AQA Chemistry A-level

Topic 3.7 - Optical Isomerism

Flashcards

What property must a carbon atom have for the molecule to display optical isomerism about that carbon atom?

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4 different substituents attached to one carbon atom

What are the similarities and differences between two optical isomers?

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Same atoms and bonds, but they are non-superimposable mirror images of one another. NOT IDENTICAL in chemical properties necessarily.

Differ in the way they rotate plane polarised light - rotate plane of polarisation by the same angle but in different directions.

What word is used to describe optically active molecules?

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chiral

What are the pair of isomers called?

What are the pair of isomers called?

Enantiomers

What is the chiral centre?

What is the chiral centre?

The carbon that has four different substituents attached to it

How is the chiral centre denoted?

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C* (star on C)

Give two examples of chiral molecules. Draw one of them (both enantiomers).

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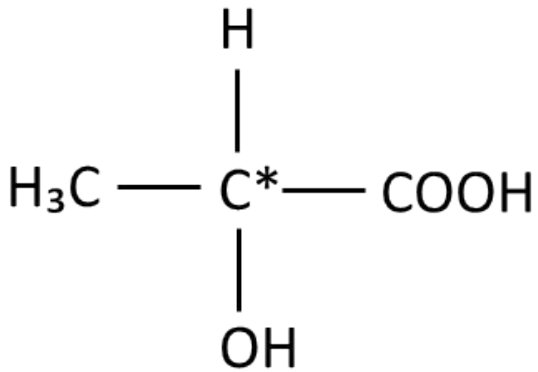
All alpha amino acids, except glycine.

Lactic acid / 2-hydroxypropanoic acid



How is light polarised?

How is light polarised?

By passing it through a polaroid filter, so oscillations are only in one plane.

What effect does the racemic mixture have on plane polarised light?

What effect does the racemic mixture have on plane polarised light?

None, as the rotation by each enantiomer cancels out to nothing

What effect does the + isomer have on plane polarised light?

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Rotates plane of polarisation by x^0 clockwise

What effect does the - isomer have on plane polarised light?

What effect does the - isomer have on plane polarised light?

Rotates plane of polarisation by x° anti clockwise (same angle, opposite direction)

What is the structure of a polarimeter?

What is the structure of a polarimeter?

Light source (unpolarised light) → polarising filter (polarised light) → polarised light passes through compartment containing sample → detector determines the angle of rotation of the plane polarised light

What are polarimeters used for?

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To identify which enantiomer is present, the purity of the sample, the concentration of the sample etc.

What is the first stage of the synthesis of lactic acid (2-hydroxypropanoic acid) from ethanal? (Equation).

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(Reagents are KCN and HCl but it is acceptable to write HCN in the balanced equation as this is the H^+ from the HCl and ^-CN from KCN)

$CH_3CHO + HCN \rightarrow CH_3CH(OH)CN$

Why is the $CH_3CH(OH)CN$ molecule formed chiral?

Why is the $CH_3CH(OH)CN$ molecule formed chiral?

H, CH_3, OH and CN groups attached to the central chiral carbon atom - 4 substituents

What is the second stage of the synthesis of lactic acid (2-hydroxypropanoic acid) from ethanal?

What is the second stage of the synthesis of lactic acid (2-hydroxypropanoic acid) from ethanal?

Hydrolysis: $CH_3CH(OH)CN + HCl + 2H_2O \rightarrow CH_3CH(OH)COOH + NH_4Cl$

How does this second stage affect the chirality?

How does this second stage affect the chirality?

Does not affect it - still racemic as chirality not affected by this stage.

Are racemic mixtures formed in nature? Why?

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Not often, as enzyme mechanisms are 3D so only form one enantiomer

Why is optical isomerism a problem for the drug industry?

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Sometimes, only one enantiomer is effective due to enzyme's active site/cell receptors being 3D.

What are the options to resolve the issue of only one enantiomer being effective?

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1. Separate enantiomers - difficult and expensive as have very similar properties
2. Sell racemate - wasteful as half is inactive
3. Design alternative synthesis to only produce one enantiomer.

Examples of optically active drugs?

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Ibuprofen, Thalidomide

Why is ibuprofen able to be sold as a racemate, even though the + isomer is needed to treat inflammation?

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Sold as 50% racemate.

But body converts 60% of R- isomer to S+ isomer → end up with 80% S+ isomer