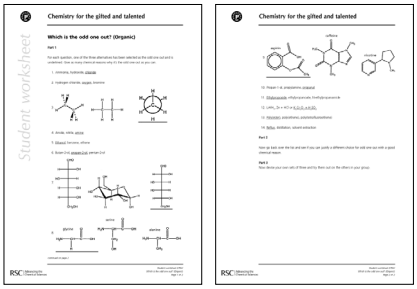
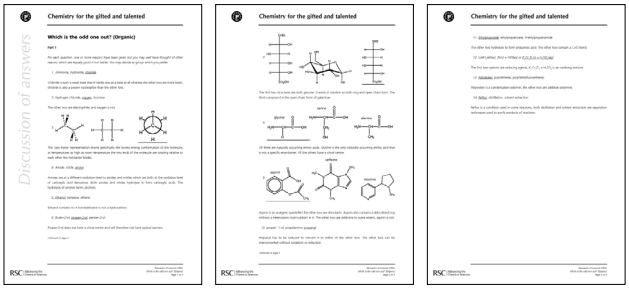
Which is the odd one out? (Organic)



Student worksheet: CDROM index 27SW



Discussion of answers: CDROM index 27DA

Topics

Oxidation level, functional groups, saw-horse projections, drug molecules, amino acids, addition and condensation polymers and the ring and chain forms of glucose.

Level

Able post-16 chemistry students.

Prior knowledge

Chirality, oxidation level, electrophiles, nucleophiles, bases and π bonds.

Rationale

This activity should encourage a rapid consideration of the range of concepts met in organic chemistry. As scientists we survey the available models or concepts to decide which is most pertinent to the current problem. This activity is designed to develop those skills. The students need to think laterally in some cases. It may help students develop the skills needed for synoptic style questions.

Use

The activity can be used as a revision tool towards the end of a post-16 course. It is synoptic in nature and draws on several aspects of organic chemistry. It is probably best used as a discussion tool in small groups.

Student worksheet

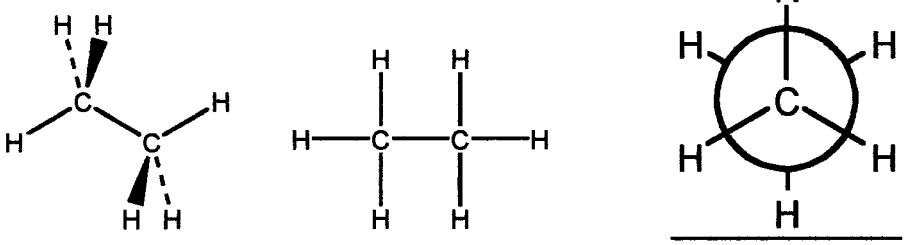
Which is the odd one out? (Organic)

Part 1

For each question, one of the three alternatives has been selected as the odd one out and is underlined. Give as many chemical reasons why it's the odd one out as you can.

1. Ammonia, hydroxide, <u>chloride</u>

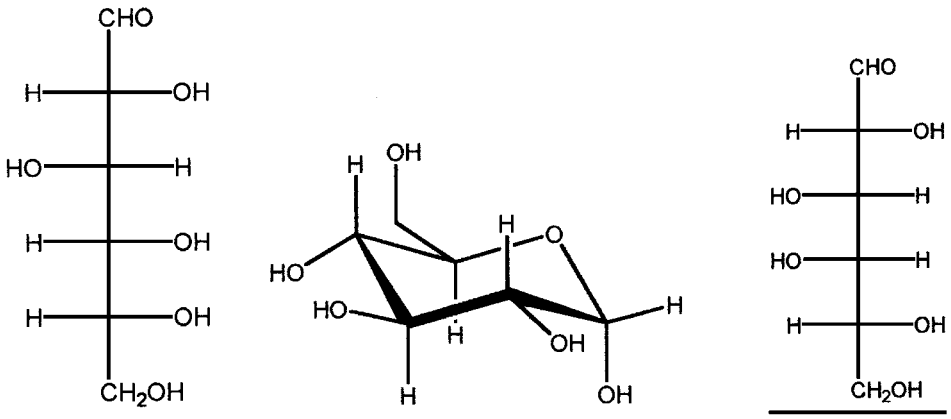
2. Hydrogen chloride, <u>oxygen</u>, bromine

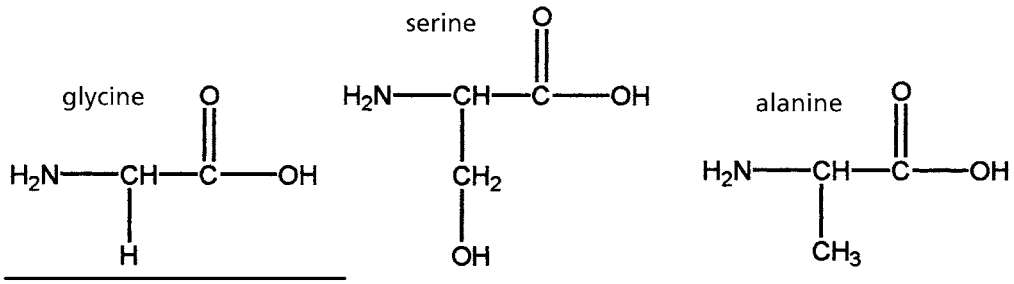
3. 

