

Organic Chemistry

Part 1



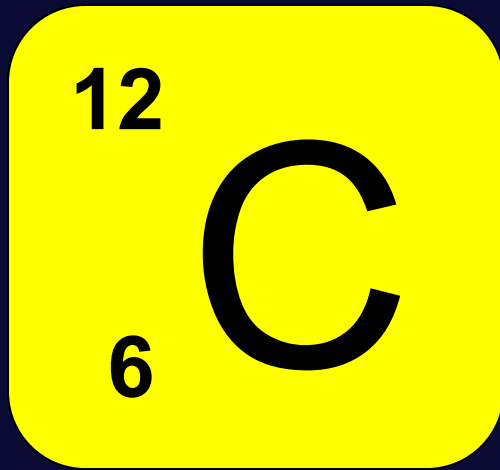
Juffrou Karen

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



Carbon

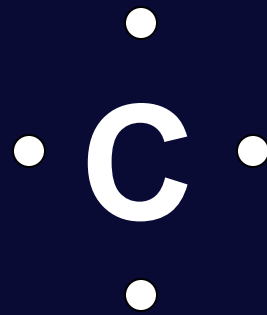
- Atomic number of 6
- Group IV
- Valency of 4



Periodic Table of Elements

IA																												0	
1		IIA												III A	IV A	V A	VIA	VII A	2										
1	H																	5	B	6	C	7	N	8	O	9	F	10	He
2	Li	4	Be											13	Al	14	Si	15	P	16	S	17	Cl	18	Ar				
3	Na	12	Mg	III B	IV B	V B	VI B	VII B	— VII —			IB	IB	31	Ga	32	Ge	33	As	34	Se	35	Br	36	Kr				
4	K	20	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	49	In	50	Sn	51	Sb	52	Te	53	I	54	Xe				
5	Rb	38	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	81	Tl	82	Pb	83	Bi	84	Po	85	At	86	Rn				
6	Cs	56	Ba	*La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg																
7	Fr	88	Ra	+Ac	Rf	Ha	106	107	108	109	110																		

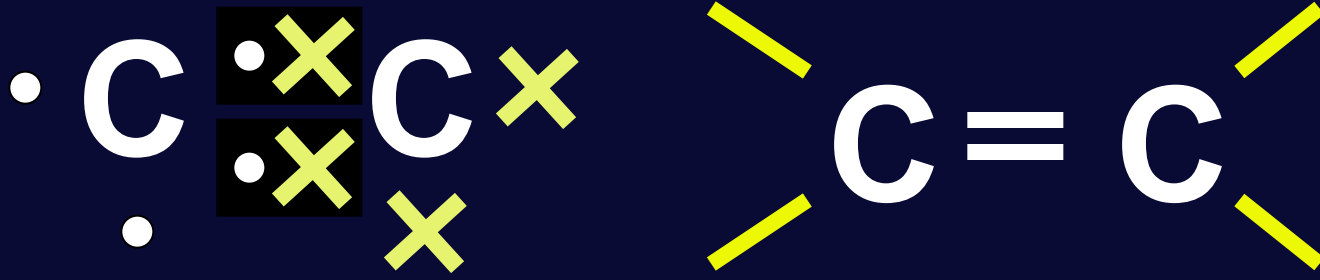
Lewis structure for Carbon



Triple bond:



Double bond:



Single bond:



Organic chemistry

Molecules of: **C—H**

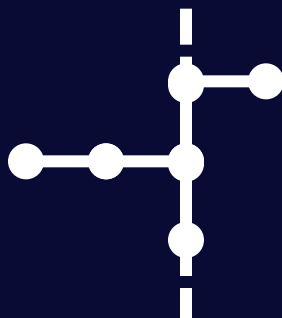
These bonds can also include:

O N F I

Cl P S Br



Chains, branches and cyclic structures



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



Molecular formula

Shows the number of atoms in the molecule

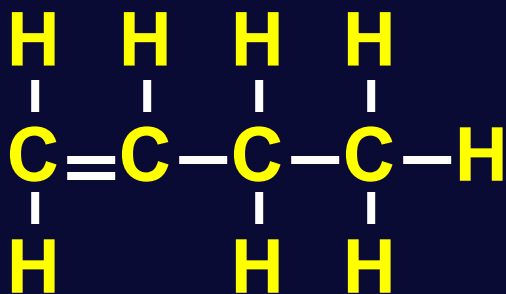


Representation of organic molecules:

Structural formula

Illustrates bonds and atoms in a molecule

Butene:



or



Condensed



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



Functional groups

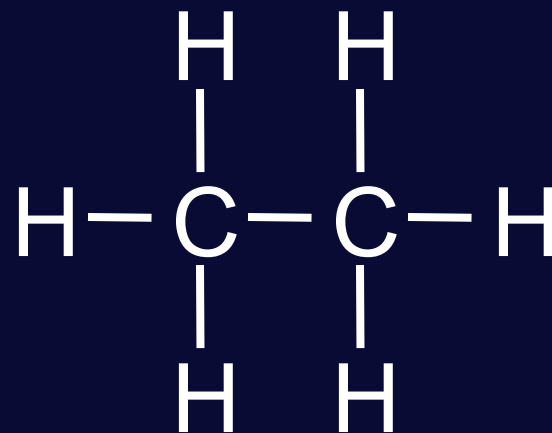
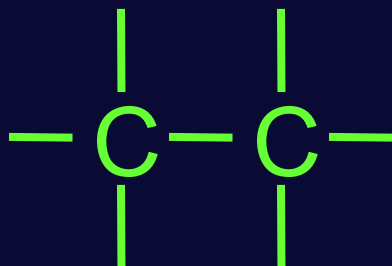
Homologous series:

Alkanes

General formula:



Functional group:



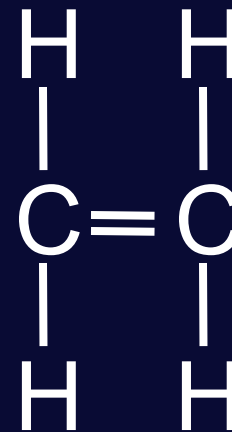
Ethane

Functional groups

Homologous series:

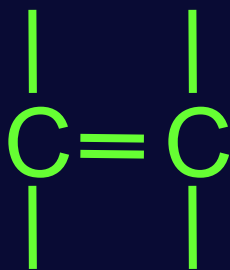
Alkenes

General formula:



Ethene

Functional group:



Functional groups

Homologous series:

Alkynes



General formula:



Ethyne

Functional group:

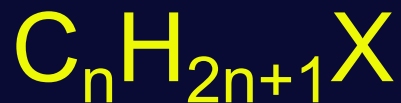


Functional groups

Homologous series:

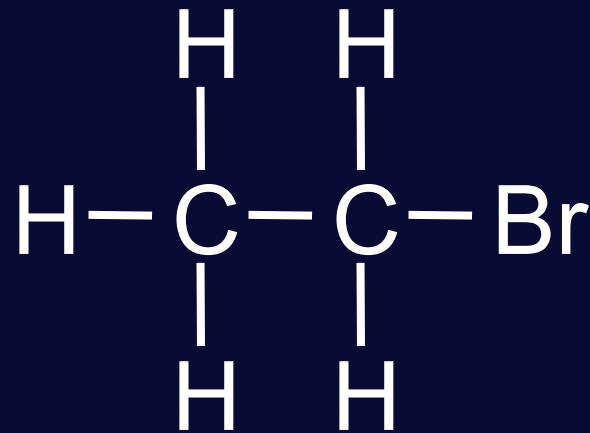
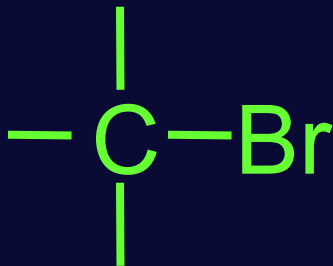
Halo-alkanes / Alkyl halides

General formula:



with $X = Cl, Br, I, F$

Functional group:



Bromoethane



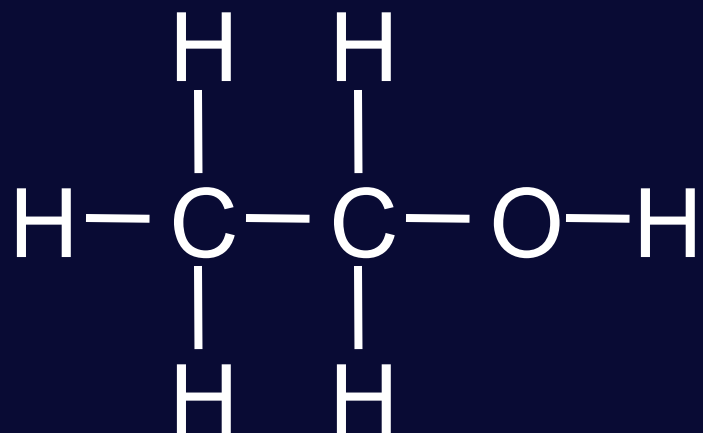
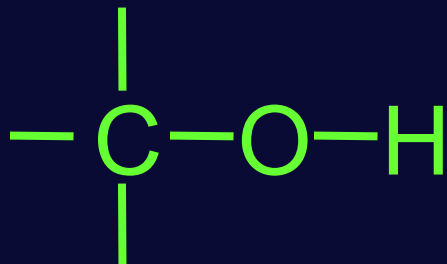
Functional groups

Homologous series:
Alcohols

General formula:



Functional group:



Ethanol

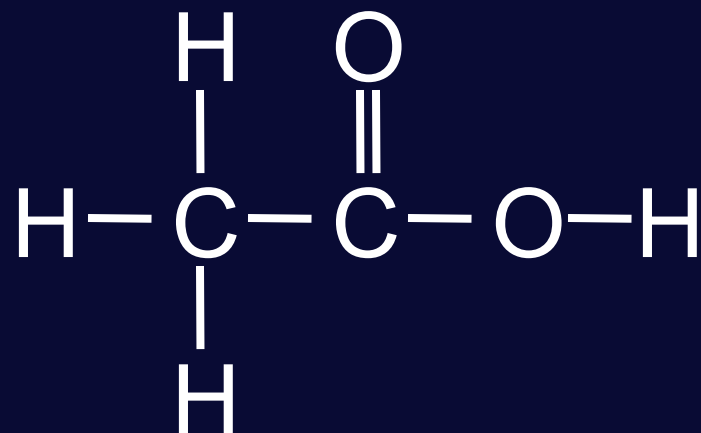
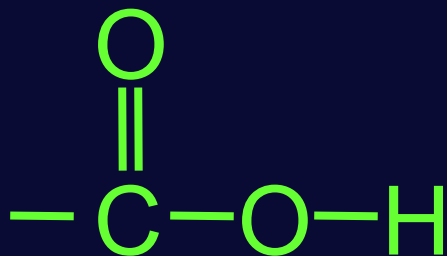
Functional groups

Homologous series:
Carboxylic acid

General formula:



Functional group:



Ethanoic acid



Functional groups

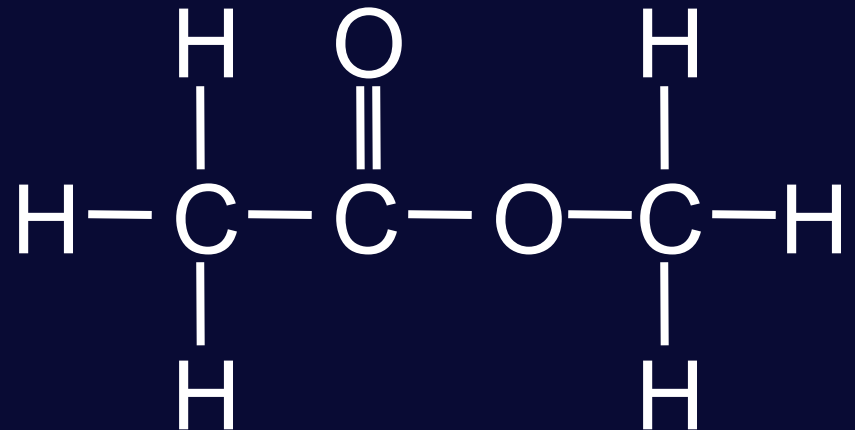
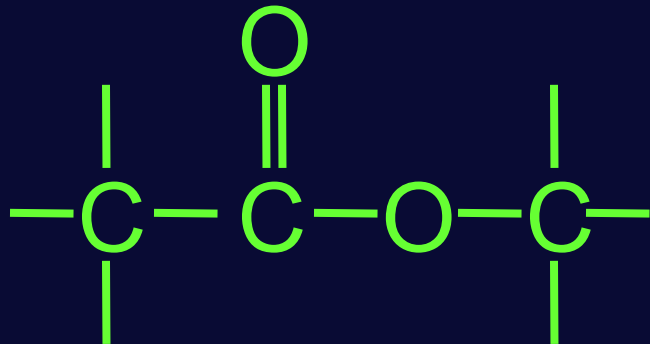
Homologous series:

Esters

General formula:



Functional group:



Methyl ethanoate



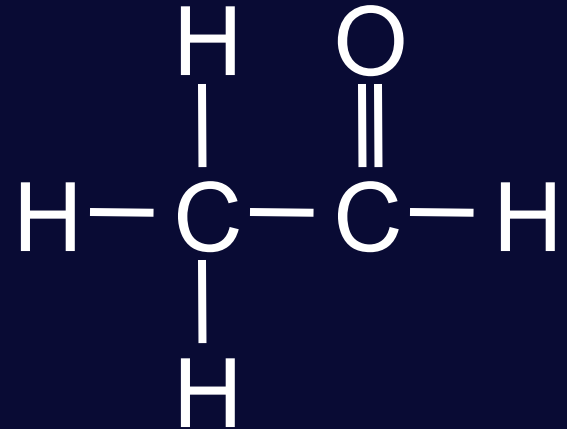
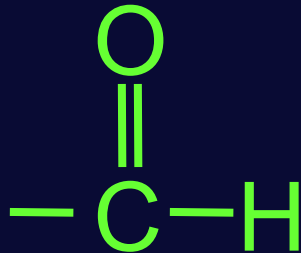
Functional groups

Homologous series:
Aldehydes

General formula:



Functional group:



Ethanal



Functional groups

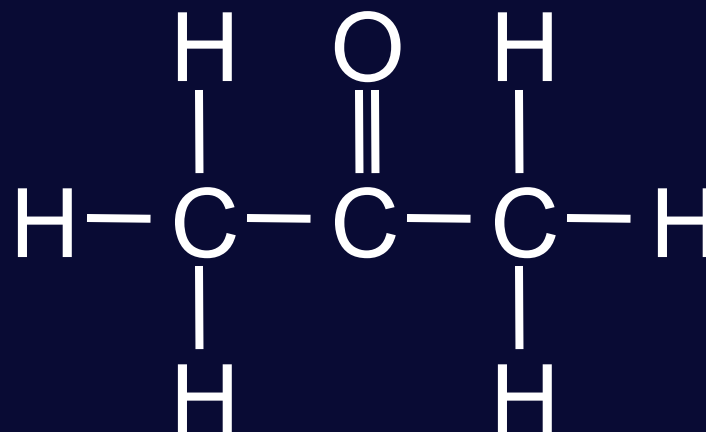
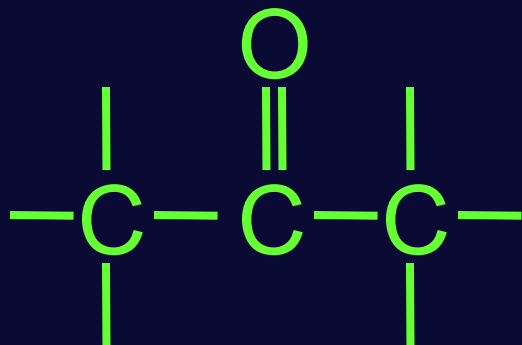
Homologous series:

Ketones

General formula:



Functional group:



Propanone



Hydrocarbons and isomers



Hydrocarbons

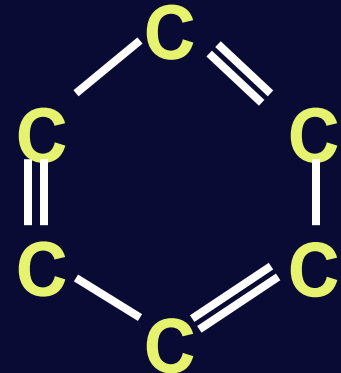
are organic compounds that
consist only of carbon and
hydrogen



Hydrocarbons

Aliphatic

Aromatic



1 or more Benzene ring(s)



