Organic Chemistry Part 1

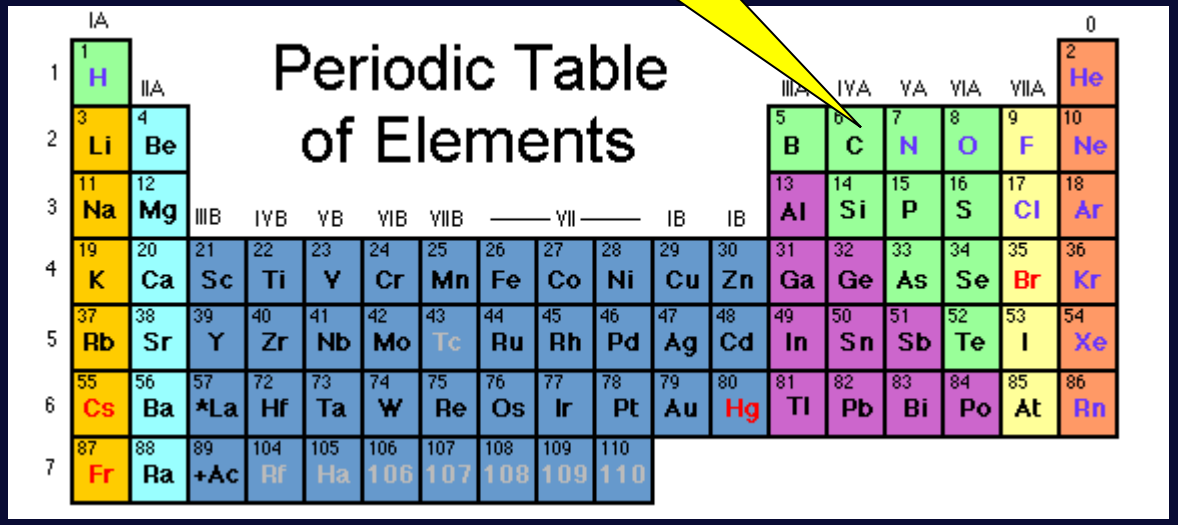
Juffrou Karen

- Organic molecules consist of C – atoms
- C is the basic building block of organic compounds

Carbon

- Atomic number of 6
- Group IV
- Valency of 4

12
C
6



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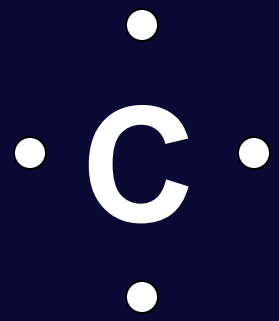
Lewis structure for Carbon



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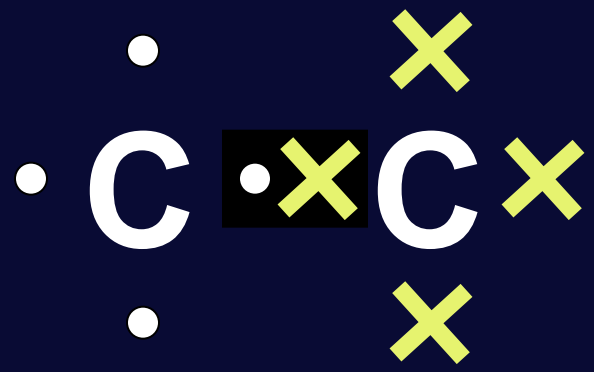
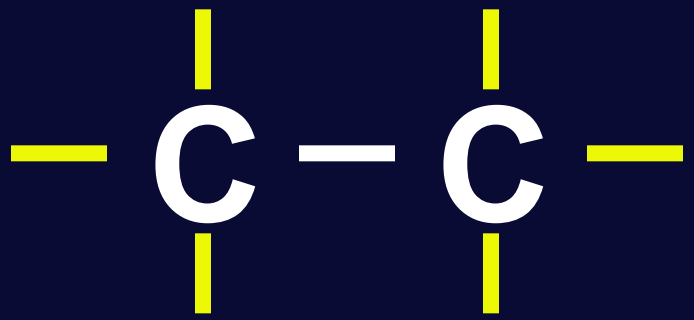
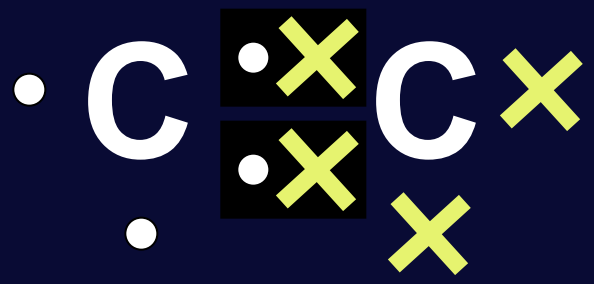
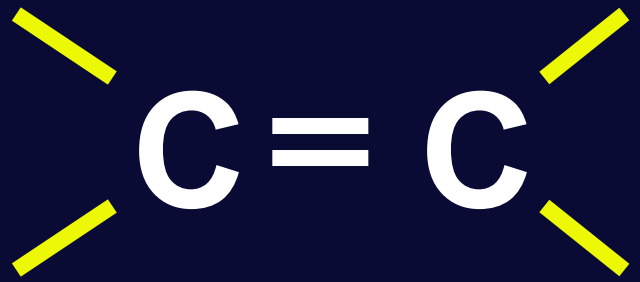
Single bond:



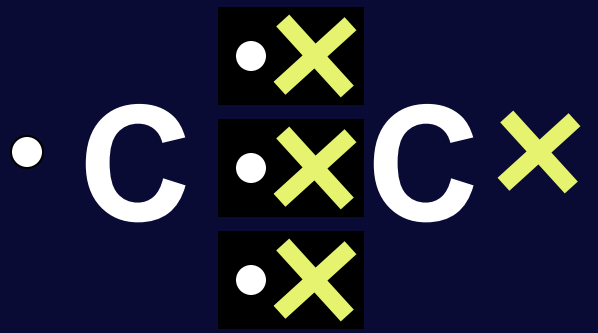


Double bond:





Triple bond:



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Organic chemistry

Molecules of: C—H

These bonds can also include:

O N F I

Cl P S Br

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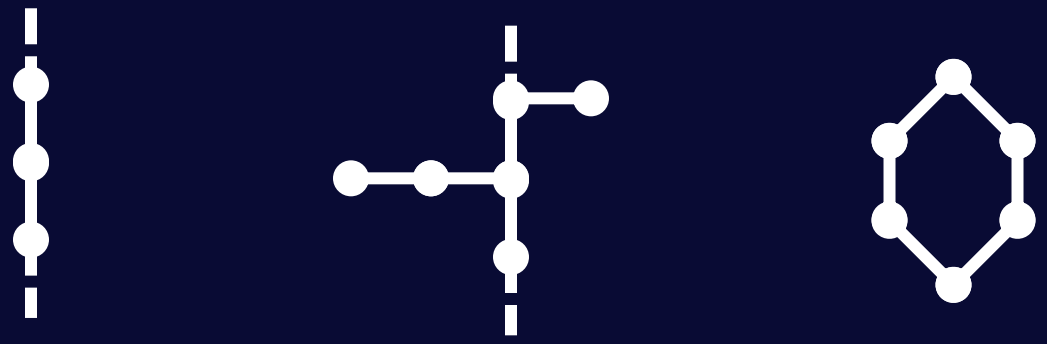
Chains, branches and cyclic structures



Juffrou Karen

Homologous series

a series of organic compounds that can be described by the same general formula

Representation of organic molecules:

General formula (Homologous series)

Formula for a group of similar compounds

Alkene: C_nH_{2n}

Molecular formula

Shows the number of atoms in the molecule

Butene: C_4H_8

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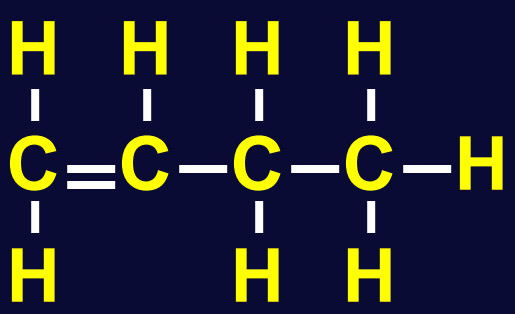
Representation of organic molecules:

Structural formula

Illustrates bonds and atoms in a molecule

Butene:



or

$CH_2CHCH_2CH_3$

Condensed

Juffrou Karen

Functional groups

a bond or an atom or a group of atoms which determine(s) the physical and chemical properties of a group of organic compounds

Alkanes – Single bonds

Alkenes – Double bonds

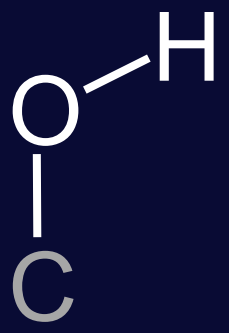
Alkynes – Triple bonds

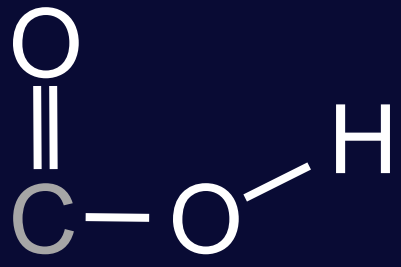
Functional groups

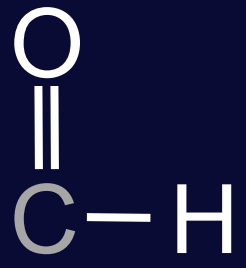
Know the functional group of each homologous series in the examination guidelines

Important structures

Carbonyl – group 

Hydroxyl – group 

Carboxyl - group 

Formic - group 

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Functional groups

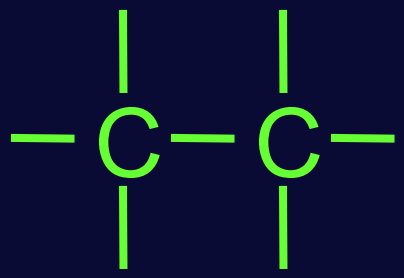
Homologous series:

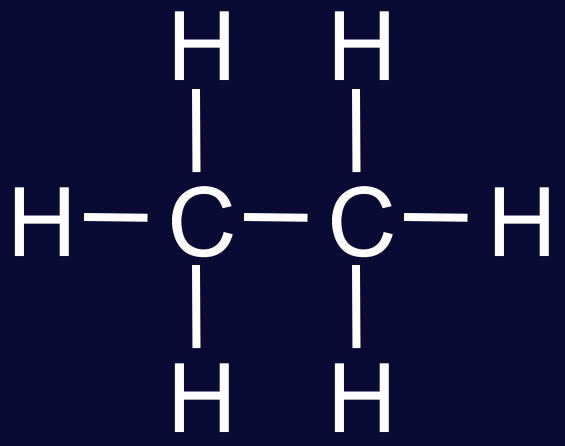
Alkanes

General formula:

C_nH_{2n+2}

Functional group:





Ethane

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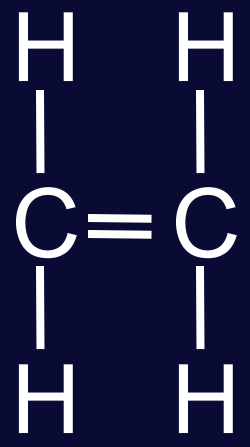
Functional groups

Homologous series:

Alkenes

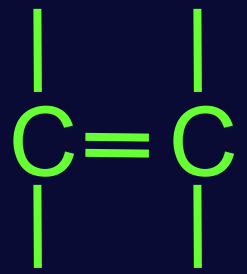
General formula:

C_nH_{2n}



Ethene

Functional group:



Juffrou Karen

Functional groups

Homologous series:

Alkynes

General formula:

C_nH_{2n-2}

Ethyne

Functional group:

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Functional groups

Homologous series:

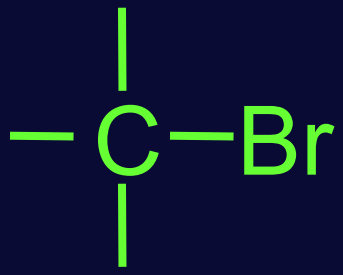
Halo-alkanes / Alkyl halides

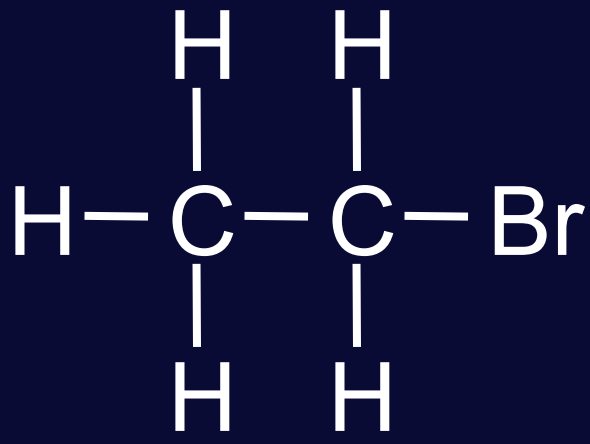
General formula:

$C_nH_{2n+1}X$

with X = Cℓ, Br, I, F

Functional group:





Bromoethane

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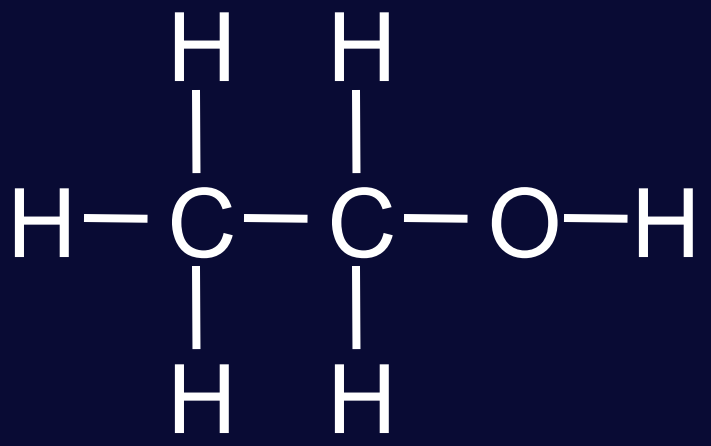
Functional groups

Homologous series:

Alcohols

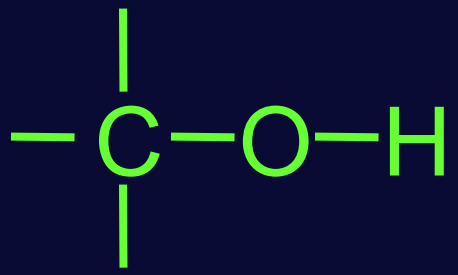
General formula:

$C_nH_{2n+1}OH$



Ethanol

Functional group:

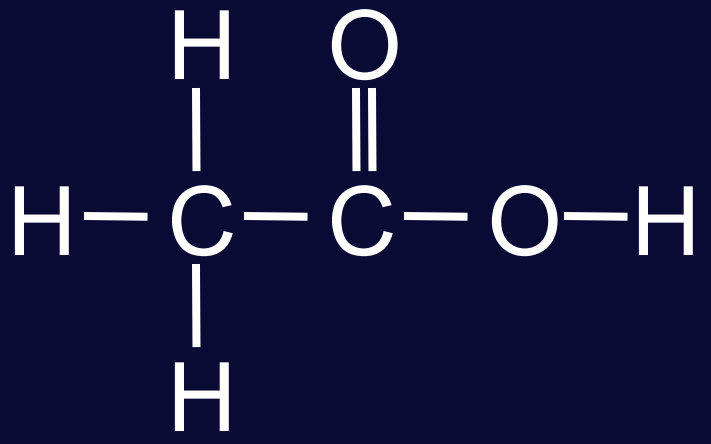


Functional groups

Homologous series:
Carboxylic acid

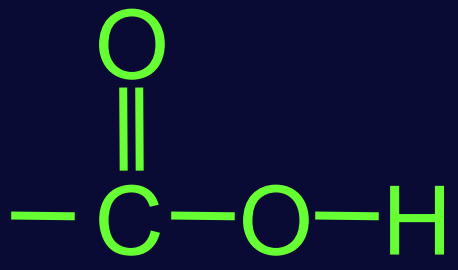
General formula:

$C_nH_{2n}O_2$



Ethanoic acid

Functional group:



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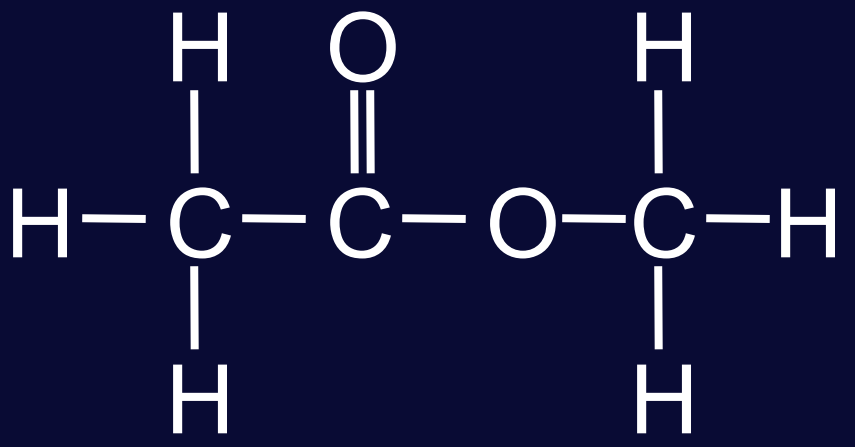
Functional groups

Homologous series:

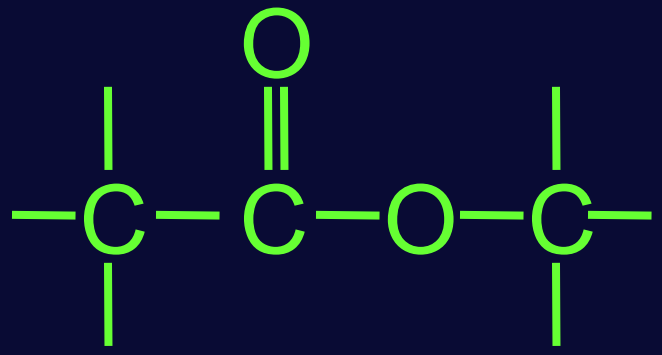
Esters



General formula:

$C_nH_{2n}O_2$

Functional group:



Methyl ethanoate

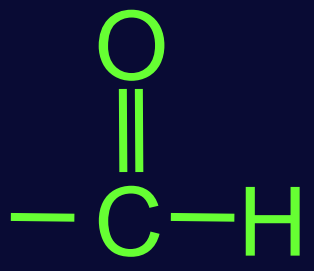
Functional groups

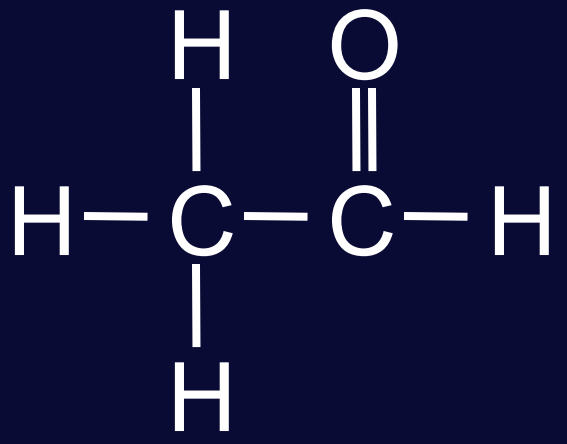
Homologous series:
Aldehydes

General formula:

$C_nH_{2n}O$

Functional group:





Ethanal

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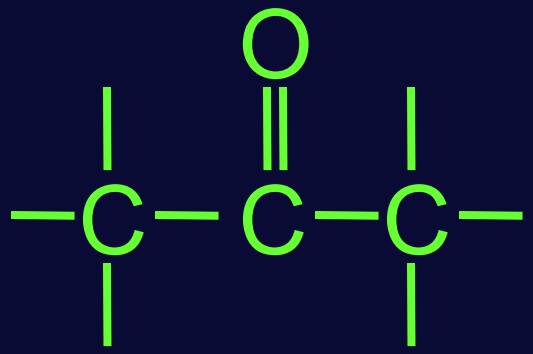
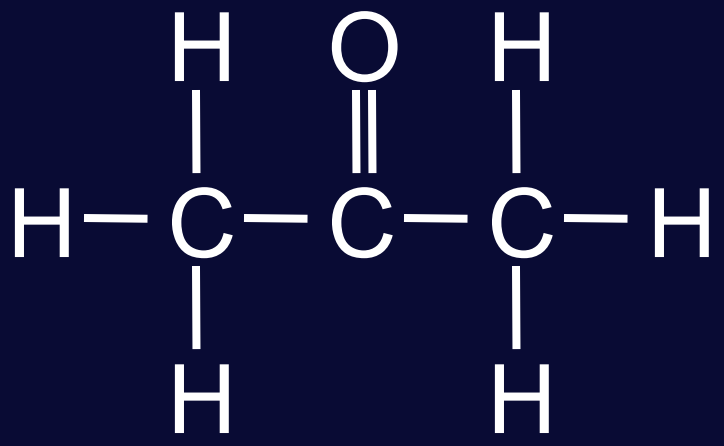
Functional groups

Homologous series:
Ketones

General formula:
$C_nH_{2n}O$

Functional group:





Propanone

Hydrocarbons and isomers

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Hydrocarbons

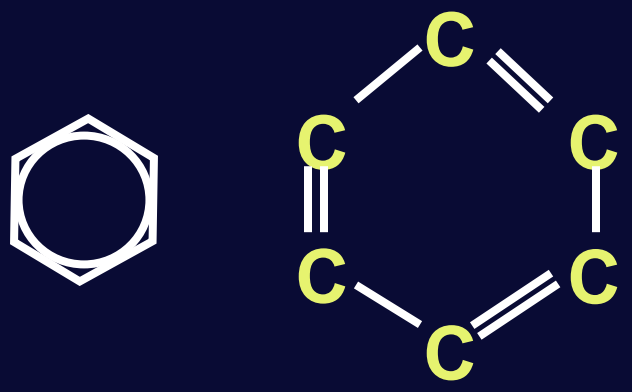
are organic compounds that consist only of carbon and hydrogen

C_3H_8 or CH_4

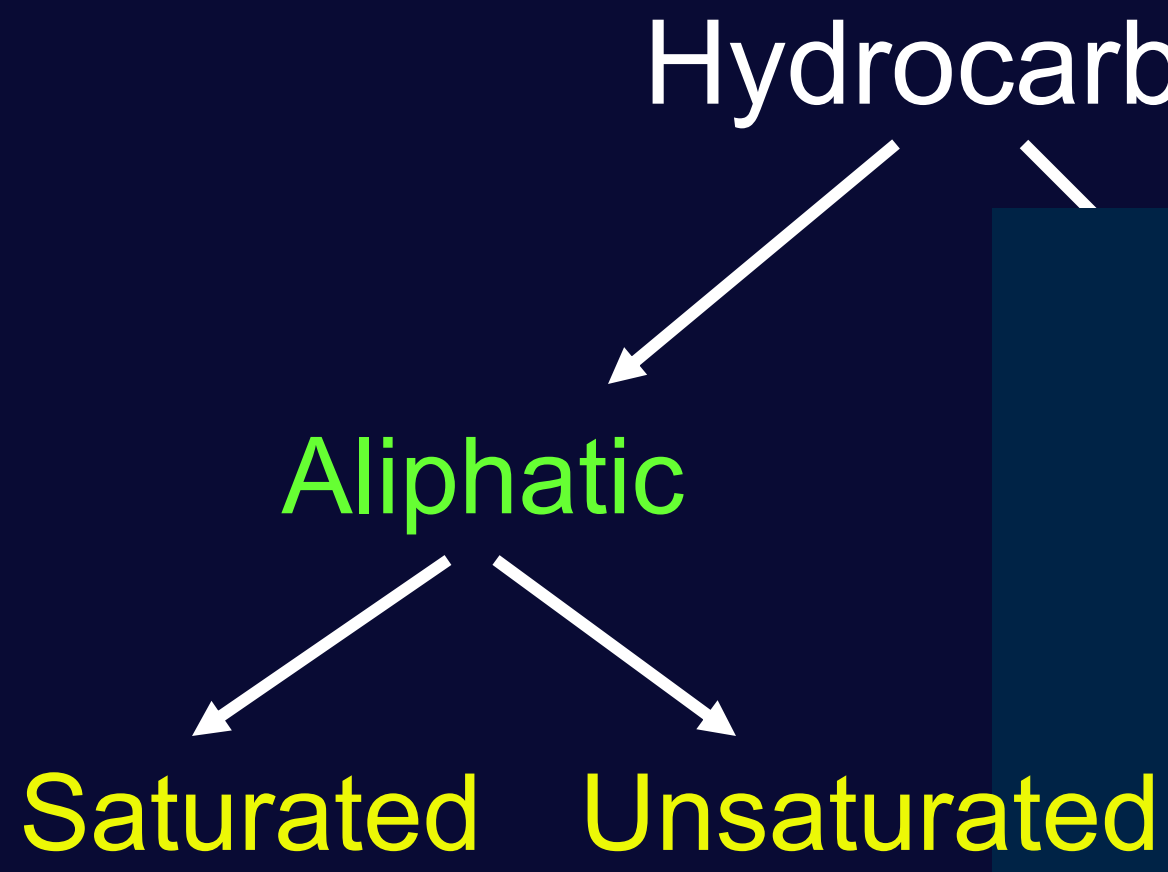
Hydrocarbons

Aliphatic

Aromatic



1 or more Benzene ring(s)