4. Amide, nitrile, <u>amine</u>

5. <u>Ethanol</u>, benzene, ethene

6. Butan-2-ol, <u>propan-2-ol</u>, pentan-2-ol

7. 

8. 

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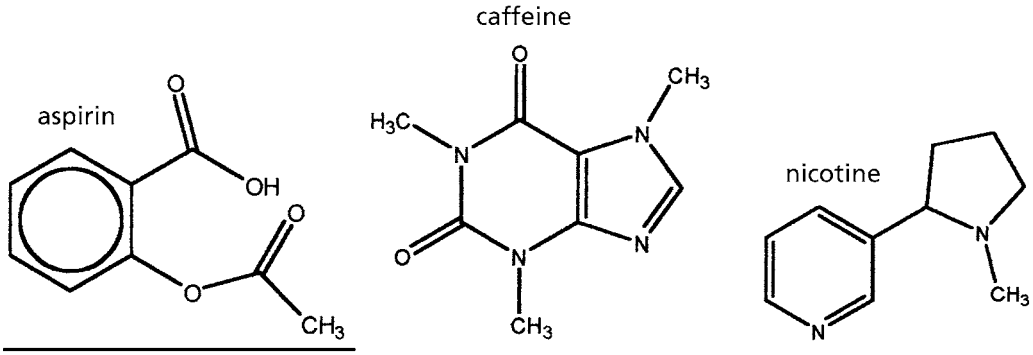


10. Propan-1-ol, propylamine, propanal

11. Ethylpropoxide, ethylpropanoate, N-ethylpropanamide

12. $LiAlH_4$, Zn + HCl, $K_2Cr_2O_7 + H_2SO_4$

13. Poly(ester), poly(ethene), poly(tetrafluoroethene)

14. Reflux, distillation, solvent extraction

Part 2

Now go back over the list and see if you can justify a different choice for the odd one out with a good chemical reason.

Part 3

Now devise your own sets of three and try them out on the others in your group.

Discussion of answers

Which is the odd one out? (Organic)

Part 1

For each question, one or more reasons have been given but you may well have thought of other reasons which are equally good if not better. You may decide as group which you prefer.

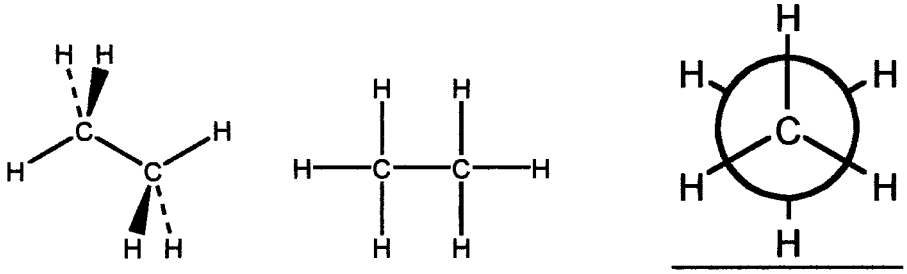
1. Ammonia, hydroxide, chloride

Chloride is such a weak base that it hardly acts as a base at all whereas the other two are more basic. Chloride is also a poorer nucleophile than the other two.

2. Hydrogen chloride, oxygen, bromine

The other two are electrophiles and oxygen is not.

3.



The 'saw-horse' representation shows specifically the lowest energy conformation of the molecule at temperatures as high as room temperature, with the two ends of the molecule rotating relative to each other like helicopter blades.

4. Amide, nitrile, amine

Amines are at a different oxidation level to amides and nitriles which are both at the oxidation level of carboxylic acid derivatives. Both amides and nitriles hydrolyse to form carboxylic acids. The hydrolysis of amines forms alcohols.

5. Ethanol, benzene, ethene

Ethanol contains no π bonds/ethanol is not a hydrocarbon.

6. Butan-2-ol, propan-2-ol, pentan-2-ol

Propan-2-ol does not have a chiral centre and will therefore not have optical isomers.

