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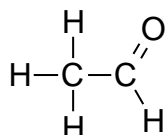
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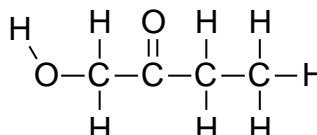
Assignment on Alcohols and Carboxylic Acids

1. An organic compound, **X**, has the empirical formula C_2H_4O and a relative molecular mass of 88. It reacts with ethanol in the presence of concentrated sulphuric acid to produce a sweet smelling liquid. Which one of the following structures could **X** have?

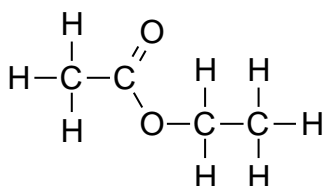
A



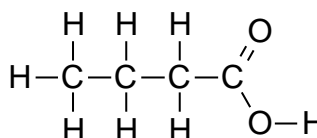
B



C



D



2. Which one of the following substances is formed when propan-1-ol (C_3H_7OH) is oxidised by acidified sodium dichromate(VI) ($Na_2Cr_2O_7$)?

A C_3H_8

B C_3H_6

C C_3H_7ONa

D C_2H_5COOH

3. Which one of the following is the correct formula for the ester formed when butanoic acid ($CH_3CH_2CH_2COOH$) reacts with methanol (CH_3OH)?

A $CH_3COOCH_2CH_2CH_3$

B $CH_3CH_2COOCH_2CH_3$

C $CH_3CH_2COOCH_3$

D $CH_3CH_2CH_2COOCH_3$

4. Which one of the following compounds has more than two carbon atoms per molecule?

A Ethyl ethanoate.

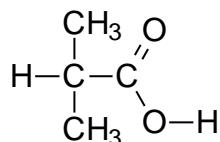
B Ethene.

C Ethanol.

D Ethane.

5. Fermentation is a process involving the conversion of:
- A Hydrocarbons to ethanol plus carbon monoxide gas.
 - B Hydrocarbons to ethanol plus carbon dioxide gas.
 - C Carbohydrates to ethanol plus carbon monoxide gas.
 - D Carbohydrates to ethanol plus carbon dioxide gas.

6. The compound with the structure:



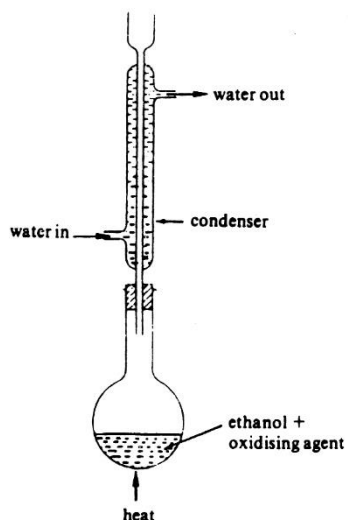
is a member of which homologous series?

- A Acids.
 - B Alcohols.
 - C Alkanes.
 - D Alkenes.
7. What is the formula of the ester formed when propanoic acid reacts with ethanol?
- A $\text{C}_2\text{H}_5\text{COOCH}_3$
 - B $\text{CH}_3\text{COOCH}_3$
 - C $\text{C}_2\text{H}_5\text{COOC}_2\text{H}_5$
 - D $\text{CH}_3\text{COOC}_2\text{H}_5$
8. What are the molecular formulae and empirical formulae of ethanoic acid?

