

# Level 3 Chemistry, 2007

## 90698 Describe aspects of organic chemistry

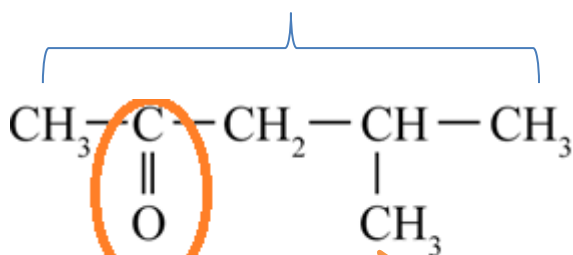
Annotated answers to this organic paper.

Give the proper name that gives the structure a unique name

### Q1 QUESTION ONE

(a) Give the systematic IUPAC names for the following molecules

Longest carbon chain = **5 (pent)** with functional group on lowest carbon number ( 2)



Systematic name is

**4-methylpentan-2-one**

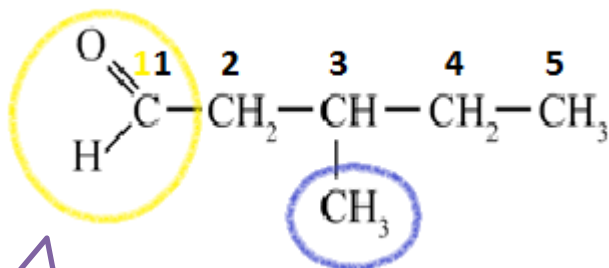
A carbonyl group with 2 alkyl groups makes it a **ketone**

There is a **methyl** (-CH<sub>3</sub>) group on the 4<sup>th</sup> carbon atom



Remember to use a hyphen – to separate words and numbers

Try these examples



Systematic name is

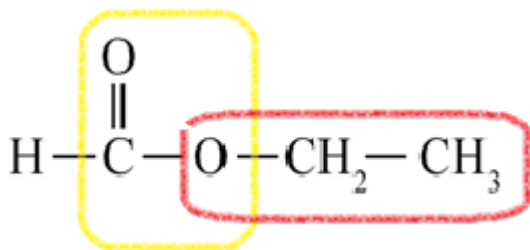
**3-methylpentanoic acid**

A **carboxylic acid** functional group

A **methyl** (-CH<sub>3</sub>) group on the 3<sup>rd</sup> carbon atom

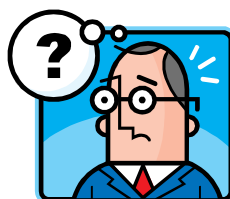
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This part of the ester was made from the alcohol ethanol (2 carbon atoms in the alcohol).

An ester functional group – esters are made by reacting a carboxylic acid with an alcohol – so look for the carboxylic acid part – in this case it was methanoic acid HCOOH. It only had 1 carbon atom in the carboxylic acid molecule.

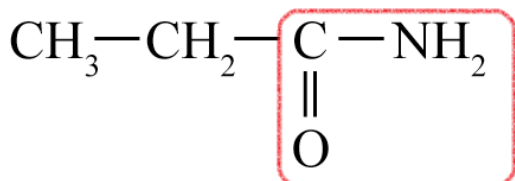


Esters are always somethingyl somethingoate

Eg ethyl methanoate

From ethanol + methanoic acid

When naming esters the alcohol part goes first and the acid part second



Amide functional group

Systematic name is

propanamide

Longest carbon chain is 3 (prop)

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(b) Draw the structural formula of each of the organic compounds below:

(i) 2-amino-2,3-dimethyl butane



### What clues are in the name?

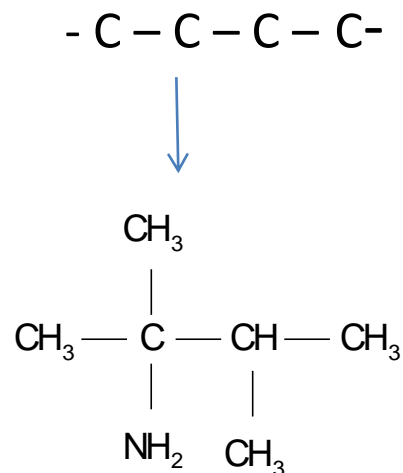
2- amino means an  $\text{NH}_2$  group is attached to the second carbon atom in the longest chain

The longest carbon chain has 4 carbon atoms (butane)

There are 2 methyl side groups ( $\text{CH}_3$ ) attached to carbon atoms numbers 2 and 3 in the longest chain