Hydrocarbons

Aliphatic

Saturated Unsaturated



Hydrocarbons

```
graph TD; A[Hydrocarbons] --> B[Aliphatic]; A --> C[ ]; B --> D[Saturated]; B --> E[Unsaturated]; D --> F[Alkanes]; E --> G[Alkenes]; E --> H[Alkynes]; F --- I[Single bonds]; G --- J[Double bonds]; H --- K[Triple bonds];
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The diagram is a hierarchical flowchart. At the top is the word 'Hydrocarbons' in white. Two white arrows point downwards from it. The left arrow points to the word 'Aliphatic' in green. From 'Aliphatic', two white arrows point downwards to the words 'Saturated' and 'Unsaturated', both in green. Below 'Saturated', a green arrow points down to the word 'Alkanes' in green. Below 'Unsaturated', two orange arrows point down to the words 'Alkenes' and 'Alkynes' in orange. Underneath 'Alkanes' is the text 'Single bonds' in green. Underneath 'Alkenes' is the text 'Double bonds' in orange. Underneath 'Alkynes' is the text 'Triple bonds' in orange.

Aliphatic

Saturated

Unsaturated



Alkanes

Alkenes

Alkynes

Single bonds

Double bonds

Triple bonds

Hydrocarbons



Aliphatic



Saturated Unsaturated



Alkanes

Single bonds



Saturated hydrocarbons

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



Unsaturated hydrocarbons

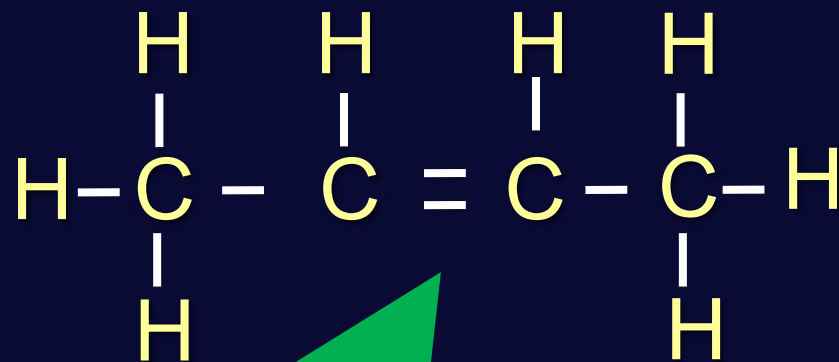
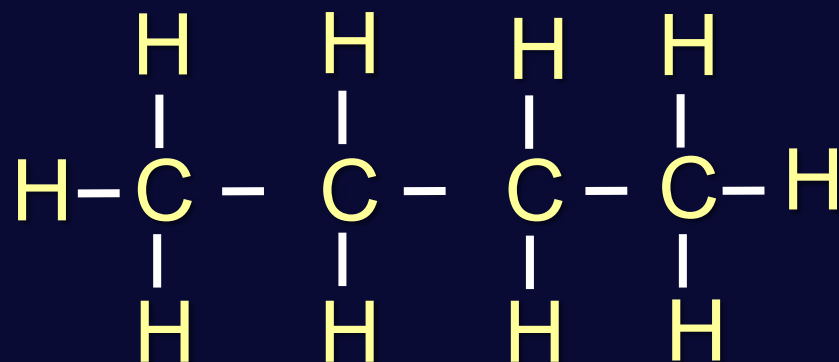
organic compounds with one or more multiple covalent bonds between C-atoms



Test for saturated hydrocarbon

Add Brown bromine water (or KMnO_4)

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



Spot where reaction can take place immediately



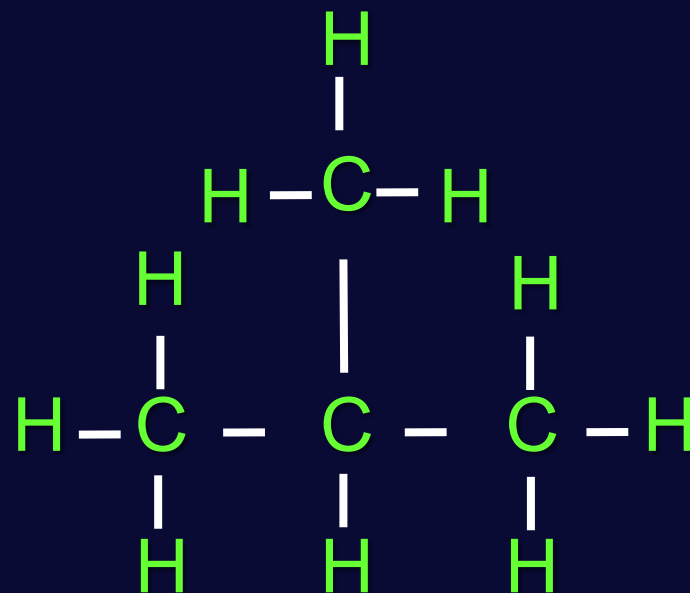
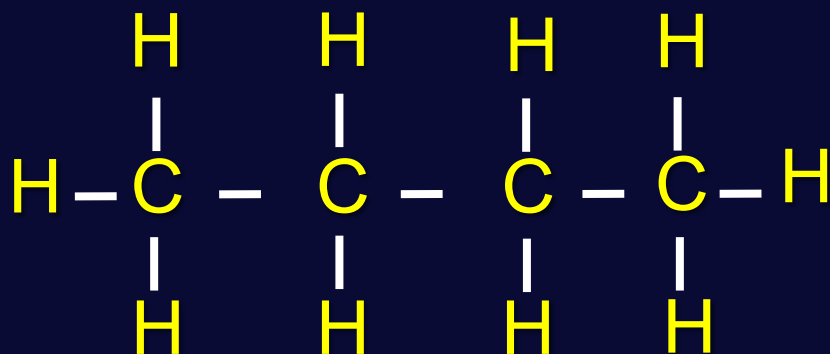
Isomers

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



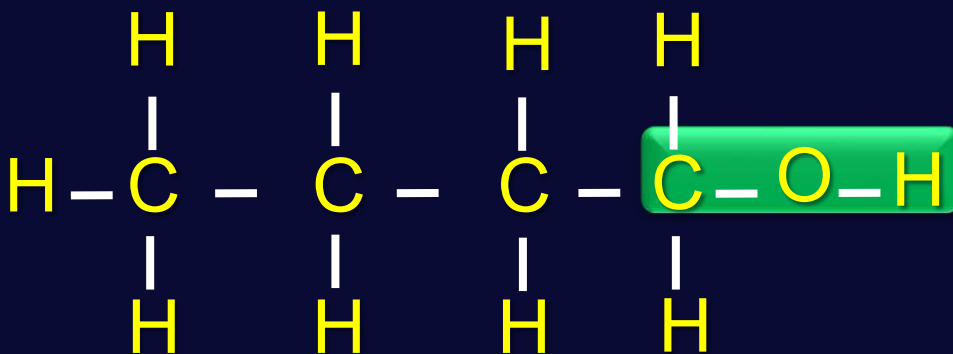
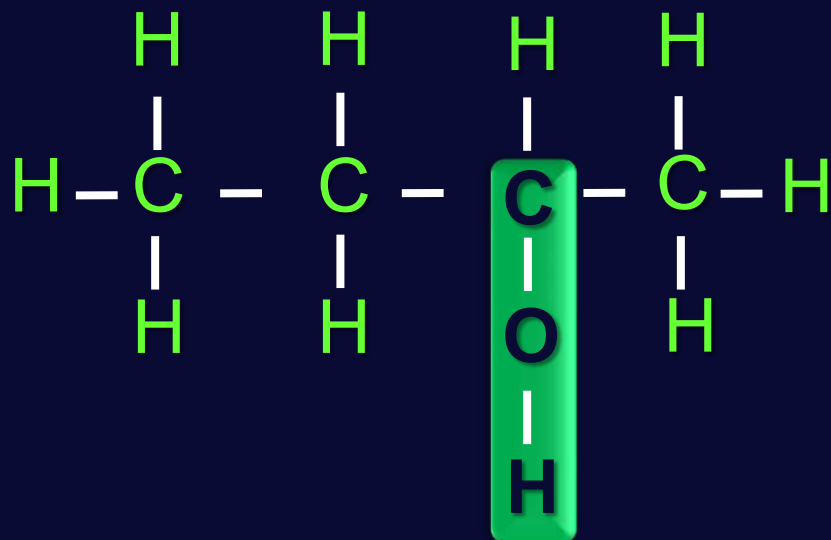
Chain-isomers

Different chains



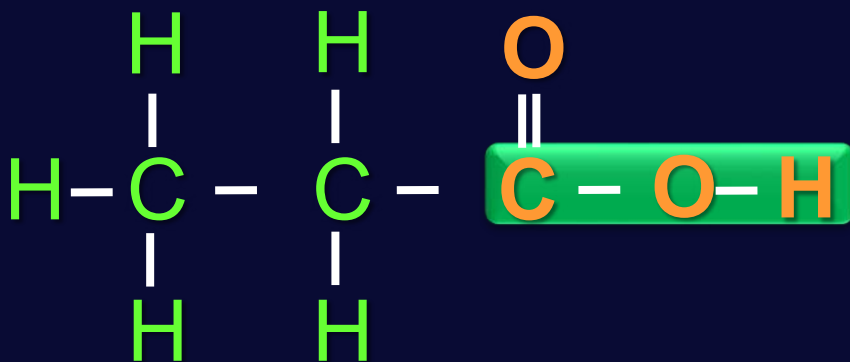
