Activity 8B: Functional groups in organic compounds

Ans p. 39

1. For each of the following:

i. use the structures to determine the functional groups present in the molecules

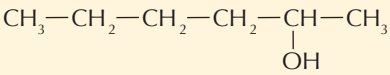
ii. decide how to use *Solubility* (see page 84) and the *Scheme to identify an organic functional group* (see page 86) to identify the functional groups.

Note that some of these compounds will *not* be suitable for use in a school laboratory. Assume that each of the compounds is a liquid at room temperature.

a.

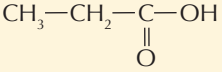
cyclohexane

cyclohexene

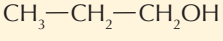


hexan-2-ol

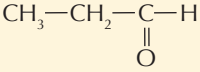
b.



propanoic acid

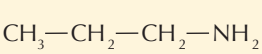


propan-1-ol

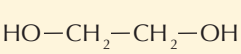


propanal

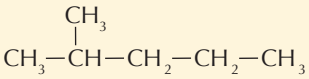
c.



propan-1-amine



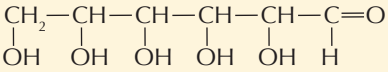
ethan-1,2-diol



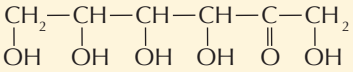
2-methylpentane

2. Use *Solubility* (see page 84) and the *Scheme to identify an organic functional group* (see page 86) to determine how to distinguish between each of the following pairs of compounds. Indicate the expected observations and justify your answers by linking the reactivity to the functional groups present.

a.

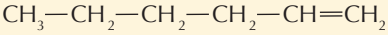


glucose

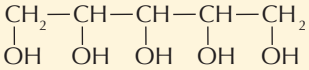


fructose

b.



hex-1-ene



xylitol

RESOURCES

Activity 8B: Functional groups in organic compounds (page 38)

1. a. i. cyclohexane is an alkane
cyclohexene is an alkene
hexan-2-ol is an alcohol

ii. It might be expected that hexan-2-ol will mix with water more easily than the two hydrocarbons (cyclohexane and cyclohexene).
None of these compounds will change the colour of moist litmus paper.
Cyclohexene will rapidly decolourise bromine water. The bromine molecule easily adds across the double bond.
Hexan-2-ol will change the colour of acidified potassium dichromate from orange to green/blue when heated. The dichromate solution oxidises the alcohol to a ketone.

b. i. propanoic acid has an acid functional group
propan-1-ol is a primary alcohol
propanal is an aldehyde

ii. Propanoic acid will change the colour of moist blue litmus paper red, since propanoic acid is acidic.
Both propan-1-ol and propanal will change the colour of potassium dichromate from orange to green. This is because the dichromate solution is able to oxidise both the alcohol and the aldehyde functional groups to a carboxylic acid.
Only propanal will react with Benedict's solution or Fehling's solution, changing the blue solution to a brick-red solid when heated. These mild oxidants are able to oxidise the aldehyde to a carboxylic acid. (Alternatively, Tollens' reagent could be used. On heating, a silver mirror would be observed with propanal.)

c. i. propan-1-amine is an amine
ethan-1,2-diol is an alcohol
2-methylpentane is an alkane

ii. Ethan-1,2-diol will be very soluble in water due to the polar –OH groups in both water and ethan-1,2-diol. 2-methylpentane will form two layers when mixed with water as it is non-polar and hence insoluble in water.
Propan-1-amine will change moist red litmus paper blue, since propan-1-amine is basic. Ethan-1,2-diol will not change the colour of litmus; 2-methylpentane will not change the colour of litmus.
Ethan-1,2-diol will change the colour of potassium dichromate solution from orange to green/blue, since the alcohol groups can be oxidised to an acid. 2-methylpentane will not react with acidified potassium chromate.

2. a. Glucose has an aldehyde functional group, fructose has a ketone functional group (they are structural isomers). Only glucose will be oxidised with Fehling's reagent, Benedict's reagent or Tollens' reagent.

b. Xylitol will be soluble in water, hex-1-ene is not. Xylitol is more likely to dissolve in water as it has multiple polar –OH groups and water molecules are also polar. Xylitol will be oxidised by acidified potassium dichromate solution, but hex-1-ene will not since the –OH (alcohol) groups can be oxidised by $Cr_2O_7^{2-}/H^+$ in solution.

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However, hex-1-ene will rapidly decolourise bromine water, but xylitol will not since Br_2 is able to add to the double bond in hex-1-ene (Br_2 will only react slowly with the xylitol molecules).

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