SL Organic Chemistry

Multiple Choice

Identify the letter of the choice that best completes the statement or answers the question.

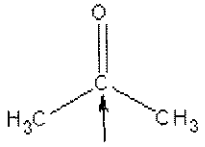
1. Which formula is that of a tertiary halogenoalkane?
   a. $(CH_3)_3CF$
   b. $CH_3CH_2CH_2F$
   c. $CH_3CHBrCH_2CH_3$
   d. $(CH_3)_2CH_2CH_2Br$

2. What kind of reaction does the equation below represent?
   $CH_2{=}CH_2 + Br_2 \rightarrow BrCH_2CH_2Br$
   a. Condensation
   b. Substitution
   c. Reduction
   d. Addition

3. Which formula represents an aldehyde?
   a. CH_3CH_2CHO
   b. CH_3COOCH_3
   c. CH_3COCH_3
   d. CH_3CH_2COOH

4. Which list is correctly ranked from least soluble in water to most soluble in water?
   I. Butan-1-ol Pentan-1-ol Hexan-1-ol
   II. Hexan-1-ol Pentan-1-ol Butan-1-ol
   III. Pentane Pentanal Pentan-1-ol
   IV. Pentan-1-ol Pentanal Pentane
   a. I and III only
   b. II and III only
   c. II and IV only
   d. I and IV only

5. What is the correct bond angle for the indicated carbon atom?

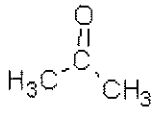


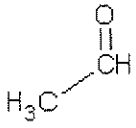
   a. 109.5^0
   b. 180^0
   c. 120^0
   d. 90^o

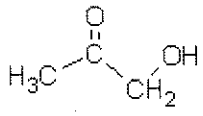
6. Which of these can be used to test for the presence of double bonds via a visible color change?
   I. Br_2 II. HBr III HCl
   a. I only
   b. I and II only
   c. II and III only
   d. I, II, or III

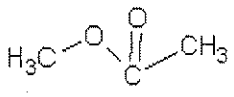
7. Reacting which of the following substances with acidified potassium dichromate will produce a color change from orange to green?
   I. Propan-1-ol
   II. Propan-2-ol
   III. Propanone
   a. I and II only
   b. I, II and III
   c. III only
   d. II and III only

8. Which of the following structures represents an aldehyde?

a. 

c. 

b. 

d. 

9. What is the best definition of a structural isomer?
   a. Compounds which have the same atomic numbers but different mass numbers
   b. Compounds that have the same general formula but differ by a CH_2 group
   c. Compounds that have the same molecular formula but a different arrangement of atoms
   d. Compounds that have the same empirical formula but a different molecular formula.

10. Which of the following could represent a repeating unit of a polymer formed by propene?
   a. (- $CH_2CH(CH_3)$ -)
   b. (- CH_2 - CH_2 - CH_2 -)
   c. (- $CH(CH_3)$ - $CH(CH_3)$ -)
   d. (- CH_2 - CH_2 -)

11. In which reaction does carbon undergo the greatest change in oxidation number?
   a. Ethanol to ethanal
   b. Ethanol to ethanoic acid
   c. Propan-2-ol to propanone
   d. Combustion of ethanol with oxygen to CO_2 and H_2O

12. What is the product when CH_2CH_2 reacts with F_2 ?
   a. CHF_2CH_3
   b. $CH_3CH_2F + HF$
   c. CH_2FCH_2F
   d. $CHF_2CH_3 + H_2$

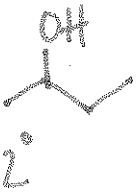
13. Which products can be formed from the incomplete combustion of a hydrocarbon?
   I. Carbon
   II. Hydrogen
   III Carbon monoxide
   a. I, II, and III
   b. I, and III only
   c. II and III only
   d. III only

Problem

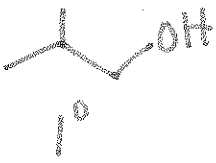
14. (a)Four alcohol isomers with the formula $C_4H_{10}O$ exist. Draw each isomer, provide its IUPAC name, and identify it a primary, secondary, or tertiary alcohol. [12].

