

Edexcel IAL Chemistry

A-Level

Topic 20 - Organic synthesis

Flashcards

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What should be taken into account when choosing a reaction pathway to synthesise a product?



What should be taken into account when choosing a reaction pathway to synthesise a product?

- Quickest process possible.
- Readily available reactants.
- Safety of conditions and reactants required.
- Highest atom economy possible.



A sample containing only hydrogen and carbon is burned in oxygen. 0.069 g of CO_2 and 0.0113 g of H_2O is produced. What is the empirical formula of the sample burned?



A sample containing only hydrogen and carbon is burned in oxygen. 0.069 g of CO_2 and 0.0113 g of H_2O is produced. What is the empirical formula of the sample burned?

Moles of carbon in the sample = $(0.069/44) = 0.00157$.

Moles of hydrogen in the sample = $(0.0113/18) \times 2 = 0.00126$.

Ratio of carbon to hydrogen = 1.25 : 1.

Empirical formula ratio = 5 : 4 so the empirical formula is C_5H_4 .



A compound has the empirical formula HO and the relative formula mass is 34.
What is the molecular formula?



A compound has the empirical formula HO and the relative formula mass is 34. What is the molecular formula?

Empirical formula mass = $16 + 1 = 17$

$34/17 = 2$ so the molecular formula is H_2O_2 .



What is the percentage mass of copper
in copper sulfate?



What is the percentage mass of copper in copper sulfate?

Cu in CuSO_4 ?

Relative atomic mass of Cu = 63.5.

Relative molecular mass of CuSO_4 = 159.6.

% of Cu in CuSO_4 = $(63.5/159.6) \times 100 = 39.8 \%$.



An organic compound forms a colourless solution when reacted with bromine water. What functional group must be present?



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Alkene $C=C$ functional group.



What tests can be carried out to distinguish between an aldehyde and a ketone?



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Tollen's reagent:

- Aldehyde: Silver mirror formed on the test tube.
- Ketone: No reaction.

Fehling's solution:

- Aldehyde: Blue solution forms a brick red precipitate.
- Ketone: No reaction.



What test can be carried out to identify a carboxylic acid?



What test can be carried out to identify a carboxylic acid?

Add sodium hydrogen carbonate, NaHCO_3 .

Carbon dioxide gas will be produced as effervescence and can be identified by bubbling it through limewater. The limewater will go cloudy if carbon dioxide is present.



What analytical processes can be used to identify compounds and calculate their molecular formula?



What analytical processes can be used to identify compounds and calculate their molecular formula?

- Mass spectroscopy
- Infrared spectroscopy
- Proton NMR spectroscopy
- C^{13} NMR spectroscopy



What is a Grignard reagent?



What is a Grignard reagent?

A Grignard reagent has the formula Mg-X-R where X is a halogen and R is an alkyl group.

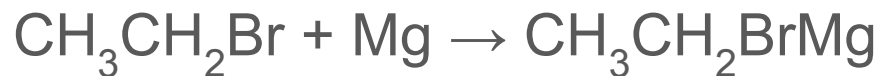


How can magnesium be used to increase the length of a carbon chain in a molecule?

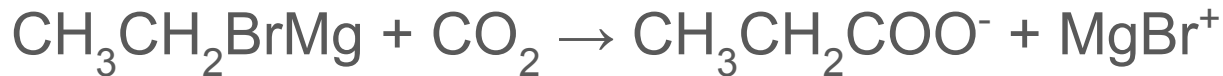


How can magnesium be used to increase the length of a carbon chain in a molecule?

Magnesium is reacted with a halogenoalkane in dry ether to form a Grignard reagent:



The Grignard reagent is then reacted with CO_2 to increase the carbon chain by one carbon atom:



How does a Grignard reagent react with aldehydes and ketones?



How does a Grignard reagent react with aldehydes and ketones?

Grignard reagents react with aldehydes to form secondary alcohols.

Grignard reagents react with ketones to form tertiary alcohols.



What condition is required to ensure a primary alcohol forms a carboxylic acid on oxidation?



What condition is required to ensure a primary alcohol forms a carboxylic acid on oxidation?

The reaction needs to be setup in reflux.

Reflux is the boiling setup with a vertical condenser that allows the vapours to return to the same mixture once they condense.



Why might a sample be washed with water?



Why might a sample be washed with water?

An insoluble sample can be washed with water for purification. The water will dissolve and remove any soluble ions in the sample.



Why might a sample be washed with sodium carbonate solution?



Why might a sample be washed with sodium carbonate solution?

Sodium carbonate can be added to an impure solution to remove acid from it.



How can you separate an insoluble product from a solution?



How can you separate an insoluble product from a solution?

Filtration:

- Filter paper placed in a funnel over a conical flask.
- Pour the mixture through the funnel.
- The insoluble product is left on the filter paper.



Describe how to carry out simple distillation



Describe how to carry out simple distillation

Heat a solution in a round bottomed flask using a Bunsen burner. The solvent evaporates then cools in the condenser. The pure liquid is collected in a beaker.



What is solvent extraction?



What is solvent extraction?

Solvent extraction is a process used to separate two compounds based on their relative solubilities in two immiscible liquids.

This can be done by shaking the mixture in a separating funnel, allowing the layers to separate and then draining off each layer individually.



How can water be removed from a purified product?



How can water be removed from a purified product?

The water can be removed by drying the product.

This can be done by adding an anhydrous salt.

The salt will act as a drying agent and will bind to any water, becoming hydrated. The solid drying agent can then be removed from the solution by filtration.



Describe how a solid can be purified by
recrystallisation



Describe how a solid can be purified by recrystallisation

1. Add a minimum volume of hot solvent to the impure solid until it dissolves.
2. Filter the solution to remove any insoluble impurities.
3. Leave the solution to slowly cool. Crystals will start to form.
4. Remove the liquid containing the soluble impurities from the crystals by filtering the mixture under a reduced pressure. This can be done using a Büchner funnel.
5. Wash the crystals with ice cold solvent to remove any soluble impurities from the surface. Leave the crystals to dry.



How can you determine the melting point of an organic solid?



How can you determine the melting point of an organic solid?

1. Pack a small sample of the solid into a capillary tube. Place the tube inside a heating element.
2. Increase the temperature of the heating element until the sample turns to liquid.
3. Compare the melting point to data book values to identify the solid.



How can the melting point of a substance be used to evaluate its purity?



How can the melting point of a substance be used to evaluate its purity?

A pure substance will have an exact sharp melting point. An impure substance will melt over a range of temperatures.