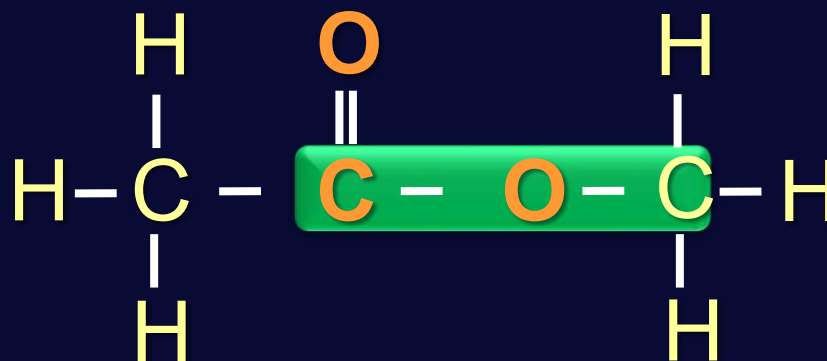
Positional-isomers

Different positions
of the same
functional group

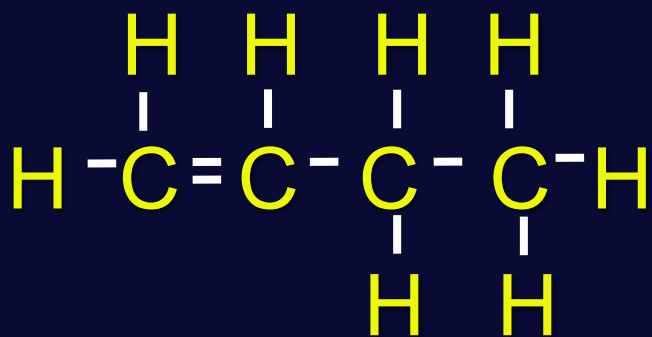
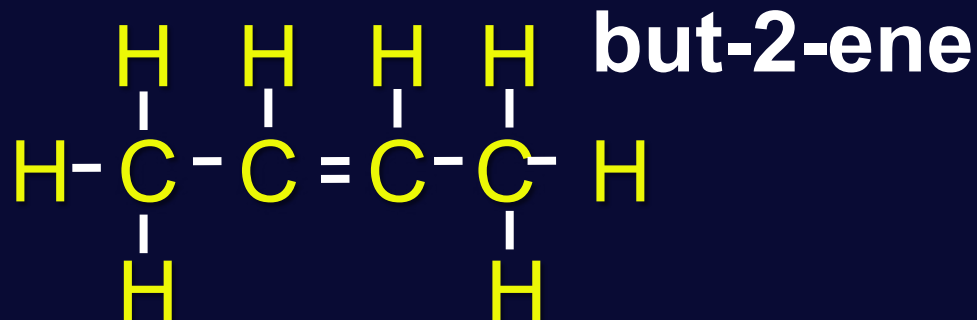


Functional-isomers

Different
functional groups



Butene has the molecular formula of C_4H_8 and the following isomers

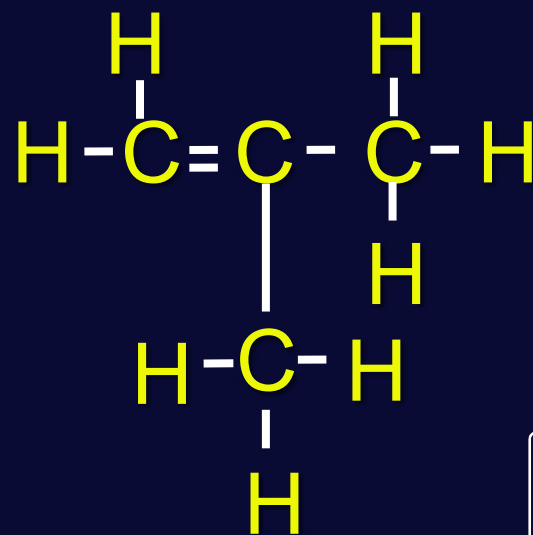


but-1-ene

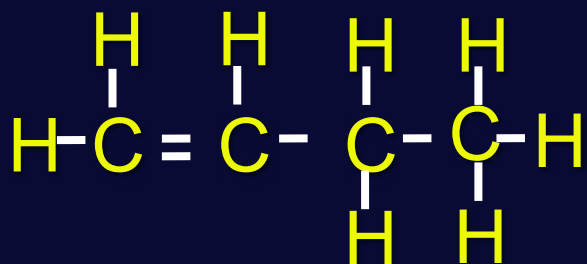
What type of isomers are but-1-ene and but-2-ene?

Positional isomers

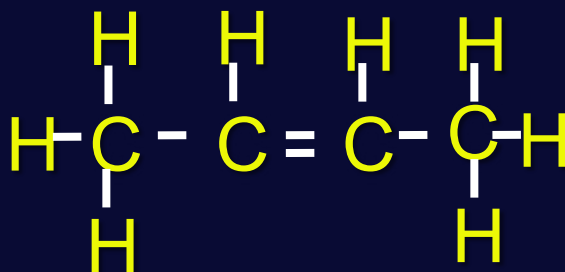
methylpropene



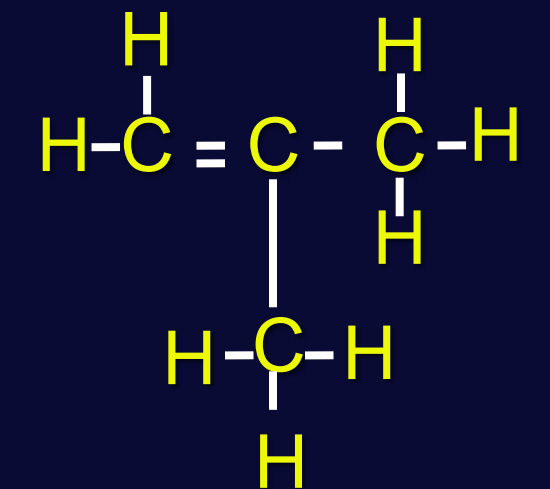
Butene has the molecular formula of C_4H_8 and the following isomers.



but-1-ene



but-2-ene



methylpropene

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

Chain isomers



Alkanes and substituents



Alkanes

Saturated hydrocarbons

Only single bonds
between carbons



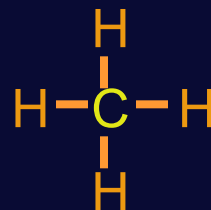
Alkanes

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

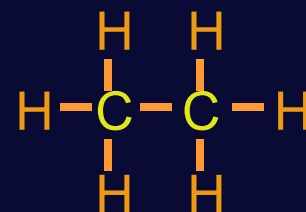


Alkanes

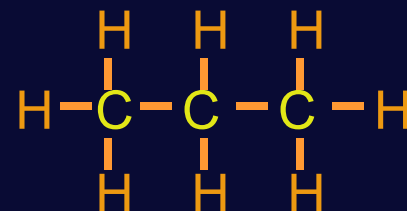
Meth = 1 carbon → methane



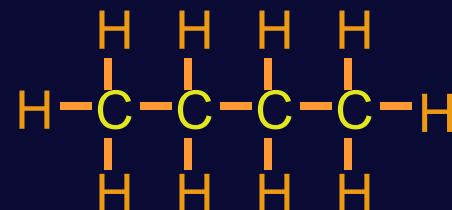
Eth = 2 carbons → ethane



Prop = 3 carbons → propane

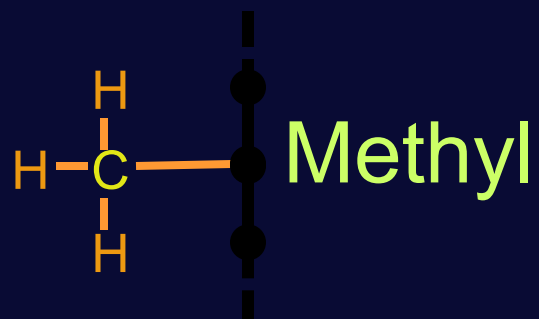


But = 4 carbons → butane

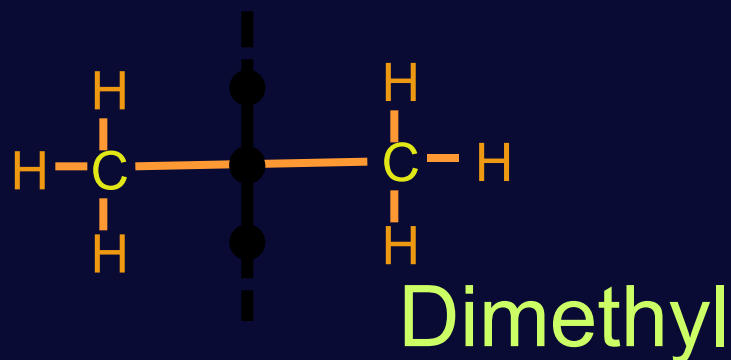
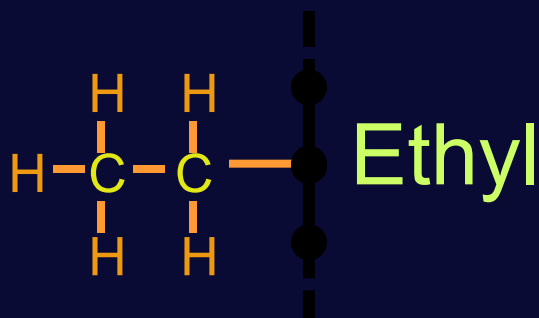


Substituents

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



Use di or tri to indicate two or three substituents



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



Propane



Pentane

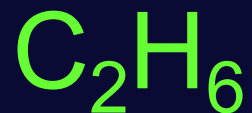


Octane



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

ethane



hexane



heptane



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

C_5H _____ 12

C_8H _____ 18

CH _____ 4

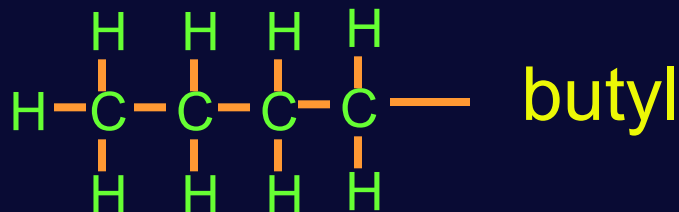
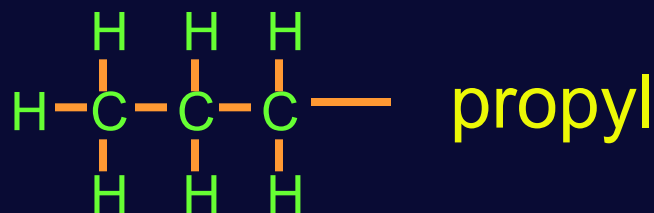
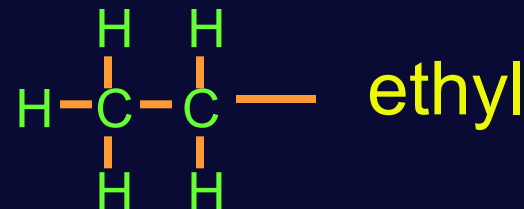