butan-1-ol

2-methylpropan-2-ol



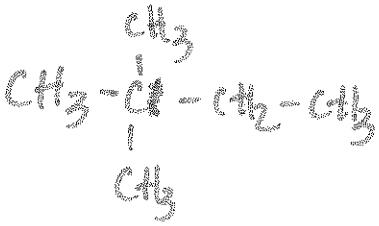
butan-2-ol



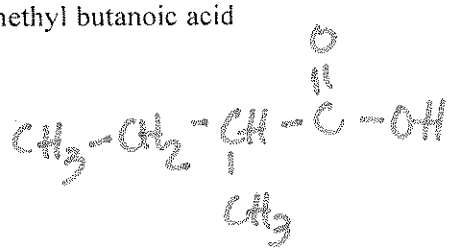
2-methylpropan-1-ol

15. Draw the structural formula of the following. Show all hydrogens [4]

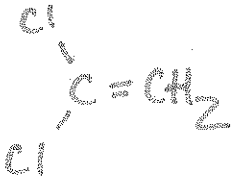
2,2 dimethyl butane



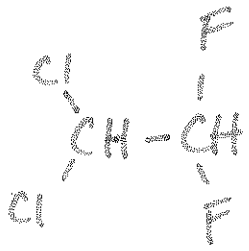
2 methyl butanoic acid



1,1 dichloroethene



1,1 dichloro 2,2 difluoro ethane

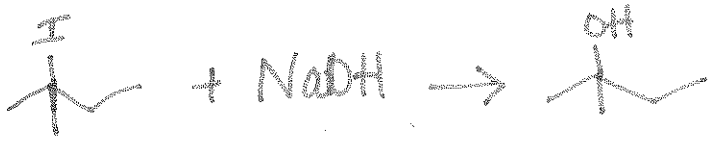


16. Define the term "nucleophile" and provide an example of a nucleophile. [2]

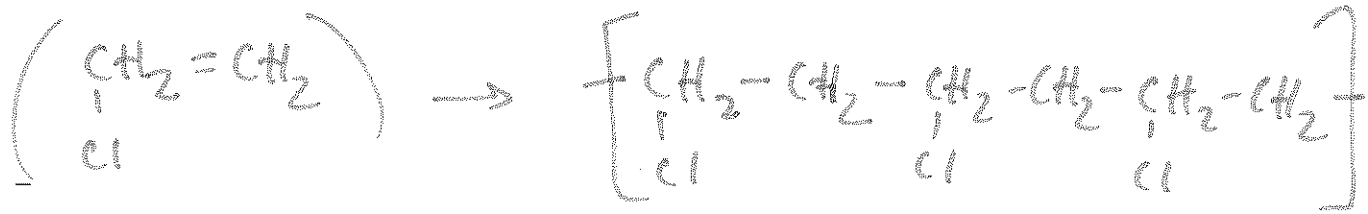
- partially neg. w/ lone pair - (+) loving

OH^-

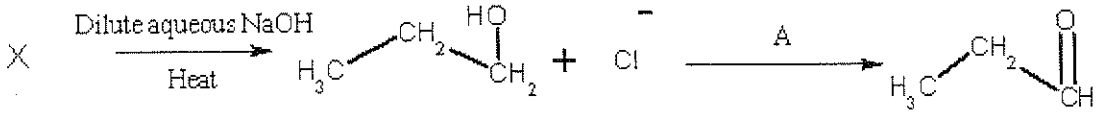
17. Give the most likely mechanism for the conversion of 2 methyl 2 iodobutane to 2 methyl butan -2-ol. [4]



18. Draw three repeating units of the polymer polychloroethene. [1]



19.



a) Draw the structure of reactant "X" [1]

B) Supply the reaction conditions at "A" to isolate the organic product given. [1]

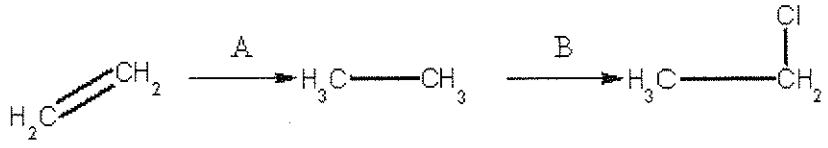
1° alcohol ⇒ aldehyde

heat, distillation

$K_2Cr_2O_7$

20. 

a) Complete the reaction above by drawing the structure of the most likely product to the right of the arrow[2]

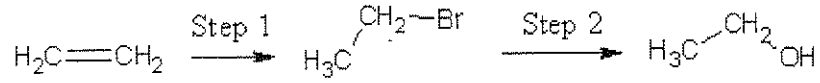
21. 

A) What reaction conditions are required for step A? [1]

add H_2 Ni catalyst

B) What reaction conditions are required for step B? [1]

substitution Cl· free radical, UV light

22. 

a) State the name of the reagent used for step 1 [1]

HBr

b) State the name of the reagent and the conditions used for step 2. [2]

nucleophilic substitution

NaOH

c) State the conditions required to make ethanol directly from ethene and state one important commercial use of ethanol. [2]

