Alcohols and carboxylic acids

Edexcel GCSE Chemistry (1CH0) · Foundation and Higher

Show your working where needed. Check the worked answers when you finish.

Name _____ Date _____

1. Identify the functional groups

Sort CH_3CH_2OH, $HCOOH$, $CH_3CH_2CH_3$ and CH_3CH_2COOH into alcohol, carboxylic acid or neither. Underline the characteristic group in each alcohol and acid.

2. Recognising an alcohol series

Name CH_3OH and $CH_3CH_2CH_2OH$. State how the molecular formula changes from one member of the alcohol series to the next.

3. Changing a functional group

Ethanol can be converted to ethanoic acid. Name the type of reaction. Use the same change to predict the name and condensed structural formula of the product from butan-1-ol.

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4. Testing ethanoic acid

A pupil adds calcium carbonate to ethanoic acid. State what they would see and give a test and expected result for the gas produced.

5. Yeast in a sugar solution

A pupil adds yeast to an aqueous glucose solution. In warm conditions with very little oxygen, ethanol and a gas form. Name the process and the gas. Explain why adding yeast helps.

6. Separating a mixture

Fermentation gives a mixture of ethanol and water. Ethanol boils at 78 °C and water at 100 °C at the same pressure. Name a method for collecting an ethanol-rich liquid. Explain how the mixture and the selected component behave during the process.

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7. A different reaction of ethanol

Ethanol can lose a molecule of water to form a product. Name the type of reaction and draw the displayed formula of the organic product. Show all its covalent bonds.

8. Higher · acids at the same concentration

Ethanoic acid and hydrochloric acid solutions have the same concentration. Which has the higher pH? Explain your choice in terms of particles in solution.

9. Extra challenge · Choose between two reaction routes

Lab records say an ethanol sample was either oxidised or dehydrated. Trial A gives a liquid that fizzes with sodium carbonate. Trial B gives a gas that turns orange bromine water colourless.

Assign a route to each trial. Name each organic product and draw its displayed formula.

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Worked answers

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1. Identify the functional groups

CH_3CH_2OH is an alcohol with an -OH group. HCOOH and CH_3CH_2COOH are carboxylic acids with a -COOH group. $CH_3CH_2CH_3$ is neither.

2. Recognising an alcohol series

CH_3OH is methanol. $CH_3CH_2CH_2OH$ is propan-1-ol, often called propanol at this level. Each successive member has one extra carbon atom and two extra hydrogen atoms, a difference of CH_2.

3. Changing a functional group

The reaction is oxidation. Butan-1-ol gives butanoic acid, $CH_3CH_2CH_2COOH$. The product still has four carbon atoms and has an acid group at the end of the chain.

4. Testing ethanoic acid

The mixture fizzes as carbon dioxide forms. Pass it through limewater. The limewater becomes cloudy.

5. Yeast in a sugar solution

The process is fermentation and the gas is carbon dioxide. Enzymes in the yeast catalyse the conversion of glucose to ethanol and carbon dioxide.

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Worked answers

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6. Separating a mixture

Use fractional distillation. The vapour above the heated mixture is richer in lower-boiling ethanol. Repeated evaporation and condensation in the column enrich the vapour further. Cooling the vapour that leaves the column gives an ethanol-rich liquid.

7. A different reaction of ethanol

The reaction is dehydration. Ethene forms. Draw two carbons joined by a double bond and two C-H single bonds on each carbon.

8. Higher · acids at the same concentration

Ethanoic acid has the higher pH. It partially ionises in water, whereas hydrochloric acid ionises completely. The ethanoic acid solution has fewer hydrogen ions per unit volume.

9. Extra challenge · Choose between two reaction routes

A was oxidation, forming ethanoic acid. Its -COOH group reacts with carbonates to release carbon dioxide. Draw CH_3-C(=O)-O-H, showing each bond to H.

B was dehydration, forming ethene, CH_2=CH_2. Show two C-H bonds on each carbon and the C=C double bond. Ethene's double bond reacts with bromine.

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