	Molecular Formula	Empirical Formula
A	CH_2O	$\text{C}_2\text{H}_4\text{O}$
B	$\text{C}_2\text{H}_4\text{O}_2$	$\text{C}_2\text{H}_4\text{O}_2$
C	$\text{C}_2\text{H}_4\text{O}_2$	CH_2O
D	$\text{C}_2\text{H}_6\text{O}$	$\text{C}_2\text{H}_6\text{O}$

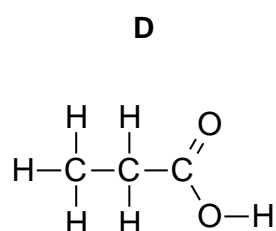
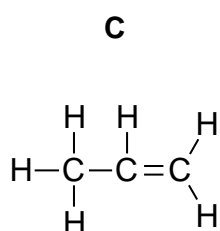
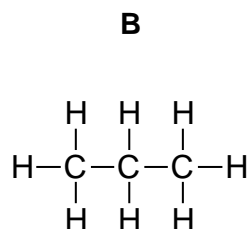
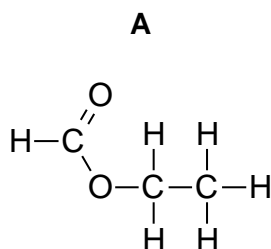
9. Ethanol vapour ($M_r = 46$) was bubbled through concentrated sulphuric acid. A gas **X** was produced which decolourised bromine water. Which one of the following is the molecular formula of gas **X**?
- A CH_4
 - B C_2H_4
 - C C_2H_6
 - D C_3H_6
10. Ethanol is manufactured by a reaction between:
- A ethane and oxygen.
 - B ethene and oxygen.
 - C ethane and steam.
 - D ethene and steam.

11. Ethanol was oxidised to ethanoic acid using the apparatus shown below:



The purpose of the condenser was to prevent the:

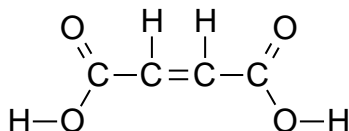
- A Conversion of the ethanol to ethene.
 - B Escape of any unreacted ethanol.
 - C Reforming of ethanol from the ethanoic acid.
 - D Reaction of the ethanoic acid with the ethanol.
12. Which one of the following equations represents the complete combustion of C_3H_7OH ?
- A $C_3H_7OH + O_2 \rightarrow C_2H_5COOH + H_2O$
 - B $2C_3H_7OH + 3O_2 \rightarrow 6C + 8H_2O$
 - C $2C_3H_7OH + 5O_2 \rightarrow 6CO_2 + H_2$
 - D $2C_3H_7OH + 9O_2 \rightarrow 6CO_2 + 8H_2O$
13. An organic compound **Z** reacts separately with sodium, sodium hydroxide and sodium carbonate. Which of the following can represent the structure of **Z**?



14. What reacts at room temperature with ethanol and also with ethanoic acid?

- A** Calcium carbonate.
- B** Methanol.
- C** Copper(II) oxide.
- D** Sodium.

15. The structural formula of butenedioic acid is given below:



Which one of the following statements about butenedioic acid is **not** correct?

- A** It is an unsaturated compound.
- B** Its empirical formula is the same as its molecular formula.
- C** Its relative molecular mass is 116.
- D** It decolourises bromine.

16. Ethanol is used in some perfumes and deodorants. Which pair of properties makes it suitable for these uses?

- A** It is flammable and mixes easily with water.
- B** It is flammable and vaporises easily.
- C** It is colourless and has a low freezing point.
- D** It is a good solvent and vaporises easily.

17. When glasses of wine or beer are left standing in the air for some time they become acidic. Which equation represents this change?

- A** $\text{CH}_3\text{CH}_2\text{OH} + \text{CO} \rightarrow \text{CH}_3\text{CH}_2\text{COOH}$
- B** $\text{CH}_3\text{CH}_2\text{OH} + \text{O}_2 \rightarrow \text{CH}_3\text{COOH} + \text{H}_2\text{O}$
- C** $\text{CH}_3\text{CH}_2\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$
- D** $2\text{CH}_3\text{CH}_2\text{OH} + \text{O}_2 \rightarrow 2\text{CH}_3\text{COOH} + 2\text{H}_2$

18. The reaction between a carboxylic acid, $\text{C}_x\text{H}_y\text{CO}_2\text{H}$, and an alcohol, $\text{C}_n\text{H}_{2n+1}\text{OH}$, produces an ester. How many hydrogen atoms does one molecule of the ester contain?