$CH_2=CH_2 + H_2O \rightarrow CH_3CH_2OH$

23. Three compounds with similar relative molecular masses are butane, propanal,and propan-1-ol.

a) List the three compounds in order of increasing boiling point (lowest first) and explain the differences in their boiling points. [4]

butane - lowest

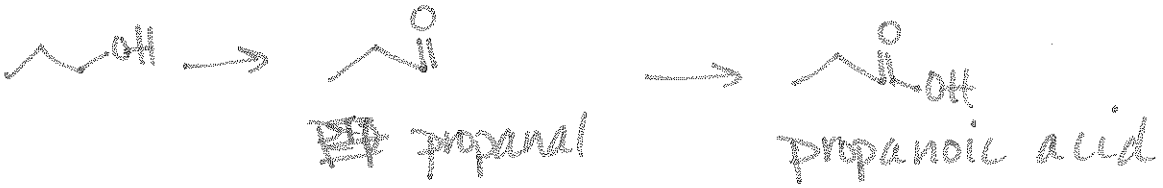
propanal

propan-1-ol highest b/c Hydrogen bonds

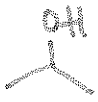
b) Predict, with an explanation, which of the three compounds is least soluble or miscible in water. [2]

butane - non polar

c)When propan-1-ol is oxidized using a warm acidified solution of potassium dichromate two different organic products can be obtained. Deduce the name and structural formula for each of the two products. [3]

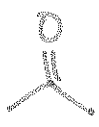


d) Propan-2-ol is an isomer of propan -1-ol.. Draw the structure of propan-2-ol.[1]



e) Identify the class of alcohols that propan-2-ol belongs to and state the name of the organic product formed when it is oxidized by an acidified solution of potassium dichromate. [2]

2° alcohols

→ ketone 

The compound C_2H_4 can be used as a starting material for the preparation of many substances.

(a) Name the compound C_2H_4 and draw its structural formula. $CH_2=CH_2$ ethene

(b) In the scheme below, state the type of reaction and identify the reagent needed for each reaction.

addition hydration oxidation

AB $C_2H_4 \rightarrow CH_3CH_2OH \rightarrow CH_3COOH$

H_2O $K_2Cr_2O_7$, H^+, heat under reflux

(c) C_2H_4 can be converted into one of the compounds below in a single step reaction.

C_2H_3Cl $C_2H_4Cl_2$ $Cl-CH_2-CH_2-Cl$

Draw the structural formula for each of these compounds and identify the compound which can be formed directly from C_2H_4.

(d) One of the two compounds in (c) has an isomer. Draw the structural formula of the isomer and explain why it can not be formed directly from C_2H_4.

(e) C_2H_4 can also react to form a polymer. Name this **type** of polymer and draw the structural formula of a section of this polymer consisting of three repeating units.

addition polymer $[CH_2-CH_2-CH_2-CH_2-CH_2-CH_2]$

not responsible for this

(f) Polymers can also be formed in a different type of reaction. Identify this type of reaction and name **two** different types of such polymers.

Condensation

Identify which of the compounds butane, chloroethane, propanone and propan-1-ol are

(i) insoluble in water and give your reasoning. butane nonpolar chloroethane no H bond slight solubility

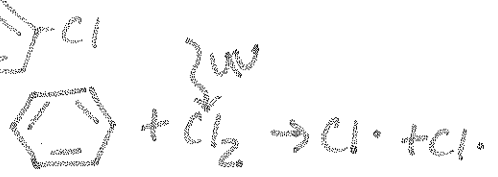
(ii) water soluble and give your reasoning.

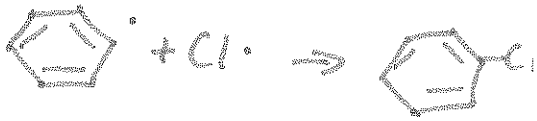
propan-1-ol H-bonding
propanone oxygen - polar

Methylbenzene, $C_6H_5CH_3$, reacts with Cl_2 to form different products depending on the conditions used. For the gas-phase reaction of $C_6H_5CH_3$ and Cl_2 in ultraviolet light,

(a) draw a structural formula for the product C_7H_7Cl.

(b) provide a stepwise mechanism, clearly labelling each step.





(c) explain the role of the ultraviolet light.

breaks bond between Cl-Cl {homolytic fission equally

Ethene, propene and but-2-ene are members of the alkene homologous series. contain double bond

(a) Describe **three** features of members of a homologous series. vary by $-CH_2$

(b) State and explain which compound has the highest boiling point.
but-2-ene more carbons

(c) Draw the structural formula and give the name of an alkene containing five carbon atoms.
pent-2-ene

(d) Write an equation for the reaction between but-2-ene and hydrogen bromide, showing the structure of the organic product. State the type of reaction occurring. addition
+ HBr →

(e) Propene can be converted to propanoic acid in three steps:

step 1 propene → propan-1-ol → step 2 propanal → step 3 propanoic acid

State the type of reaction occurring in steps 2 and 3 and the reagents needed. Describe how the conditions of the reaction can be altered to obtain the maximum amount of propanal, and in a separate experiment, to obtain the maximum amount of propanoic acid.
oxidation $K_2Cr_2O_7$ H+
distill heat under reflux

(f) Identify the strongest type of intermolecular force present in each of the compounds propan-1-ol, propanal and propanoic acid. List these compounds in decreasing order of boiling point.
H bond dipole H bond

1. propanoic acid
2. propan-1-ol
3. propanal