C_4H _____ 10



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



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



Alkanes

IUPAC naming

International Union of Pure and Applied Chemistry



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



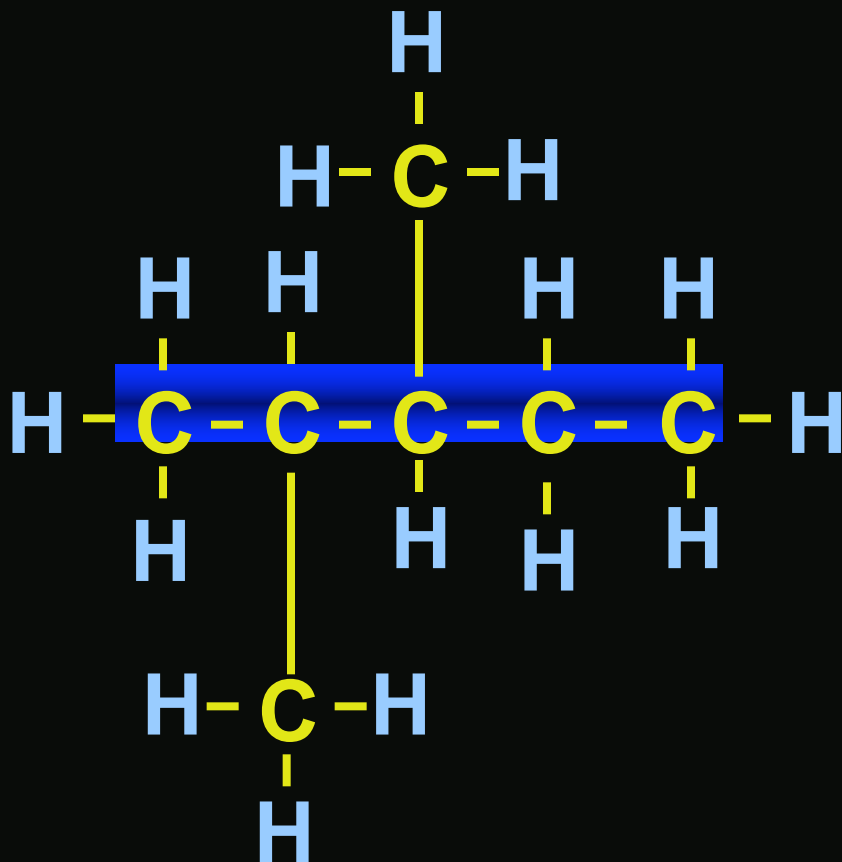
Number of C -
atoms

Basic rules

Step 1

Find the longest continuous chain of C-atoms

(You may need to go around corners):



The stem name =

pent

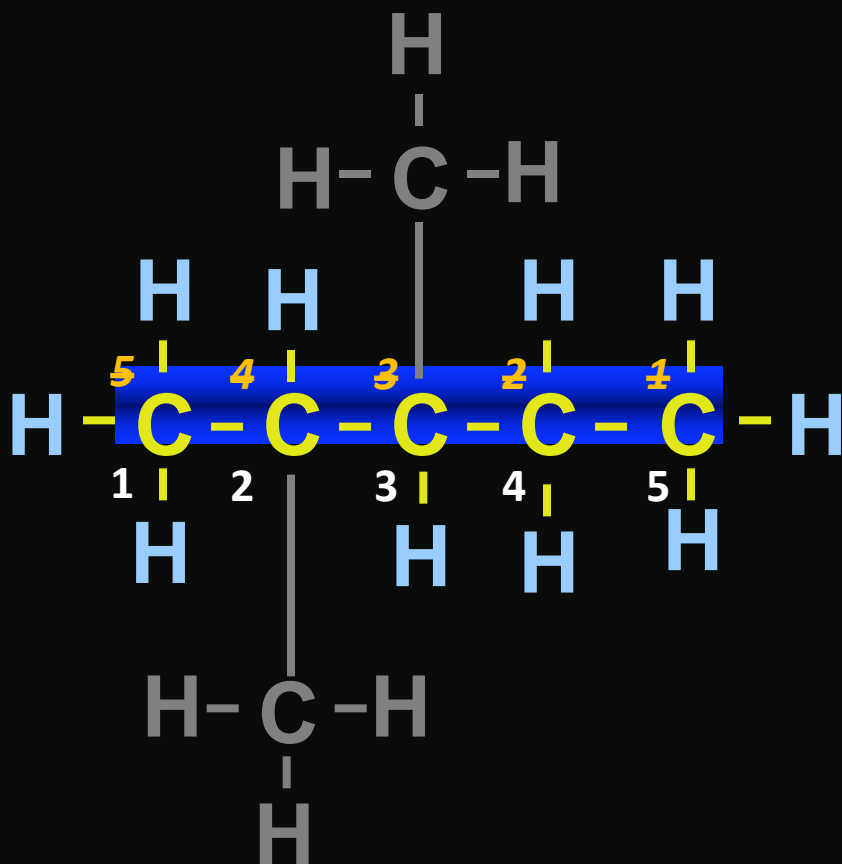
Single bonds = **ane**



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

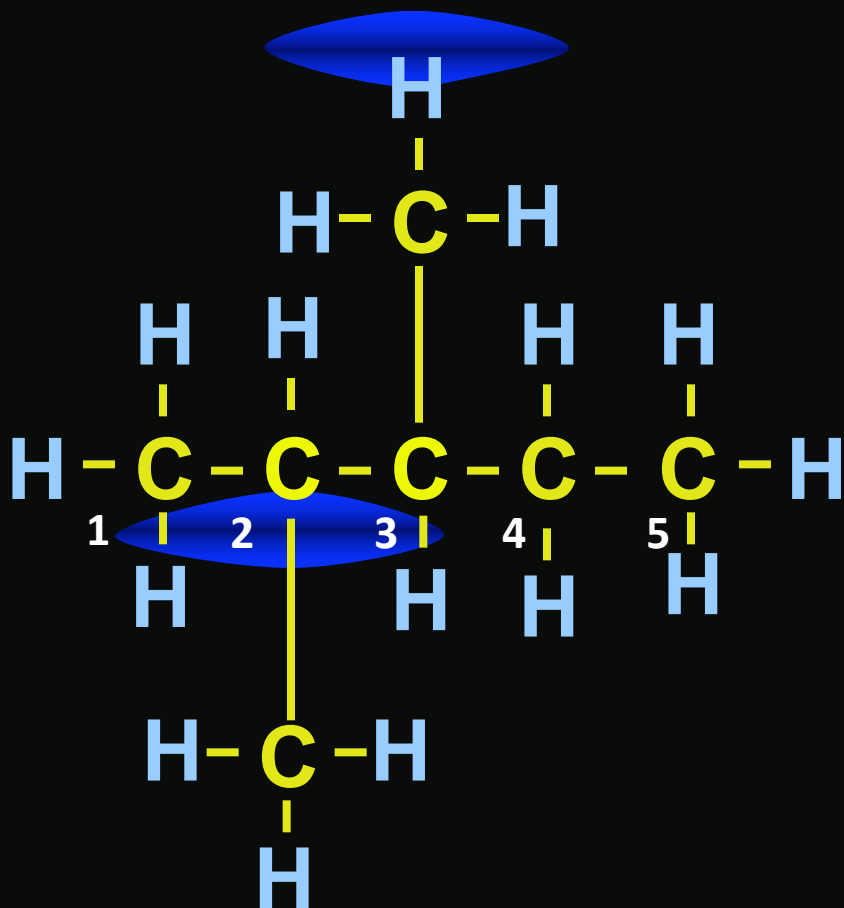
Single bonds = ane

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

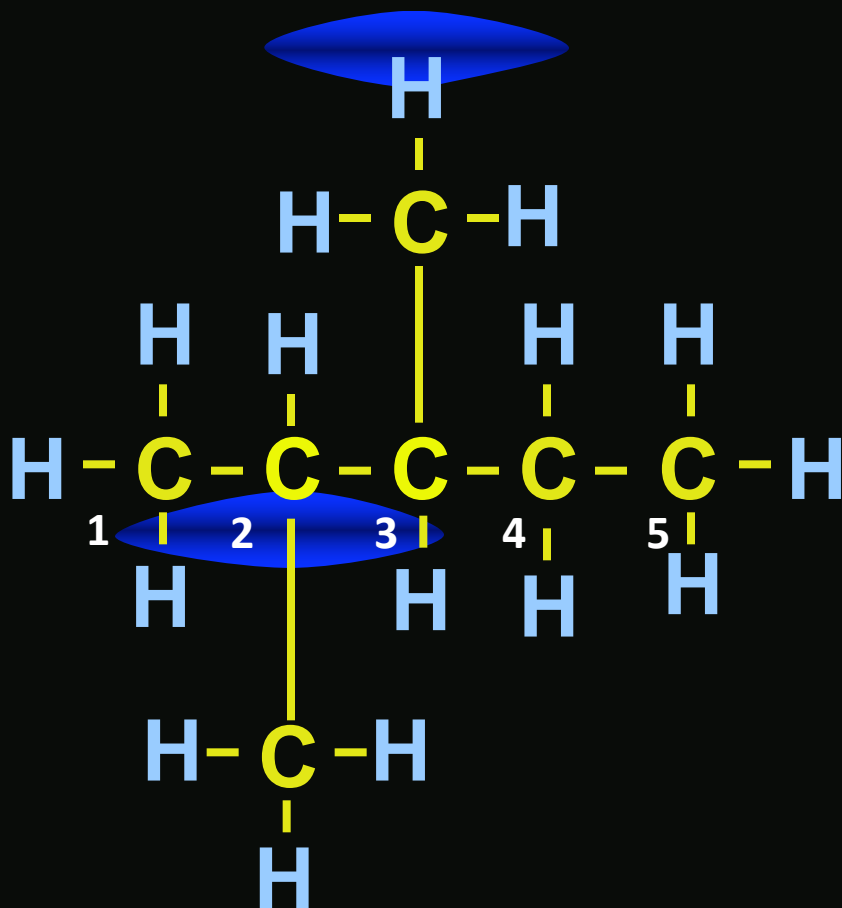
First carbon
connected to a
substituent is 2

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

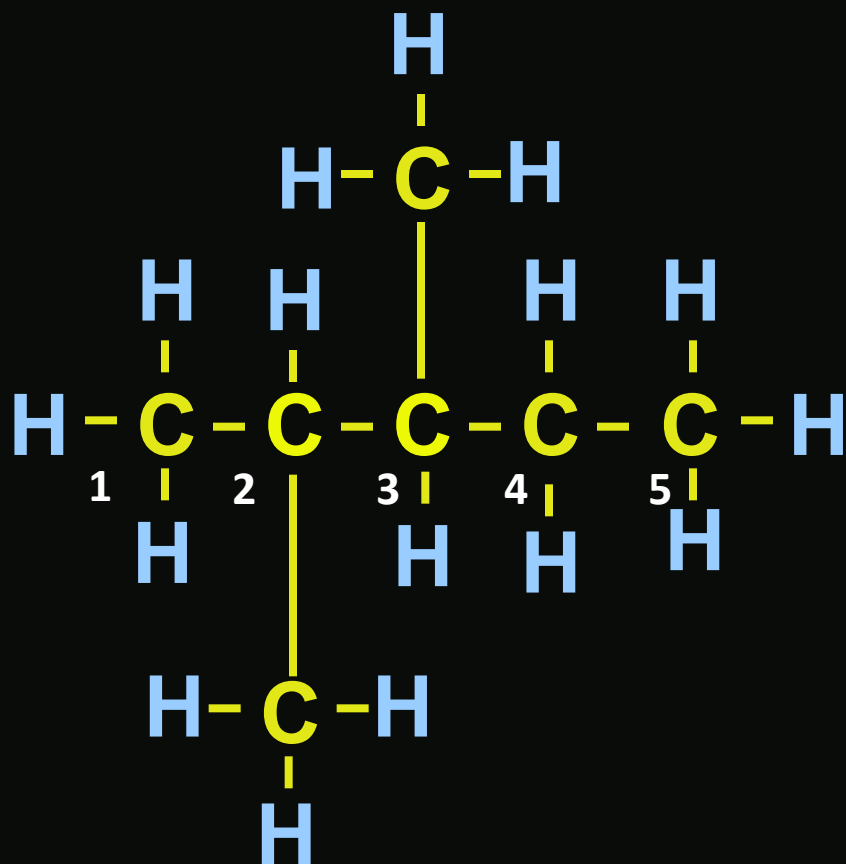
Methyl at 3

Dimethyl at 2,3

Basic rules

The name is:

Dimethyl pentane



The stem name =
pent

Single bonds = ane

First carbon connected to
a substituent is 2

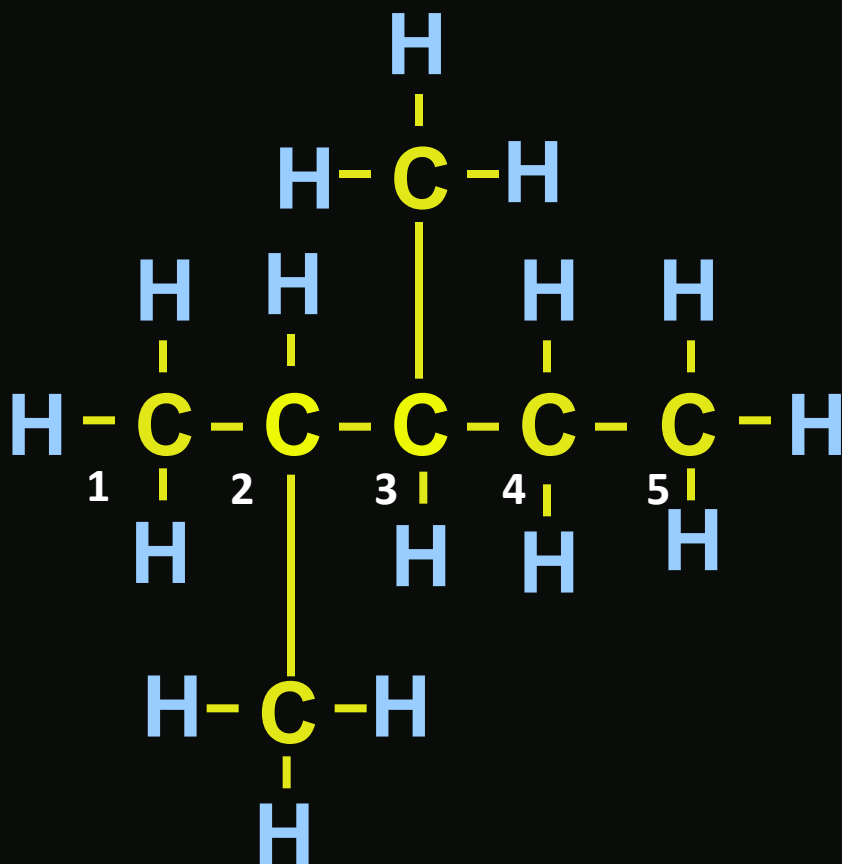
Methyl at 2
Methyl at 3

Dimethyl at 2,3

Basic rules

The name is:

2,3-Dimethylpentane



The stem name =
pent

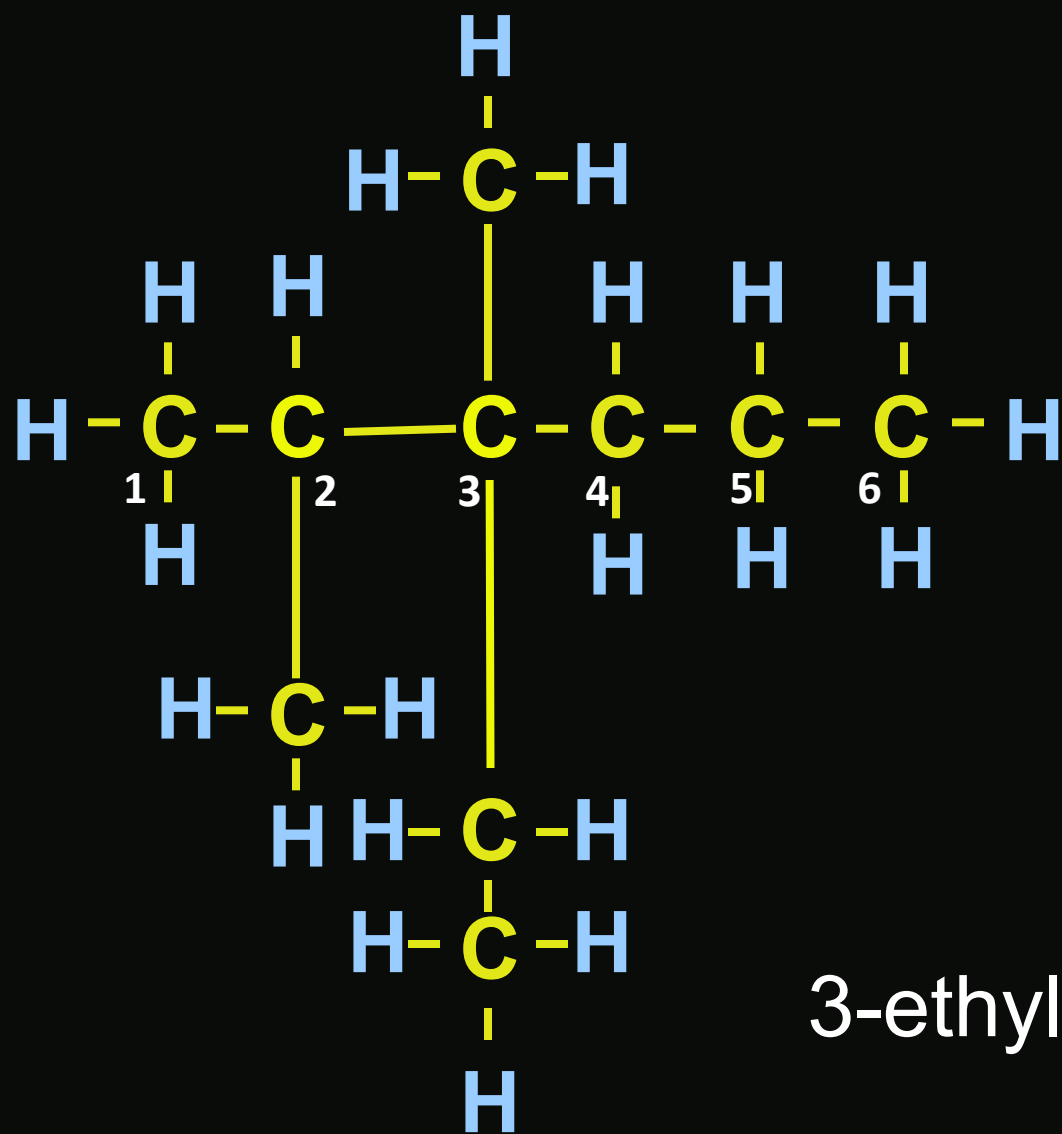
Single bonds = ane

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



Basic rules

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

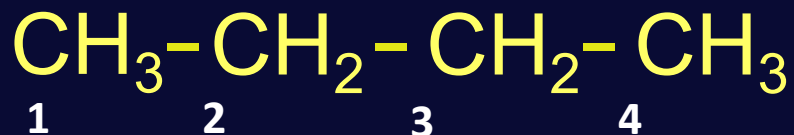


Give the IUPAC name for the following compound:

The stem is = **But**

Single bonds = **ane**

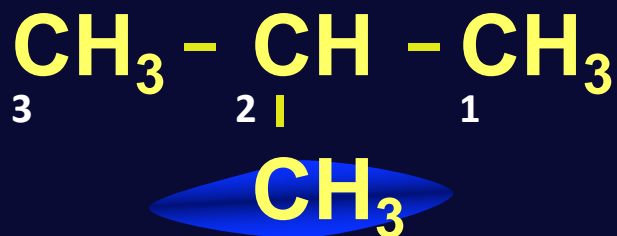
No substituents



butane

(Cadac gas = mixture of butane and propane)

Give the IUPAC name for the following compound:



The stem is = **Prop**

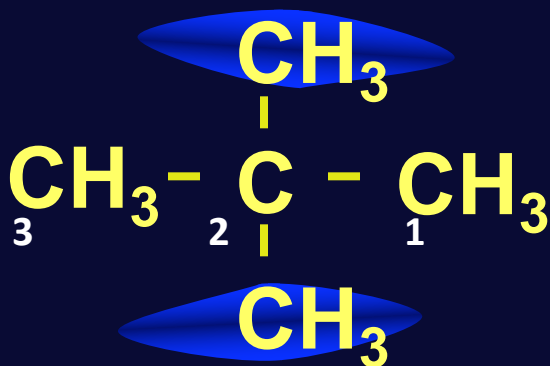
Single bonds = **ane**

Methyl at Carbon
2

2-Methylpropane



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

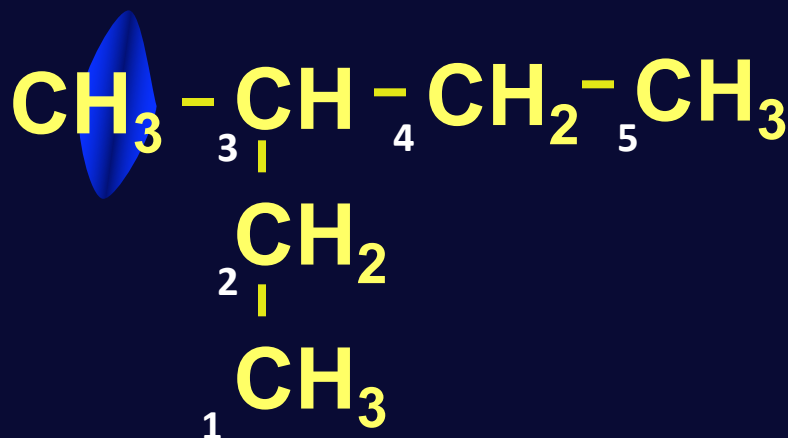