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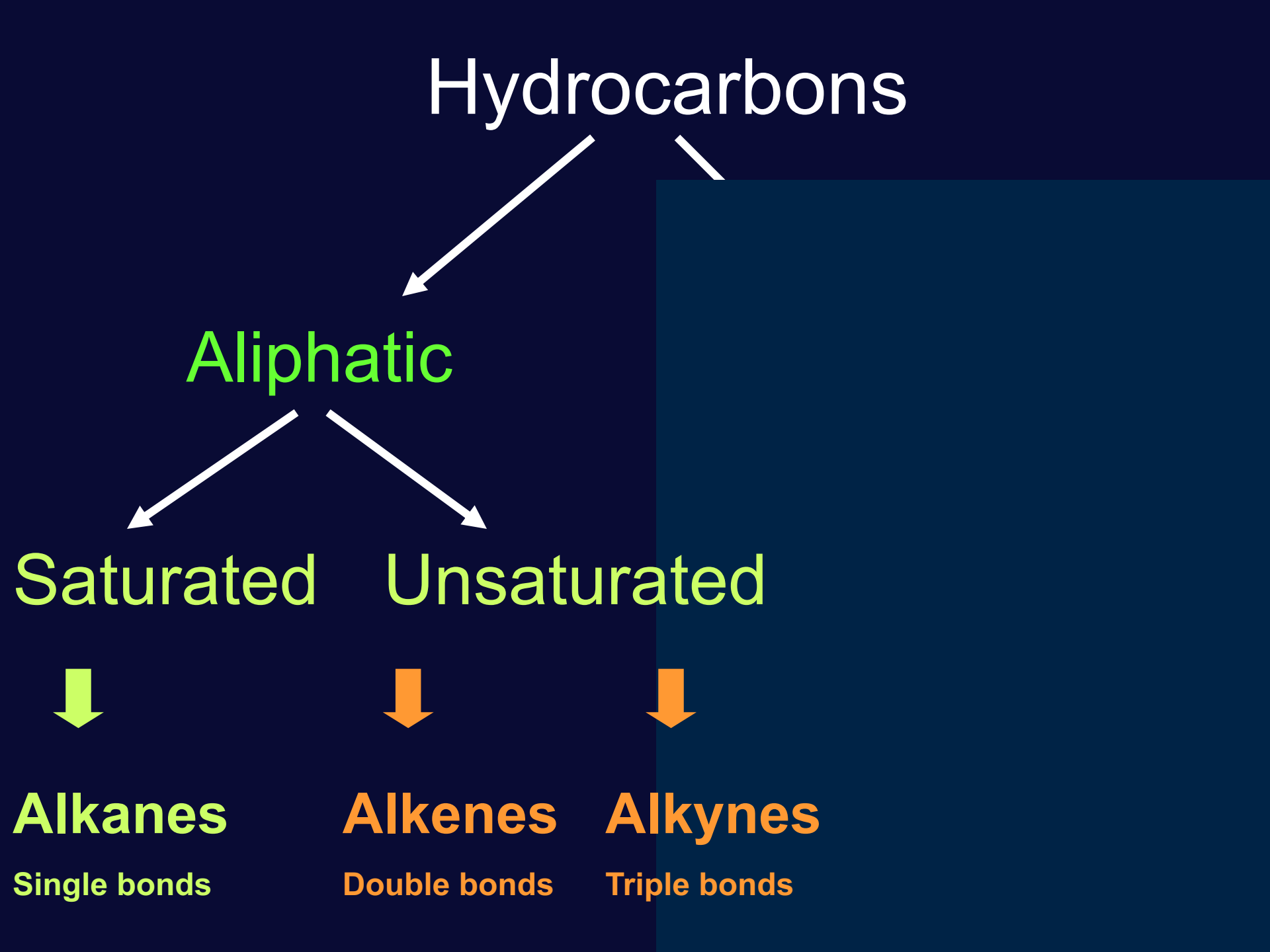

Hydrocarbons
Aliphatic
Saturated
Unsaturated
Alkanes
Single bonds
Alkenes
Double bonds
Alkynes
Triple bonds

Hydrocarbons

Aliphatic

Saturated Unsaturated

Alkanes

Single bonds

Juffrou Karen

Saturated hydrocarbons

organic compounds consisting of only carbon and hydrogen, with no multiple bonds between C-atoms (only single bonds)

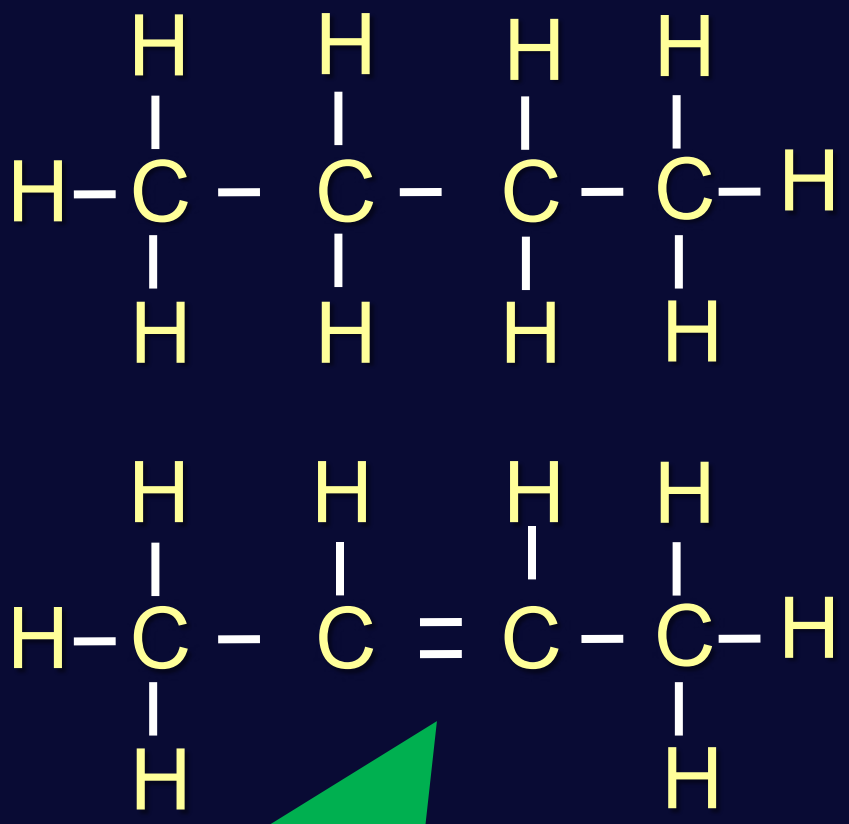
Unsaturated hydrocarbons

organic compounds with one or more multiple covalent bonds between C-atoms

Test for saturated hydrocarbon

Add Brown bromine water (or $KMnO_4$)

- If saturated – colour remain unchanged
- If unsaturated – colour changes quickly



Juffrou Karen

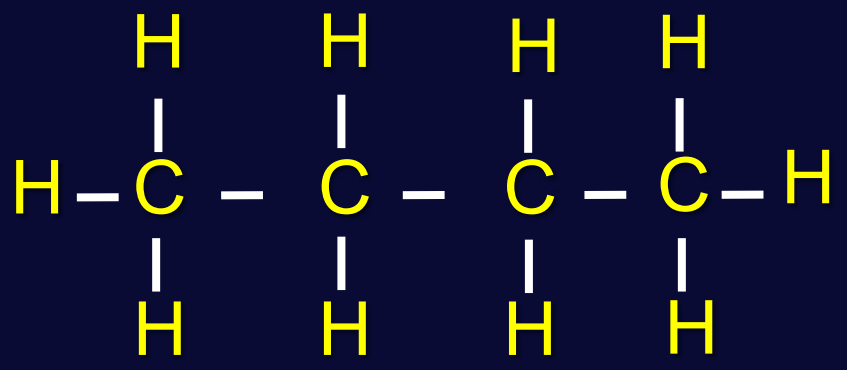
Isomers

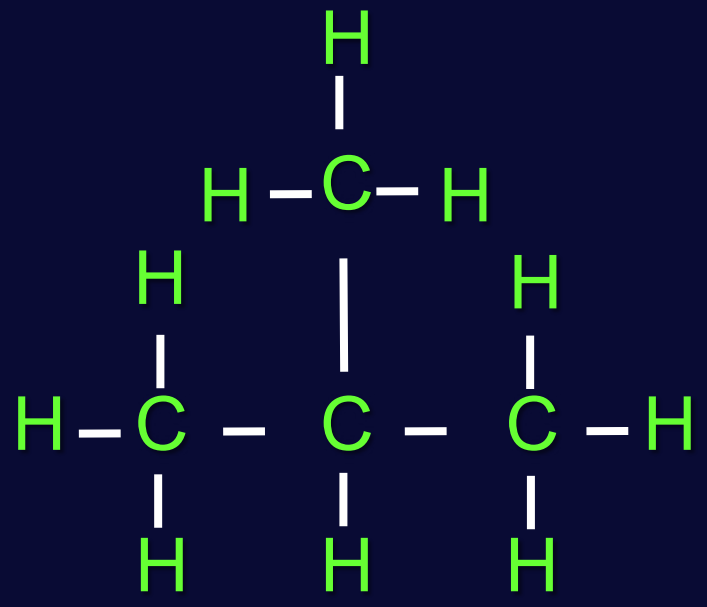
Organic molecules with the same molecular formula, but different structural formulas

Chain-isomers

Different chains

C_4H_{10}





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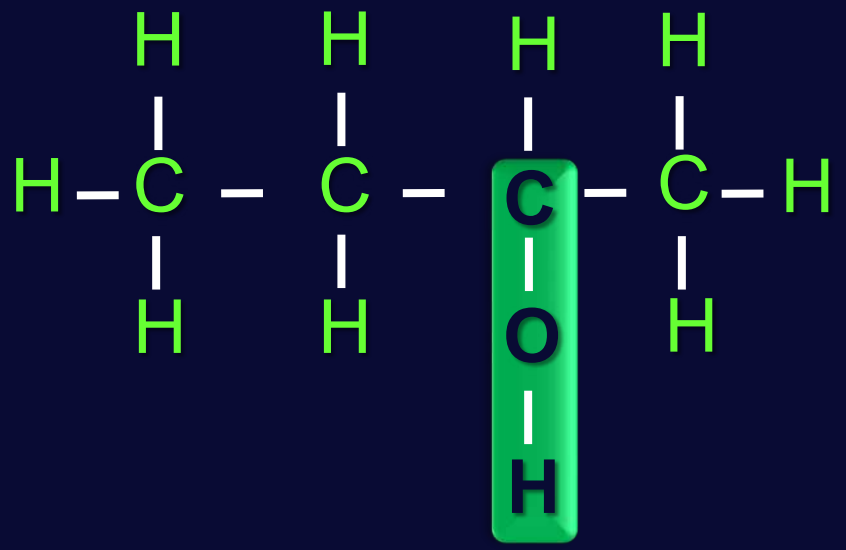
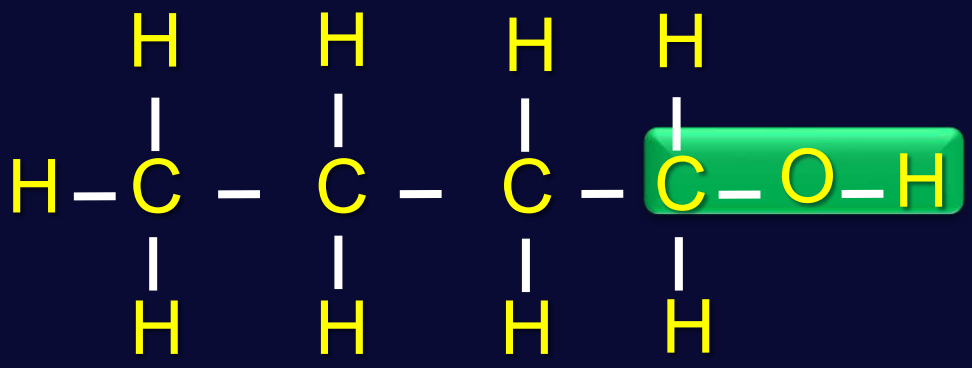
Positional-isomers

Different positions of the same functional group

C_4H_9OH



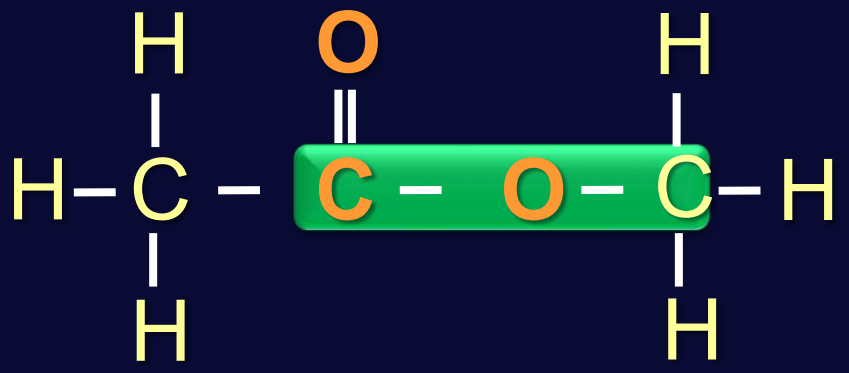


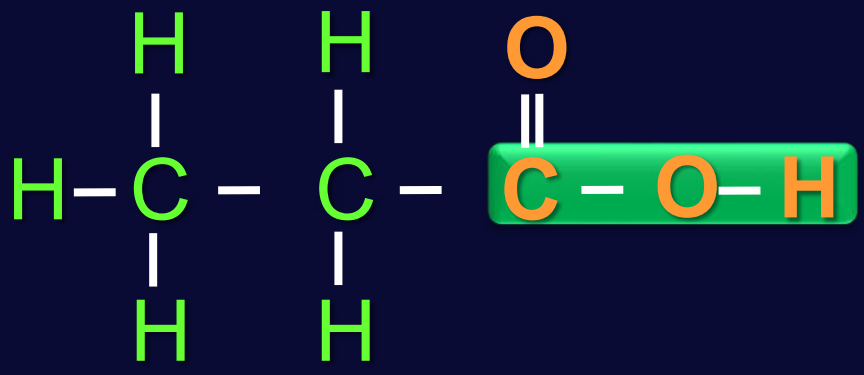
Juffrou Karen

Functional-isomers

Different
functional groups

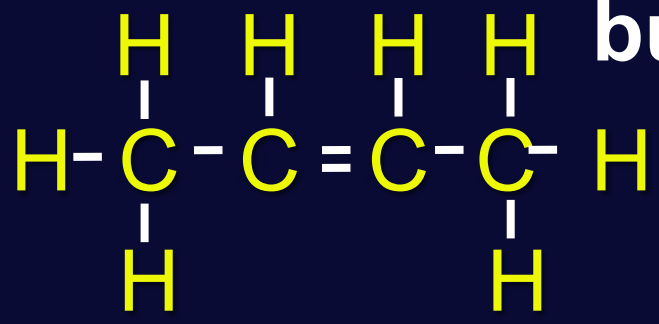
$C_3H_6O_2$



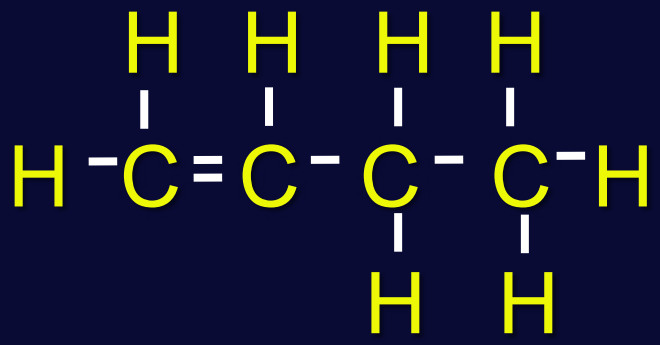


Juffrou Karen

Butene has the molecular formula of C_4H_8 and the following isomers

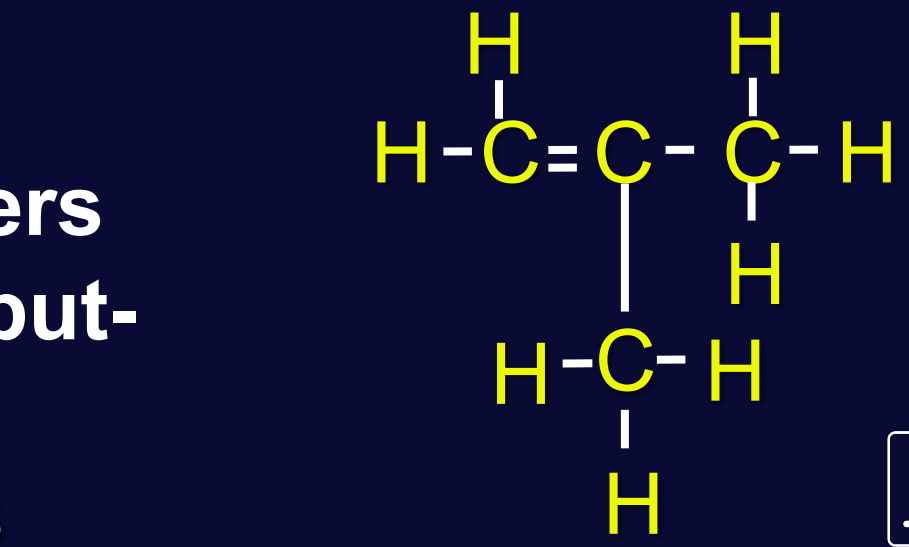


but-2-ene



but-1-ene

methylpropene

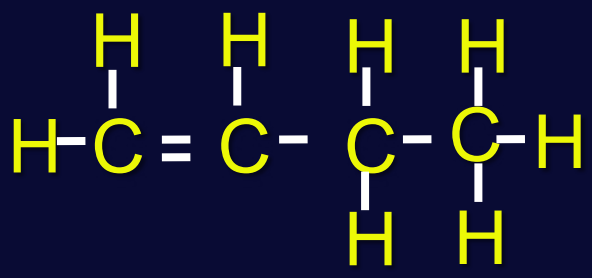


What type of isomers are but-1-ene and but-2-ene?

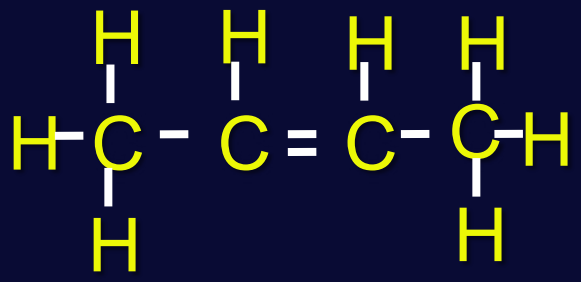
Positional isomers

Juffrou Karen

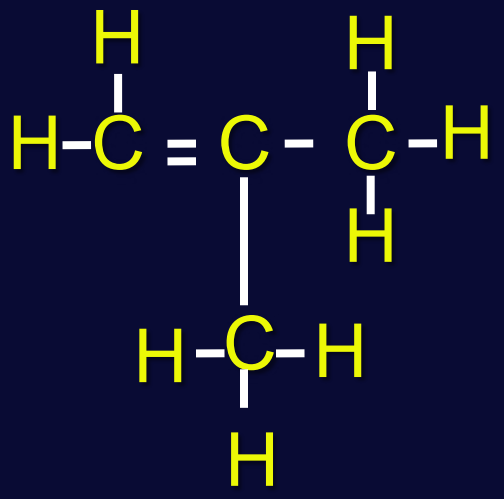
Butene has the molecular formula of C_4H_8 and the following isomers.



but-1-ene



but-2-ene



methylpropene

What type of isomers are methylpropene and but-1-ene?

Chain isomers

Alkanes and substituents

Juffrou Karen

Alkanes

Saturated hydrocarbons

Only single bonds between carbons

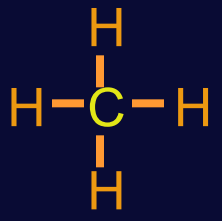
Alkanes

- Carbons are bonded with single bonds
- Low reactivity
- Saturated hydrocarbons
- General formula: C_nH_{2n+2}

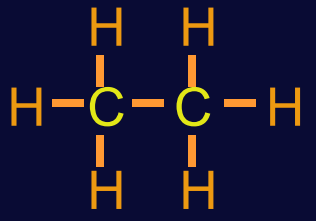
Juffrou Karen

Alkanes

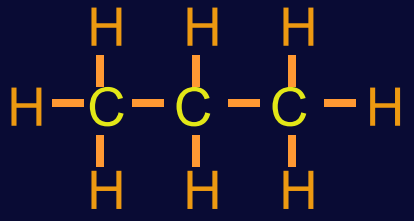
Meth = 1 carbon → methane



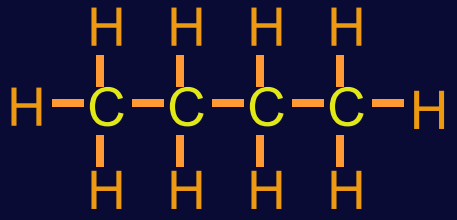
Eth = 2 carbons → ethane



Prop = 3 carbons → propane

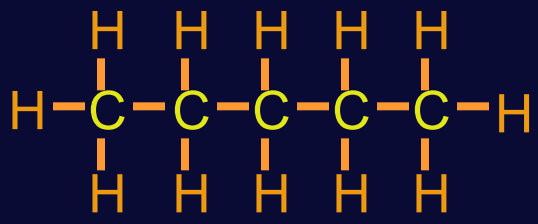


But = 4 carbons → butane

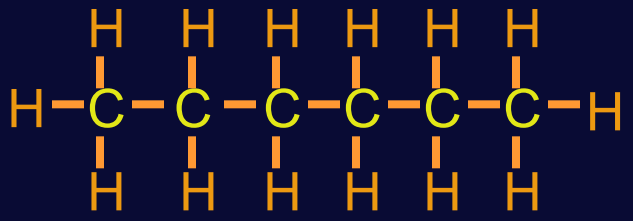


Alkanes

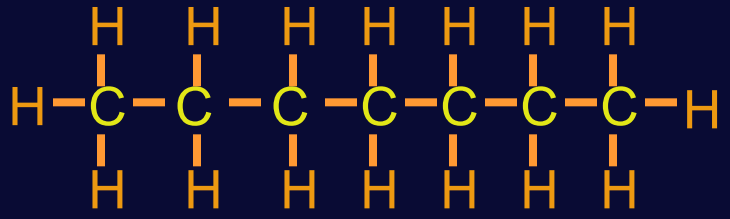
Pent = 5 carbons→ pentane



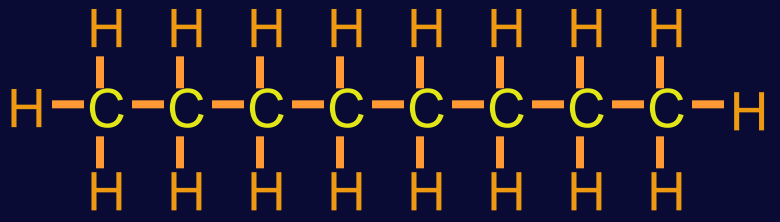
Hex = 6 carbons→ hexane



Hept = 7 carbons→ heptane

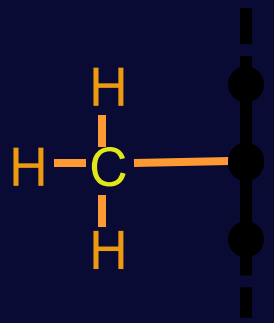


Oct = 8 carbons→ octane



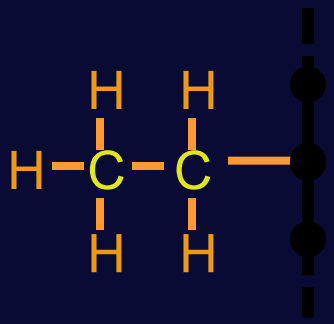
Substituents

Alkyl groups are derived from the alkanes and the name is allocated by substituting the **ane** with an **yl**

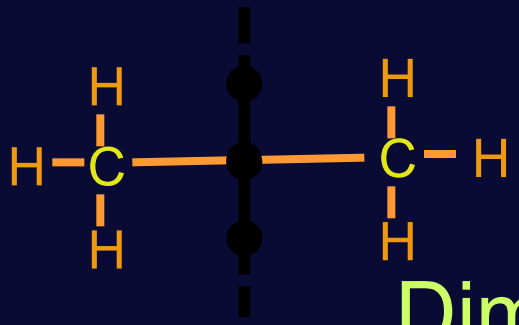


Methyl

Use di or tri to indicate two or three substituents



Ethyl



Dimethyl

Give the IUPAC names of the alkanes with the following molecular formulae:

C_3H_8 Propane

C_5H_{12} Pentane

C_8H_{18} Octane

Write down the molecular formulae for each of the following alkanes:

ethane C_2H_6

hexane C_6H_{14}

heptane C_7H_{16}

Complete the following formulae with the number of C-atoms given:

C_5H ____ 12

C_8H ____ 18

CH ____ 4

C_4H ____ 10

Juffrou Karen

Complete the following formulae with the number of H-atoms given:

C__H_{12} 5

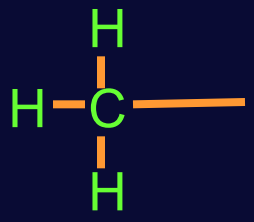
C__H_8 3

C __H_{20} 9

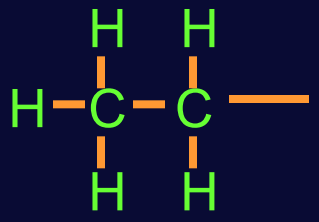
C __H_{32} 15

Juffrou Karen

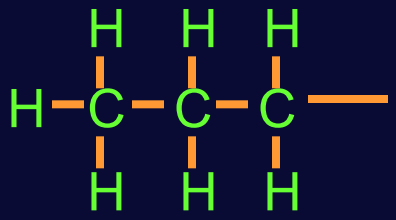
Draw the structure and give the names of the first four straight chain alkyl groups.