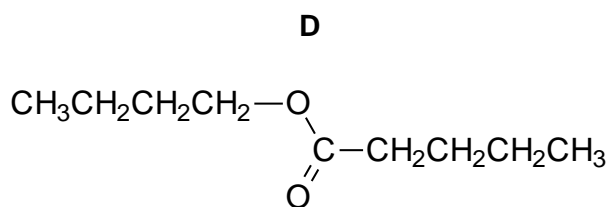
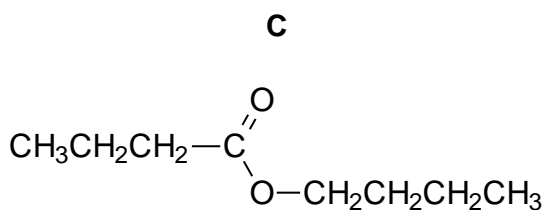
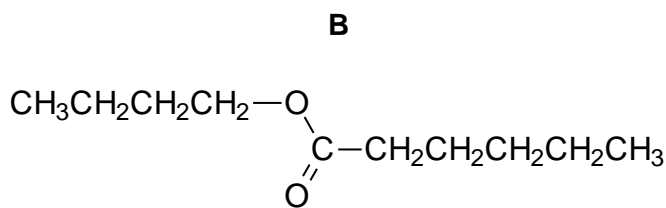
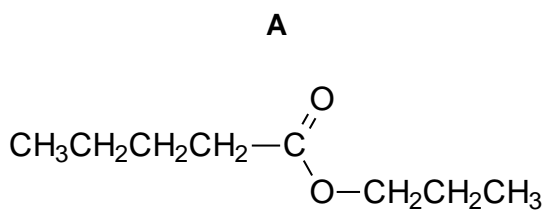
- A** $y + 2n$
- B** $y + 2n + 1$
- C** $y + 2n + 2$
- D** $y + 2n + 3$

19. An ester of molecular formula $C_4H_8O_2$ was produced by the reaction of an alcohol with a carboxylic acid.

	Alcohol	Acid
1	Methanol	Propanoic Acid
2	Ethanol	Ethanoic Acid
3	Propanol	Methanoic Acid

Which of the following could be the alcohol and the acid?

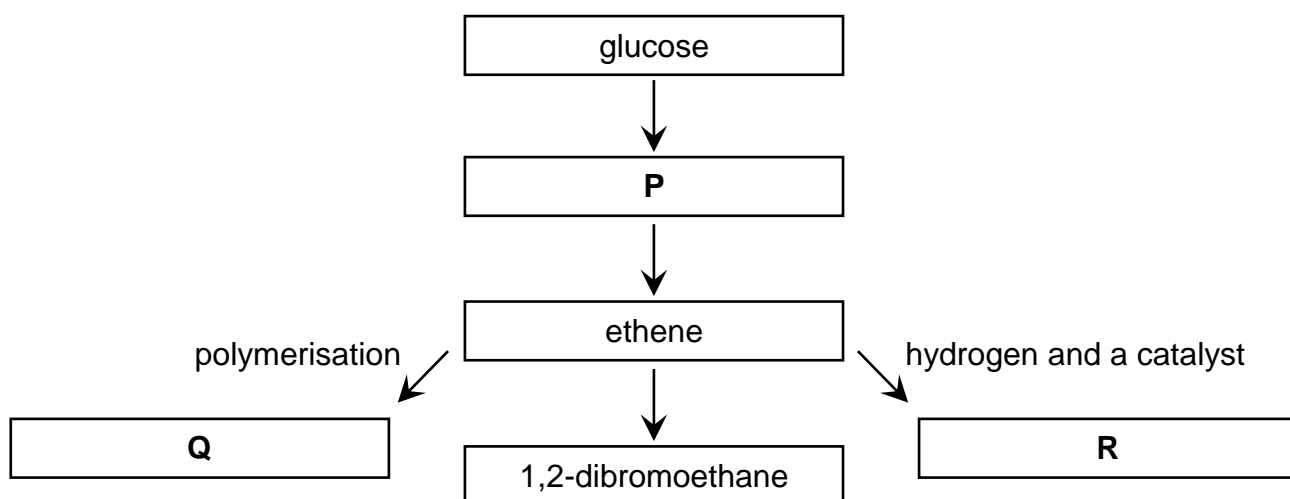
- A 1, 2 and 3.
 B 1 and 2 only.
 C 1 and 3 only.
 D 2 only.
20. Pentanoic acid has the formula $CH_3CH_2CH_2CH_2CO_2H$.
 Which formula represents butyl pentanoate?