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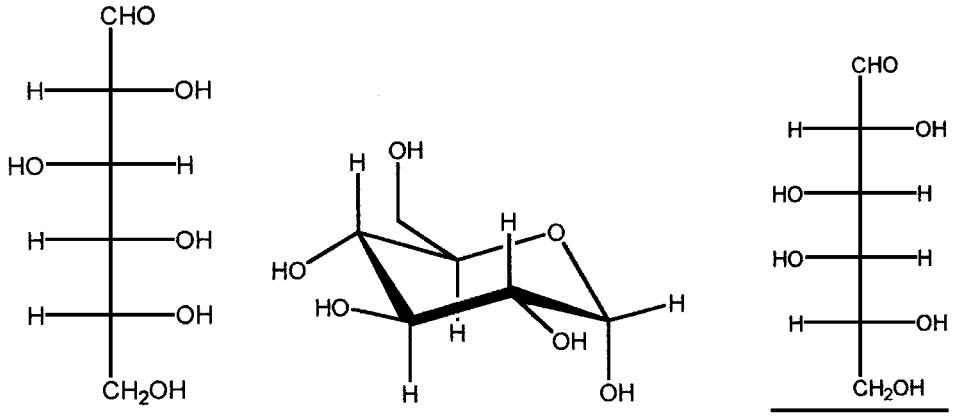

The first two structures are both glucose. It exists in solution as both ring and open chain form. The third compound is the open chain form of galactose.

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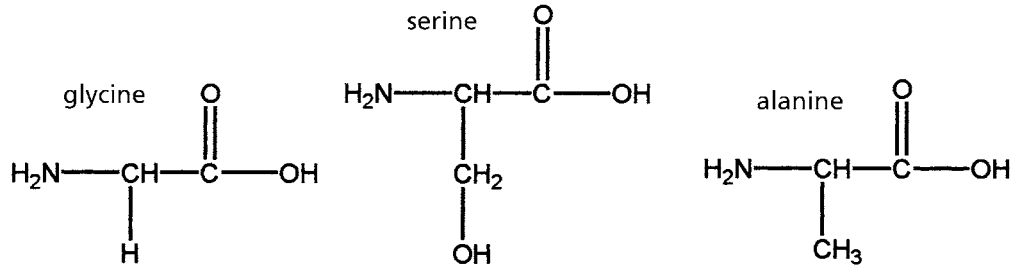

All three are naturally occurring amino acids. Glycine is the only naturally occurring amino acid that is not a specific enantiomer. All the others have a chiral centre.

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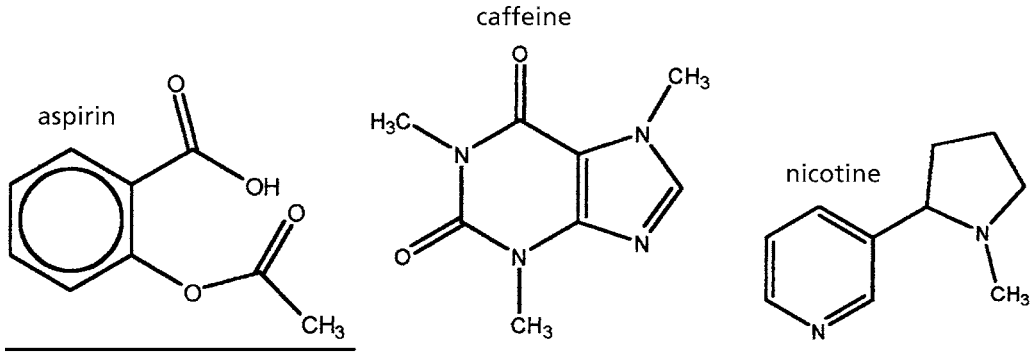

Aspirin is an analgesic (painkiller) the other two are stimulants. Aspirin also contains a delocalised ring with carbon atoms only (the other two have rings with at least one heteroatom (non carbon) in). The other two are addictive to some extent, aspirin is not.

10. Propan-1-ol, propylamine, propanal

Propanal has to be reduced to convert it to either of the other two. The other two can be interconverted without oxidation or reduction.

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11. Ethylpropoxide, ethylpropanoate, N-ethylpropanamide

The other two hydrolyse to form propanoic acid. The other two contain a C=O bond.

12. $LiAlH_4$ (ether), Zn(s) + HCl(aq) or $K_2Cr_2O_7(s) + H_2SO_4(aq)$

The first two options are reducing agents, $K_2Cr_2O_7 + H_2SO_4$ is an oxidising mixture.

13. Poly(ester), poly(ethene), poly(tetrafluoroethene)

Poly(ester) is a condensation polymer, the other two are addition polymers.

14. Reflux, distillation, solvent extraction

Reflux is a condition used in some reactions, both distillation and solvent extraction are separation techniques used to purify products of reactions.