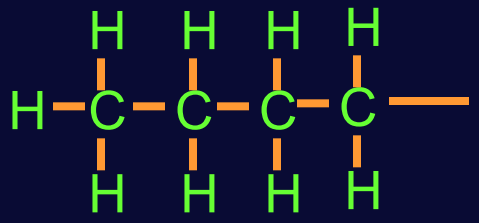
methyl



ethyl



propyl



butyl

Alkanes

IUPAC naming

International Union of Pure and Applied Chemistry

Juffrou Karen

Naming organic molecules

Who is this?

King Henry VIII from the house of Tudor

Only King, or only Tudor is not enough. We need his whole pedigree.

Family of homologous group

Prefix- Stem- Suffix

Number of C - atoms

Basic rules

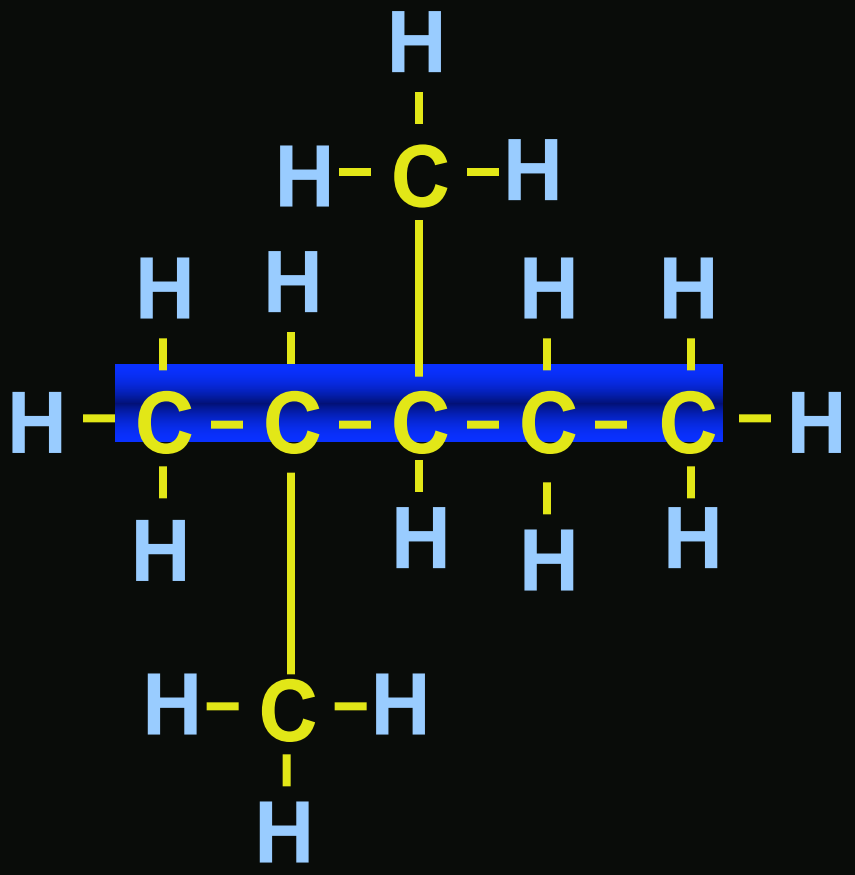
The stem name= **pent**

Single bonds= **ane**

Step 1

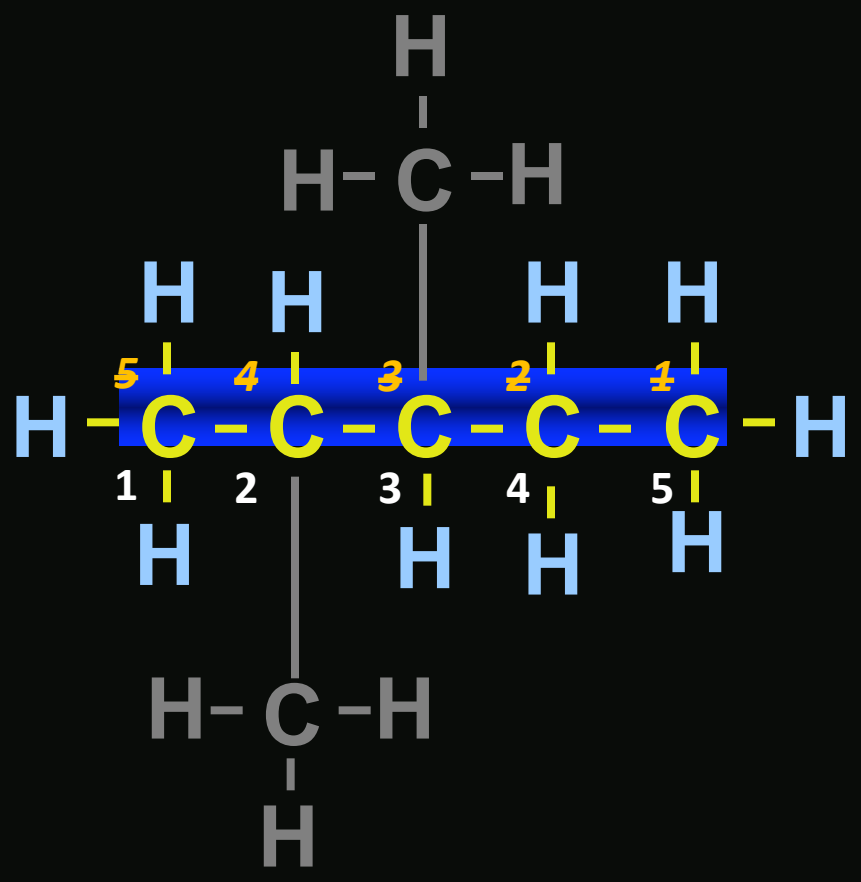
Find the longest continuous chain of C-atoms

(You may need to go around corners):



Basic rules

Step 2
Number the C-atoms in the main chain to give the alkyl group (substituent) the lowest number



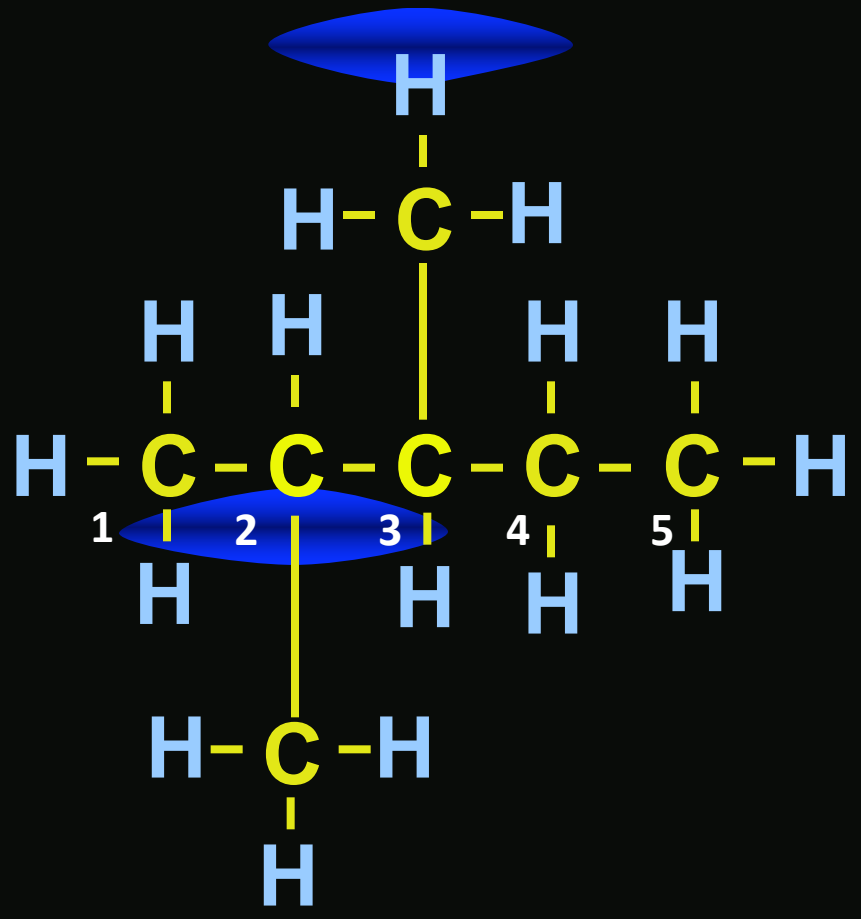
The stem name = pent

Single bonds = ane

First carbon connected to a substituent is 2

Basic rules

Step 3
Identify and number all the substituents:



The stem name = pent

Single bonds = ane

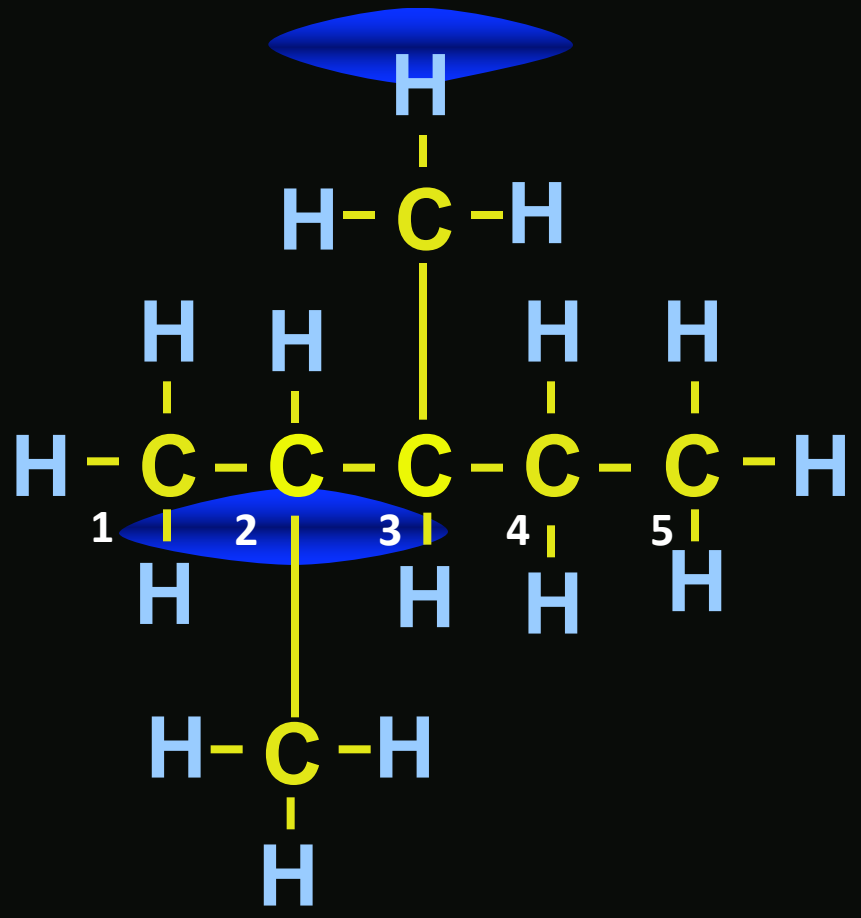
First carbon connected to a substituent is 2

Methyl at 2
Methyl at 3

Basic rules

Step 4

If there is more than one identical substituent the prefix is indicated with the prefixes di-(2), tri-(3) and tetra-(4):



The stem name = pent

Single bonds = ane

First carbon connected to a substituent is 2

Methyl at 2

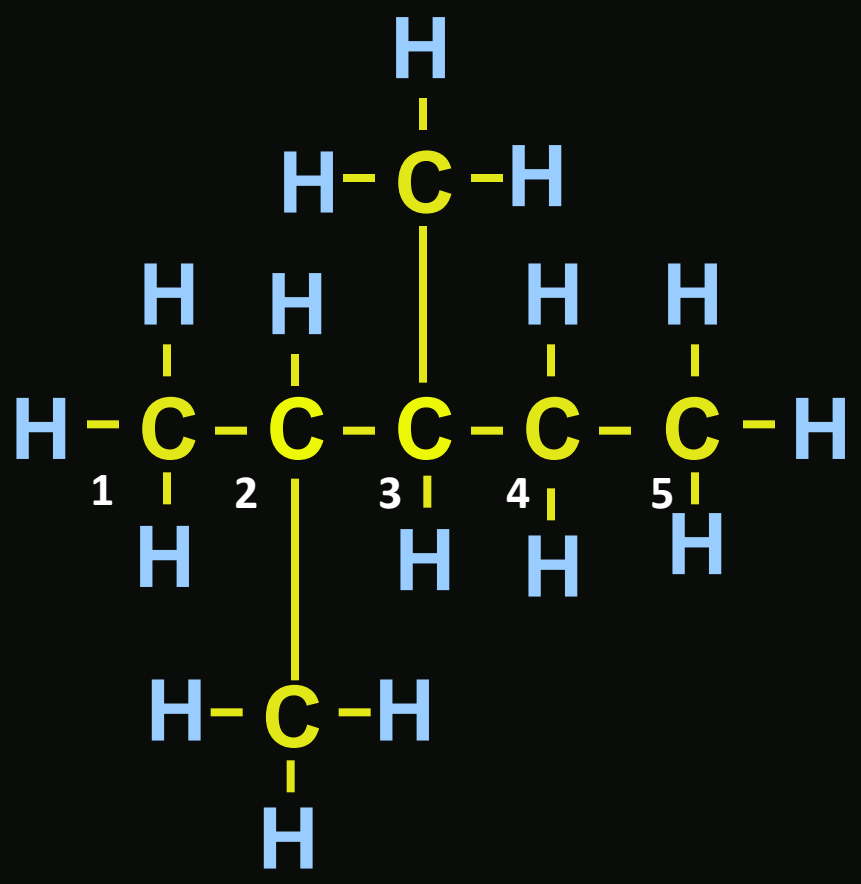
Methyl at 3

Dimethyl at 2,3

Basic rules

The name is:

Dimethyl pent ane



The stem name = pent

Single bonds = ane

First carbon connected to a substituent is 2

Methyl at 2

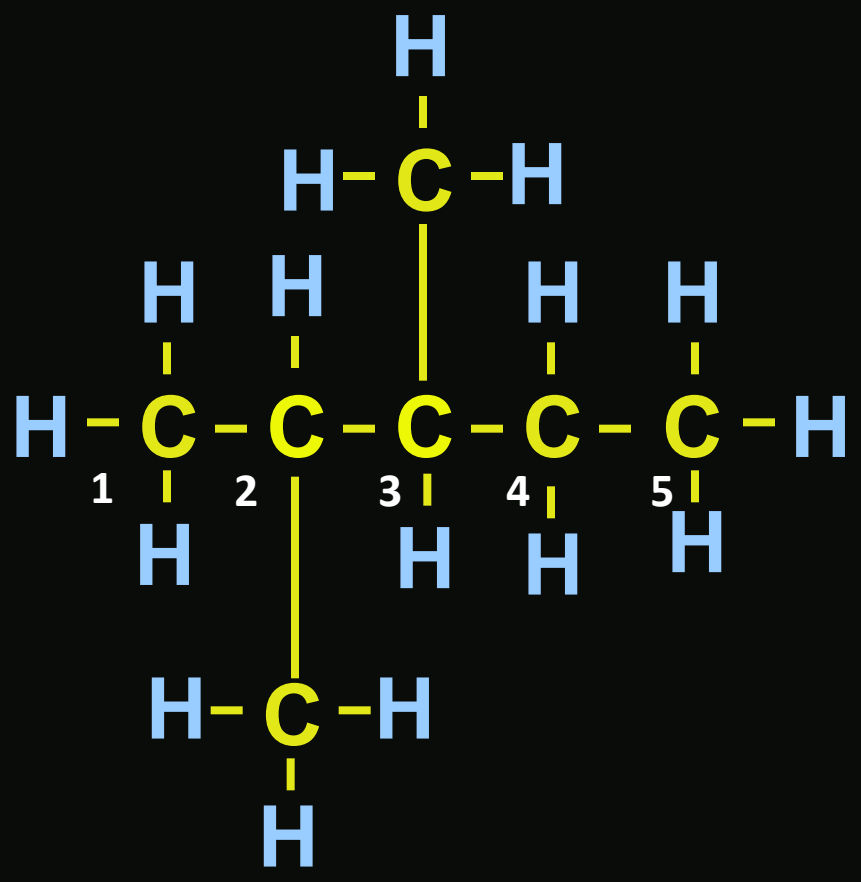
Methyl at 3

Dimethyl at 2,3

Basic rules

The name is:

2,3-Dimethylpentane



The stem name = pent

Single bonds = ane

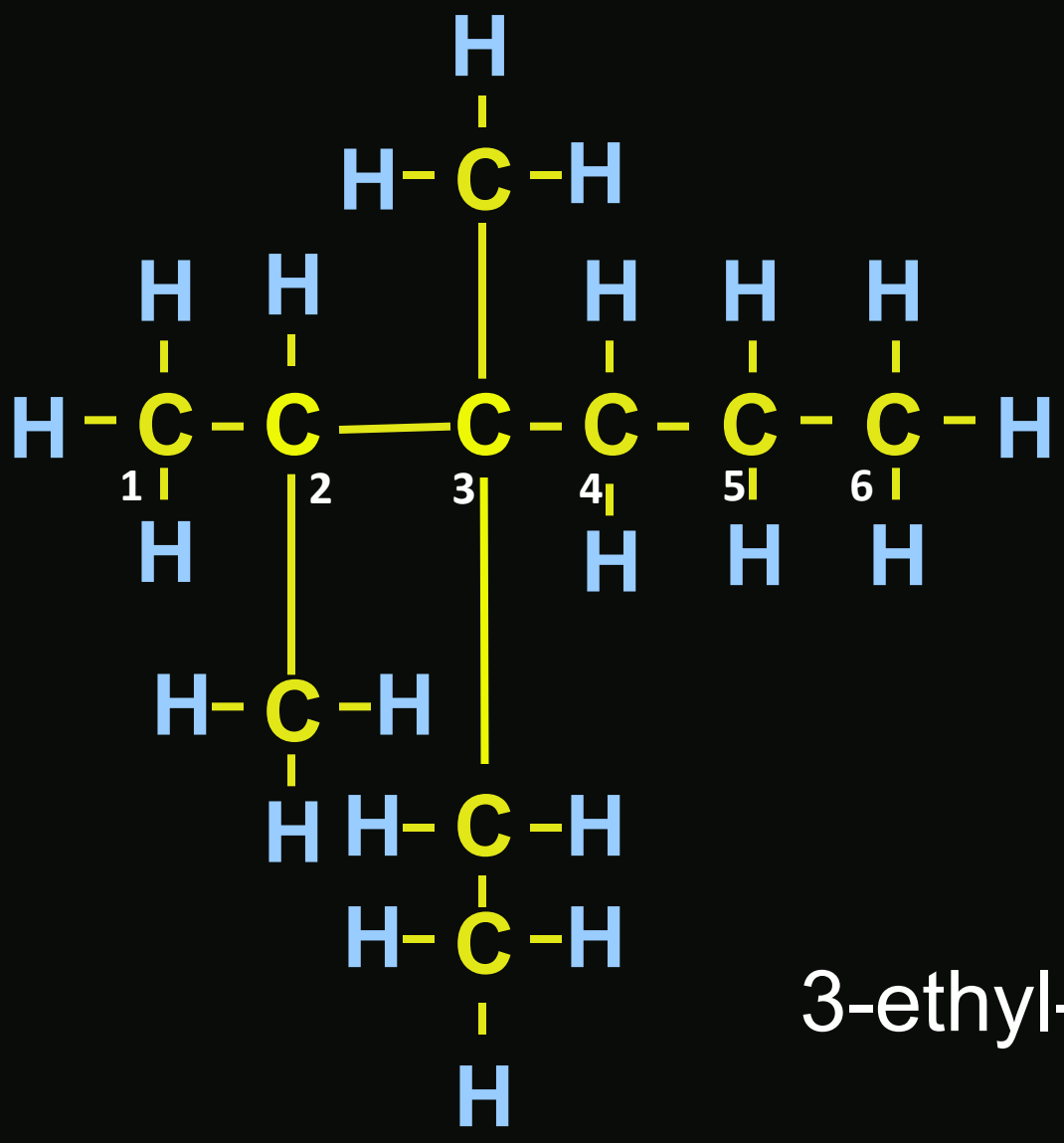
First carbon connected to a substituent is 2

Methyl at 2

Methyl at 3

Dimethyl at 2,3

Basic rules



If 2 different alkyl groups are present, they are written alphabetically (ignore the prefixes di, tri etc. for order but include for name)

3-ethyl-2,3-dimethylhexane

Basic rules

3-ethyl-2,3-dimethylhexane

- hyphens separate numbers from words
- commas separate two numbers
- write the name as a single word with no spaces

Juffrou Karen

Basic rules

These are the basic rules.
We will add to these rules
when we need to.

