AS 91165
Demonstrate understanding of the properties of selected organic compounds

Collated Organic Identification Questions

(2016)
No question asked

(2015)
Four separate colourless organic liquids are known to be:
- ethanol
- ethanoic acid
- hex-2-ene
- hexan-1-amine (1-aminohexane).

Write a procedure to identify each of these organic liquids using only the reagents listed below.
- acidified dichromate solution, $Cr_2O_7^{2-}$ /H^+(aq)
- bromine water, Br_2(aq)
- sodium carbonate solution, Na_2CO_3(aq).

In your answer, you should:
- identify the test reagents used
- describe any observations that would be made
- identify the type of reaction that occurs
- identify the organic product of any reaction.

You do not need to include equations in your answer

(2014)
No question asked

(2013)

Five separate colourless organic liquids are known to be:
- pentan-1-ol
- ethanol
- pent-1-ene
- pentane
- ethanamine.

Write a valid method to show how each of these liquids can be identified using only water, litmus paper, and bromine water, Br_2(aq).

Your method should allow another student to identify these liquids, and include:
- the reagent used
- any observations made.

You do not need to include equations in your answer.

(2012)

Two bottles containing pent-1-ene, $CH_3CH_2CH_2CH{=}CH_2$, and hexane, $CH_3CH_2CH_2CH_2CH_2CH_3$, require identification. Two reagents, bromine water, Br_2, and acidified potassium permanganate, MnO_4^- / H^+, are available.

Evaluate the possible use of BOTH reagents to distinguish between the pent-1-ene and hexane.
In your answer you should include:

- a description of the type of reactions that would occur
- any conditions that would be required

- any observations that would be made
- equations showing the structural formulae of the organic reactant(s) and product(s).

Note: After 2011 esters were removed from level 2 Organic Chemistry Achievement standards and amines were added.

(2010) From expired standard

Samples of hexane, hex-1-ene and propanoic acid, require identification.
Only two reagents are available: acidified potassium permanganate solution, MnO_4^- / H^+, and sodium carbonate solution, Na_2CO_3.

Discuss how each of the three samples can be identified using only the reagents above.
Your answer must include:

- a clear description of what you would do
- reagent used
- observations
- equations showing the structural formulae of organic reactant(s) and product(s).

(2009) From expired standard

The following substances require identification:

- acidified potassium dichromate
- bromine water
- methanol
- hexane
- hex-1-ene.

Two of these substances are orange in colour, the other three are colourless.
Discuss, using only the five substances, how each could be identified.
Your answer should include:

- a clear description of what you would do
- observations
- equations showing the structural formulae of organic substances for any reactions occurring.

(2007) From expired standard

Three colourless organic liquids have no labels on the bottles. They are known to be pentanoic acid, pentan–1–ol and pent–1–ene.

(a) Draw structural formulae for these three substances.

(b) Using only aqueous solutions of bromine and potassium permanganate, discuss how a student could identify the liquids.
Your answer should include:
- what is done
- related observations
- conclusions made
- organic products for any reactions occurring.

(2004) From expired standard

Chemical tests can be used to distinguish between butan-1-ol and but-2-ene.
Identify tests to distinguish between the following pairs of compounds and:

(i) describe the test to be carried out,
(ii) describe the expected observations for the test used,
(iii) clearly explain how the test results can be used to distinguish between the molecules and why the test used is a suitable one.

ANSWERS

(2015)

Three liquids will be identified and the fourth will be the 'last one'. The tests used to identify the liquids include:

$Cr_2O_7^{2-}$ / H^+ which will turn from orange to green when the ethanol is oxidised to ethanoic acid.

Ethanoic acid can be identified by an acid-base reaction with sodium carbonate. Bubbles of gas will be produced. Sodium ethanoate / ethanoate ion is formed.

Hex-2-ene can be identified by an addition reaction with bromine water, which turns from red / brown to colourless straightaway when added to the alkene. It will form 2,3-dibromohexane

Hexan-1-amine will be the chemical left over that will not react with any of the given reagents.

(2014)

n/a

(2013)

Water

Add water to the five liquids. Two solutions will dissolve in water (ethanol, ethanamine*), three will not (pentan-1-ol, pent-1-ene and pentane). * also known as aminoethane

Litmus

Use the solutions formed by dissolving in water. Add red litmus paper to both solutions.
One will not change the colour of the litmus paper; this is ethanol.
One will turn red litmus blue; this is ethanamine.