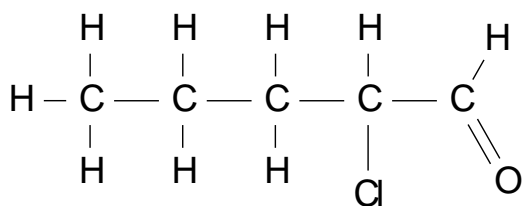
So – draw out the longest chain

- Stick an amino group on the second
- carbon atom
- Then add the 2 methyl groups
- Then complete by adding hydrogen atoms to complete the bonds



(ii) 2-chloro pentanal

- 5 carbon atoms in the longest chain with an aldehyde group at the end ( $\text{CHO}$ )
- Put a chlorine atom onto the second carbon atom in the chain.
- The functional group dictates which is carbon atom number 1

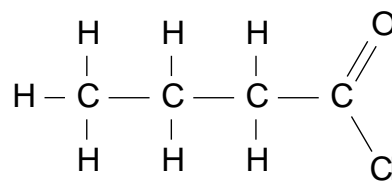


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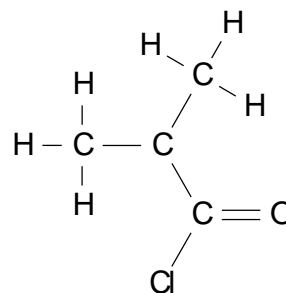
(iii) An acid chloride with 4 carbon atoms

Eg butanoyl chloride



Try a structural isomer as well?

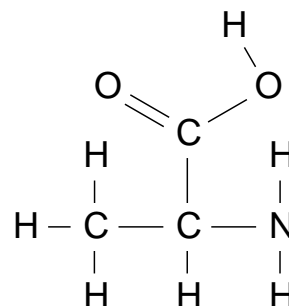
2-methyl propanoyl chloride



(iv) An amino acid with 3 carbon atoms

Amino acids have an amino group (  $\text{NH}_2$  ) and a carboxylic acid group (  $\text{COOH}$  )

So try 2-aminopropanoic acid

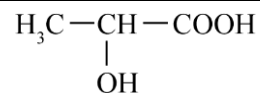


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### QUESTION TWO (NCEA 2007)

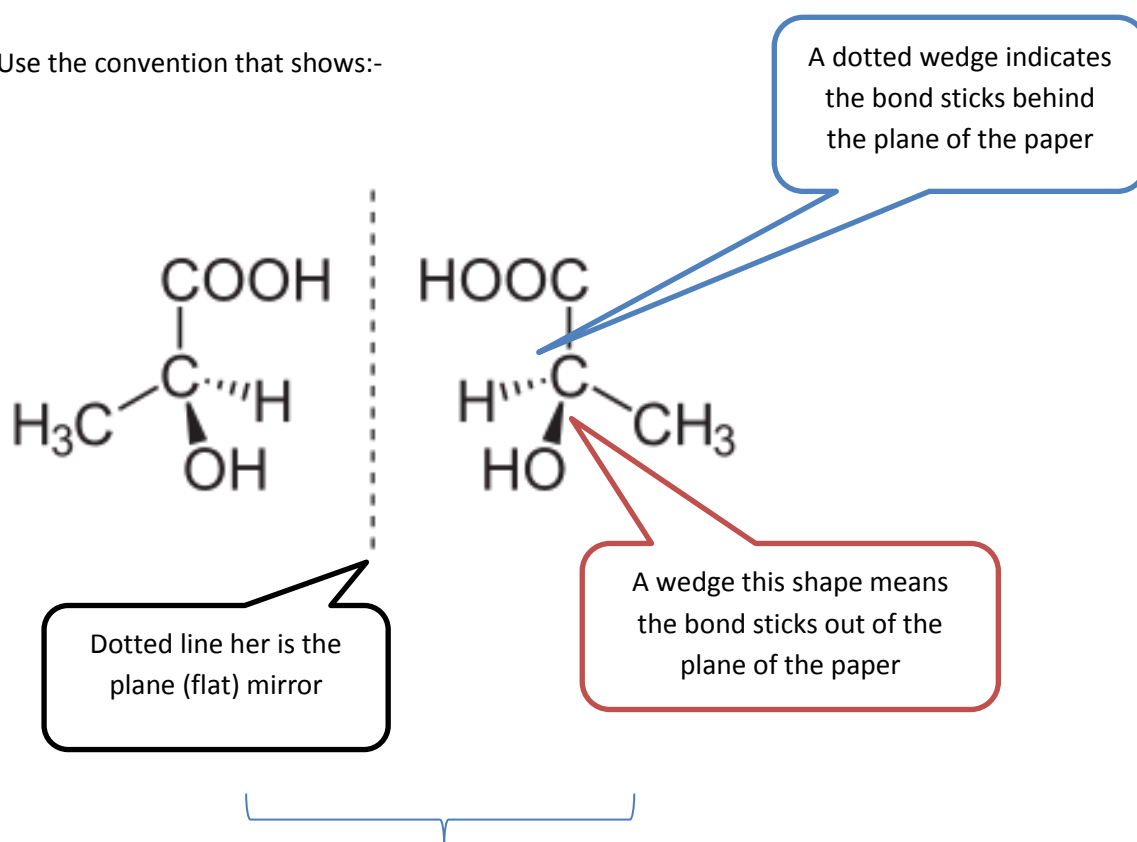
Lactic acid is the common name for 2-hydroxypropanoic acid.