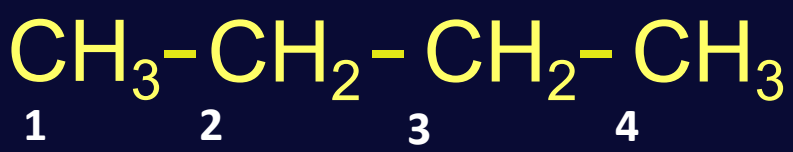
Juffrou Karen

Give the IUPAC name for the following compound:

The stem is = **But**

Single bonds = **ane**

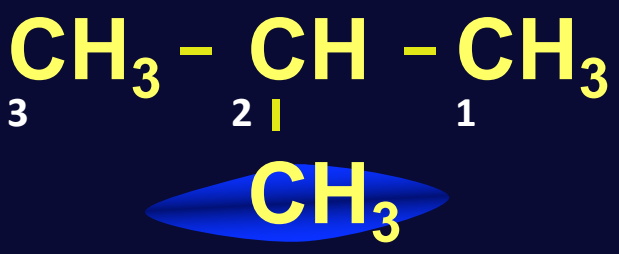
No substituents



butane

(Cadac gas = mixture of butane and propane)

Give the IUPAC name for the following compound:



The stem is = **Prop**

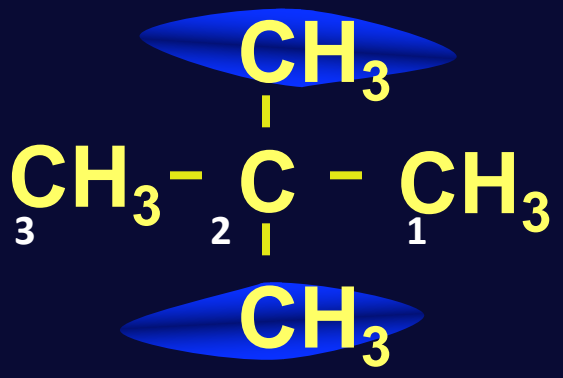
Single bonds = **ane**

Methyl at Carbon 2

2-Methylpropane

Juffrou Karen

Give the IUPAC name for the following compound:



The stem is = **Prop**

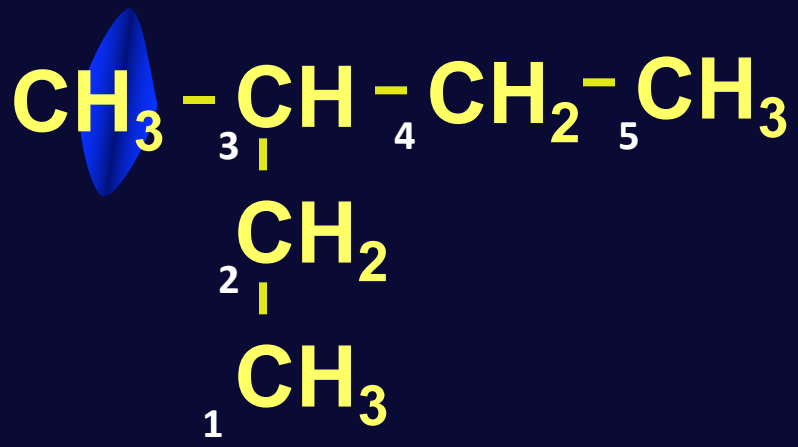
Single bonds = **ane**

2 Methyls at carbons 2 and 2

2,2-Dimethylpropane

Juffrou Karen

Give the IUPAC name for the following compound:



The stem is = pent

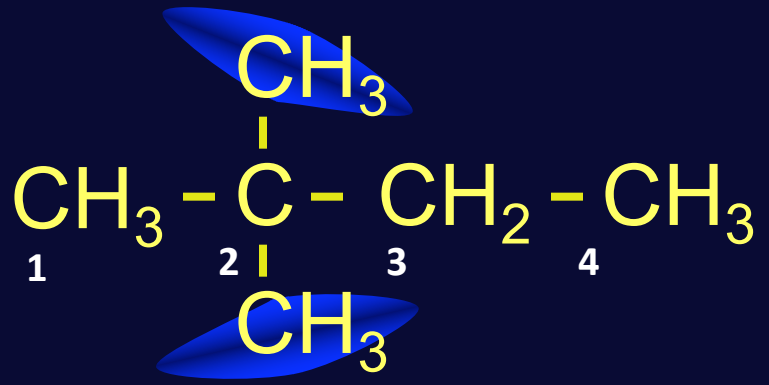
Single bonds = **ane**

1 Methyl at carbon 3

3-Methylpentane

Juffrou Karen

Give the IUPAC name for the following compound:



The stem is = **But**

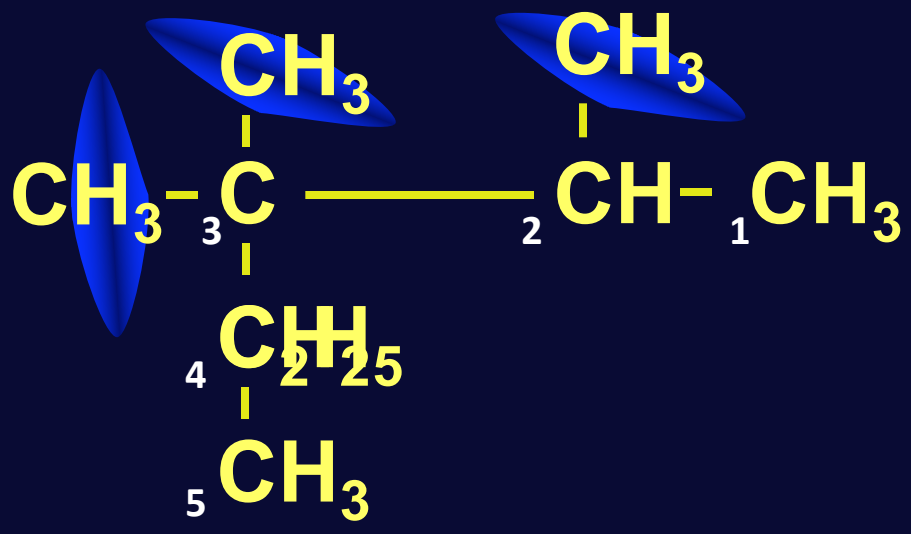
Single bonds = **ane**

2 Methyls at carbons 2 and 2

2,2-Dimethylbutane

Juffrou Karen

Give the IUPAC name for the following compound:



The stem is = **Pent**

Single bonds = **ane**

3 Methyls at carbons 2, 3 and 3

2,3,3-trimethylpentane

Juffrou Karen

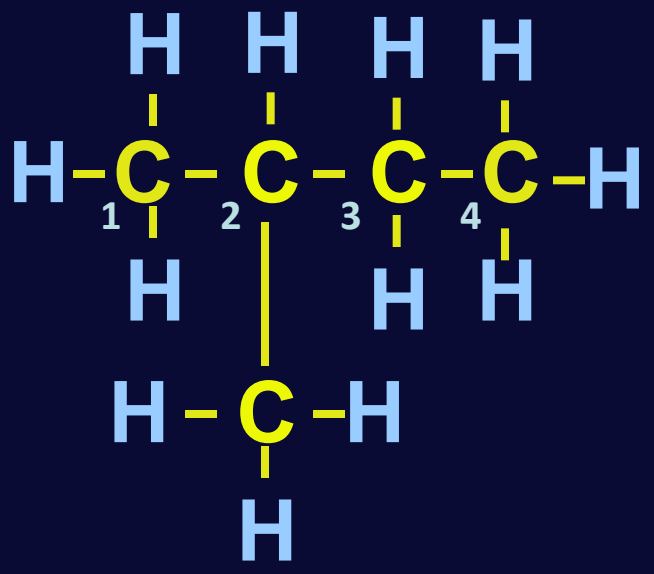
Draw a structural formula for the following compound:

2-Methylbutane

4 carbons

Methyl at carbon 2

Single bonds



Juffrou Karen

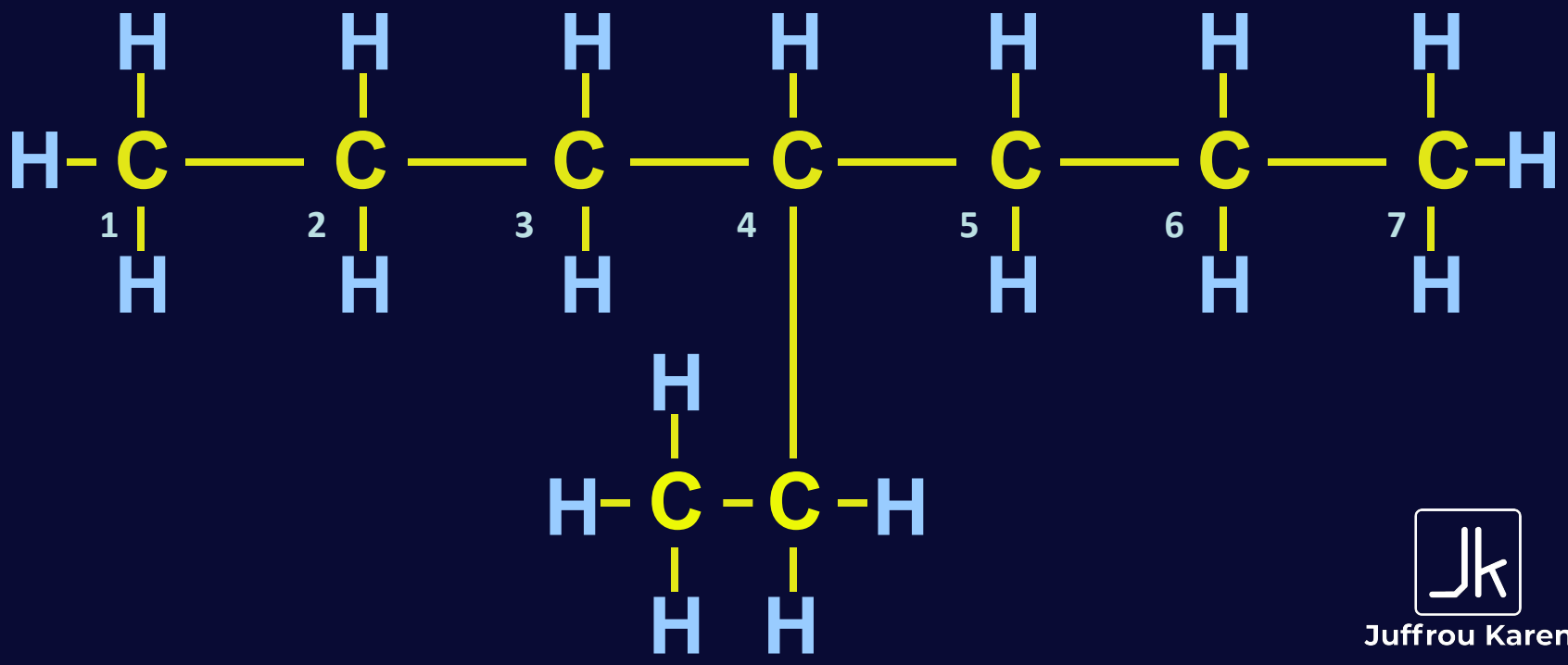
Draw a structural formula for the following compound:

4-Ethylheptane

7 carbons

Ethyl at 4

Only single bonds



Juffrou Karen

Organic Chemistry Part 2

Juffrou Karen

Boiling point

The temperature at which the vapour pressure of the substance is equal to the atmospheric pressure.

Melting point

The temperature at which the solid and liquid phases of a substance are at equilibrium.

Juffrou Karen

Vapour pressure

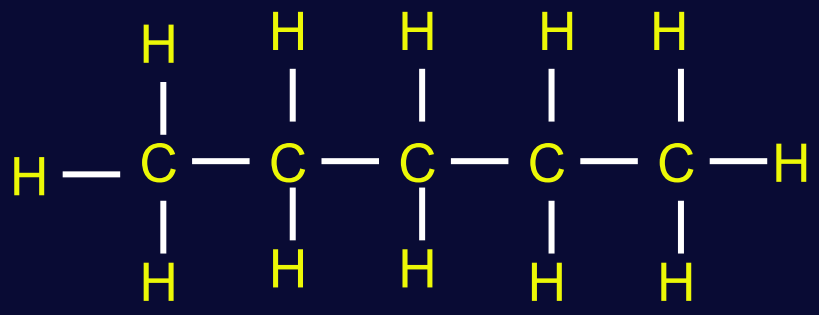
The pressure exerted by a vapour at equilibrium with its liquid in a closed system.

A high vapour pressure means that a substance is volatile and that the substance evaporates easily.

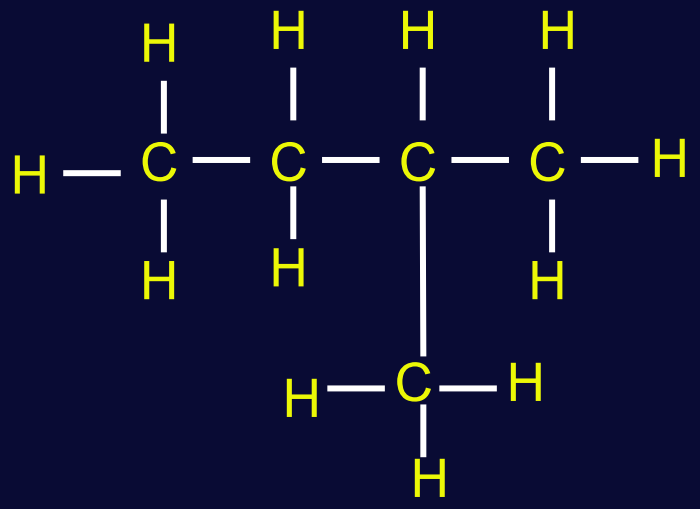
Intermolecular forces

London forces/ Dispersion forces	Dipole-dipole forces	Hydrogen bonds
Alkanes Alkenes Alkynes	Aldehydes Ketones Esters Alkyl halides	Alcohols (1 bonding site) Carboxylic acids (2 bonding sites)

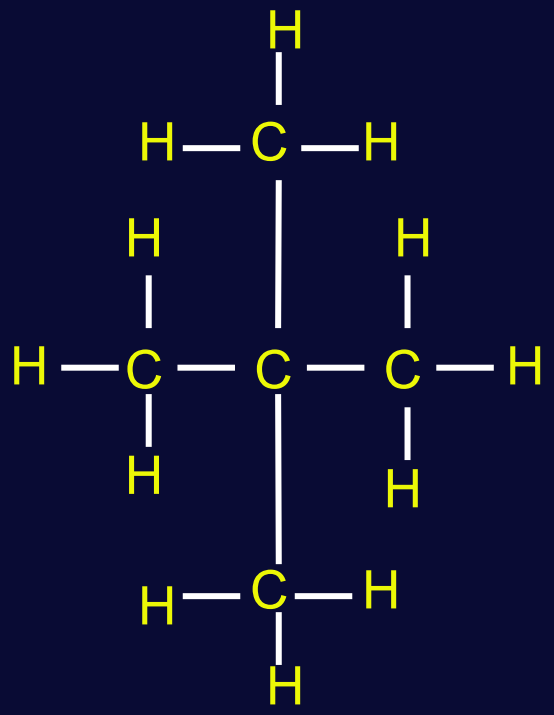
Consider the following three compounds with the formula C_5H_{12}



Pentane

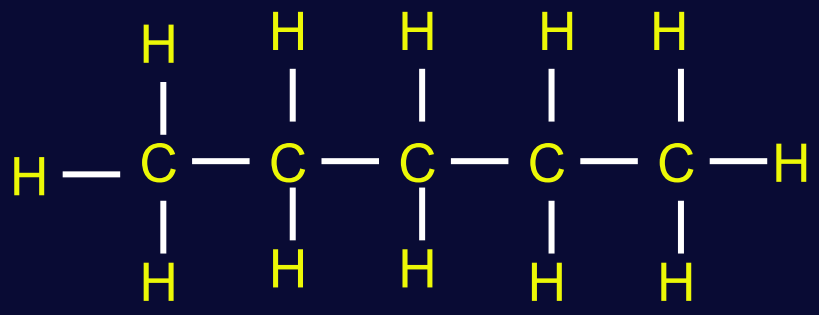


2-methylbutane

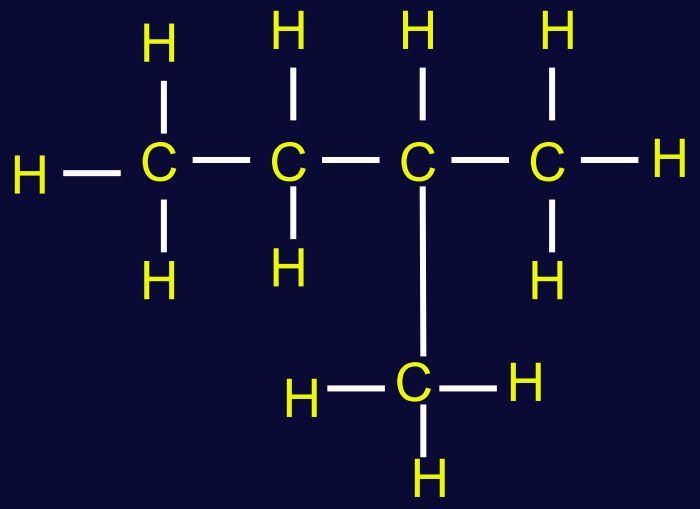


2,2-dimethylpropane

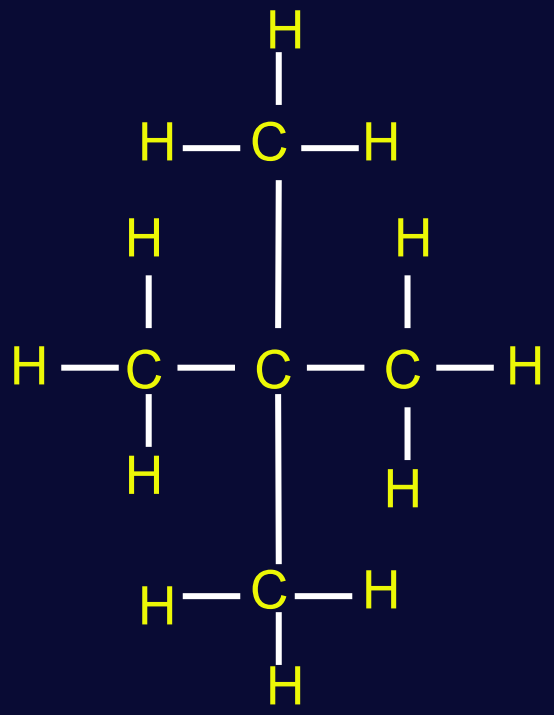
Consider the following three compounds with the formula C_5H_{12}
Are these compounds isomers?



Pentane

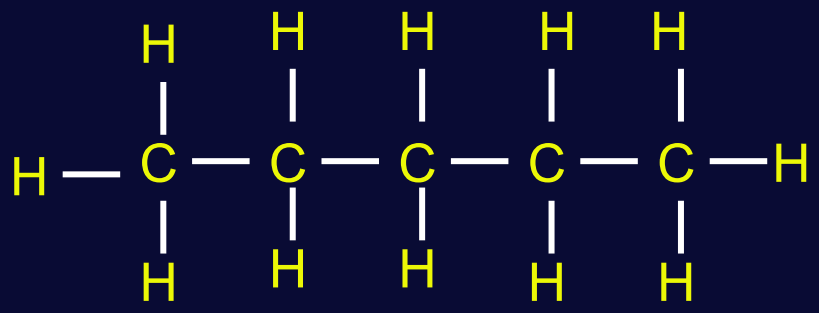


2-methylbutane

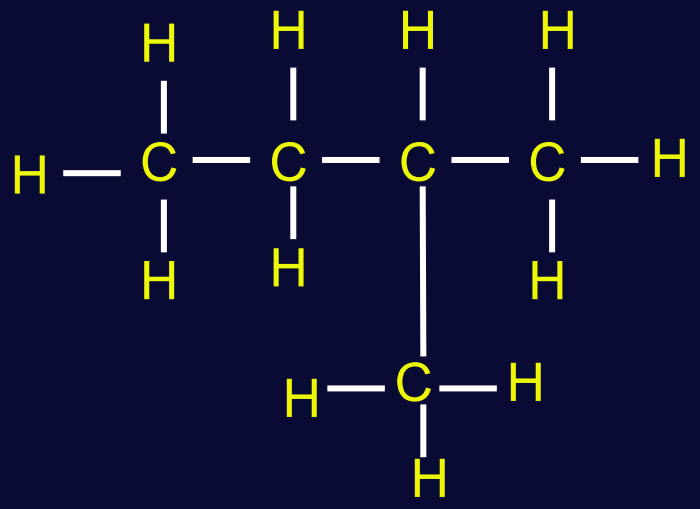


2,2-dimethylpropane

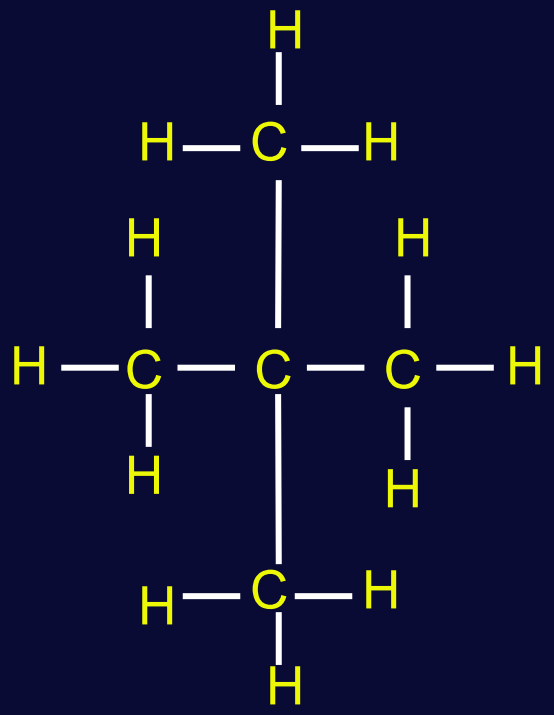
Consider the following three compounds with the formula C_5H_{12}
Identify the type of isomers present.



Pentane



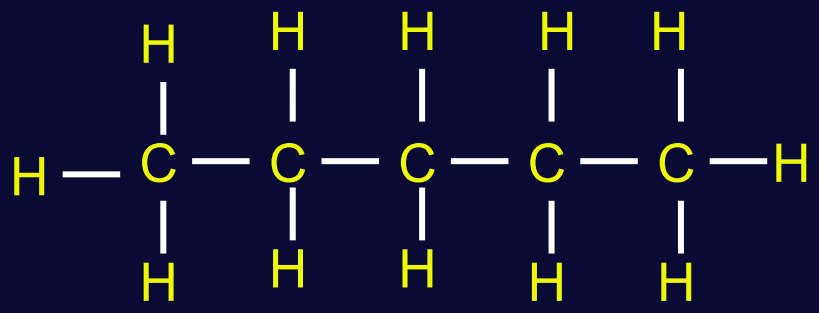
2-methylbutane



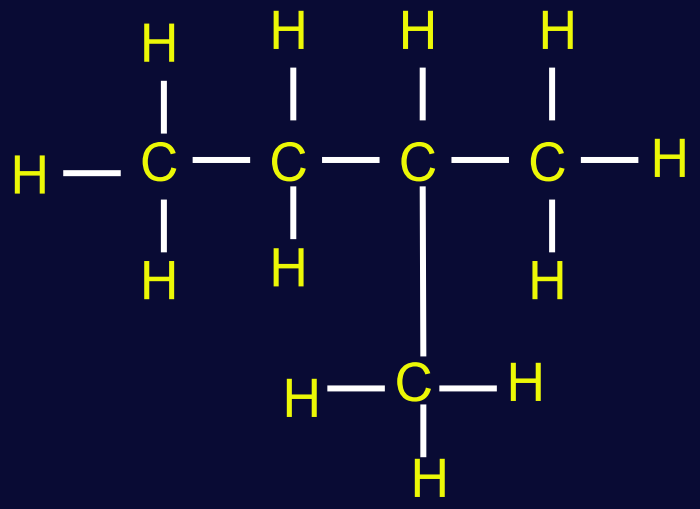
2,2-dimethylpropane

Consider the following three compounds with the formula C_5H_{12}

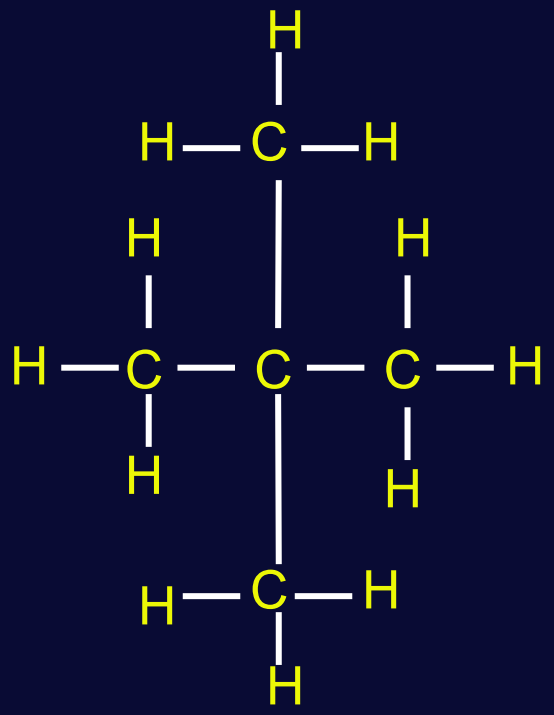
Chain isomers



Pentane



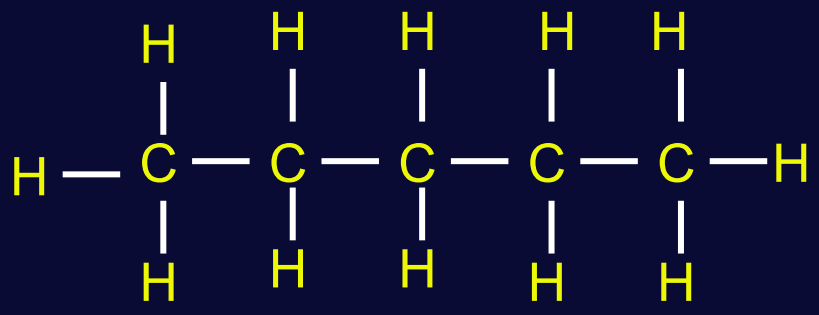
2-methylbutane



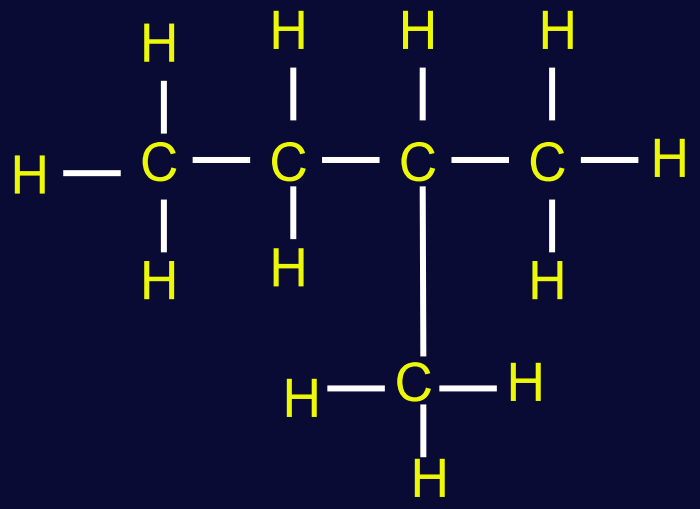
2,2-dimethylpropane

Consider the following three compounds with the formula C_5H_{12}

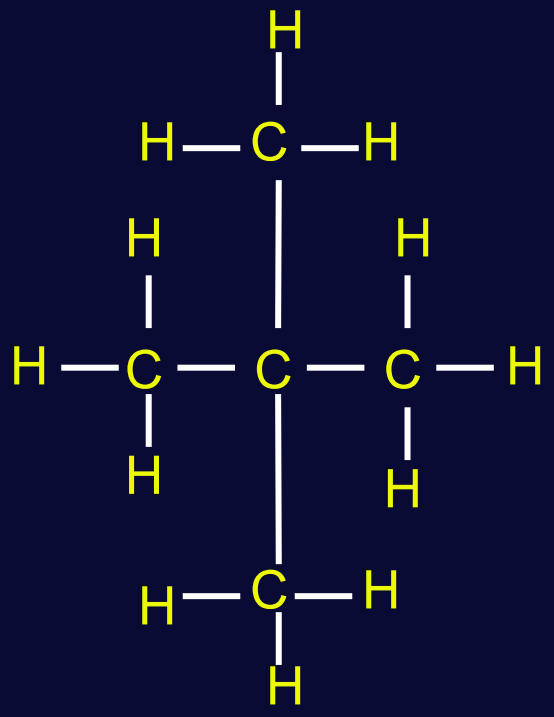
Which intermolecular forces are present?