Bromine water

Test the liquids that did not dissolve in water by reacting fresh samples with bromine water. Pent-1-ene will (rapidly) turn the orange solution to colourless. (UV) light is required for the reaction with pentane / Br_2 does not react with pentane / no colour change / slow colour change.
The remaining liquid is pentan-1-ol.

(2012)

Either of the two reagents could be used.
Br_2 will react with both substances, but the reaction with hexane is slow and requires UV light.
Permanganate will only react with pent-1-ene.
Br_2 reacts with pent-1-ene in an addition reaction. Br_2 changes colour from orange to colourless.
Reaction is: $CH_3CH_2CH_2CH{=}CH_2 + Br_2 \rightarrow CH_3CH_2CH_2CHBrCH_2Br$
Br_2 reacts with hexane in a substitution reaction, UV light is required for the reaction / Br_2 does not react with hexane. Br_2 changes colour from orange to colourless / no colour change.
Reaction is: $C_6H_{14} + Br_2 \rightarrow C_6H_{13}Br + HBr$

MnO_4^- / H^+ will react only with pent-1-ene. The reaction is an oxidation / addition reaction. Acidified MnO_4^- changes from purple to colourless. (MnO_4^- changes colour from purple to brown).
Reaction for permanganate is: $CH_3CH_2CH_2CH{=}CH_2 + H_2O + [O] \rightarrow CH_3CH_2CH_2CHOHCH_2OH$
(H_2O + [O] has been used to represent the oxidising agent)

(2010)

Add Na_2CO_3 to a sample of each organic substance. The substance which produces bubbles is the propanoic acid.
The bubbles are CO_2.
$2CH_3CH_2COOH + Na_2CO_3 \rightarrow 2CH_3CH_2COONa + CO_2 + H_2O$
Add MnO_4^-/H^+ to the two remaining samples. One of the two samples will turn the solution from purple to colourless. This is hex-1-ene. The organic substance that does not change the colour of acidified potassium permanganate nor reacts with sodium carbonate is hexane.

(2009)

Orange solutions are acidified dichromate and bromine water. Add one of the orange substances to all three colourless substances. If the orange substance decolourised, then it was bromine water. The solution it decolourised was hex-1-ene.

If the orange substance turned green, it was acidified potassium dichromate. The solution that made the acidified dichromate turn green was methanol. The substance that did not react with either orange reagent was hexane.

$CH_3OH \rightarrow HCOOH$

$CH_2CH(CH_2)_3CH_3 + Br_2 \rightarrow CH_2BrCHBr(CH_2)_3CH_3$

(Or accept miscibility argument for methanol versus hexane / hex-1-ene.)

(2007)

BROMINE FIRST

1. Add bromine solution to a sample of each of the 3 liquids: orange colour goes colourless liquid is pent-1-ene as (OR 1,2-dibromopentane) is formed. Orange colour remains the liquid is either pentan-1-ol or pentanoic acid.
2. Then add permanganate solution to separate samples of the remaining 2 liquids (pentan-1-ol, and pentanoic acid): purple colour changes to a brown precipitate, indicating pentan-1-ol as (OR pentanoic acid) is formed from the alcohol. If purple colour remains, then the liquid is pentanoic acid.

OR

PERMANGANATE FIRST

1. Add potassium permanganate solution. If the purple colour remains, (no reaction) the liquid is pentanoic acid.
   Permanganate reacts with both pent-1-ene and pentan-1-ol: purple solution changes to a brown precipitate*. (*Will go purple to colourless only if the permanganate was acidified, H^+/MnO_4^-)
   The product from the pent-1-ene is pentan-1,2-diol while the product from the alcohol is pentanoic acid
2. Test these two remaining liquids with bromine. Bromine reacts with pent-1-ene but not with the alcohol. The orange colour goes colourless with pent-1-ene as (OR 1,2-dibromopentane) is formed.

(2004)

(i) Add bromine water to a sample of each.

(ii) Butan-1-ol: Orange colour of bromine remains : But-2–ene: Orange colour of bromine disappears / goes colourless OR bromine decolourises.

(iii) An addition reaction occurs OR occurs due to C = C / unsaturated bond : (in alkene)

OR

(i) Add $Cr_2O_7^{2-}$ / H^+.

(ii) Butan-1-ol: orange colour of $Cr_2O_7^{2-}$ goes green; But-2-ene: orange colour of $Cr_2O_7^{2-}$ remains

(iii) The (primary) alcohol can be oxidised with acidified dichromate / Alkene cannot be oxidised by acidified dichromate.