Lactic acid can exist as enantiomers (optical isomers)

- (a) Draw **three-dimensional** structures for the two enantiomers of lactic acid that clearly show the relationship between them.

Use the convention that shows:-



The 2 mirror images are called enantiomers

As the carbon atom in the centre has 4 bonding pairs of electrons the bond angles will be  $109^\circ$

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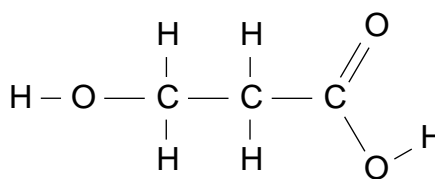
(b) Compound X is a structural isomer of lactic acid. Compound X will turn blue litmus red but cannot exist as enantiomers.

(i) Draw the structural formula for Compound X.

The questions tell us that the structural isomer has a carboxylic acid group. Because it does not exist as enantiomers there is not a chiral carbon atom in the structure.

Try this structure

3-hydroxypropanoic acid

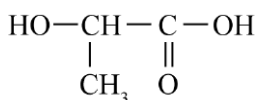


The carboxylic acid group takes priority over the hydroxyl group for numbering purposes. This structure does not have a carbon atom with 4 different groups on it – it does not have a chiral atom / centre and it is not possible to draw an optical isomer.

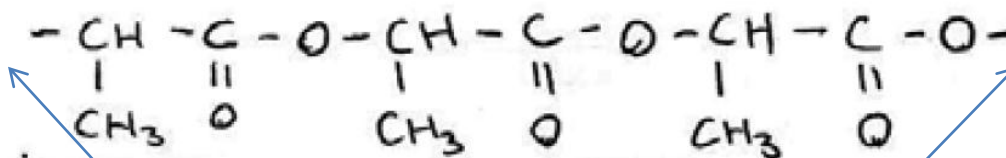
(c) Lactic acid is able to form a condensation polymer in the presence of dilute sulfuric acid.

Draw three repeating units of this polymer.

Monomer:



Examination of the structure indicates 2 different functional groups that will react with each other to form a condensation polymer. Water will be eliminated. The groups are the alcohol and carboxylic acid groups and so the monomers will be linked by ester bonds.



Don't forget to leave the ends "free"

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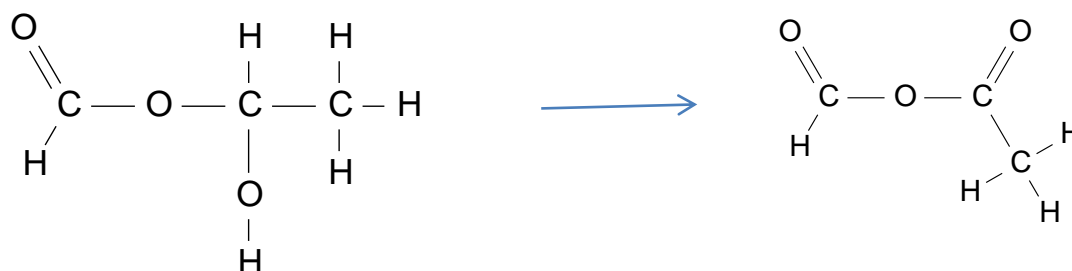
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- (d) Compound **Z** is an isomer of lactic acid that has a much lower boiling point than lactic acid. A water solution of Compound **Z** does not change the colour of blue litmus. When Compound **Z** is reacted with acidified dichromate solution, the resulting organic compound shows no acidic properties, and it is not a cyclic molecule.

Draw the structural formula for Compound **Z** and justify your answer using the information given above.

We can deduce that -

- Z has the same molecular formula.
- Z has weaker intermolecular forces due to the lower boiling point and there is no carboxylic acid group. The polar  $\text{-OH}$  group is converted to less polar  $\text{C=O}$  group.
- Because Z reacts with acidified dichromate it must be the  $\text{-OH}$  group reacting. Because the product has no acidic properties – the  $\text{-OH}$  group is not oxidised to a  $\text{-COOH}$  group, which places the  $\text{-OH}$  group in the centre of the molecule and so it is oxidised to a ketone group.