Pentane



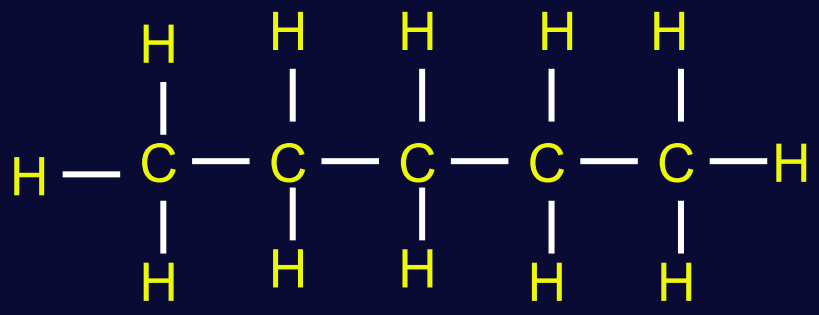
2-methylbutane



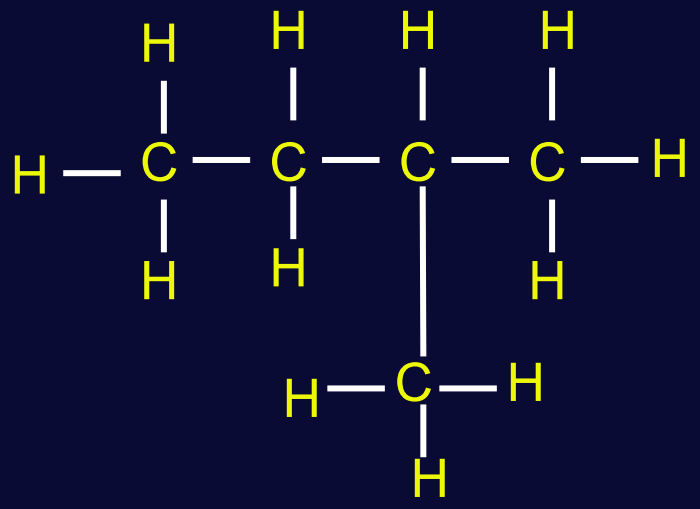
2,2-dimethylpropane

Consider the following three compounds with the formula C_5H_{12}

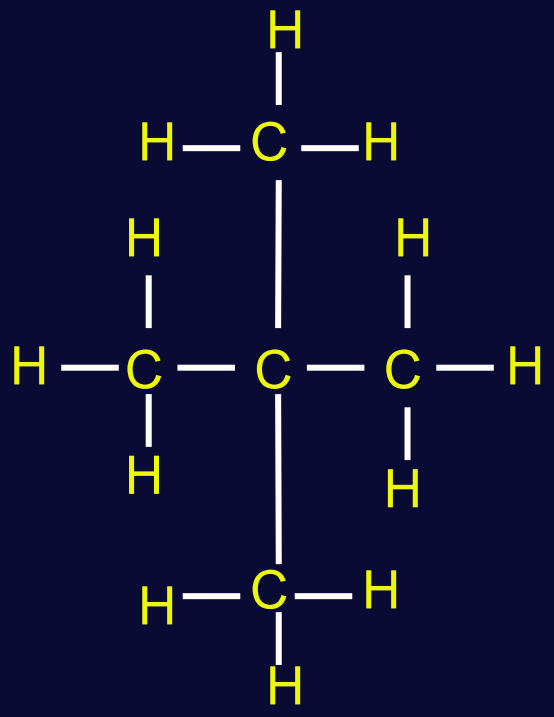
London (Dispersion) forces



Pentane



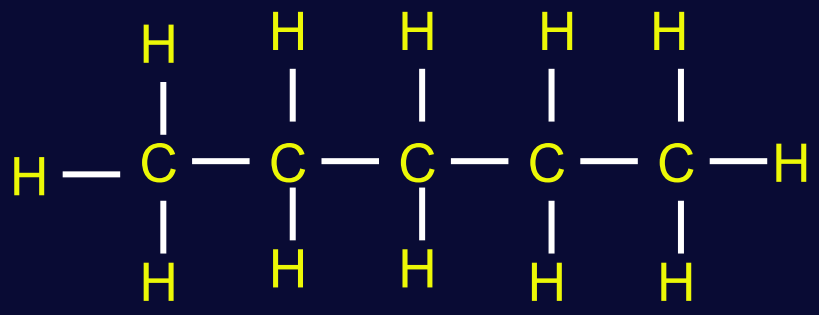
2-methylbutane



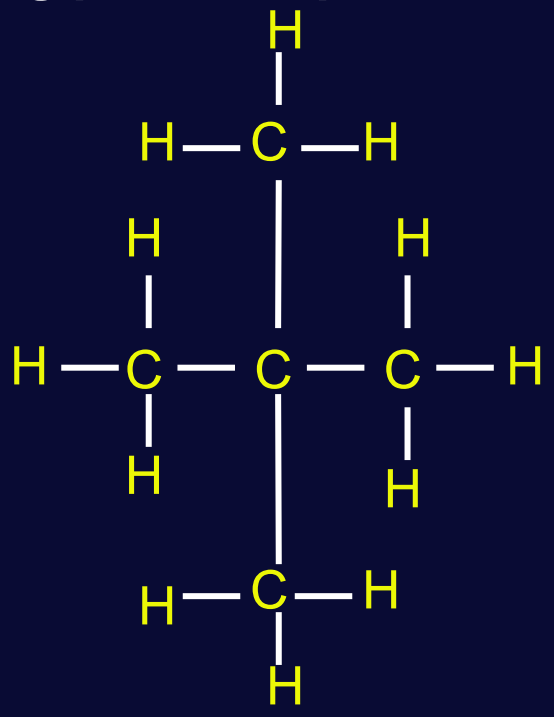
2,2-dimethylpropane

Consider the following three compounds with the formula C_5H_{12}

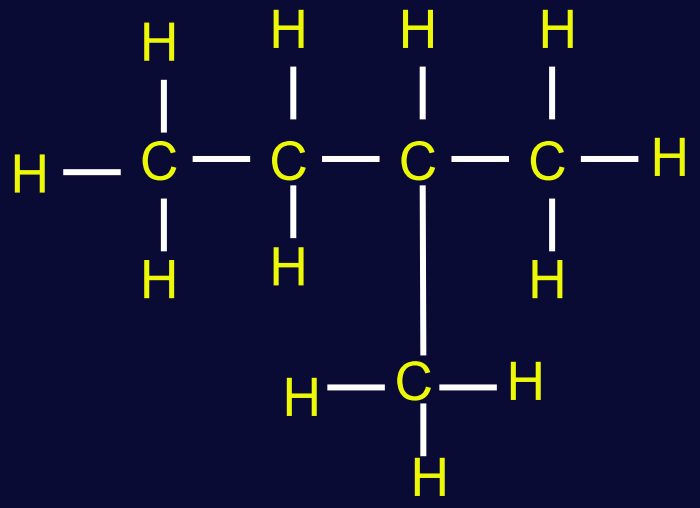
Which compound will have the highest boiling point? Explain.



Pentane



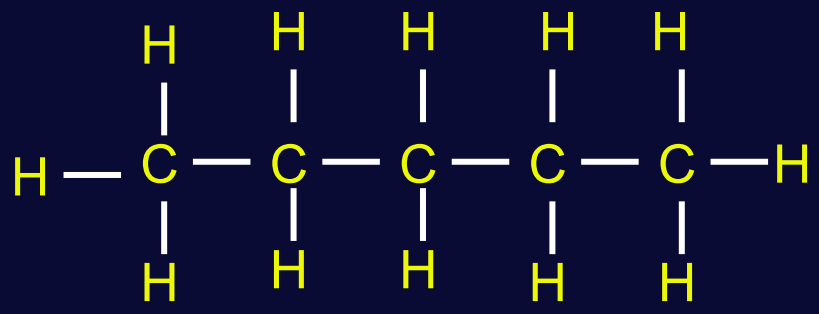
2,2-dimethylpropane



2-methylbutane

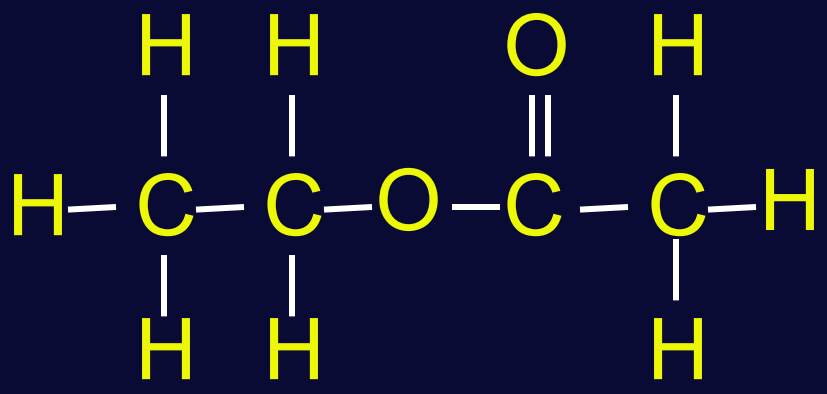
Consider the following three compounds with the formula C_5H_{12}
Which compound will have the highest boiling point? Explain.

- All have London (Dispersion) forces
- Pentane has the longest chain length, and thus the largest surface area
- The IMF between the pentane molecules will be the strongest,
- therefor more energy will be required to overcome the stronger IMF



Pentane

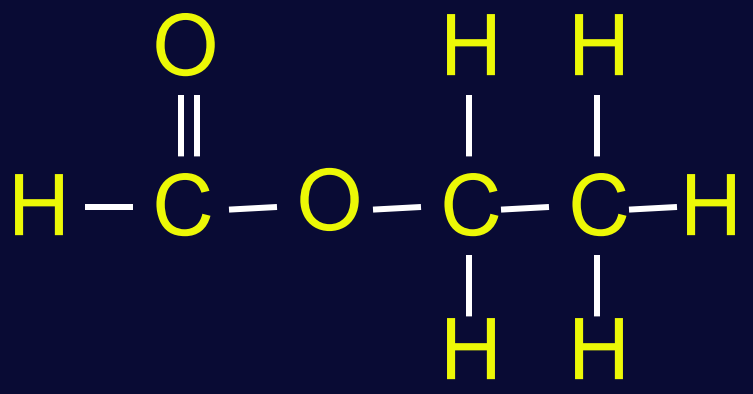
Give the IUPAC-name of the following compound:



ethyl ethanoate

Juffrou Karen

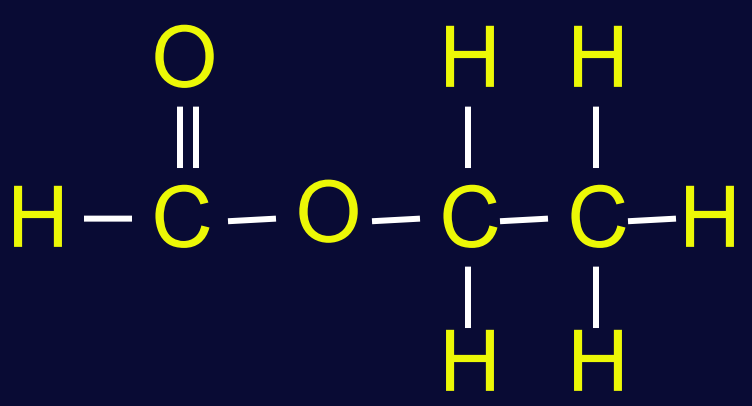
Give the IUPAC-name of the following compound:



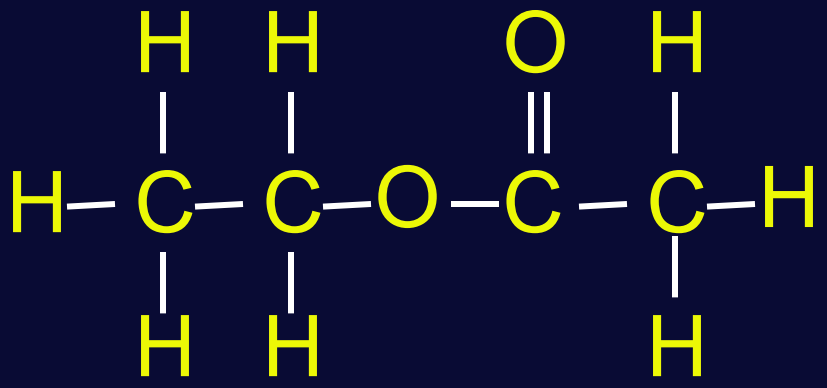
ethyl methanoate

Juffrou Karen

Which compound will have the highest boiling point? Explain



ethyl methanoate



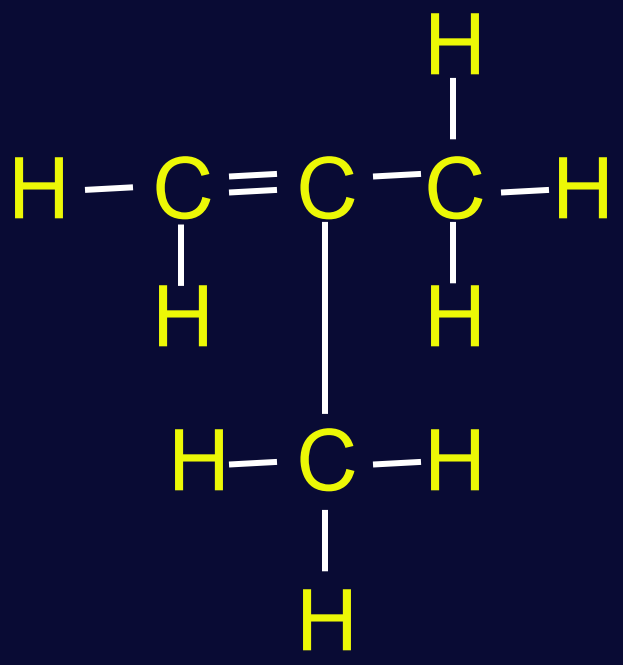
ethyl ethanoate

Juffrou Karen

- Both have dipole-dipole forces
- Ethyl ethanoate has a larger molecular mass, and the largest surface area
- The IMF between the ethyl ethanoate molecules will be the strongest,
- therefor more energy will be required to overcome the stronger IMF,
- and therefor ethyl ethanoate will have the highest boiling point

Write down the IUPAC name of the following compound:

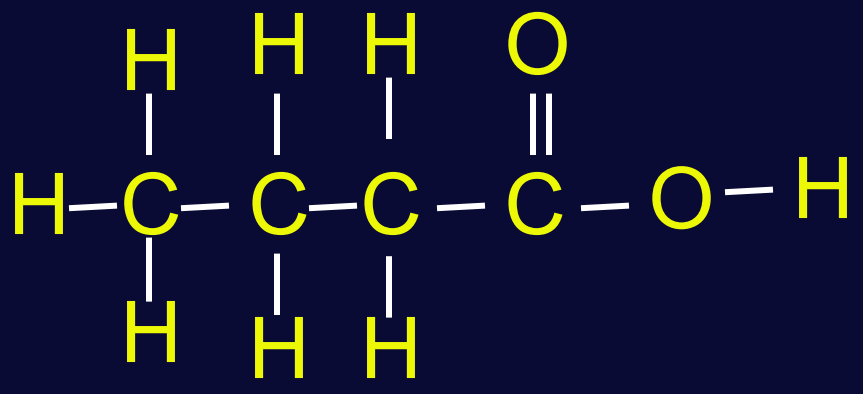
$CH_2C(CH_3)CH_3$



2-methylprop-1-ene

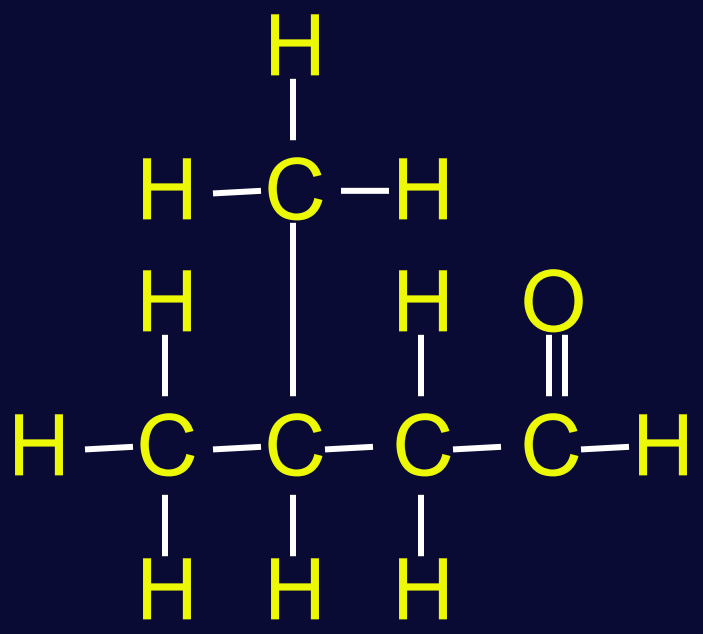
Juffrou Karen

Give the IUPAC-names for the following compound.



Butanoic acid

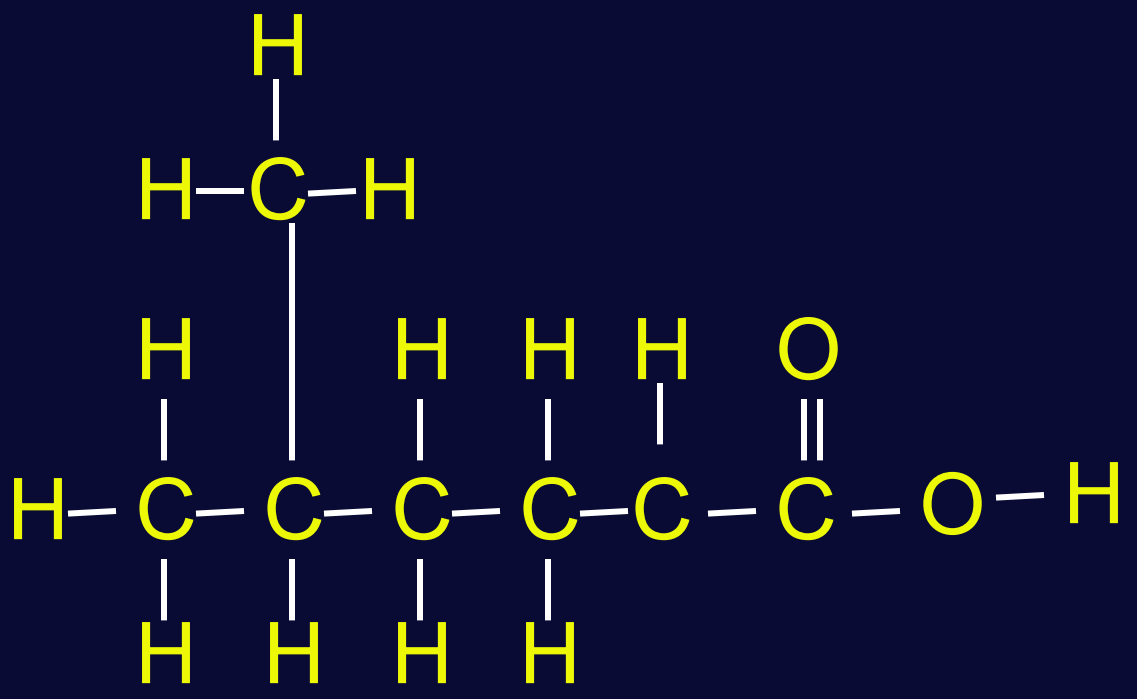
Give the IUPAC-name for the following compound:



3-methylbutanal

Juffrou Karen

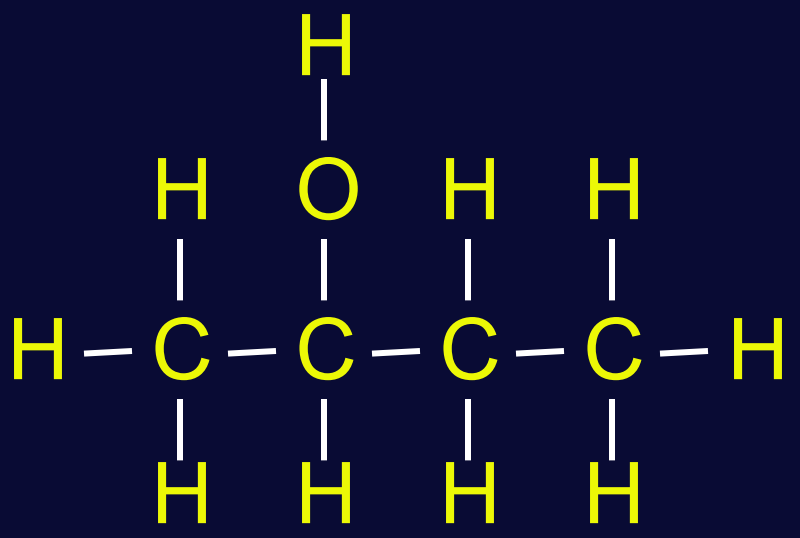
Give the IUPAC-name for the following compound:



5-methylhexanoic acid

Juffrou Karen

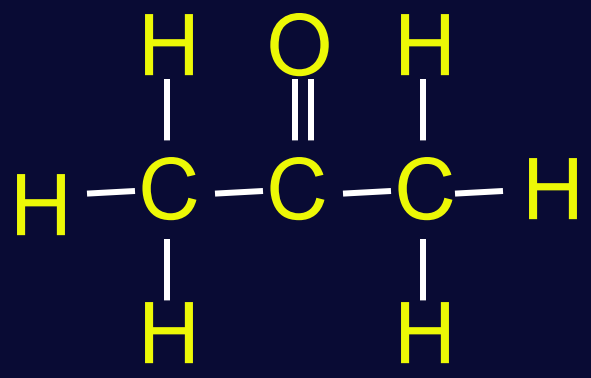
Give the IUPAC-name for the following compound:



Butan-2-ol

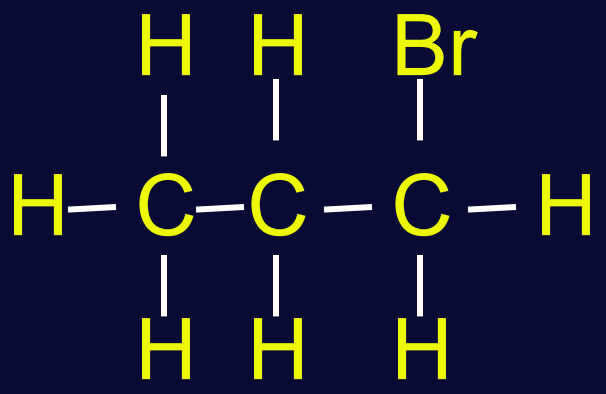
Juffrou Karen

Give the IUPAC-name for the following compound:



propan-2-one

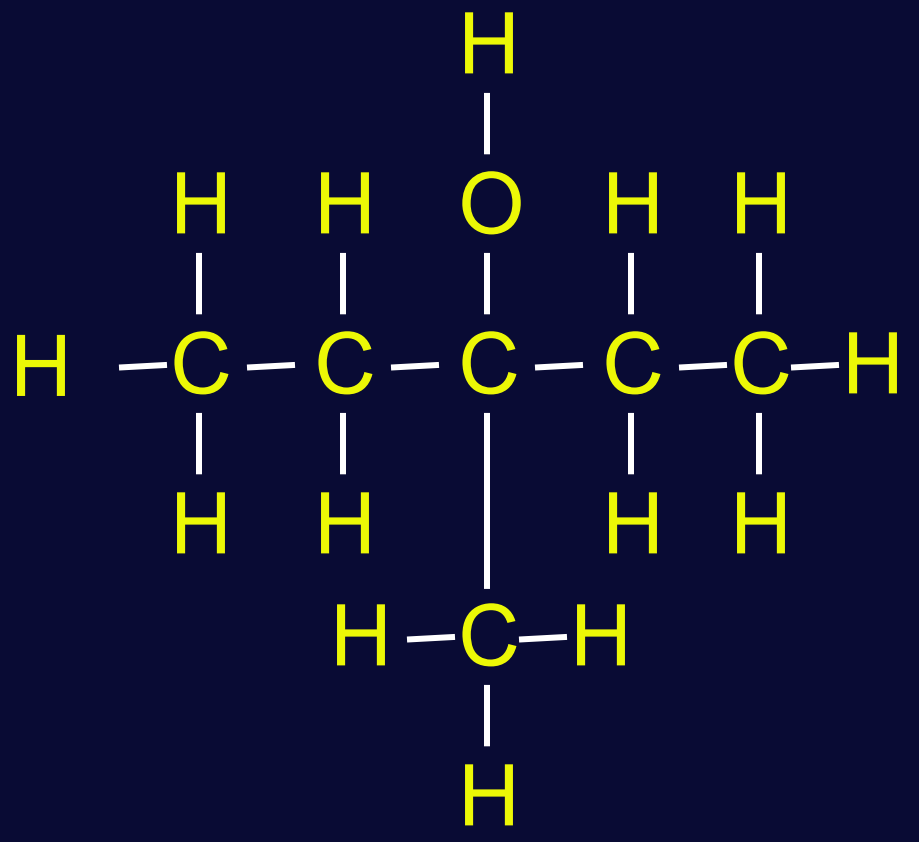
Give the IUPAC-name for the following compound:



1-bromopropane

Juffrou Karen

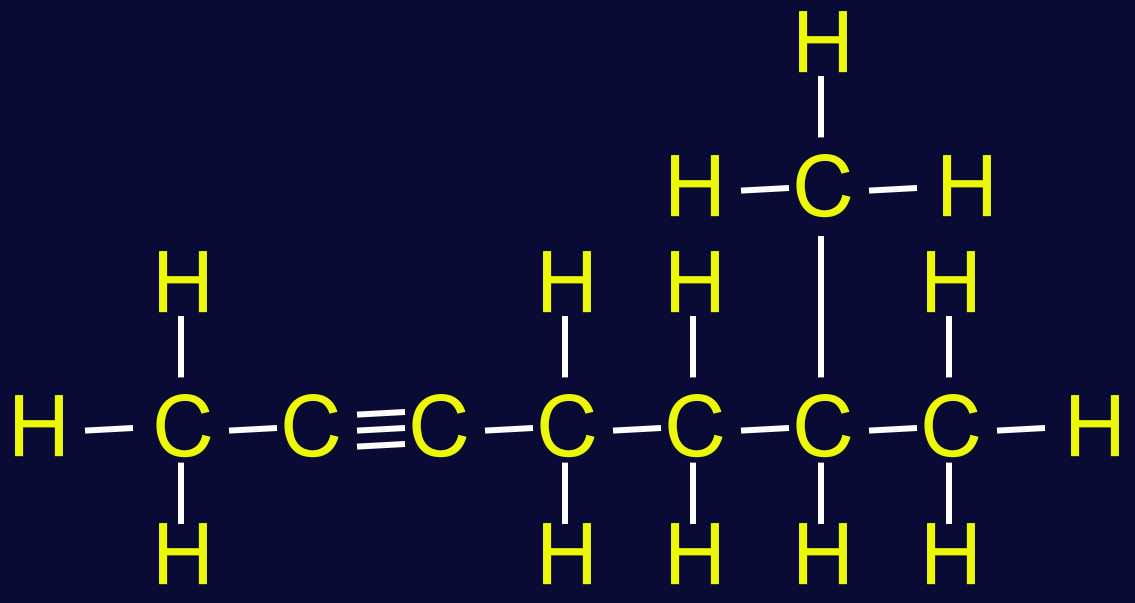
Give the IUPAC-name for the following compound:



3-methylpentan-3-ol

Juffrou Karen

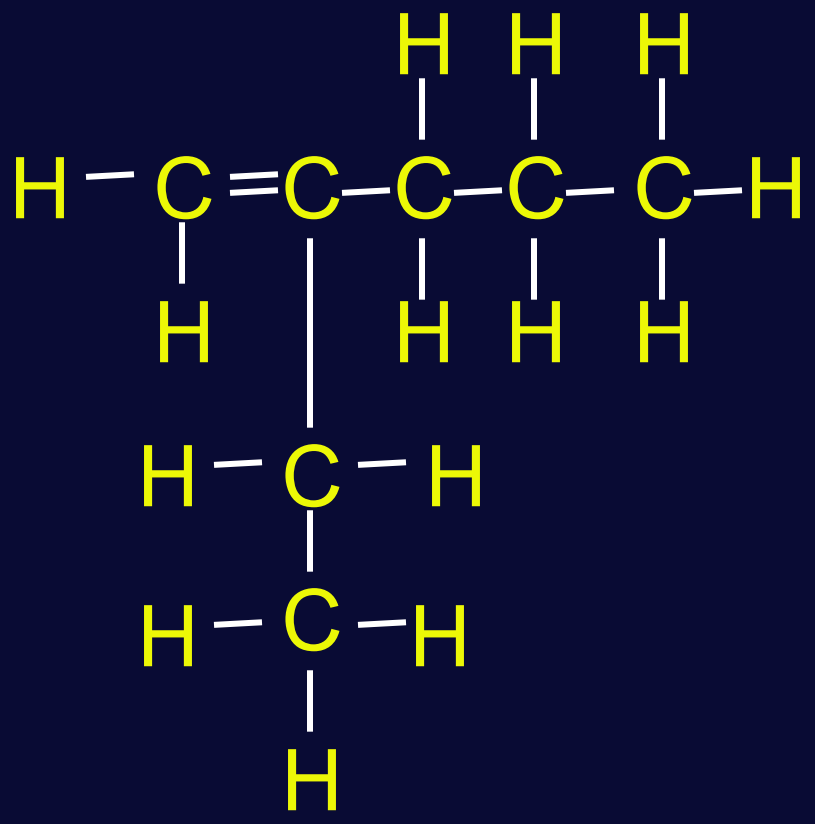
Give the IUPAC-name for the following compound:



6-methylhept-2-yne

Juffrou Karen

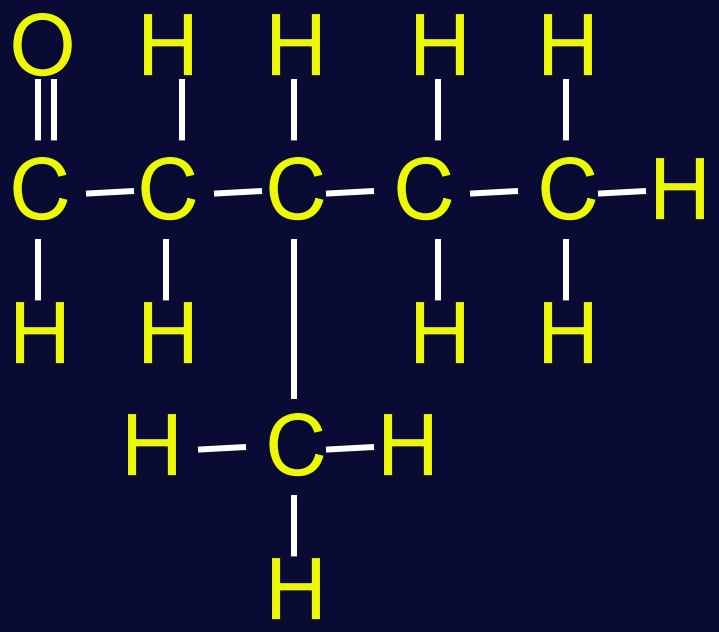
Give the IUPAC-name for the following compound:



2-ethylpent-1-ene

Juffrou Karen

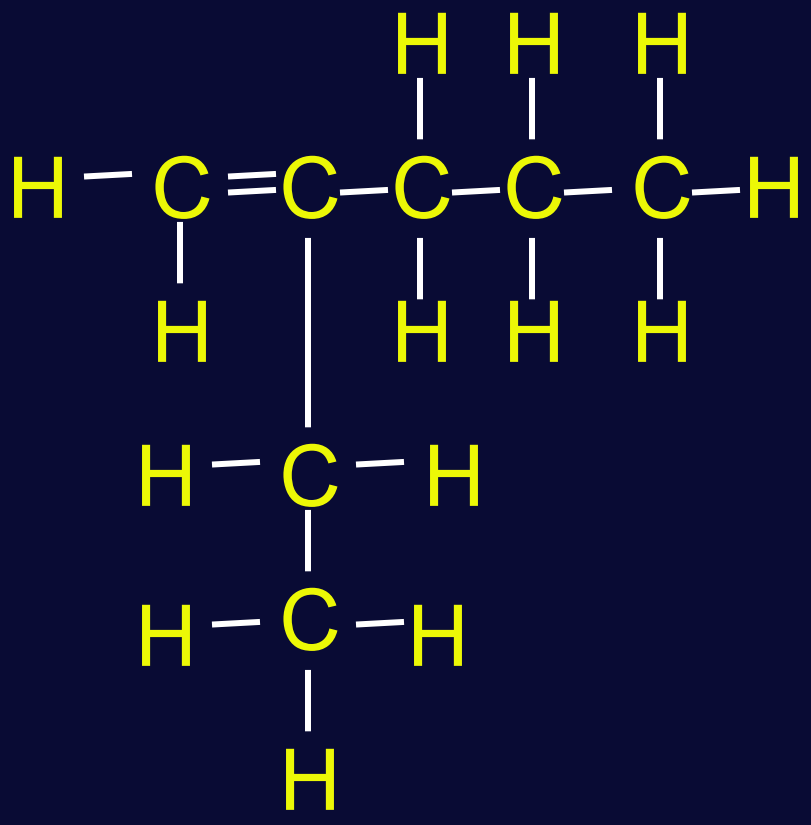
Give the IUPAC-name for the following compound:



3-methylpentanal

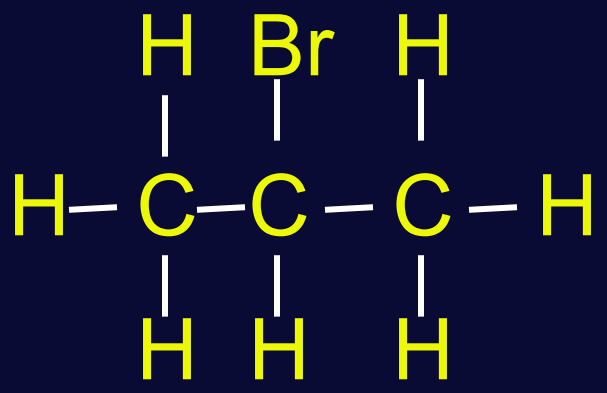
Juffrou Karen

Give the IUPAC-name for the following compound:



2-ethylpent-1-ene

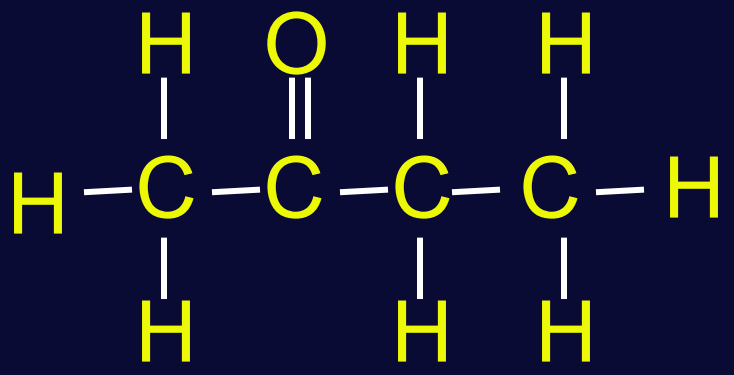
Give the IUPAC-name for the following compound:



2-bromopropane

Juffrou Karen

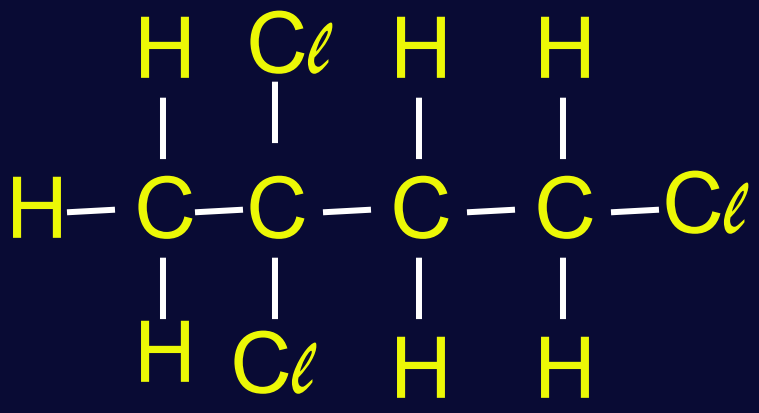
Give the IUPAC-name for the following compound:



butan-2-one

Juffrou Karen

Give the IUPAC-name for the following compound:

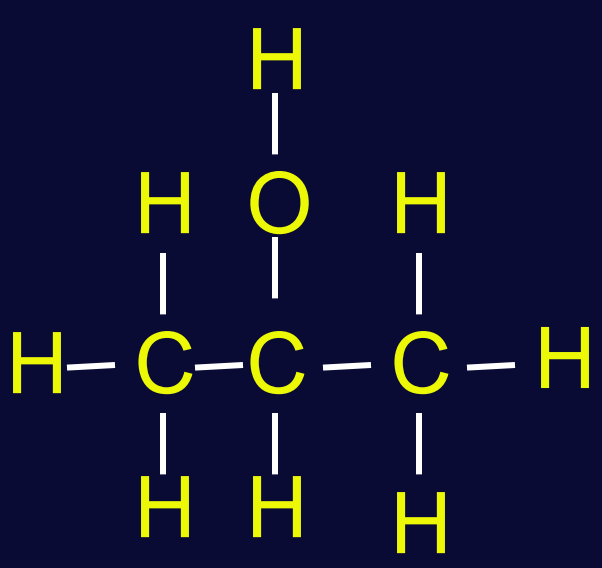


1,3,3-trichlorobutane

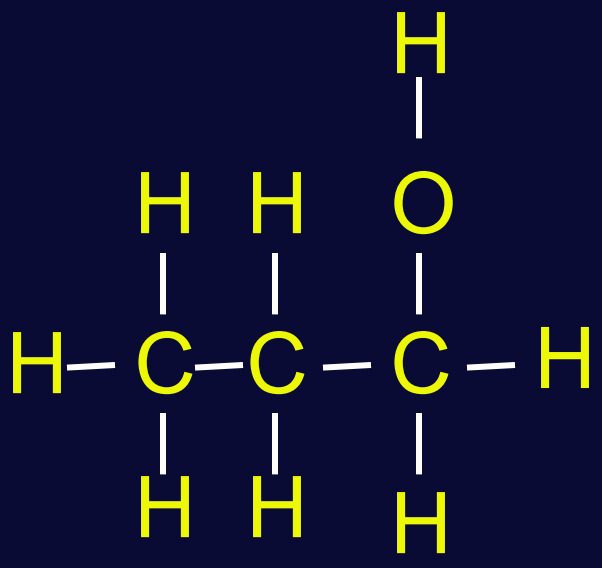
Juffrou Karen

Give the IUPAC-name for the following compound:

C_3H_8O



Propan-2-ol
Secondary alcohol

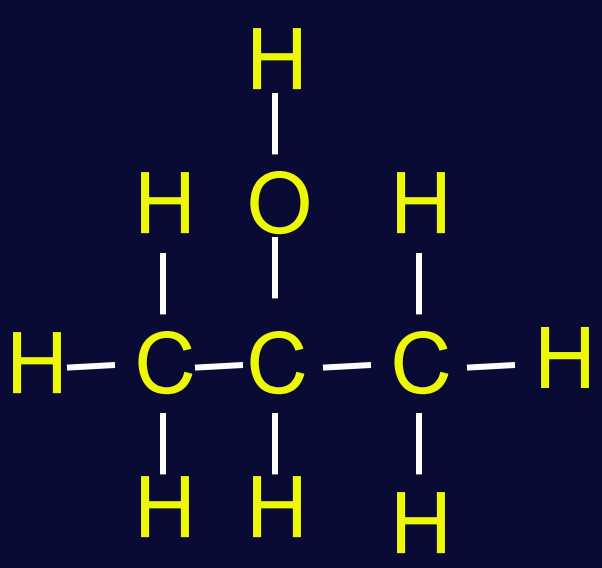


Propan-1-ol
Primary alcohol

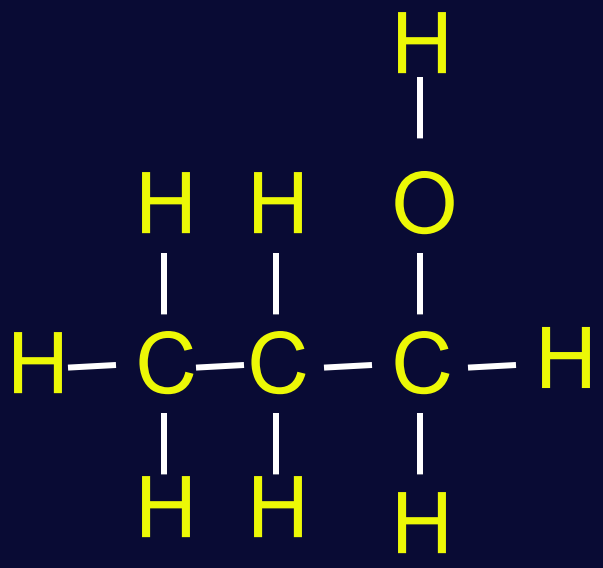
Juffrou Karen

Which type of isomers are the following two compounds?

C_3H_8O



Propan-2-ol
Secondary alcohol

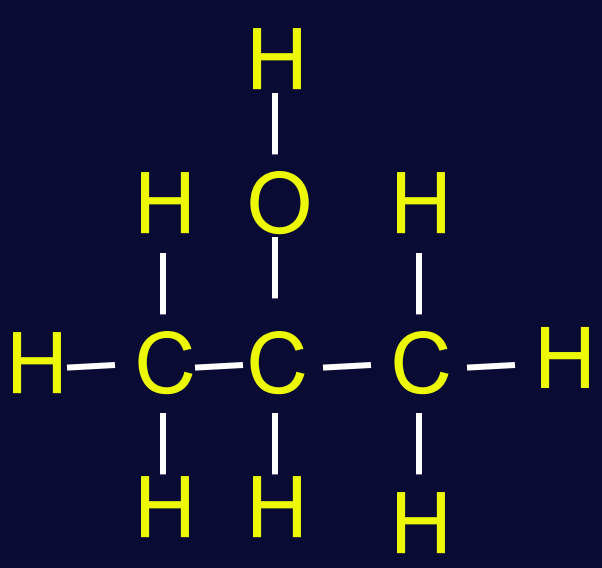


Propan-1-ol
Primary alcohol

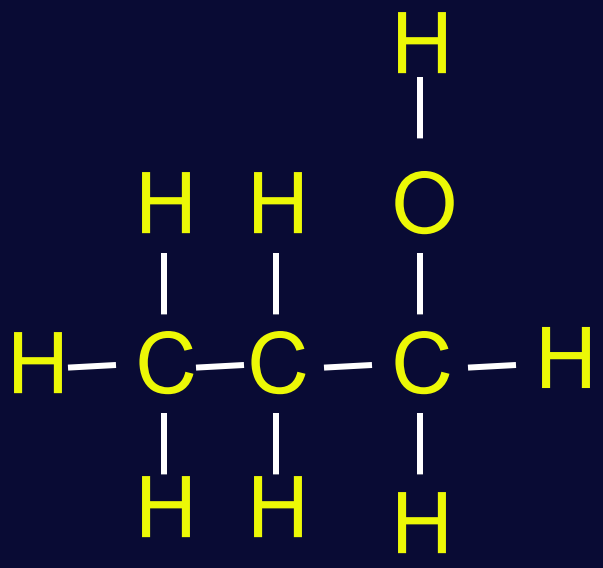
Juffrou Karen

Positional isomers

C_3H_8O



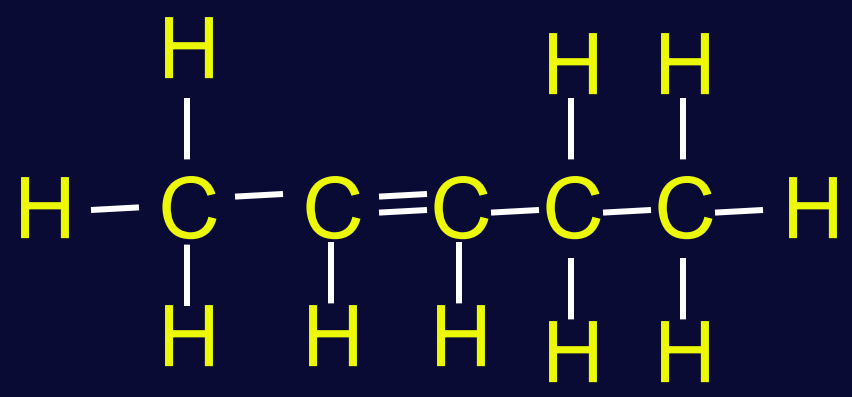
Propan-2-ol
Secondary alcohol



Propan-1-ol
Primary alcohol

Juffrou Karen

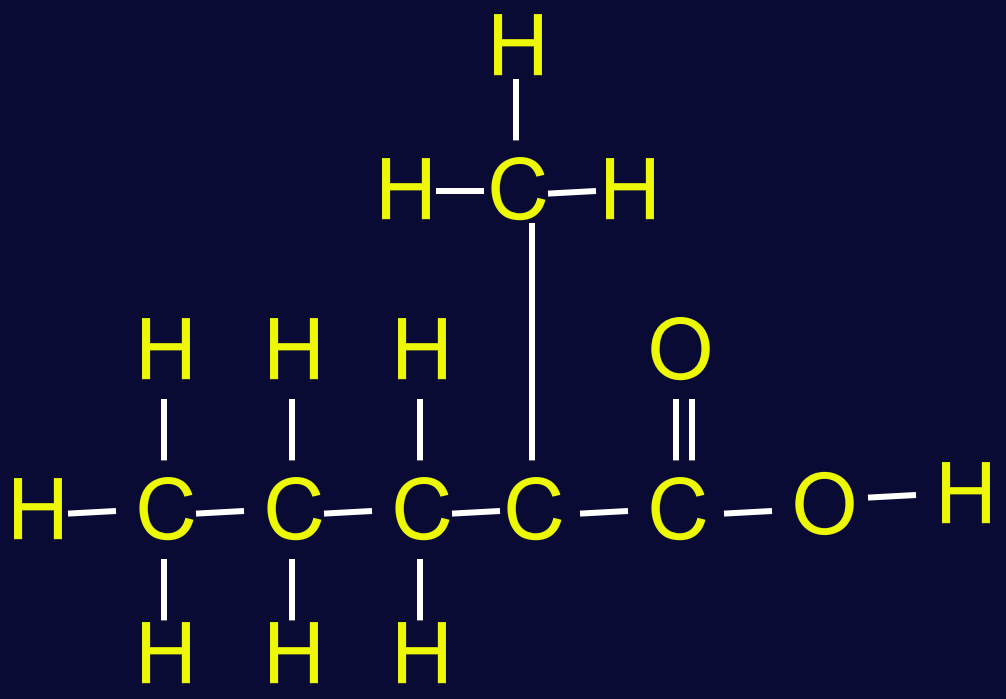
Give the IUPAC-name for the following compound:



pent-2-ene

Juffrou Karen

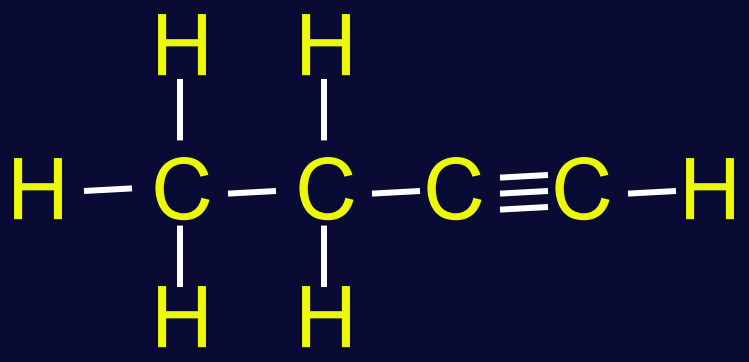
Give the IUPAC-name for the following compound:



2-methylpentanoic acid

Juffrou Karen

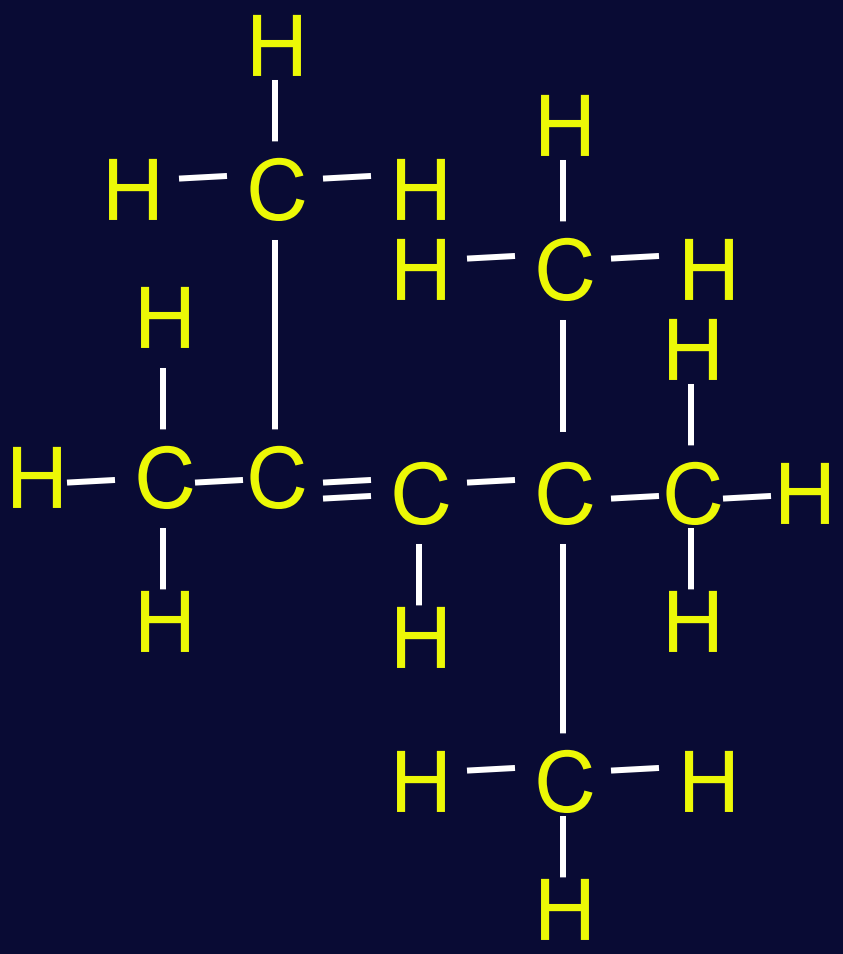
Give the IUPAC-name for the following compound:



But-1-yne

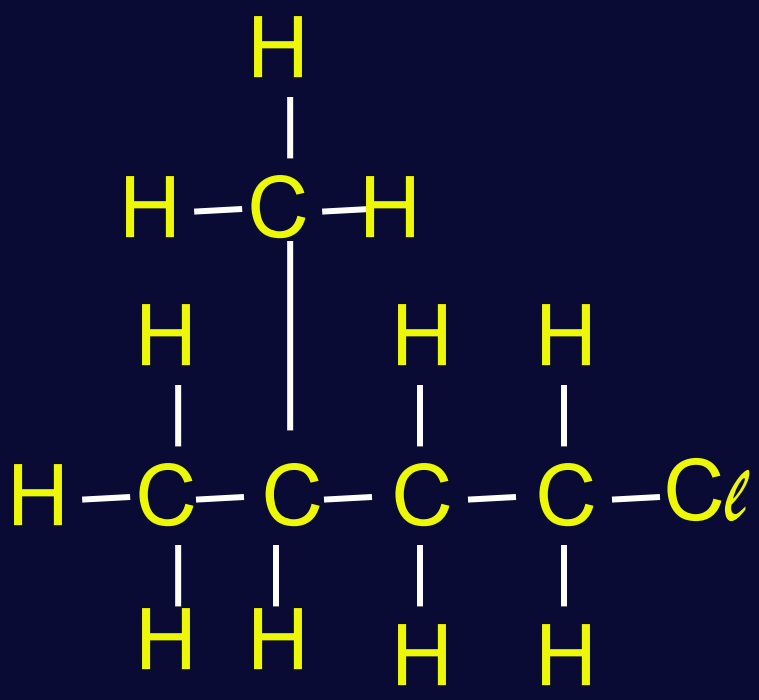
Juffrou Karen

Give the IUPAC-name for the following compound:



2,4,4-trimethylpent-2-ene

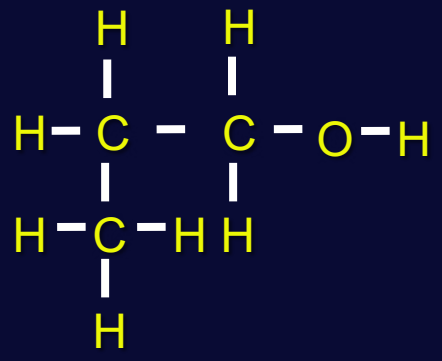
Give the IUPAC-name for the following compound:



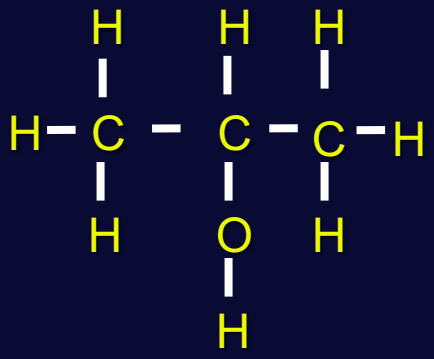
1-chloro-3-methylbutane

Consider the following six organic compounds:

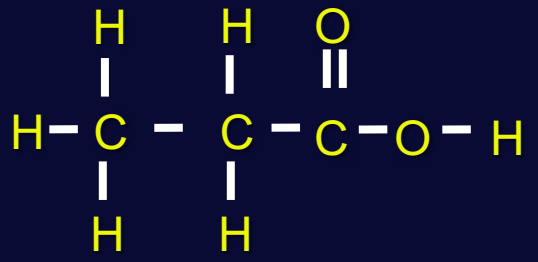
propan-1-ol



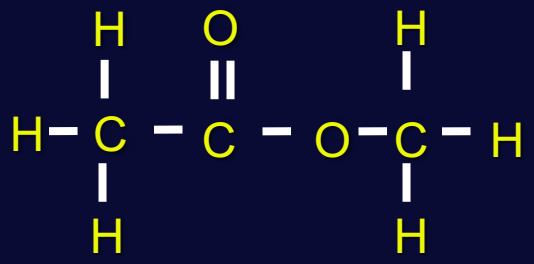
propan-2-ol



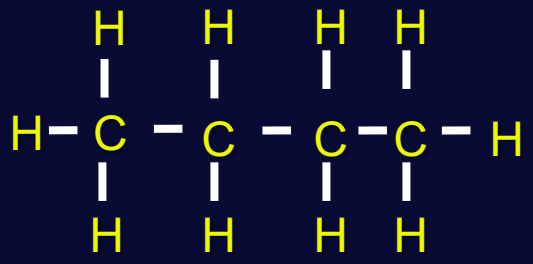
propanoic acid



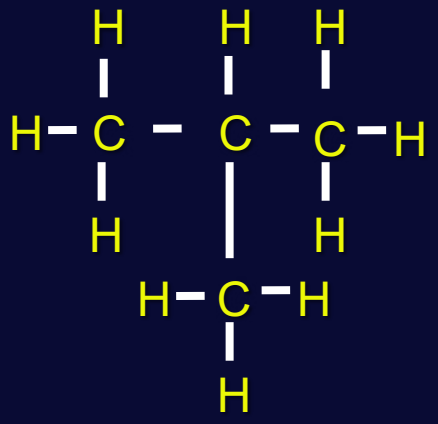
methyl ethanoate



butane

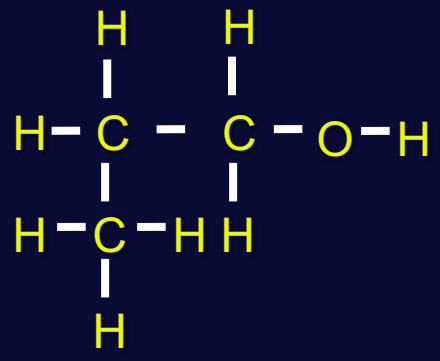


2-methylpropane

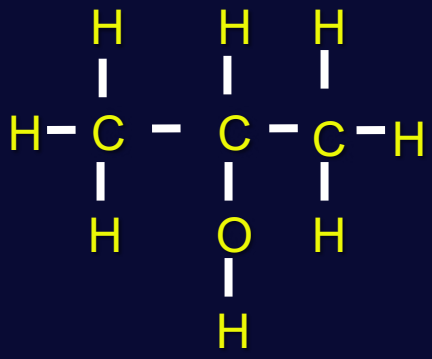


Identify two compounds that are chain isomers:

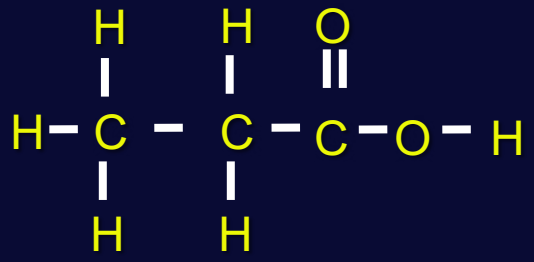
propan-1-ol

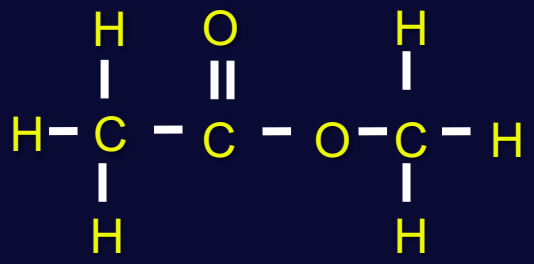


propan-2-ol

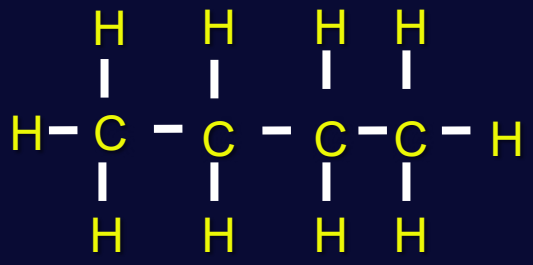


propanoic acid

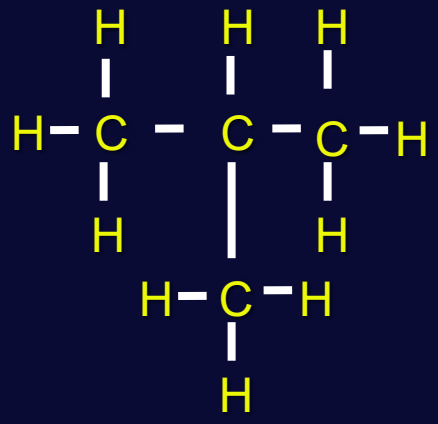




methyl ethanoate

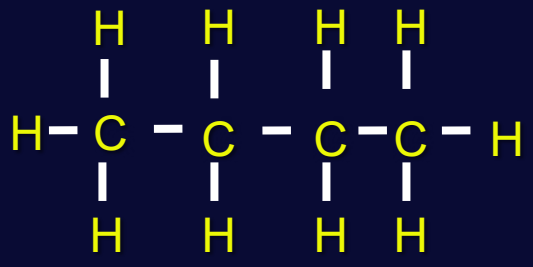


butane

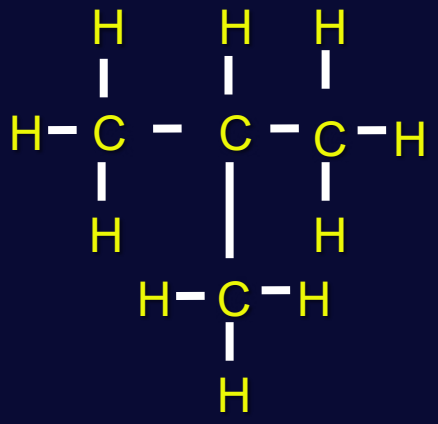


2-methylpropane

Identify two compounds that are chain isomers:



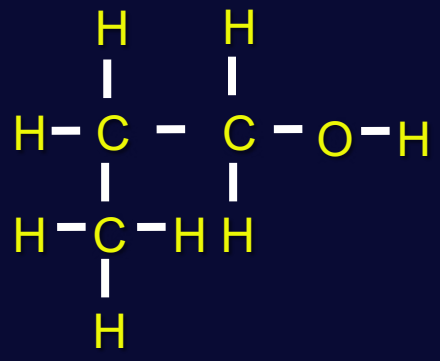
butane



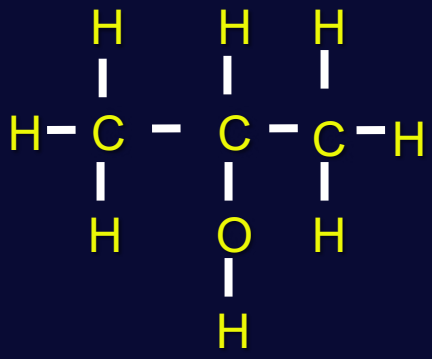
2-methylpropane

Identify two compounds that are functional isomers:

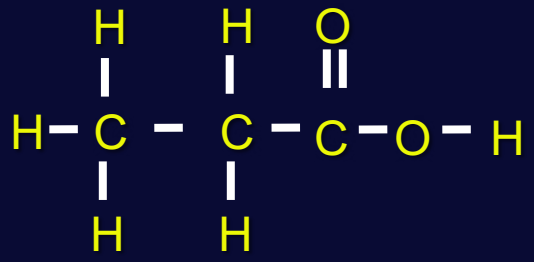
propan-1-ol

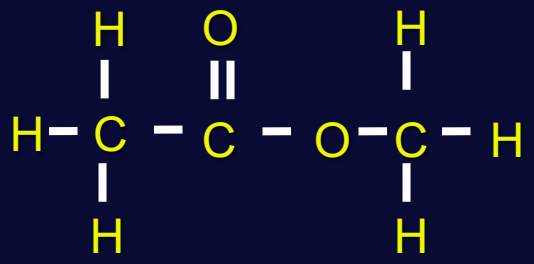


propan-2-ol

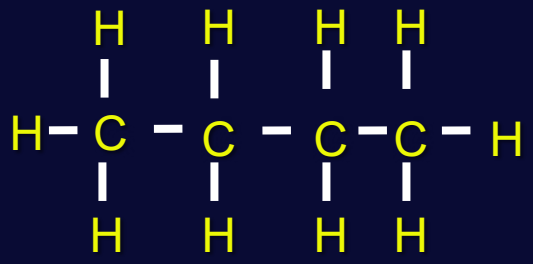


propanoic acid

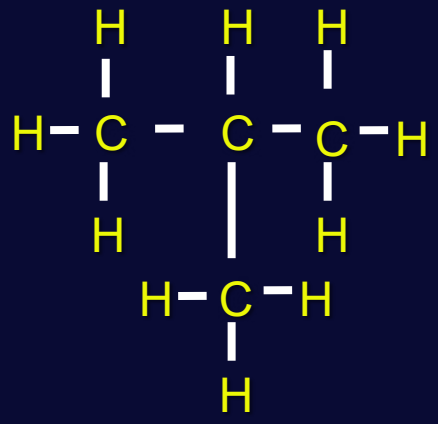




methyl ethanoate



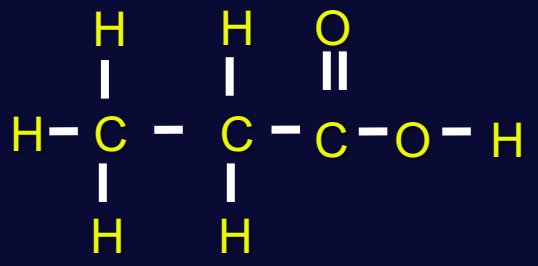
butane

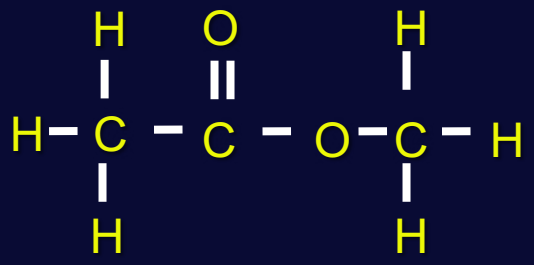


2-methylpropane

Identify two compounds that are functional isomers:

propanoic acid



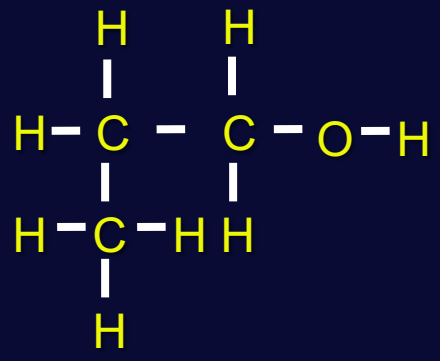


methyl ethanoate

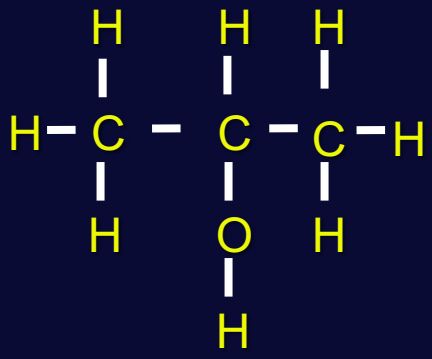
Juffrou Karen

Identify two compounds that are positional isomers:

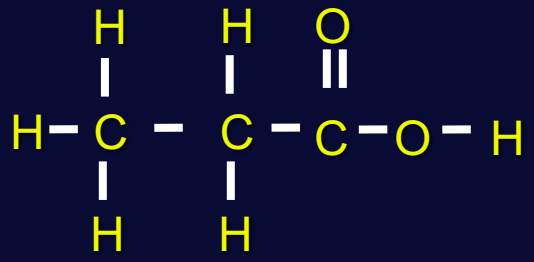
propan-1-ol

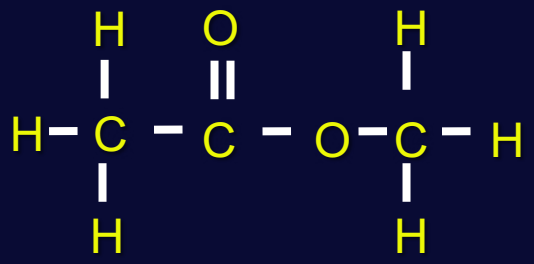


propan-2-ol

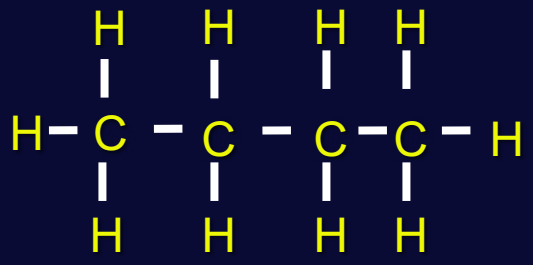


propanoic acid

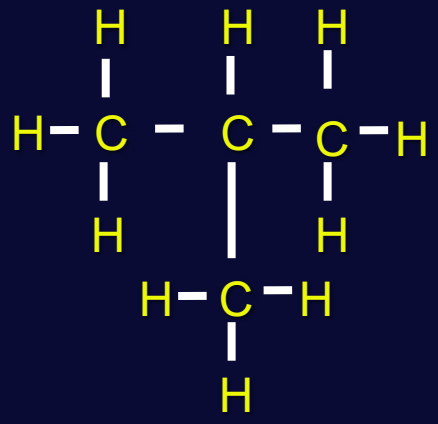




methyl ethanoate



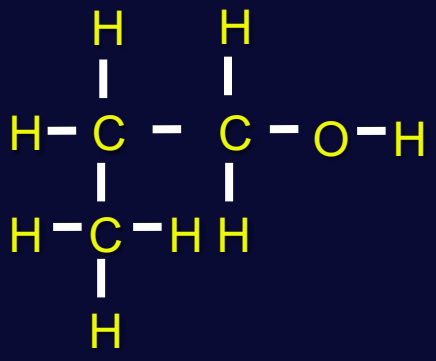
butane



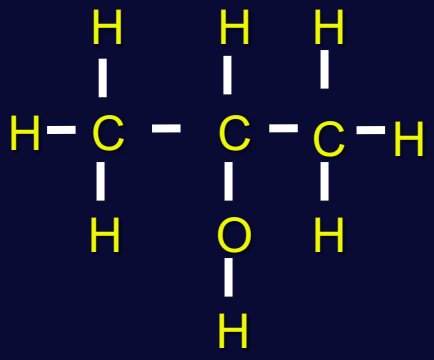
2-methylpropane

Identify two compounds that are positional isomers:

propan-1-ol



propan-2-ol



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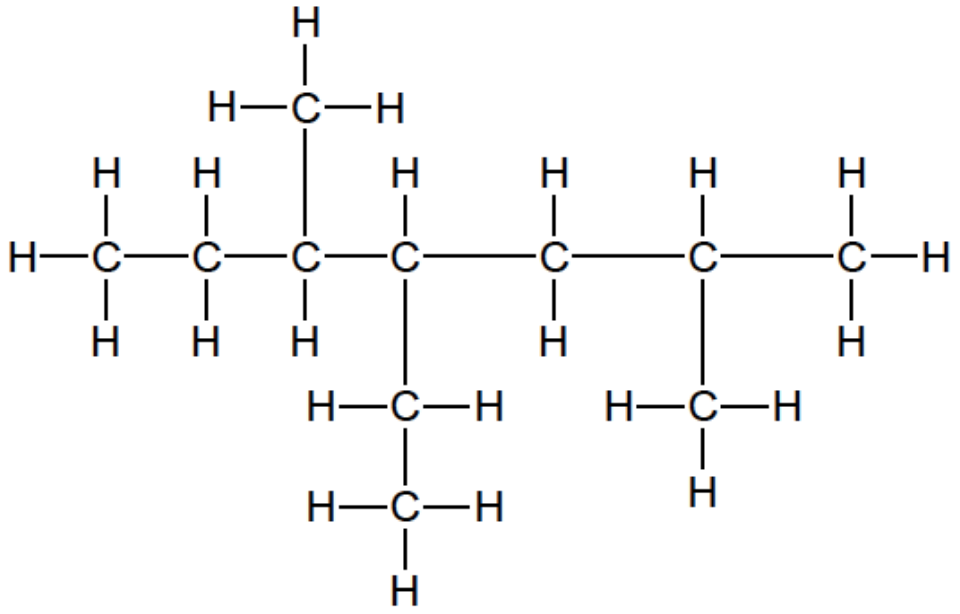
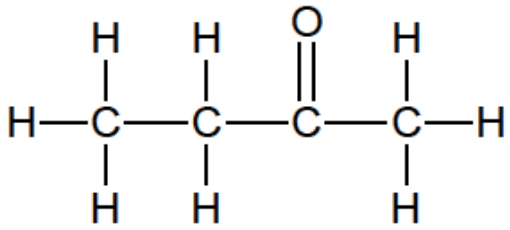
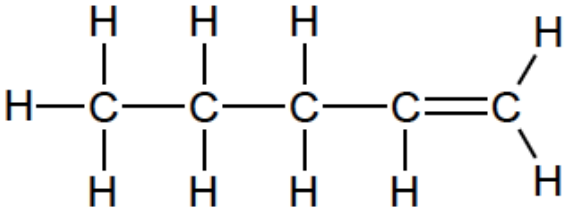
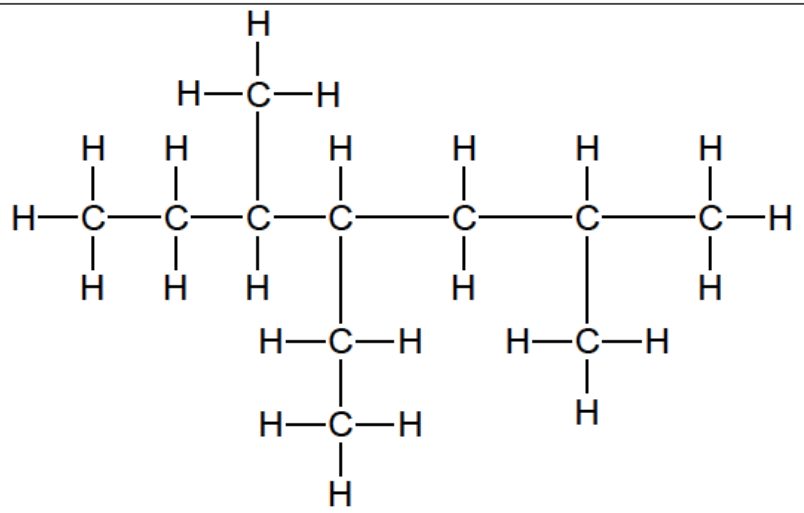
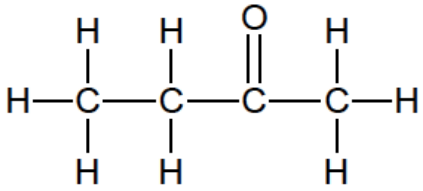
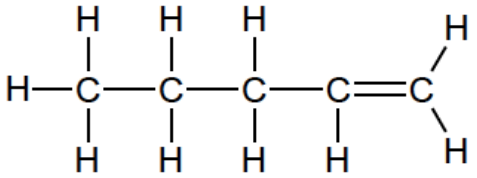
QUESTION 5

The letters **A** to **H** in the table below represent eight organic compounds.