- Write your answers to the multiple choice questions in the table provided below.

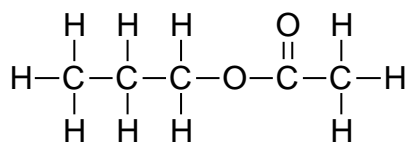
1.	2.	3.	4.
5.	6.	7.	8.
9.	10.	11.	12.
13.	14.	15.	16.
17.	18.	19.	20.

21. Carefully study the reaction scheme below and use it to answer the questions that follow:



- a) i) Give the names of the substances and the conditions needed to ferment glucose:
 Substances:
 Conditions:
- ii) Give the name of the gas that is produced during the fermentation of glucose and describe a chemical test for this gas:
 Name of gas:
 Test for gas:
 Observation:
- b) i) Give the name and molecular formula of substance **P**:
 Name:
 Molecular formula:
- ii) Give the names of substances **Q** and **R**:
 Substance **Q**:
 Substance **R**:
- c) Write the equation for the addition reaction between propene and bromine:

22. The structure of an ester made in a reversible reaction between a carboxylic acid and an alcohol is given below:



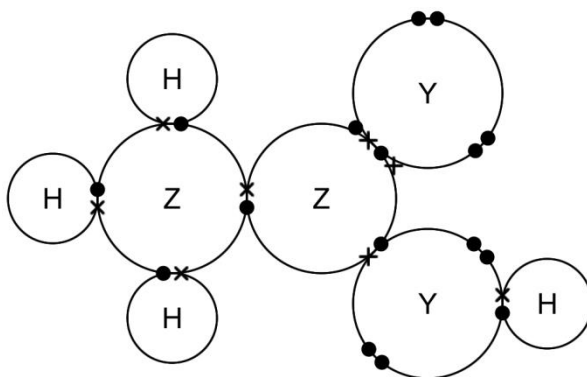
- a) Name the ester.

- b) State the conditions under which a carboxylic acid and alcohol react to form an ester.

- c) Write an equation for the formation of this ester.

- d) Draw the structure of the carboxylic acid used in this reaction.

23. The diagram below shows the arrangement of electrons in a compound of hydrogen, H, element Y and element Z. Only outer shell electrons are shown.

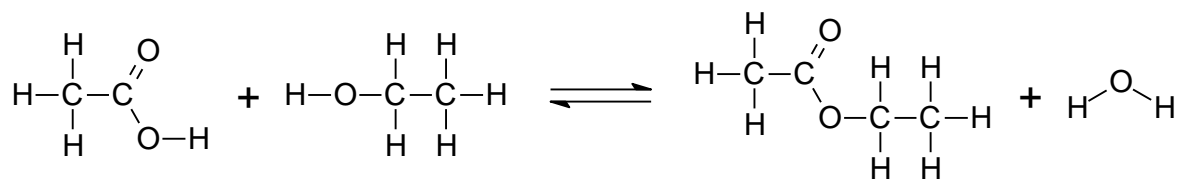


- a) What type of bonding is present in this compound?

- b) Elements Y and Z have atomic numbers between 2 and 11. Name elements Y and Z.
 Element Y:
 Element Z:
- c) Using the correct atomic symbols for elements Y and Z,
 i) Draw the full structural formula of the compound.

