Triiodomethane (iodoform) reaction in hydroxy compounds

$$C_2H_5OH_{(l)} + 4I_{2(aq)} + 6OH^-_{(aq)} \longrightarrow CHI_{3(s)} + HCOO^-_{(aq)} + 5I^-_{(aq)} + 5H_2O_{(l)}$$

iodoform (yellow solid) — appear as sodium salt

Only alcohols with the structural group of $CH_3\overset{|}{C}HOH$ undergo the triiodomethane reaction.

They produce a pale yellow precipitate of triiodomethane (CHI_3) when warmed with iodine and sodium hydroxide.

The general equation for the triiodomethane reaction for an alcohol containing the structural unit is:

$$CH_3-\overset{H}{\underset{OH}{\overset{|}{\underset{|}{C}}}}-R \xrightarrow{I_2/OH^-} \underset{\text{triiodomethane (yellow solid)}}{CHI_3} + RCO_2^-$$

Exercise 1

Write structural formulae for the following alcohols and state which ones undergo the triiodomethane reaction.

a) methanol

b) ethanol

c) propan-1-ol

d) propan-2-ol

e) 2-methylpropan-2-ol.

Exercise 2 [A]

The triiodomethane (iodoform) test can be used to distinguish between the members of one of the following pairs of compounds. Which one is this?

a. CH_3CH_2OH and $CH_3CH(OH)CH_3$

b. CH_3OH and $CH_3CH_2CH_2OH$

c. $CH_3CH_2CH_2OH$ and $CH_3CH(OH)CH_3$

d. $C_6H_5CH(OH)CH_3$ and CH_3CH_2OH

e. $C_6H_5CH_2OH$ and CH_3OH.

Exercise 1 – answer

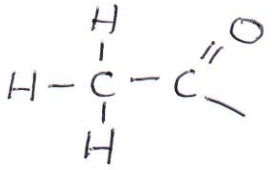
ethanol and propan-2-ol react.

Exercise 2 – answer

pair c

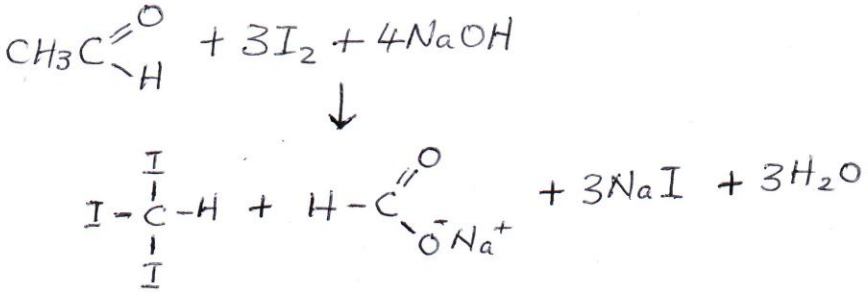
Iodoform reaction in carbonyl compounds

Aldehydes and ketones which contain the group:



This group gives a positive triiodomethane reaction.

Reaction with iodine and sodium hydroxide produces yellow crystals of triiodomethane, for example:



triiodomethane
(iodoform)

The effect of adding iodine and sodium hydroxide solution to a number of carbonyl compounds are as follow:

Name	Structural Formula	Observation.
Ethanal	CH_3CHO	yellow ppt.
Propanal	CH_3CH_2CHO	no change.
Propanone	CH_3COCH_3	yellow ppt.
Pentan-3-one	$CH_3CH_2COCH_2CH_3$	no change
Phenylethanone	$C_6H_5COCH_3$	yellow ppt.

Exercise

Describe one simple reaction to distinguish between the members of each of the following pairs of compounds:

a. CH_3CHO and C_6H_5CHO

b. aqueous solutions of CH_3CHO and $HCHO$

c. CH_3CH_2CHO and $CH_3CH_2COCH_3$

State what is observed for each compound in each pair.

Answers

a. CH_3CHO gives a pale yellow ppt of triiodomethane when treated iodine solution followed by sodium hydroxide. C_6H_5CHO does not.

or.

CH_3CHO gives a red ppt. of copper(I) oxide when warmed with Fehling's solution. C_6H_5CHO does not.

b. CH_3CHO gives a pale yellow ppt of triiodomethane when treated with aqueous iodine followed by sodium hydroxide. $HCHO$ does not.

c. $CH_3CH_2COCH_3$ gives a pale yellow ppt of triiodomethane when treated with aqueous iodine followed by aqueous sodium hydroxide.

CH_3CH_2CHO does not.

or

CH_3CH_2CHO gives a silver mirror when warmed with ammoniacal silver nitrate solution.

$CH_3CH_2COCH_3$ does not.

or

CH_3CH_2CHO gives a red ppt. of copper(I) oxide when warmed with Fehling's solution.

$CH_3CH_2COCH_3$ does not.