A	$C_4H_{10}O$	**B**	
C		**D**	
E	3,4-dimethylpentan-2-ol	**F**	$CH_3(CH_2)_2COOH$
G	Ethyl ethanoate	**H**	Pentan-3-one

QUESTION 5

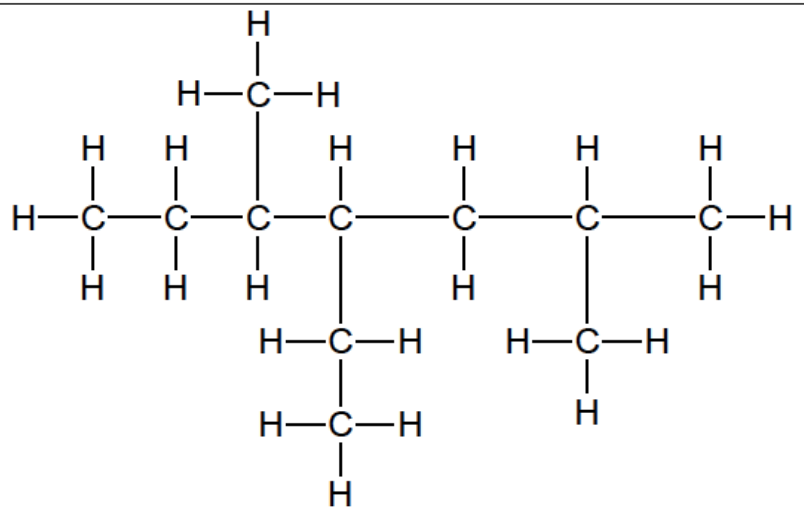
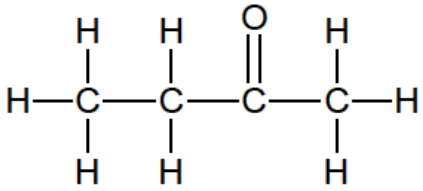
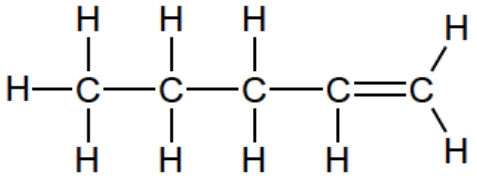
The letters **A** to **H** in the table below represent eight organic compounds.

A	$C_4H_{10}O$	**B**	
C		**D**	
E	3,4-dimethylpentan-2-ol	**F**	$CH_3(CH_2)_2COOH$
G	Ethyl ethanoate	**H**	Pentan-3-one

5.1 Define the term *saturated compound*. (2)

QUESTION 5

The letters **A** to **H** in the table below represent eight organic compounds.

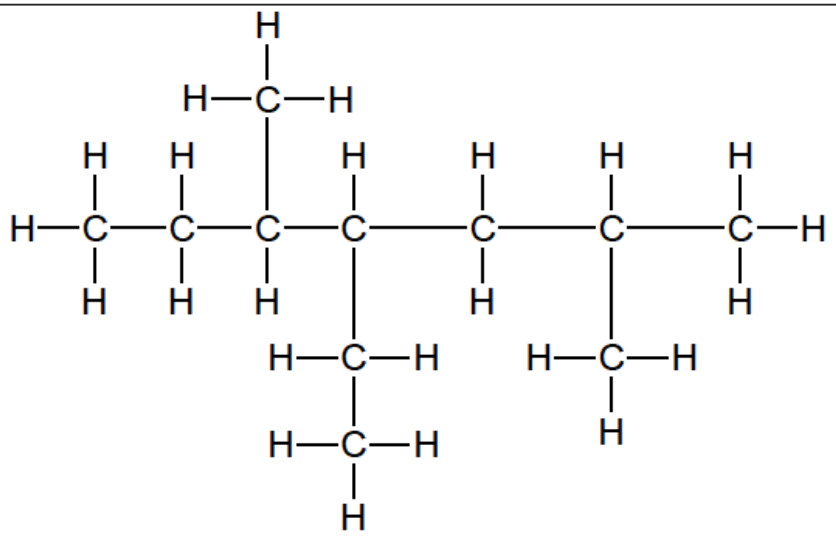
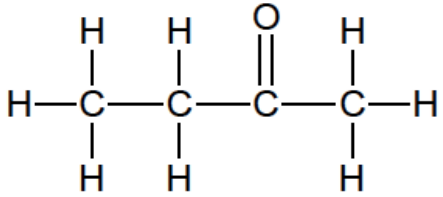
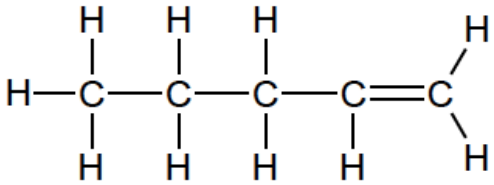
A	$C_4H_{10}O$	**B**	
C		**D**	
E	3,4-dimethylpentan-2-ol	**F**	$CH_3(CH_2)_2COOH$
G	Ethyl ethanoate	**H**	Pentan-3-one

5.2 Write down the following:

5.2.1 Letter that represents an UNSATURATED compound. (1)

QUESTION 5

The letters **A** to **H** in the table below represent eight organic compounds.

A	$C_4H_{10}O$	**B**	
C		**D**	
E	3,4-dimethylpentan-2-ol	**F**	$CH_3(CH_2)_2COOH$
G	Ethyl ethanoate	**H**	Pentan-3-one

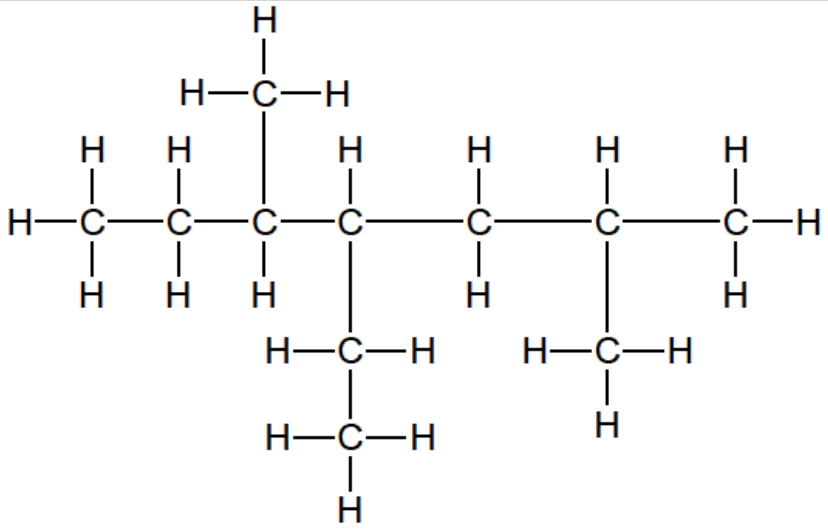
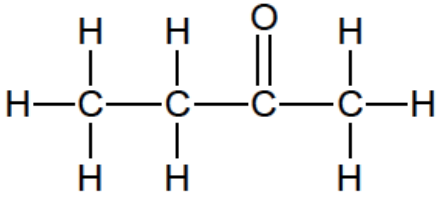
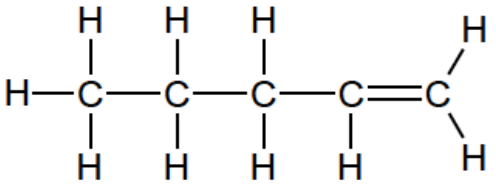
5.2 Write down the following:

5.2.1 Letter that represents an UNSATURATED compound. (1)

5.2.2 IUPAC name of **B** (3)

QUESTION 5

The letters **A** to **H** in the table below represent eight organic compounds.

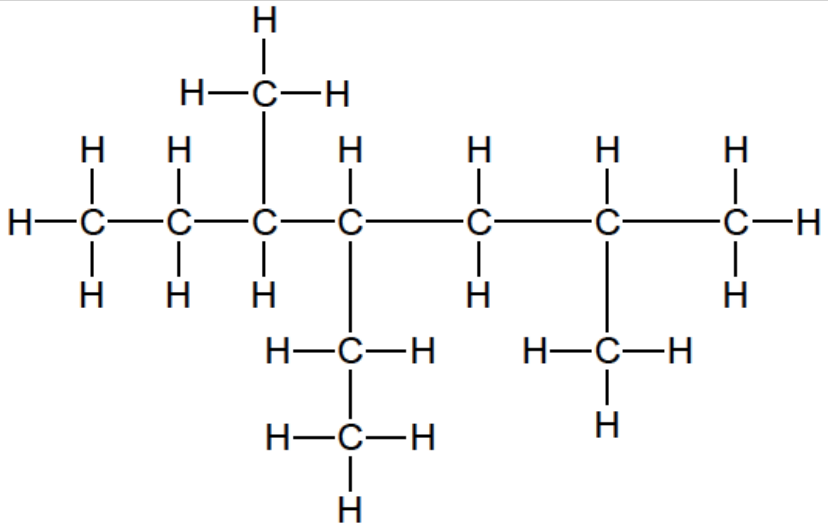
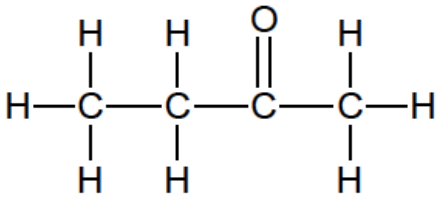
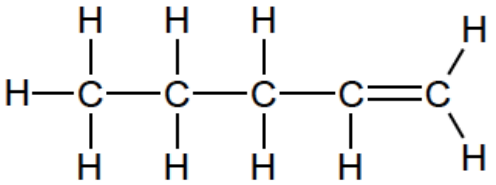
A	$C_4H_{10}O$	**B**	
C		**D**	
E	3,4-dimethylpentan-2-ol	**F**	$CH_3(CH_2)_2COOH$
G	Ethyl ethanoate	**H**	Pentan-3-one

5.2 Write down the following:

5.2.3 Letter that represents a FUNCTIONAL ISOMER of compound **F**. (1)

QUESTION 5

The letters **A** to **H** in the table below represent eight organic compounds.

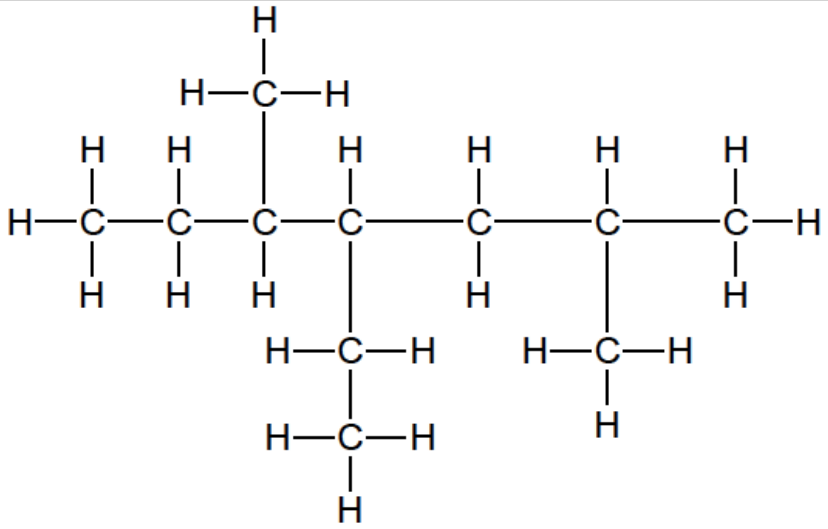
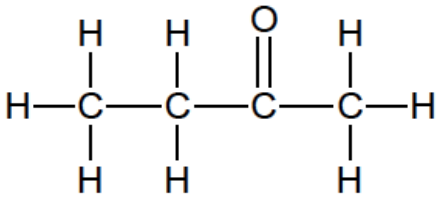
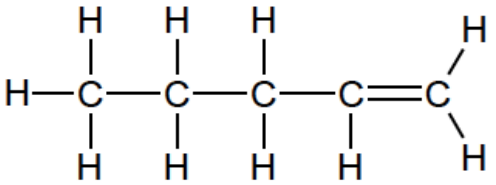
A	$C_4H_{10}O$	**B**	
C		**D**	
E	3,4-dimethylpentan-2-ol	**F**	$CH_3(CH_2)_2COOH$
G	Ethyl ethanoate	**H**	Pentan-3-one

5.2 Write down the following:

5.2.4 NAME of the functional group of compound **C** (1)

QUESTION 5

The letters **A** to **H** in the table below represent eight organic compounds.

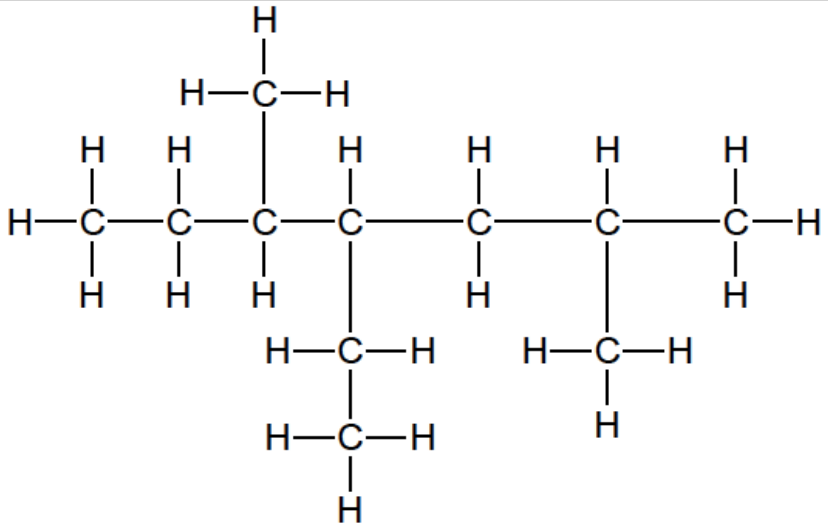
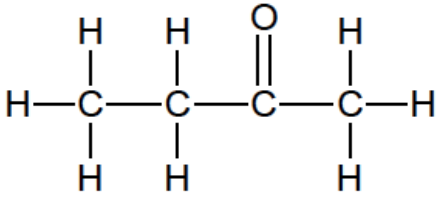
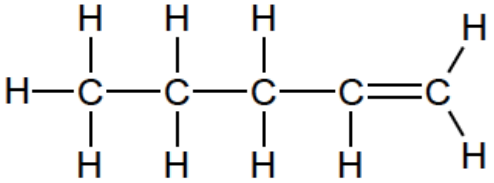
A	$C_4H_{10}O$	**B**	
C		**D**	
E	3,4-dimethylpentan-2-ol	**F**	$CH_3(CH_2)_2COOH$
G	Ethyl ethanoate	**H**	Pentan-3-one

5.2 Write down the following:

5.2.5 General formula of the homologous series to which compound **D** belongs. (1)

QUESTION 5

The letters **A** to **H** in the table below represent eight organic compounds.

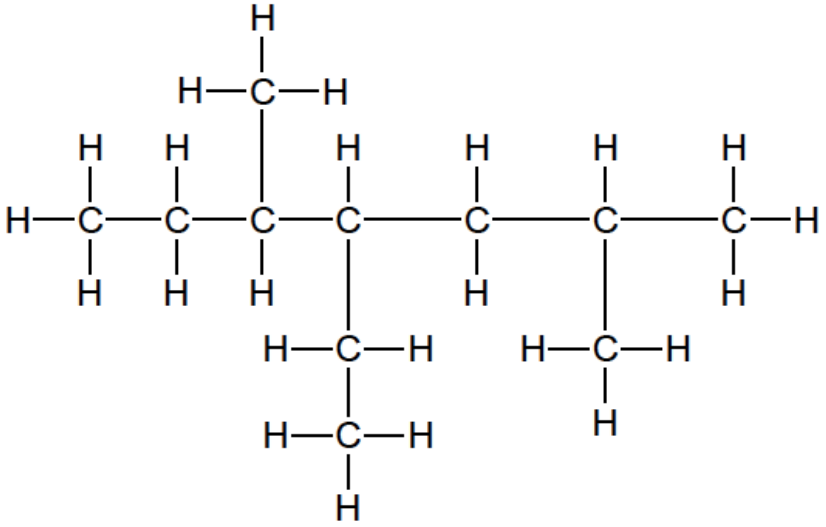
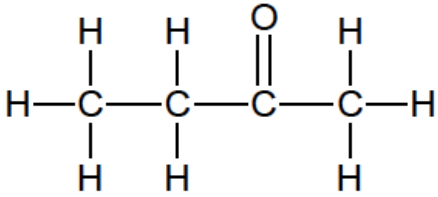
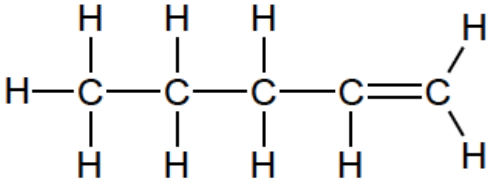
A	$C_4H_{10}O$	**B**	
C		**D**	
E	3,4-dimethylpentan-2-ol	**F**	$CH_3(CH_2)_2COOH$
G	Ethyl ethanoate	**H**	Pentan-3-one

5.4 For compound **E**:

5.4.1 To which homologous series does it belong? (1)

QUESTION 5

The letters **A** to **H** in the table below represent eight organic compounds.

A	$C_4H_{10}O$	**B**	
C		**D**	
E	3,4-dimethylpentan-2-ol	**F**	$CH_3(CH_2)_2COOH$
G	Ethyl ethanoate	**H**	Pentan-3-one

5.4 For compound **E**:

5.4.1 To which homologous series does it belong? (1)

5.4.2 Write down its CONDENSED STRUCTURAL FORMULA. (2)

QUESTION 6

A learner uses four organic compounds (**A**, **B**, **C** and **D)** to investigate the effect of the CHAIN LENGTH on BOILING POINT. The obtained results are shown in the table below.

Compound	Condensed structural formula	Boiling point (°C)
A	$CH_3CH_2CH_2CH_2CH_2OH$	138
B	$CH_3CH_2CH_2OH$	96
C	CH_3CH_2OH	77
D	CH_3OH	64

QUESTION 6

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B	$CH_3CH_2CH_2OH$	96
C	CH_3CH_2OH	77
D	CH_3OH	64

6.1 Define the term *vapour pressure*. (2)

QUESTION 6

A learner uses four organic compounds (**A**, **B**, **C** and **D)** to investigate the effect of the CHAIN LENGTH on BOILING POINT. The obtained results are shown in the table below.

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C	CH_3CH_2OH	77
D	CH_3OH	64

6.2 Write down the INDEPENDENT variable for this investigation. (1)

QUESTION 6

A learner uses four organic compounds (**A**, **B**, **C** and **D)** to investigate the effect of the CHAIN LENGTH on BOILING POINT. The obtained results are shown in the table below.

Compound	Condensed structural formula	Boiling point (°C)
A	$CH_3CH_2CH_2CH_2CH_2OH$	138
B	$CH_3CH_2CH_2OH$	96
C	CH_3CH_2OH	77
D	CH_3OH	64

6.3 State, with a reason, which ONE **(A**, **B**, **C** or **D)** of these compounds has the HIGHEST vapour pressure. (2)

QUESTION 6

A learner uses four organic compounds (**A**, **B**, **C** and **D)** to investigate the effect of the CHAIN LENGTH on BOILING POINT. The obtained results are shown in the table below.

Compound	Condensed structural formula	Boiling point (°C)
A	$CH_3CH_2CH_2CH_2CH_2OH$	138
B	$CH_3CH_2CH_2OH$	96
C	CH_3CH_2OH	77
D	CH_3OH	64

6.4 Compound **A** is now compared to pentane.

6.4.1 Is the boiling point of **A** HIGHER THAN, LOWER THAN or EQUAL TO that of pentane? (1)

6.4.2 Refer to the TYPES of intermolecular forces to explain the answer to question 6.4.1. (4)

QUESTION 6

A learner uses four organic compounds (**A**, **B**, **C** and **D**) to investigate the effect of the CHAIN LENGTH on BOILING POINT. The obtained results are shown in the table below.

Compound	Condensed structural formula	Boiling point (°C)
A	$CH_3CH_2CH_2CH_2CH_2OH$	138
B	$CH_3CH_2CH_2OH$	96
C	CH_3CH_2OH	77
D	CH_3OH	64

6.5 Write down the general conclusion that can be made about the boiling points of compounds **A**, **B**, **C** and **D**. (2)

[12]

QUESTION 5 / *VRAAG 5*

5.1 Compounds in which there are no multiple bonds between C atoms in their hydrocarbon chains. ✓✓
Verbindings waarin daar geen meervoudige bindings tussen C-atome in hul koolwaterstofkettings is nie. (2)

5.2.1 D ✓ (1)

5.2.2 4-ethyl-2,5-dimethylheptane 4-etiel-2,5-dimetielheptaan (3)

Marking criteria / Nasienriglyne:
- Correct stem, i.e. heptane ✓
  Korrekte stam, d.i. heptaan
- Substituents (ethyl & methyl) correctly identified. ✓
  Substituente/sykettings (etiel & metiel) korrek geïdentifiseer.
- IUPAC name completely correct including numbering, sequence, hyphens, and commas ✓
  IUPAC-naam heeltemal korrek insluitende nommers, volgorde, koppeltekens en kommas.

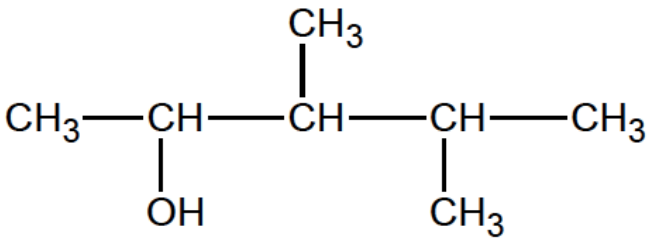
5.2.3 G ✓ (1)

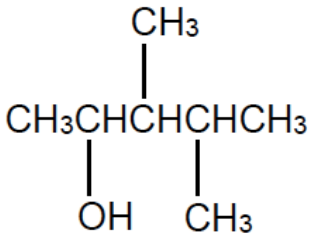
5.2.4 Carbonyl (group) ✓ Karboniel(groep) (1)

5.2.5 C_nH_{2n} ✓ (1)

5.3 A series of organic compounds that can be described by the same general formula **OR** A series of organic compounds in which one member differs from the next with a CH_2 group. ✓✓
*'n Reeks organiese verbindings wat deur dieselfde algemene formule beskryf kan word **OF** 'n Reeks organiese verbindings waarin die een lid van die volgende verskil met 'n CH2-groep.* (2)

5.4.1 Alcohols ✓ Alkohole (1)

5.4.2 

✓✓
OR/*OF*


OR/*OF*

$CH_3CH(OH)CH(CH_3)CH(CH_3)_2$ (2)

5.4.3 Secondary ✓ Sekondêr (1)

5.4.4 The carbon atom bonded to the hydroxyl/OH group is bonded to two other carbons atoms. ✓
Die koolstofatoom wat aan die hidroksiel/OH-groep verbind is, is ook aan twee ander koolstofatome verbind. (1)

[16]

QUESTION 6 / *VRAAG 6*

6.1	The pressure exerted by a vapour at equilibrium ✓with its liquid in a closed system ✓ *Die druk uitgeoefen deur 'n damp in ewewig met sy vloeistof in 'n geslote sisteem.*		(2)
6.2	Chain length/length of carbon chain ✓ *Kettinglengte/lengte van koolstofketting*		(1)
6.3	D ✓; lowest boiling point ✓	D; laagste kookpunt	(2)
6.4.1	Higher than ✓	Hoër as	(1)

6.4.2

Marking criteria

- Compare structures. ✓
- Compare strength of intermolecular forces. ✓
- Compare the energy required to overcome intermolecular forces. ✓

Nasienriglyne

- Vergelyk strukture. ✓
- Vergelyk sterkte van intermolekulêre kragte.
- Vergelyk energie benodig om intermolekulêre kragte te oorkom. ✓

- **Structure/Struktuur:**
  Between the molecules of **A** (in addition to London forces) hydrogen forces are present. ✓ Between pentane molecules London forces ✓ are present.
  *Tussen die molekule van **A** (bykomend tot Londonkragte) is waterstofbindings. Tussen pentaanmolekule is Londonkragte.*

- **Intermolecular forces / Intermolekulêre kragte**
  Stronger intermolecular forces are present in compound **A** than in pentane. ✓
  *Sterker intermolekulêre kragte is teenwoording in verbinding **A** as in pentaan.*
  (Or opposite arguments / *Of teenoorgestelde argumente*)
- **Energy/Energie:**
  More energy is needed to overcome the intermolecular forces in **A**. ✓
  *Meer energie is nodig om die intermolekulêre kragte in **A** te oorkom.* (4)
  (Or opposite arguments / *Of teenoorgestelde argumente*)

6.5 Boiling point increases ✓with an increase in the chain length / size of the molecule. ✓
Kookpunt neem toe met 'n toename in die kettinglengte / grootte van die molekuul.

(2)
[12]