- ii) Give the empirical formula of the compound.

24. Ethyl ethanoate is made from a reaction between ethanoic acid and ethanol:



ethanoic acid + ethanol \rightleftharpoons ethyl ethanoate + water

The table below gives the relative molecular masses for the reactants and products in the reaction:

Chemical	Relative Molecular Mass (M_r)
Ethanoic acid	60
Ethanol	46
Ethyl ethanoate	88
Water	18

In an experiment, 3.0 g of ethanoic acid and 4.6 g of ethanol were heated together with a catalyst.

- a) Prove by calculation that ethanoic acid is the limiting reagent for this reaction.
- b) What mass of ethyl ethanoate would be made if there was 100% conversion?
- c) In the experiment, only 2.20 g of ethyl ethanoate were obtained. What was the percentage yield of ethyl ethanoate?

25. The table shows some information about the homologous series of a class of organic compounds called acyl chlorides.

Name	Condensed Formula	Display Formula
ethanoyl chloride	CH ₃ COCl	$ \begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{C} \\ \quad // \\ \text{H} \quad \text{O} \\ \quad \quad \backslash \\ \quad \quad \text{Cl} \end{array} $
butanoyl chloride	C ₃ H ₇ COCl	$ \begin{array}{cccc} & \text{H} & \text{H} & \text{H} & & \text{O} \\ & & & & & // \\ \text{H} & -\text{C} & -\text{C} & -\text{C} & - & \text{C} \\ & & & & & \backslash \\ & \text{H} & \text{H} & \text{H} & & \text{Cl} \end{array} $

- a) i) Fill in the table to show the name, condensed formula and displayed formula of the acyl chloride that occurs between ethanoyl chloride and butanoyl chloride in the homologous series.
- ii) Explain how you can tell that these molecules are from the same homologous series.

- iii) Predict the condensed formula for the acyl chloride that contains nine carbon atoms.

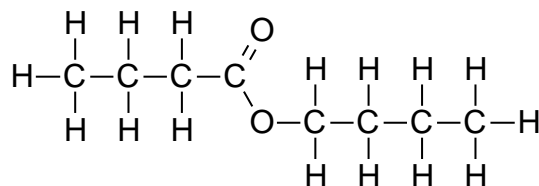
- b) Ethanoyl chloride reacts with ethanol in the following reaction:
- $$\text{CH}_3\text{COCl} + \text{C}_2\text{H}_5\text{OH} \rightarrow \text{CH}_3\text{COOC}_2\text{H}_5 + \text{HCl}$$
- i) Name the ester that is formed by this reaction.

- ii) Ethanoic acid also reacts with ethanol. Write an equation for the reaction between ethanoic acid and ethanol.

- iii) Give one **similarity** and one **difference** between the reaction of ethanoyl chloride with ethanol and the reaction of ethanoic acid with ethanol.
- Similarity:
-
- Difference:
-

26. Esters are organic compounds that have a sweet, fruity aroma. They are used as organic solvents and are widely used in the food industry and perfumery.

a) The structural formula of an ester is given below:



This ester is found to occur naturally in pineapples.

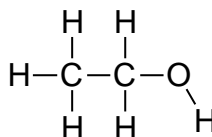
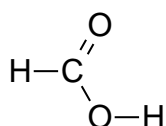
i) Name the ester.

.....

ii) Give the structural formulae and names of the carboxylic acid and alcohol that are used to make this ester.

Carboxylic Acid	Alcohol
Structural Formula	Structural Formula
Name:	Name:

b) An ester commonly found in lemons and strawberries can be made from the carboxylic acid and alcohol whose structural formulae are given below:



i) Name the carboxylic acid and the alcohol.

Carboxylic acid:

Alcohol:

b) Give the structural formula and name of the ester that is produced when the carboxylic acid and alcohol react together.

Structural Formula
Name:

- Scan the QR code given below to view the answers to this assignment.



http://www.chemist.sg/organic_chem/assignments/acids_alcohols_ans.pdf