Give the IUPAC name for the following compound:

The stem is = pent

Single bonds = **ane**

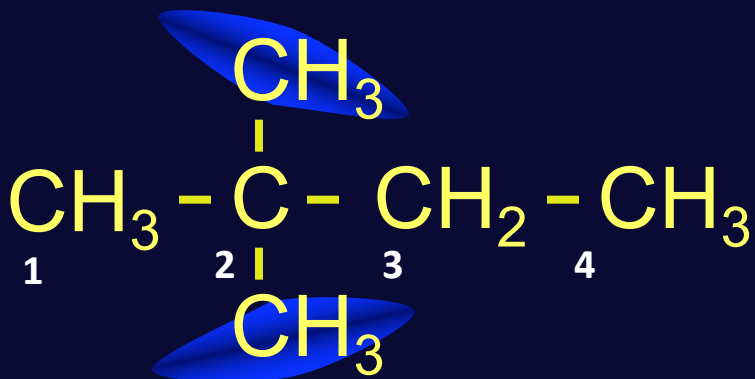
1 Methyl at carbon 3



3-Methylpentane



Give the IUPAC name for the following compound:



The stem is = **But**

Single bonds = **ane**

2 Methyls at carbons 2
and 2

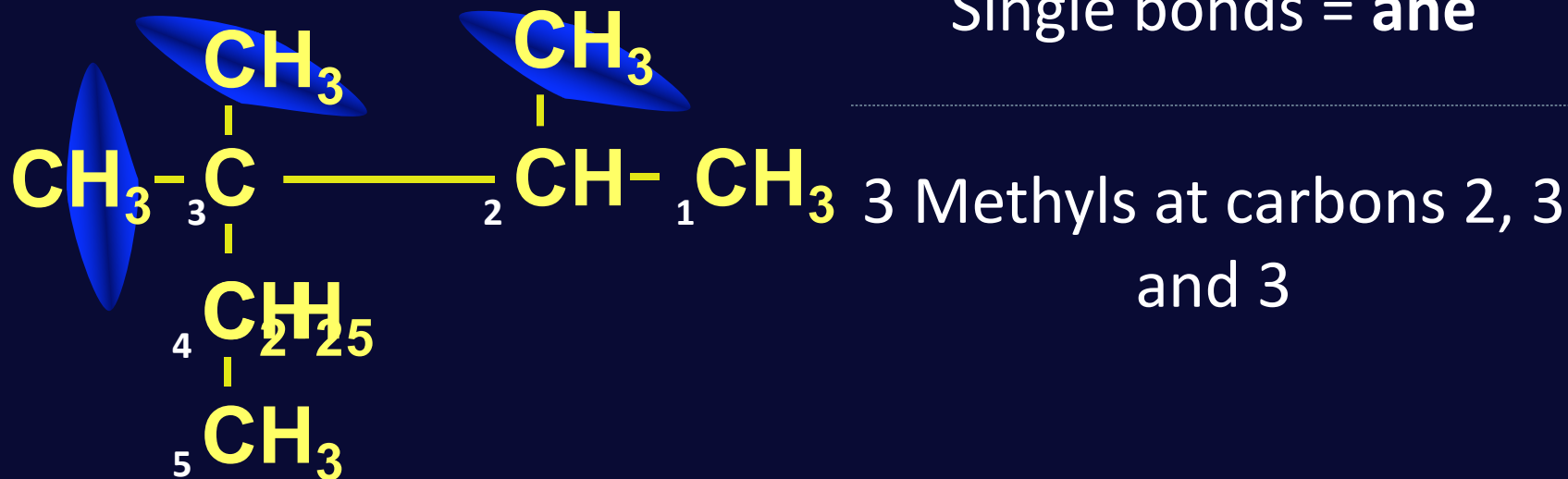
2,2-Dimethylbutane



Give the IUPAC name for the following compound:

The stem is = **Pent**

Single bonds = **ane**



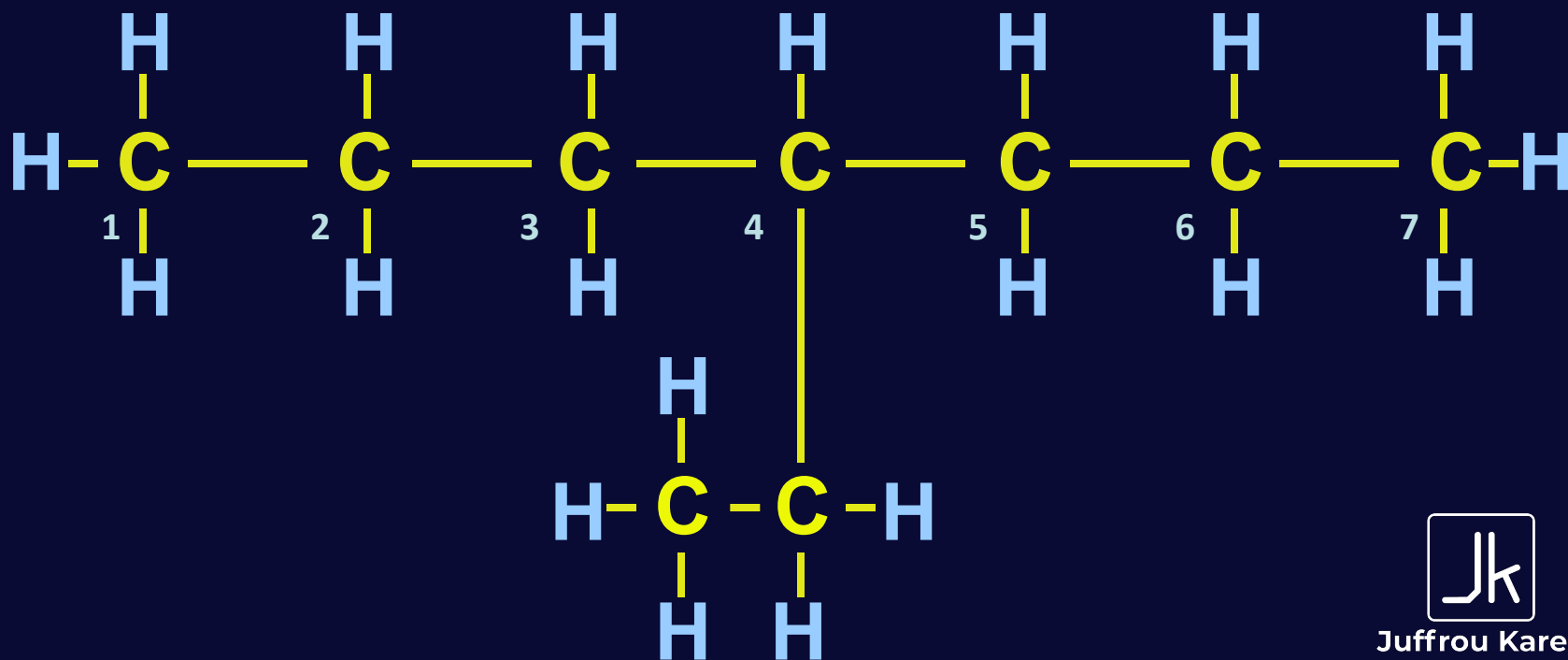
2,3,3-trimethylpentane



Draw a structural formula for the following
compound:

4-Ethylheptane

7 carbons
Ethyl at 4
Only single bonds



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.



Vapour pressure

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



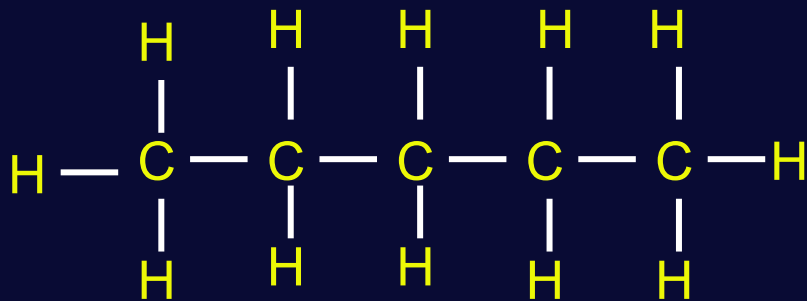
A high vapour pressure means that a substance is volatile and that the substance evaporates easily.



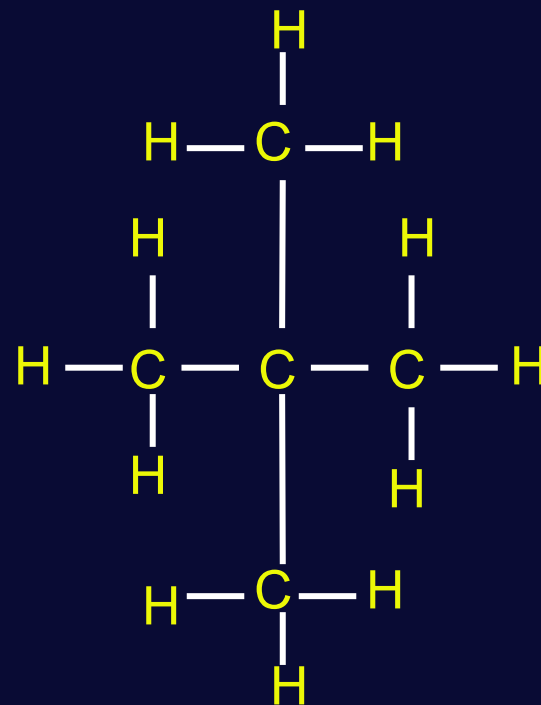
Intermolecular forces

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)

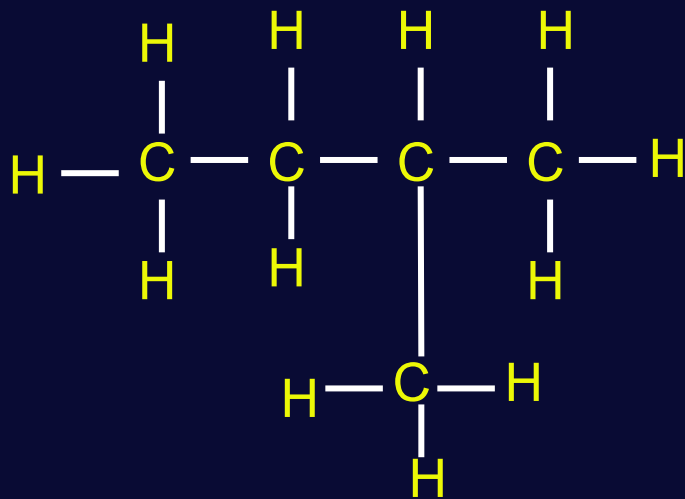
Consider the following three compounds with the formula C_5H_{12}



Pentane

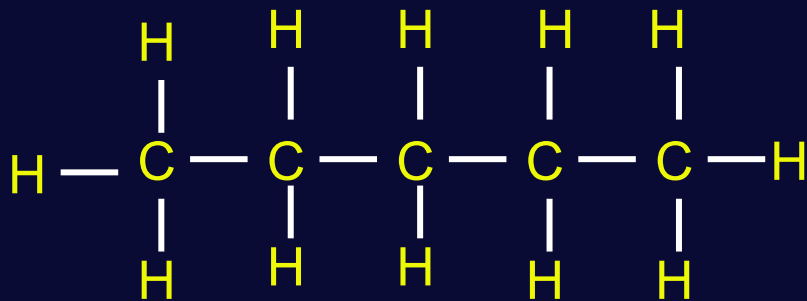


2,2-dimethylpropane

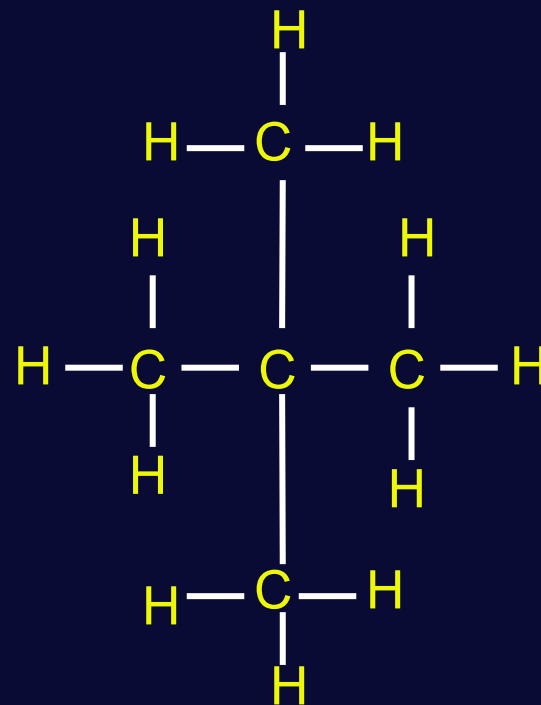


2-methylbutane

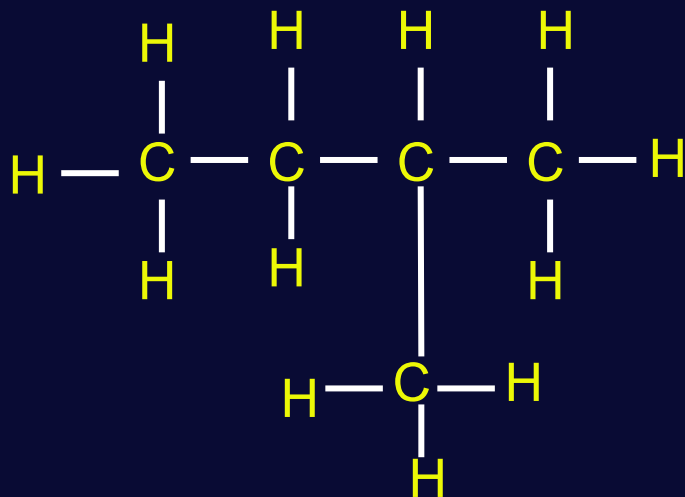
Consider the following three compounds with the formula C_5H_{12}
Are these compounds isomers?



Pentane

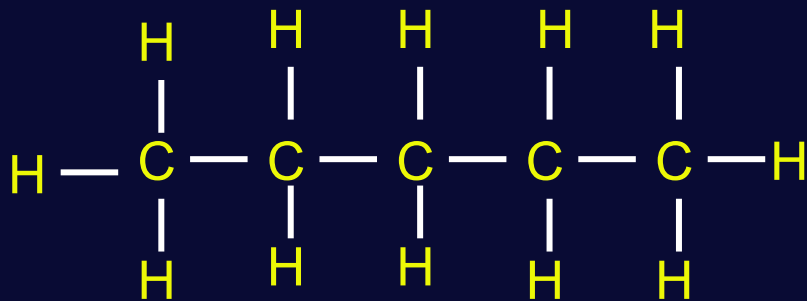


2,2-dimethylpropane

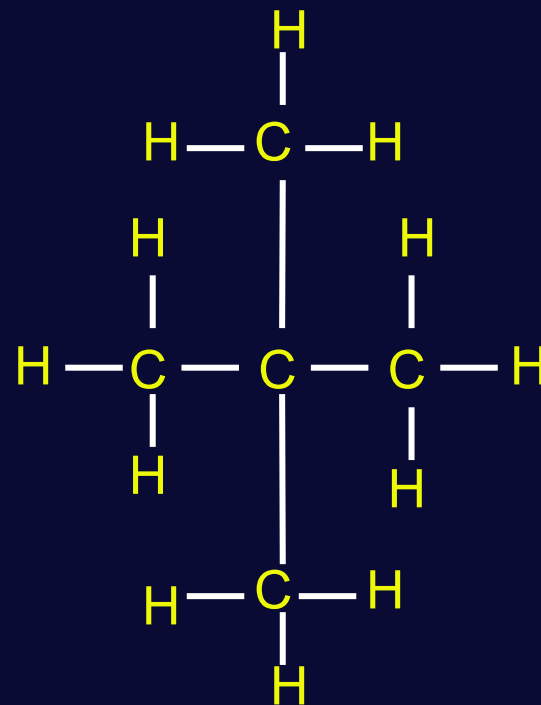


2-methylbutane

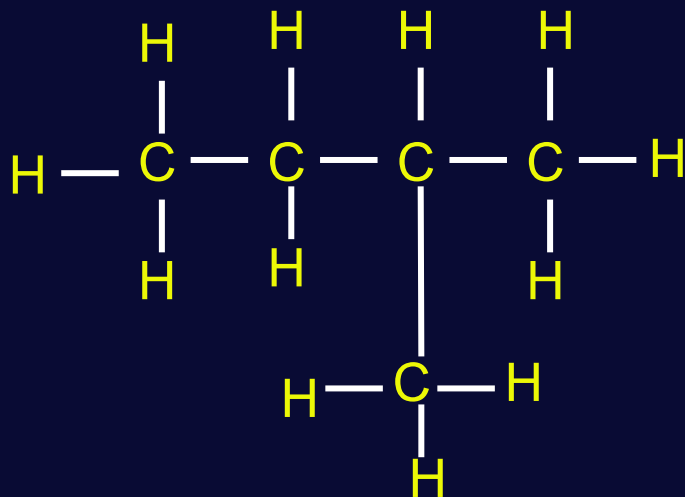
Consider the following three compounds with the formula C_5H_{12}
Identify the type of isomers present.



Pentane



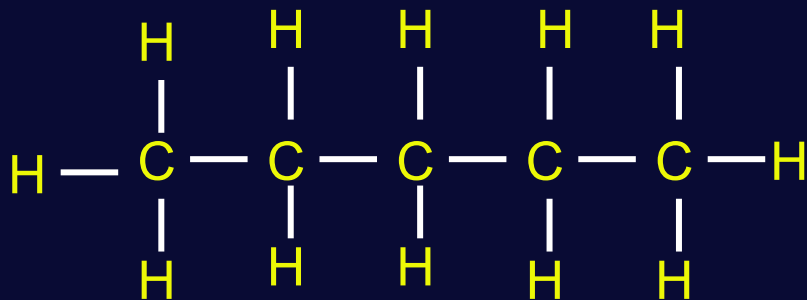
2,2-dimethylpropane



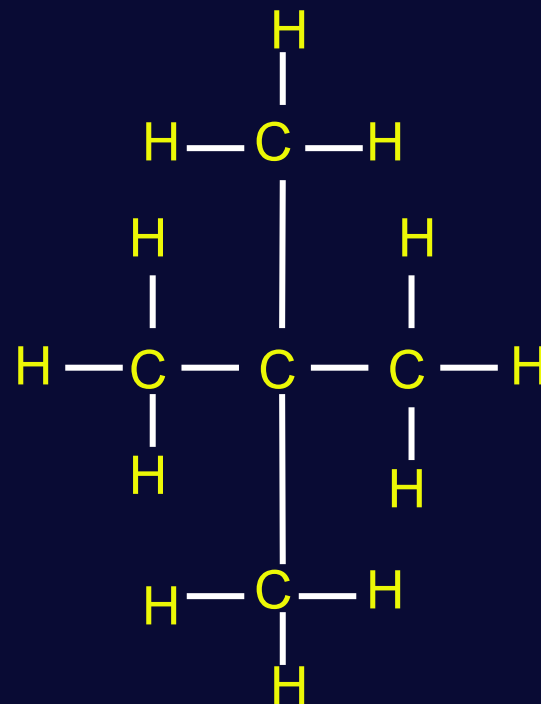
2-methylbutane

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

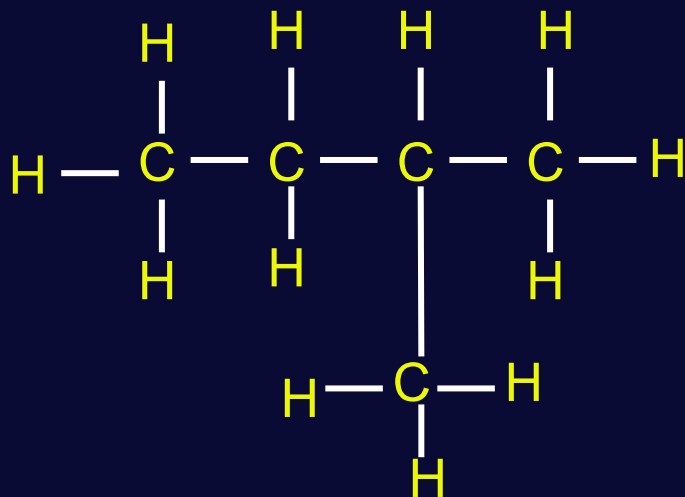