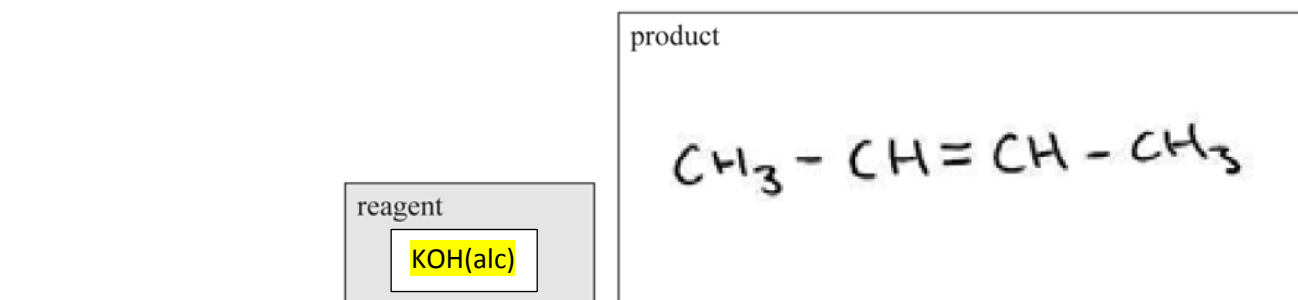
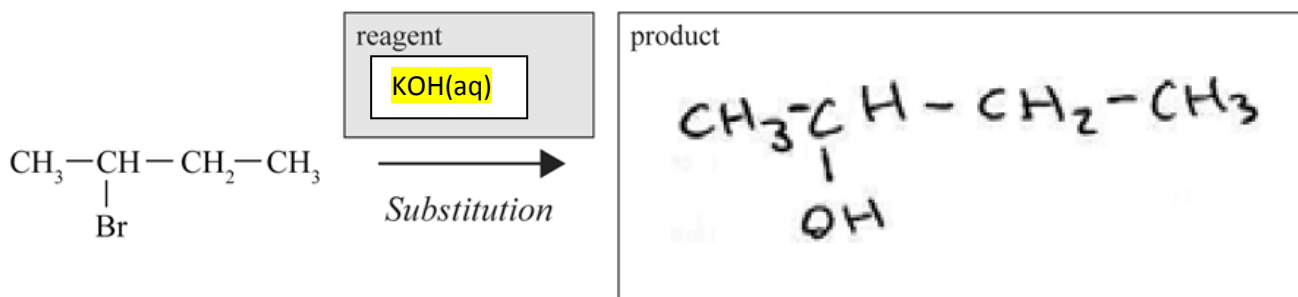
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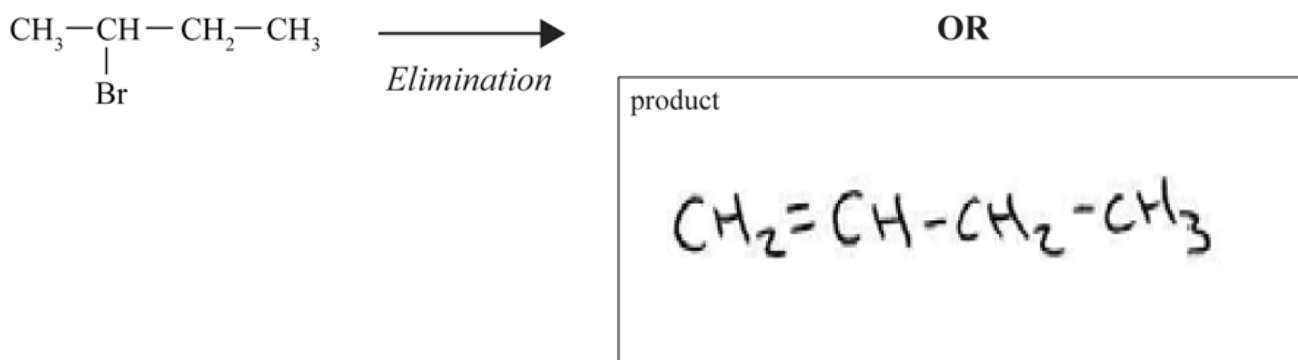
### QUESTION THREE

- (a) 2-bromobutane reacts by *substitution* to form 2-butanol. However, if the reaction conditions are changed, an *elimination* reaction occurs. There are two possible products for the elimination reaction.

Complete the following reaction scheme by indicating the reagents in the shaded boxes and the organic products in the other boxes for each of these reactions of 2-bromobutane.



OR



KOH (aq) means aqueous (dissolved in water).

KOH(alc) means KOH in alcohol (ethanol) solvent.