers**, **diastereomers but not epimers**, or **not isomers**.

1 pt each

Structures A and B epimers

Structures A and F epimers

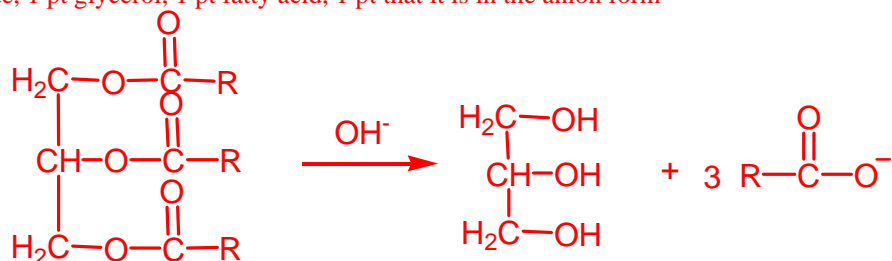
Structures C and E structural isomers

Structures C and G not isomers

Structures D and G epimers

(4) 22. The term **saponification** comes from the process of soap making. Show the reaction by which soap is made from fat by drawing the structure of both the reactants and products in this reaction.

1 pt triglyceride, 1 pt glycerol, 1 pt fatty acid, 1 pt that it is in the anion form



Relative Strengths of Some Acids and Bases:

Acid	Approx. pK _a	Base
HCl	-7	Cl ⁻
H ₃ O ⁺	-2	H ₂ O
C ₆ H ₅ NH ₃ ⁺	5	C ₆ H ₅ NH ₂
C ₅ H ₅ NH ⁺	5	C ₅ H ₅ N
RCO ₂ H	5	RCO ₂ ⁻
H ₂ CO ₃	6	HCO ₃ ⁻
NH ₄ ⁺	9	NH ₃
HCN	9	CN ⁻
C ₆ H ₅ OH	10	C ₆ H ₅ O ⁻
HCO ₃ ⁻	10	CO ₃ ⁻²
RNH ₃ ⁺	11	RNH ₂
H ₂ O	16	HO ⁻
RCH ₂ OH	16	RCH ₂ O ⁻