Chain isomers



Pentane

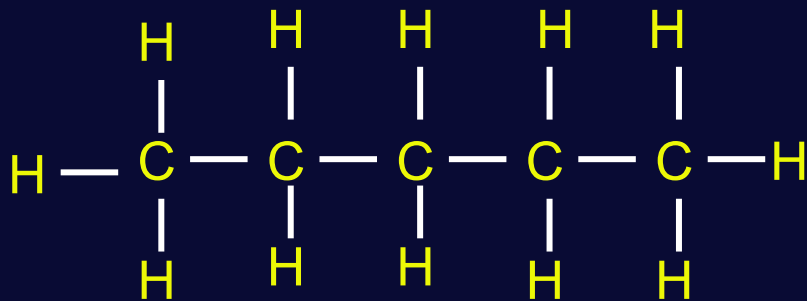


2,2-dimethylpropane

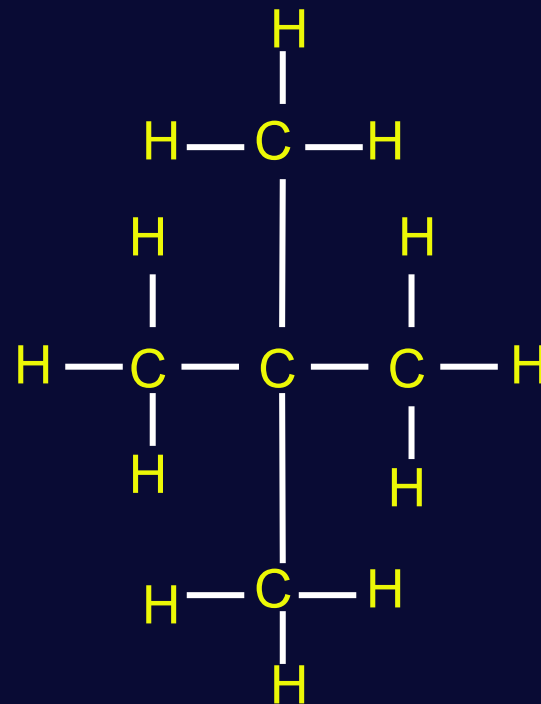


2-methylbutane

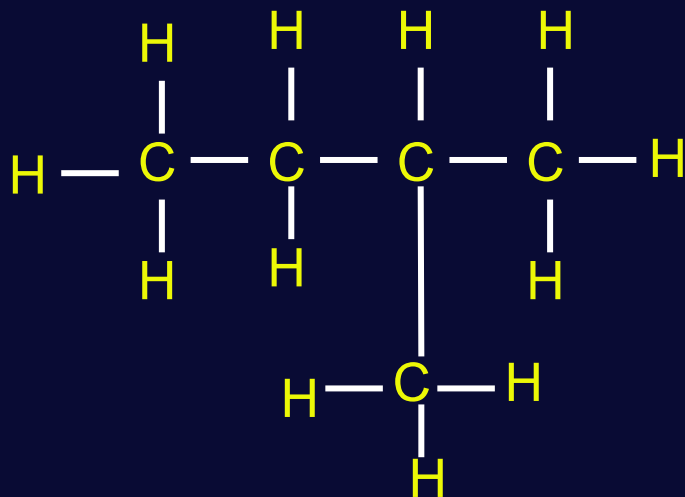
Consider the following three compounds with the formula C_5H_{12}
Which intermolecular forces are present?



Pentane



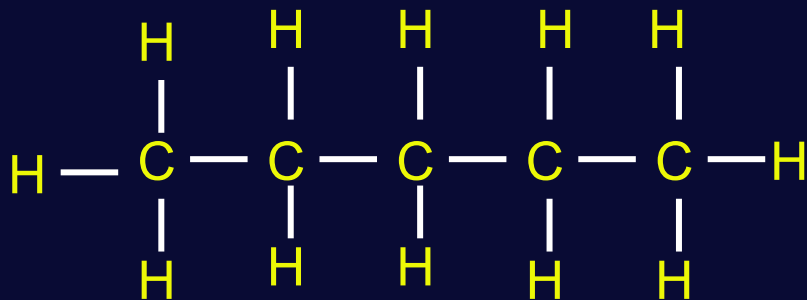
2,2-dimethylpropane



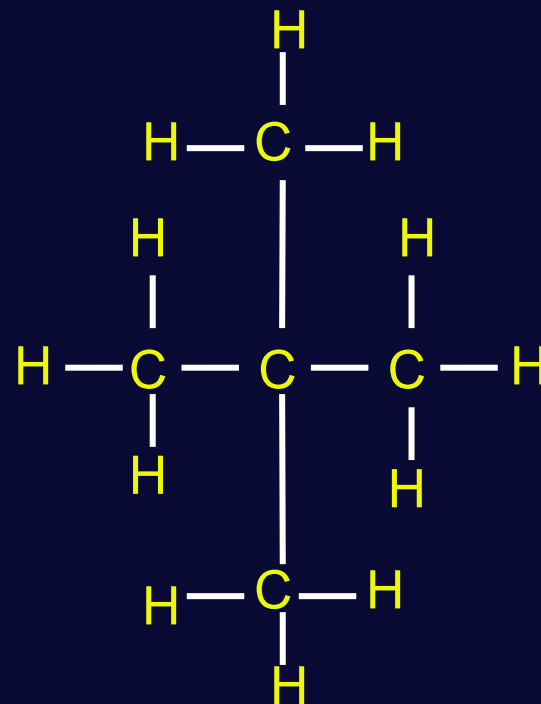
2-methylbutane

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

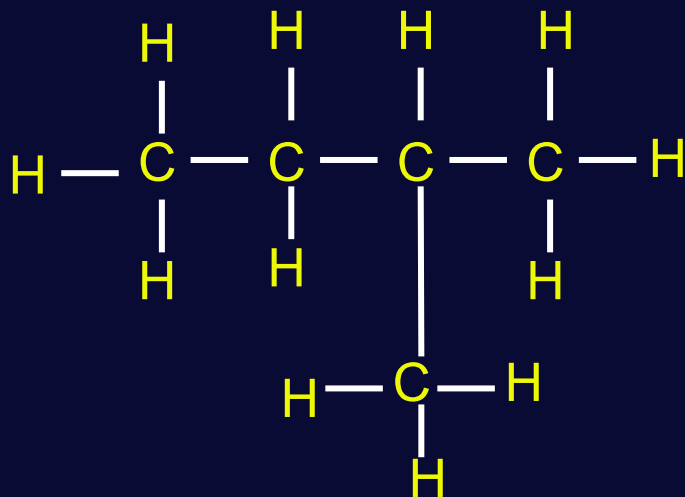
London (Dispersion) forces



Pentane

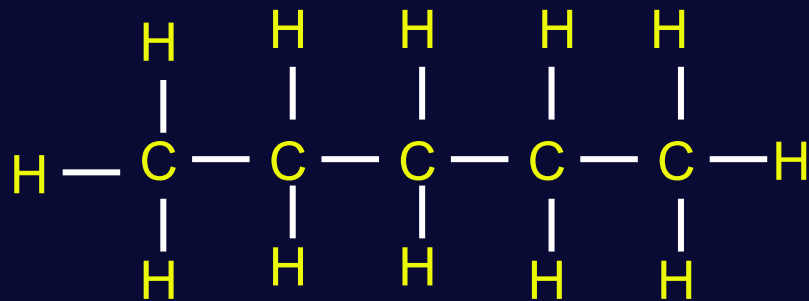


2,2-dimethylpropane

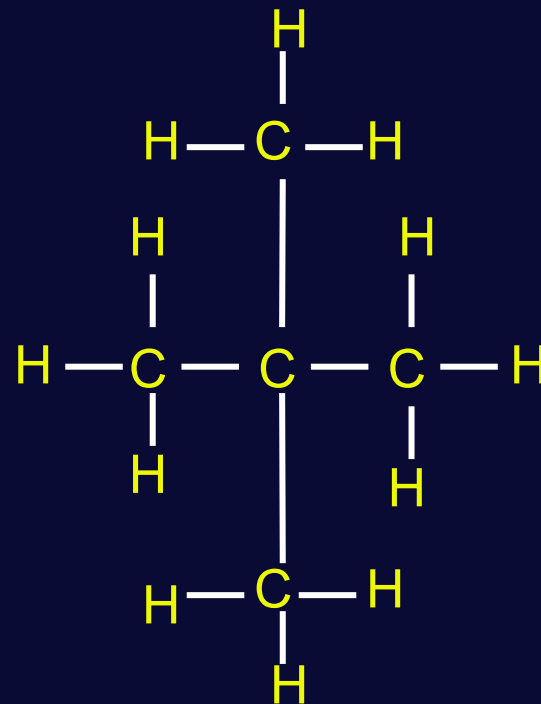


2-methylbutane

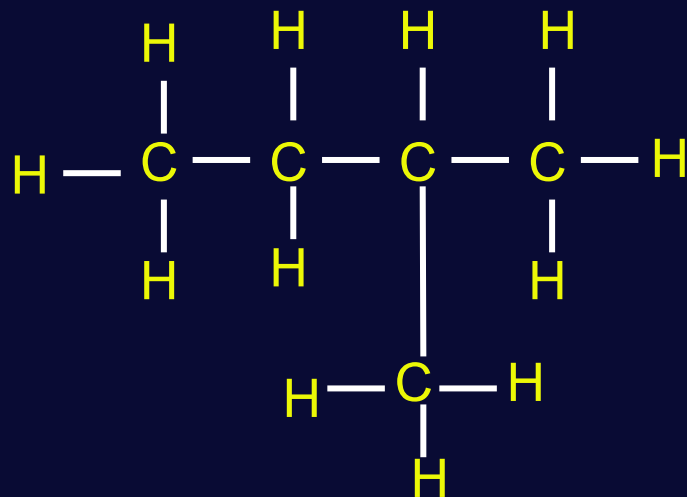
Consider the following three compounds with the formula C_5H_{12}
Which compound will have the highest boiling point? Explain.



Pentane



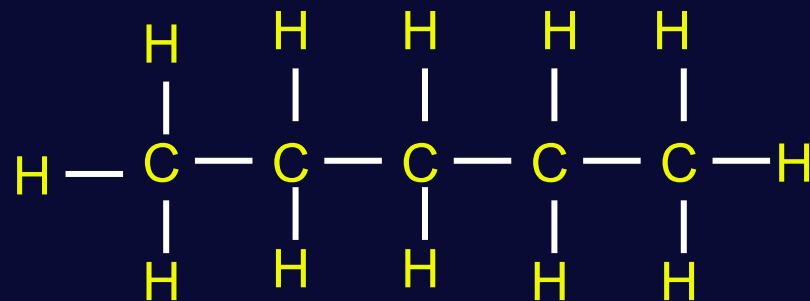
2,2-dimethylpropane



2-methylbutane

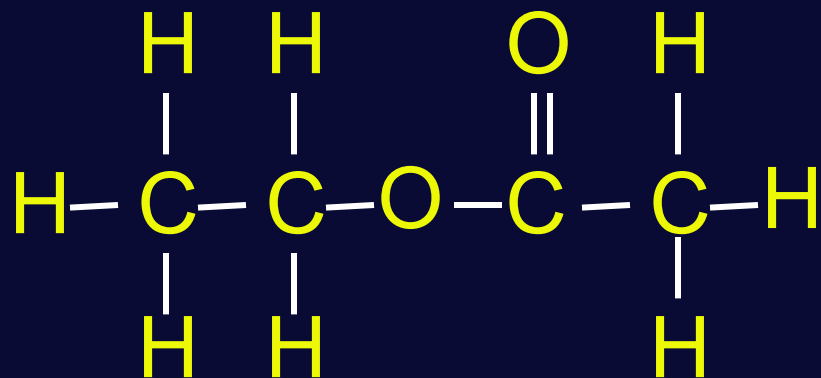
Consider the following three compounds with the formula C_5H_{12}
Which compound will have the highest boiling point? Explain.

- 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,
- therefore more energy will be required to overcome the stronger IMF



Pentane

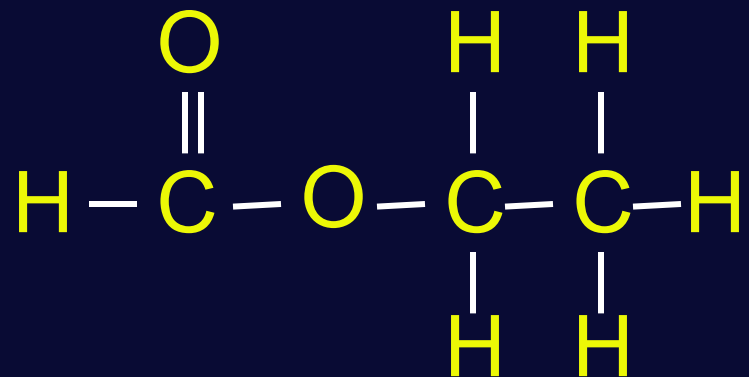
Give the IUPAC-name of the following compound:



ethyl ethanoate



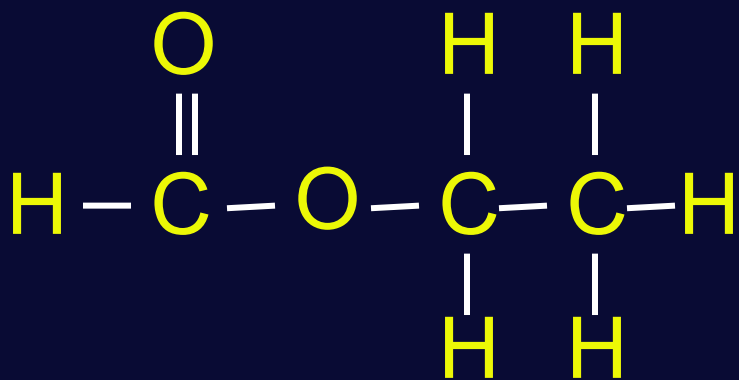
Give the IUPAC-name of the following compound:



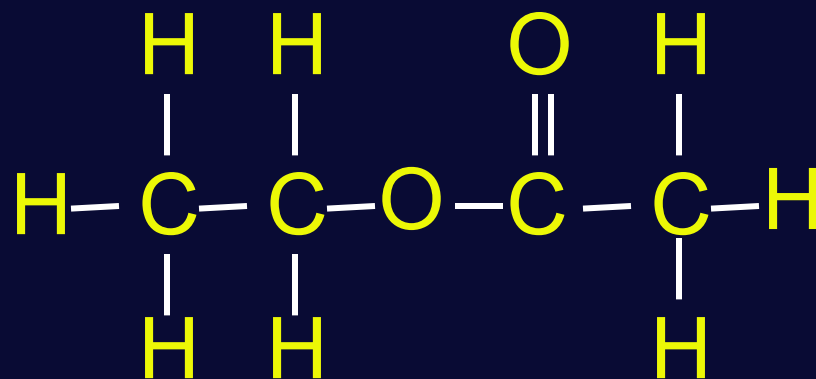
ethyl methanoate



Which compound will have the highest boiling point? Explain



ethyl
methanoate



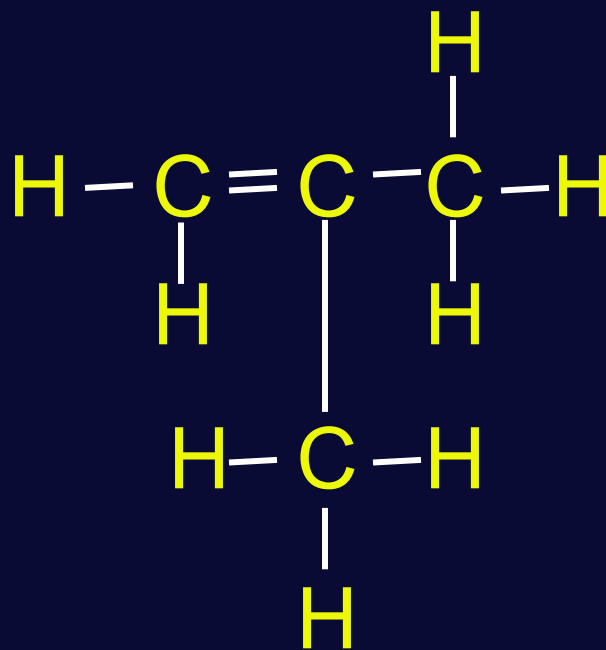
ethyl
ethanoate



- 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,
- therefore more energy will be required to overcome the stronger IMF,
- and therefore ethyl ethanoate will have the highest boiling point



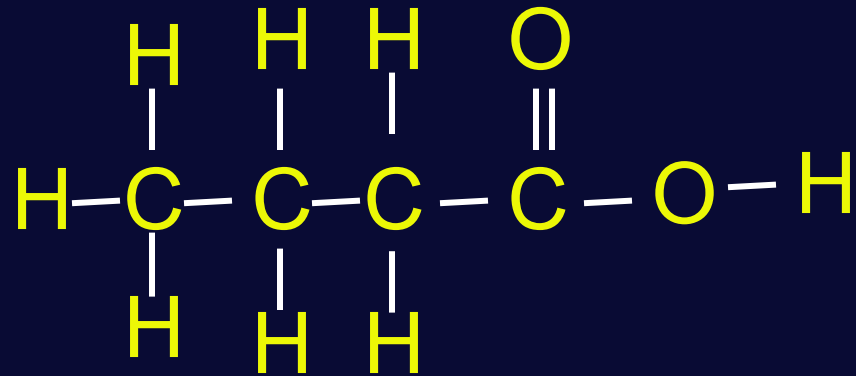
Write down the IUPAC name of the following compound:



2-methylprop-1-ene



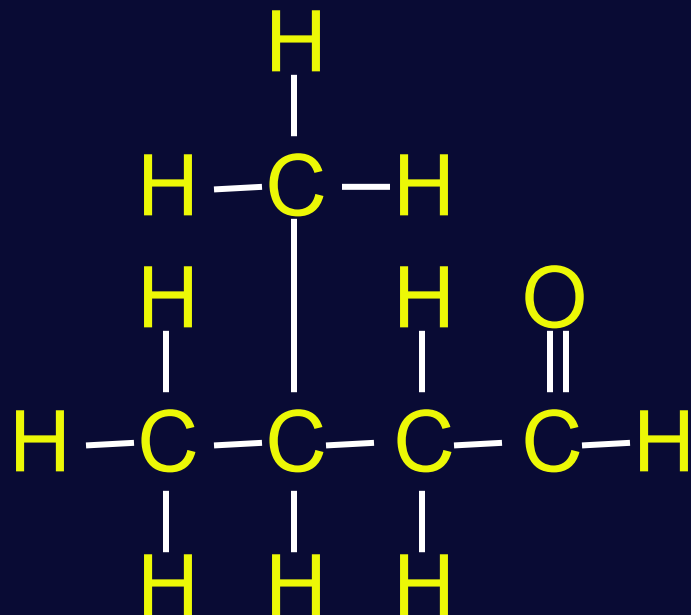
Give the IUPAC-names for the following compound.



Butanoic acid



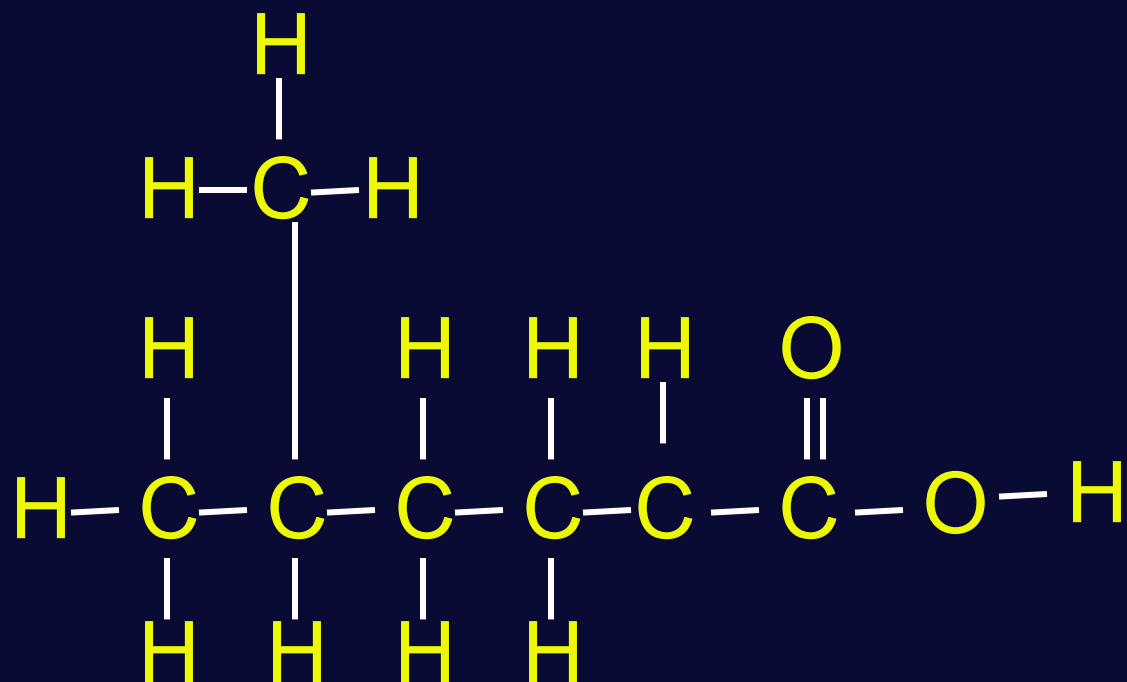
Give the IUPAC-name for the following compound:



3-methylbutanal



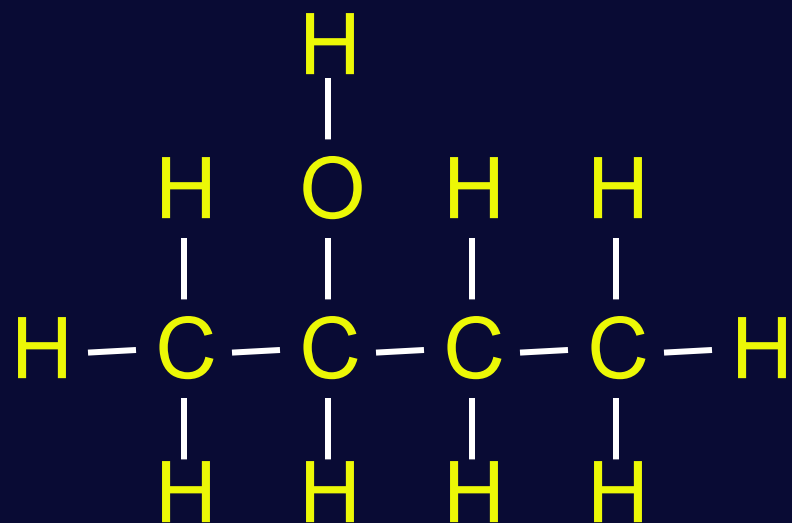
Give the IUPAC-name for the following compound:



5-methylhexanoic acid



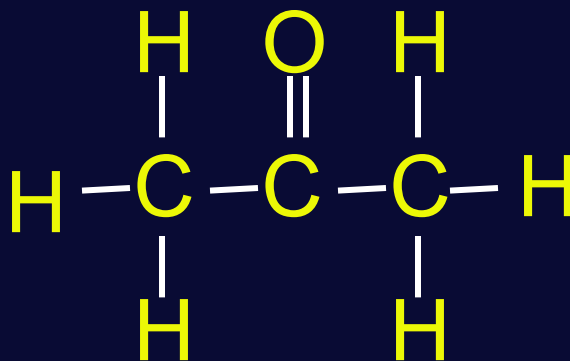
Give the IUPAC-name for the following compound:



Butan-2-ol



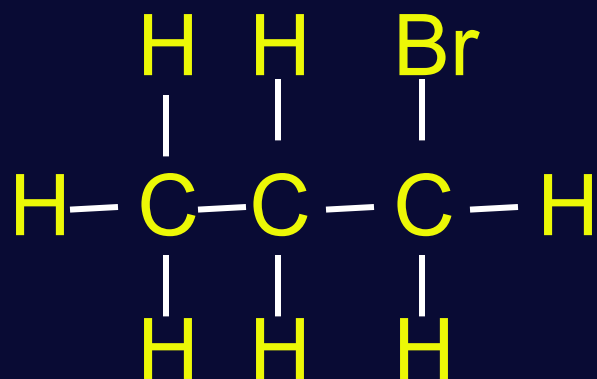
Give the IUPAC-name for the following compound:



propan-2-one



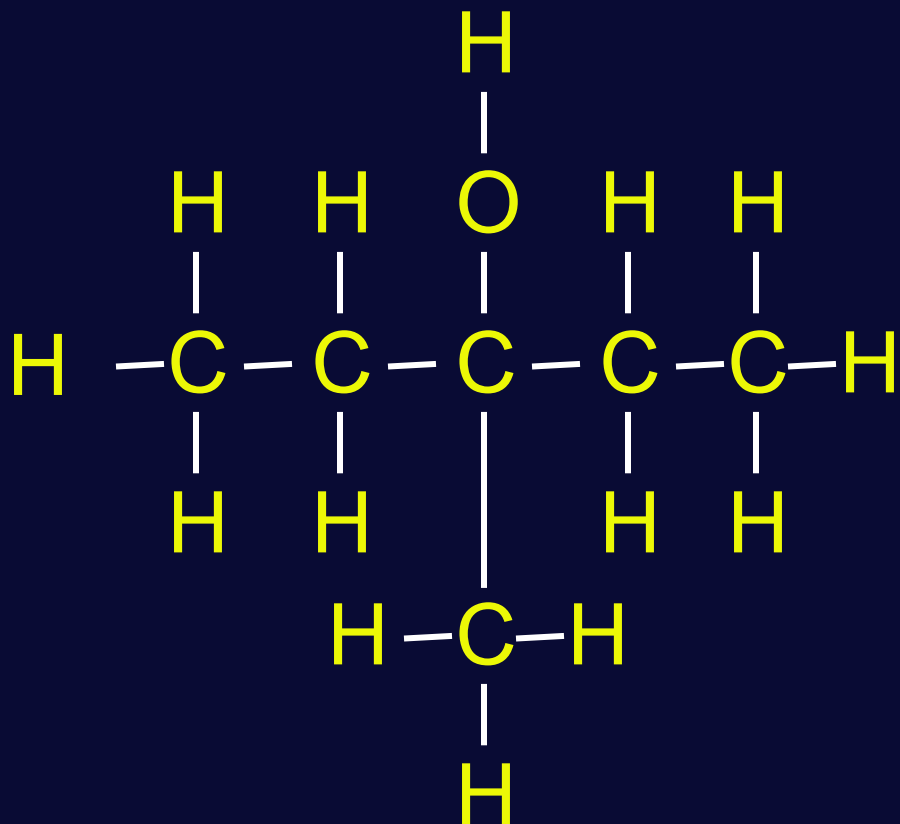
Give the IUPAC-name for the following compound:



1-bromopropane



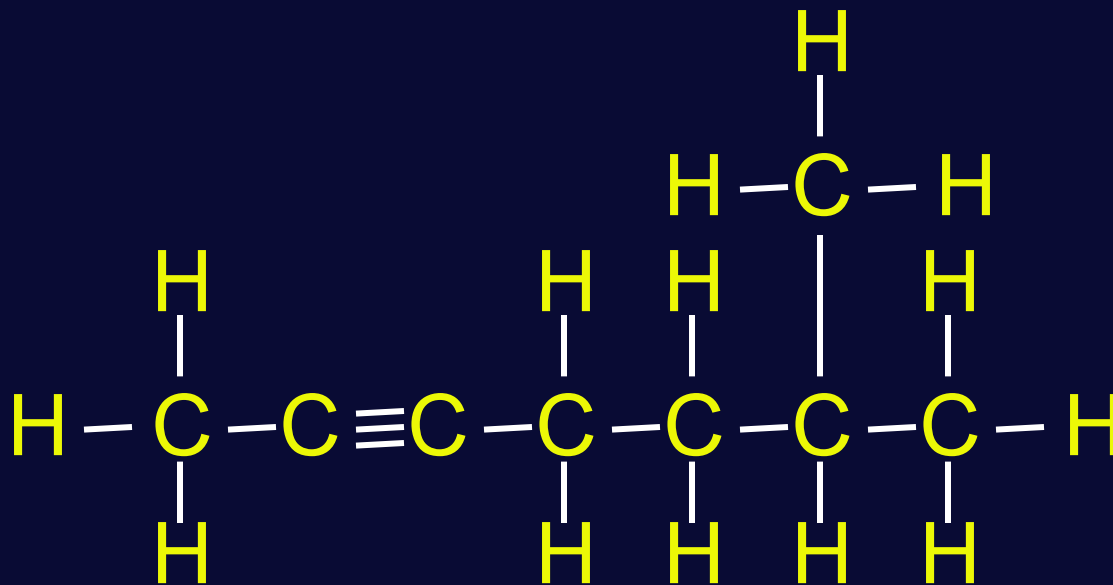
Give the IUPAC-name for the following compound:



3-methylpentan-3-ol



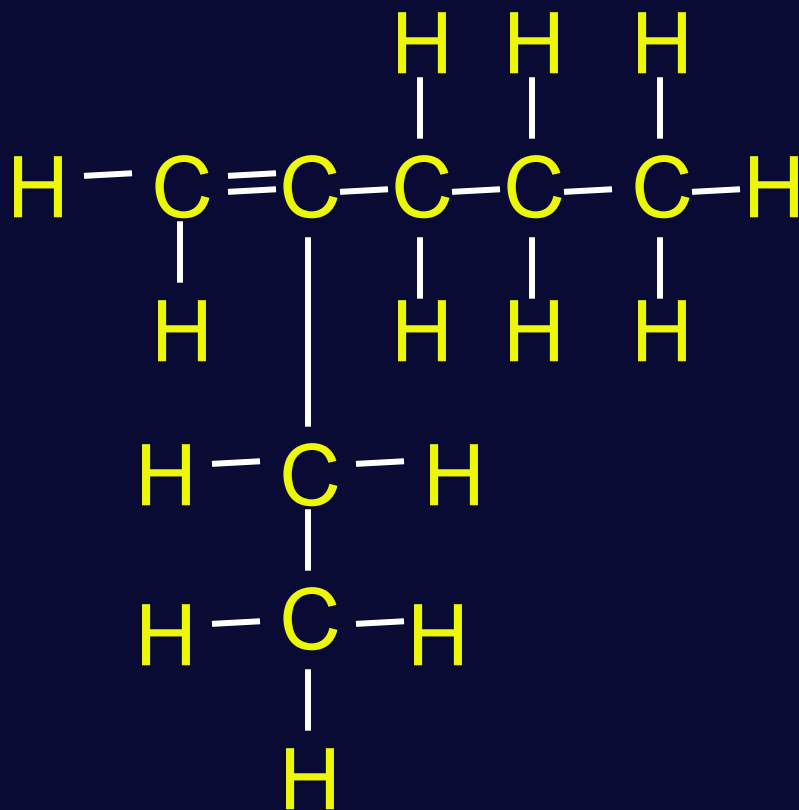
Give the IUPAC-name for the following compound:



6-methylhept-2-yne



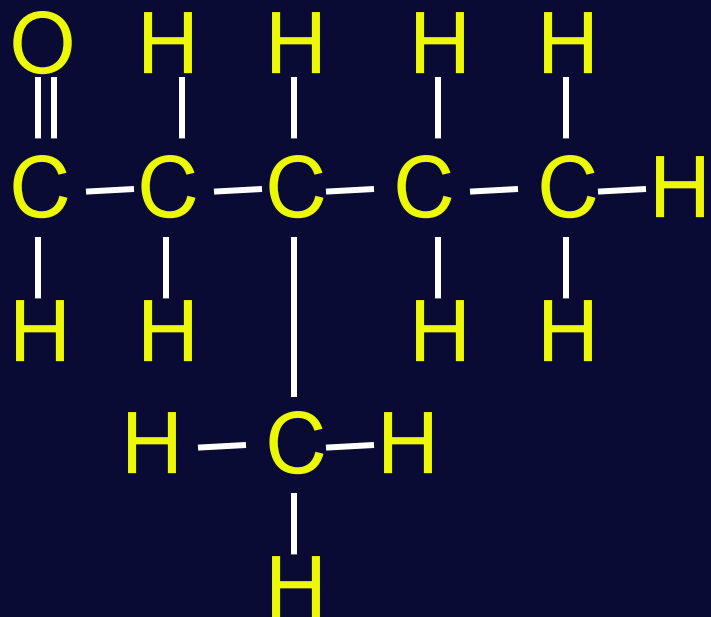
Give the IUPAC-name for the following compound:



2-ethylpent-1-ene



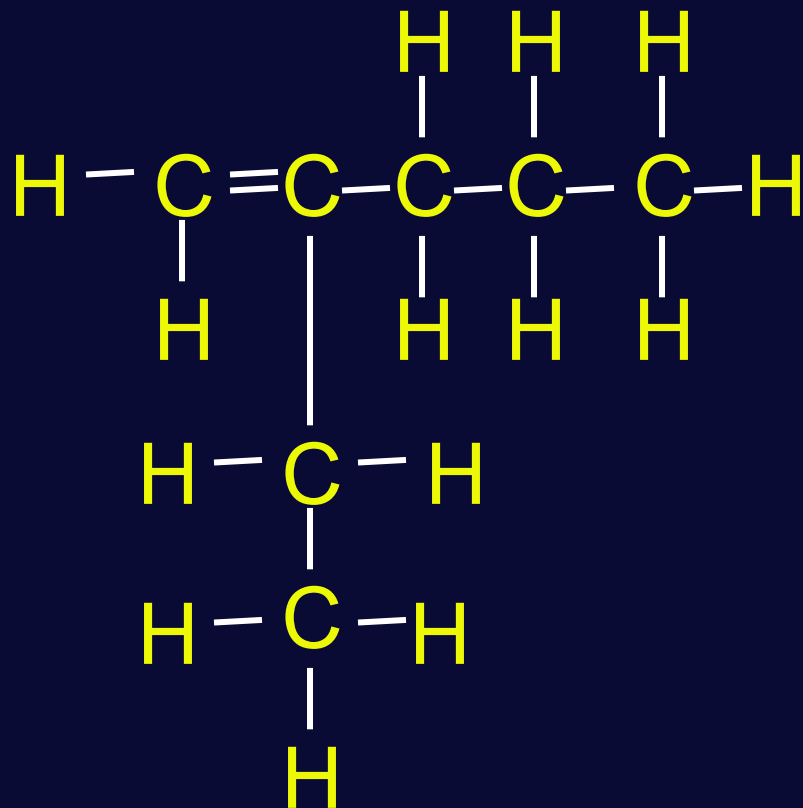
Give the IUPAC-name for the following compound:



3-methylpentanal

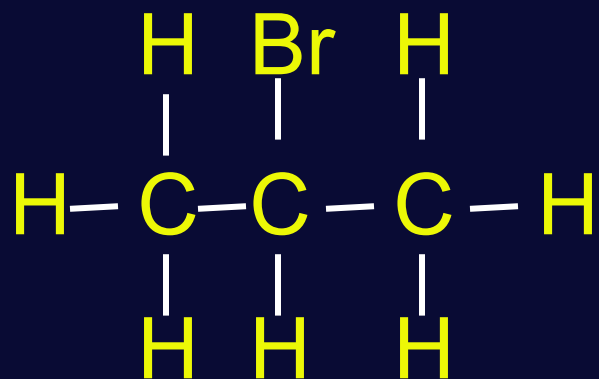


Give the IUPAC-name for the following compound:



2-ethylpent-1-ene

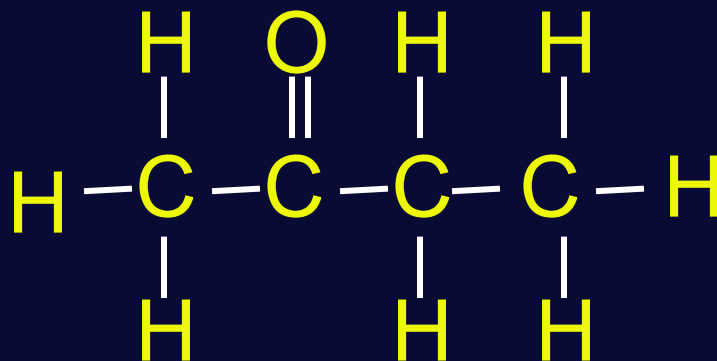
Give the IUPAC-name for the following compound:



2-bromopropane



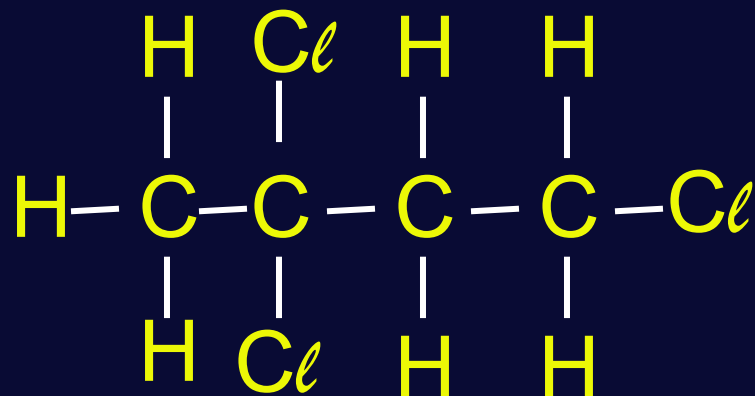
Give the IUPAC-name for the following compound:



butan-2-one



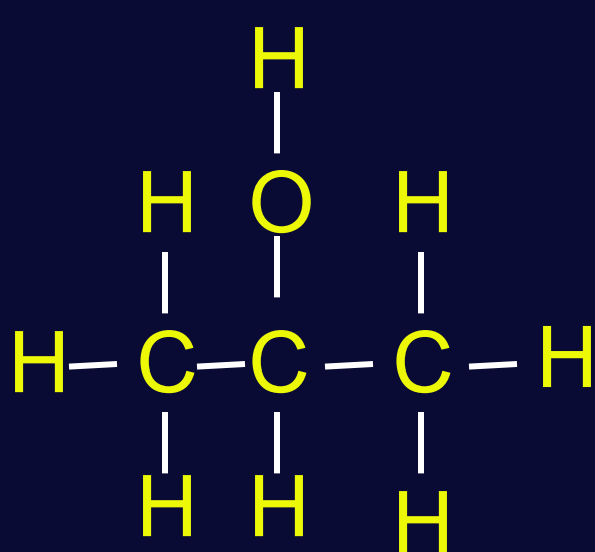
Give the IUPAC-name for the following compound:



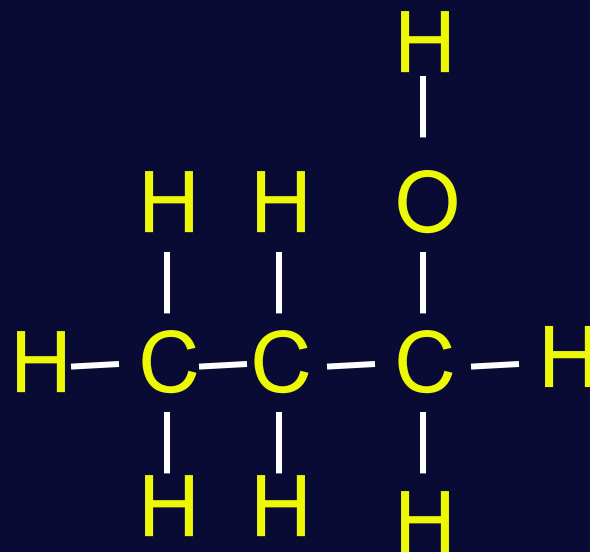
1,3,3-trichlorobutane



Give the IUPAC-name for the following compound:



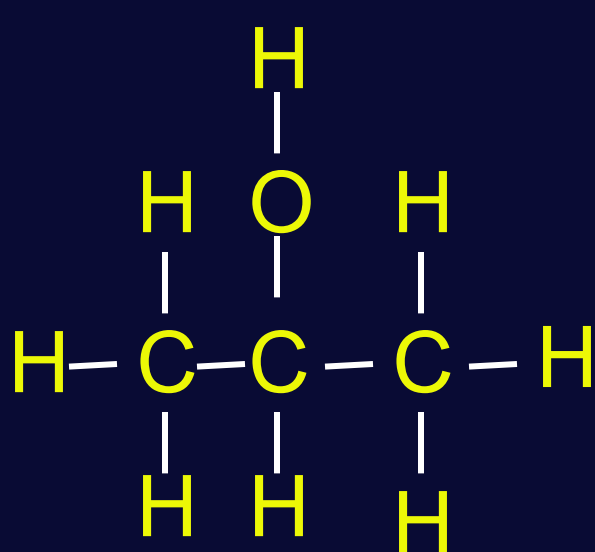
Propan-2-ol
Secondary alcohol



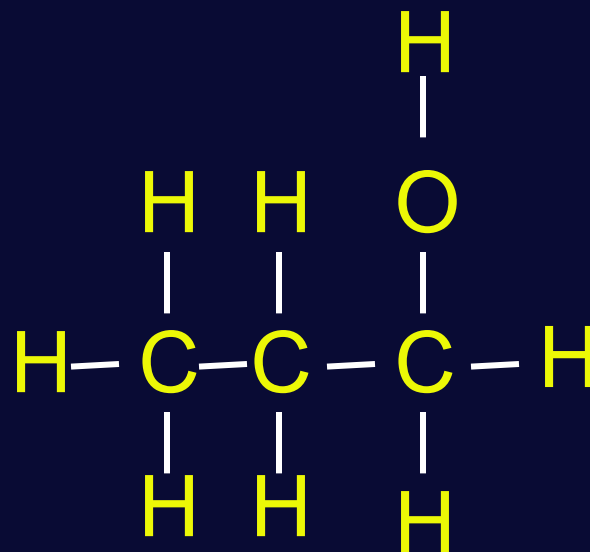
Propan-1-ol
Primary alcohol



Which type of isomers are the following two compounds?



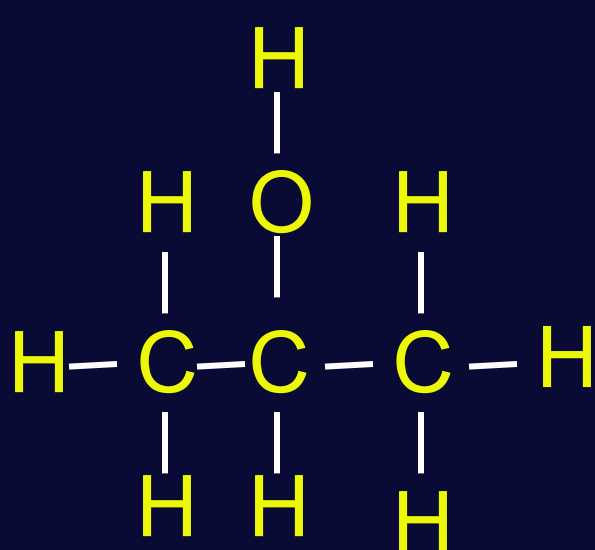
Propan-2-ol
Secondary alcohol



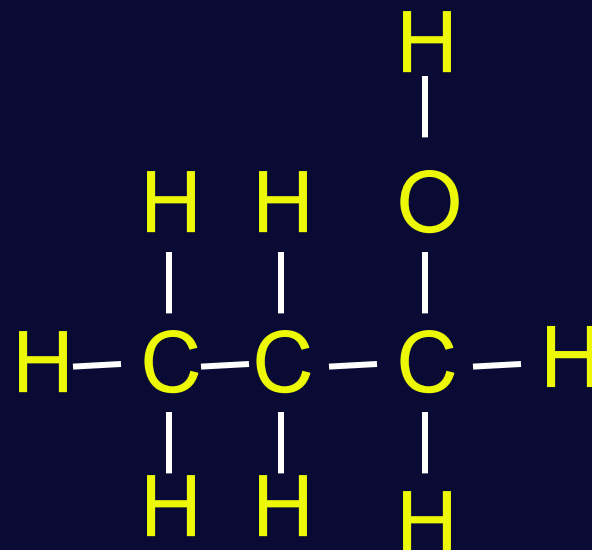
Propan-1-ol
Primary alcohol



Positional isomers



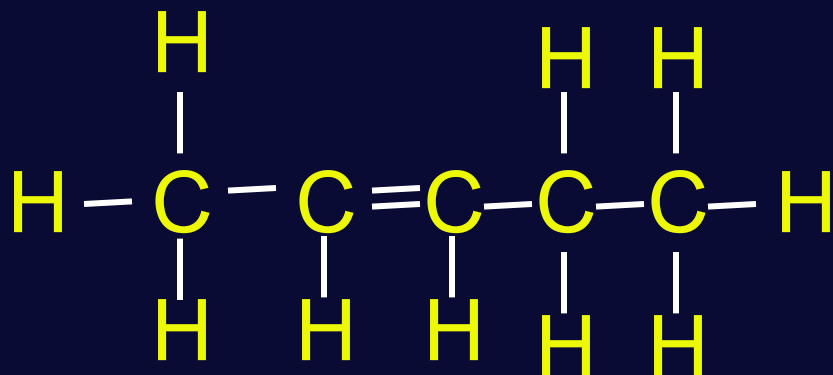
Propan-2-ol
Secondary alcohol



Propan-1-ol
Primary alcohol



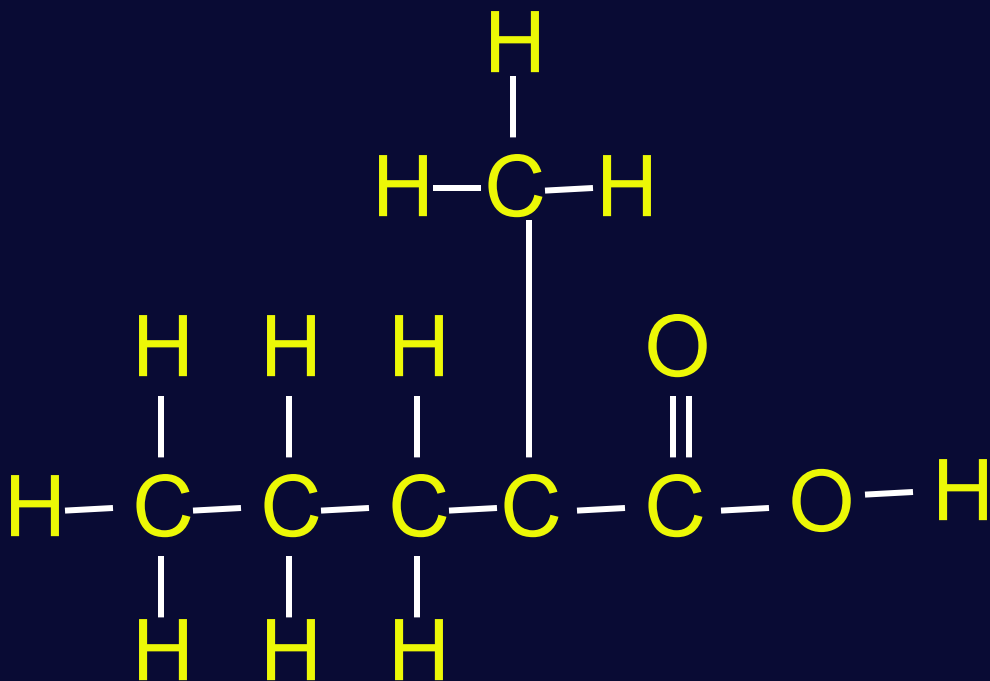
Give the IUPAC-name for the following compound:



pent-2-ene



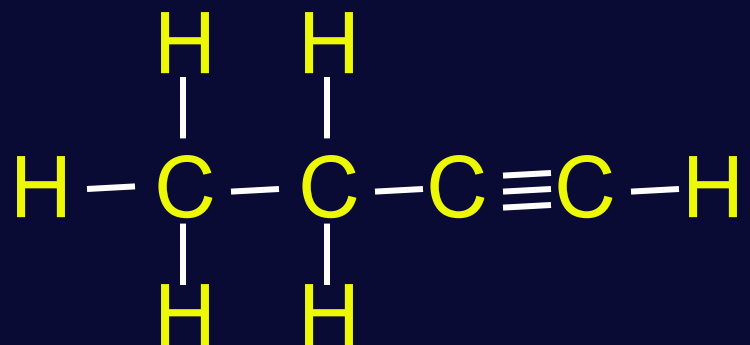
Give the IUPAC-name for the following compound:



2-methylpentanoic acid



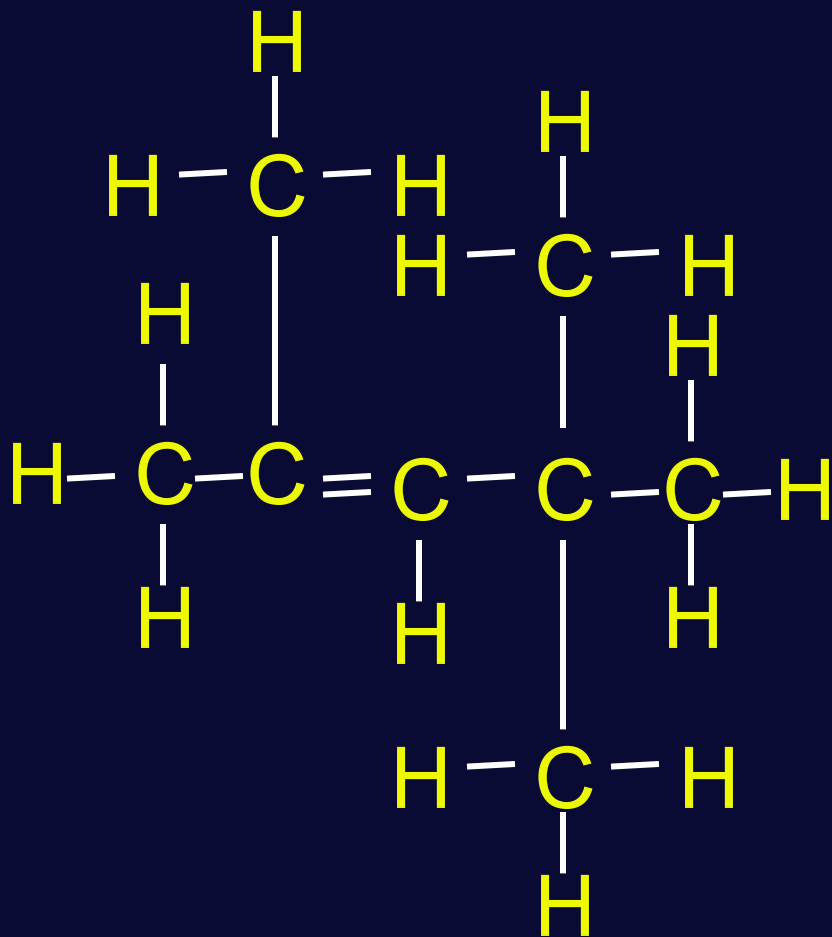
Give the IUPAC-name for the following compound:



But-1-yne

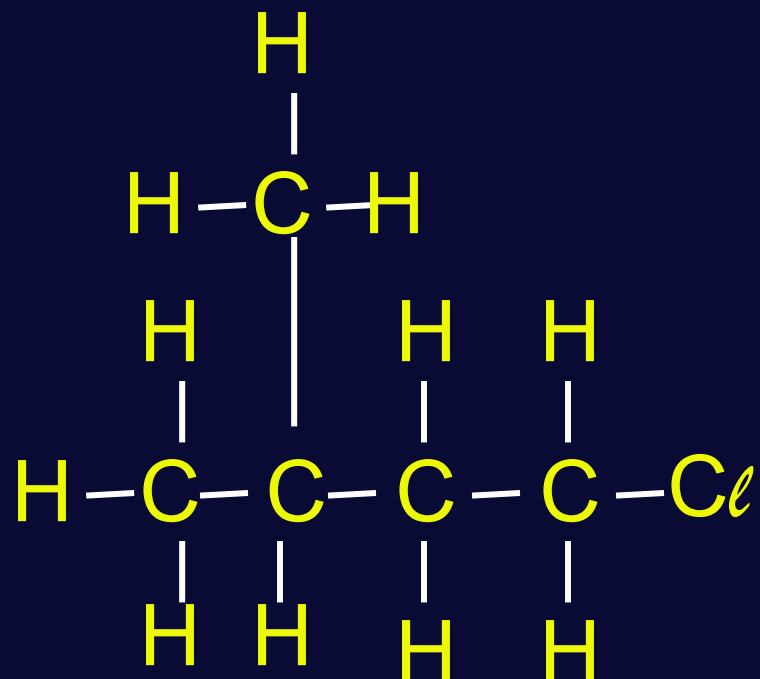


Give the IUPAC-name for the following compound:



2,4,4-trimethylpent-2-ene

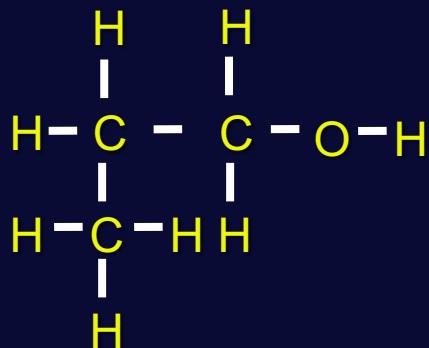
Give the IUPAC-name for the following compound:



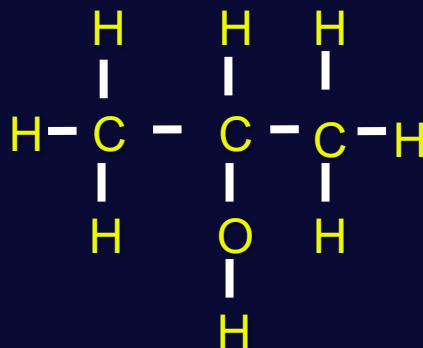
1-chloro-3-methylbutane

Consider the following six organic compounds:

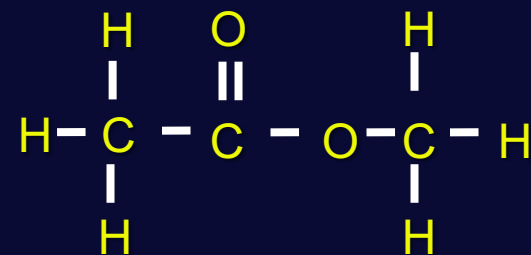
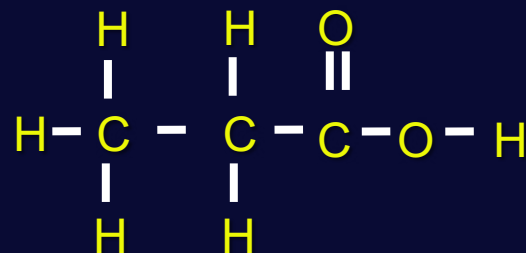
propan-1-ol



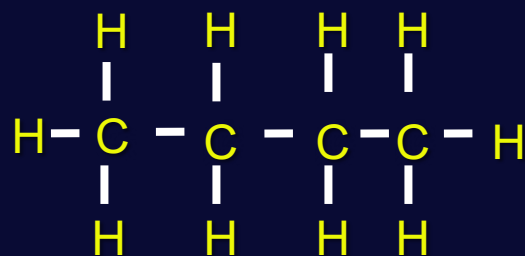
propan-2-ol



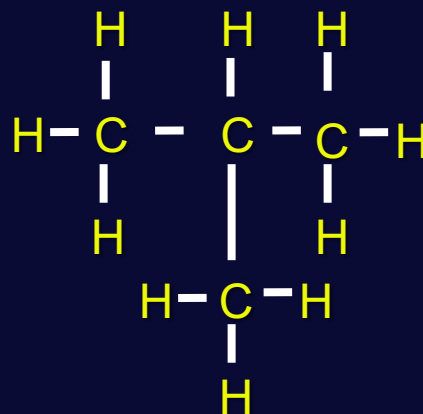
propanoic acid



methyl ethanoate



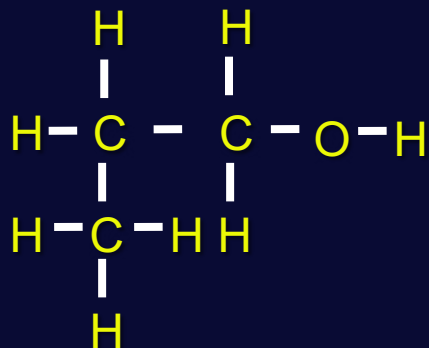
butane



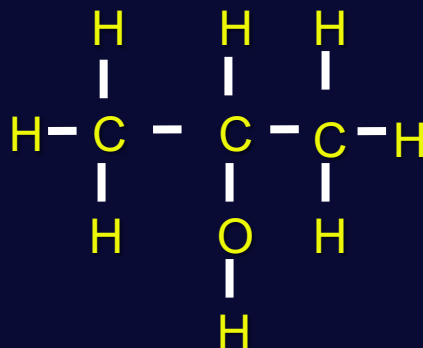
2-methylpropane

Identify two compounds that are chain isomers:

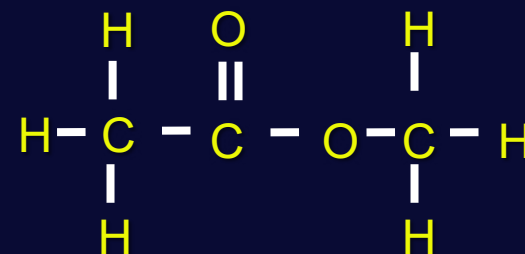
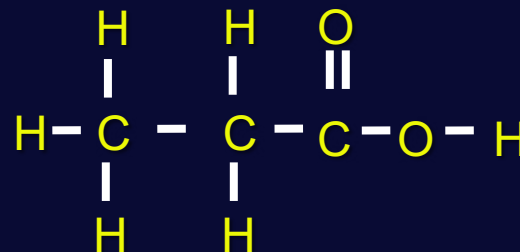
propan-1-ol



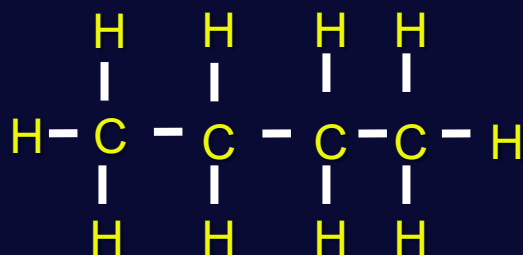
propan-2-ol



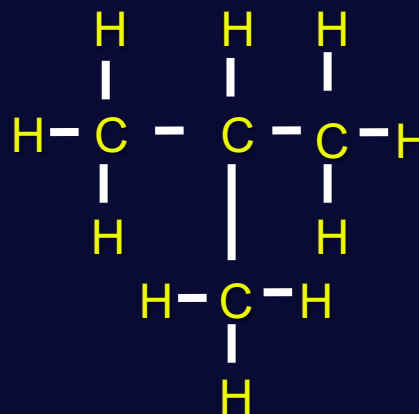
propanoic acid



methyl ethanoate

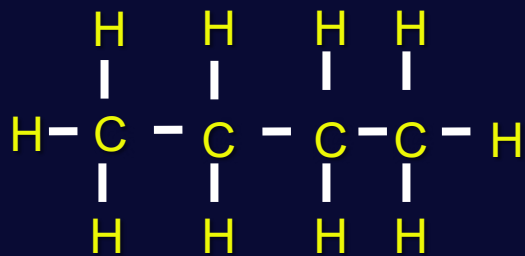


butane

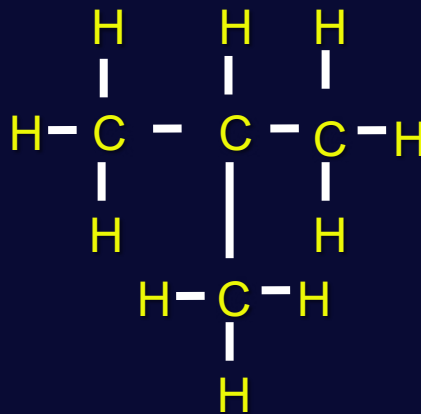


2-methylpropane

Identify two compounds that are chain isomers:



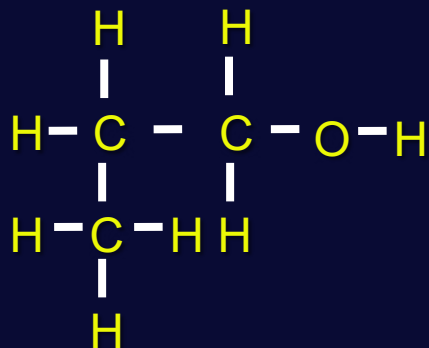
butane



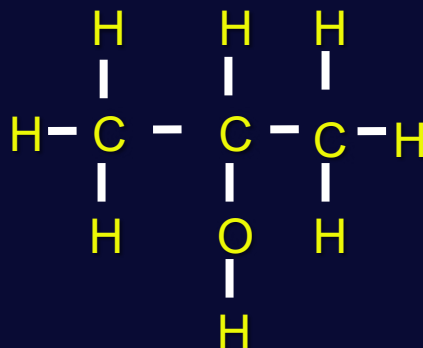
2-methylpropane

Identify two compounds that are functional isomers:

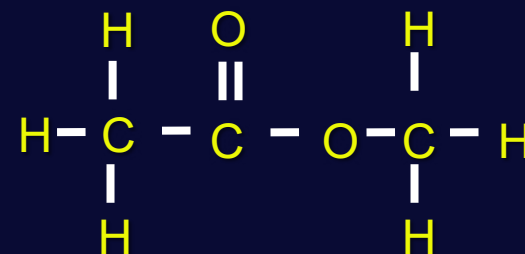
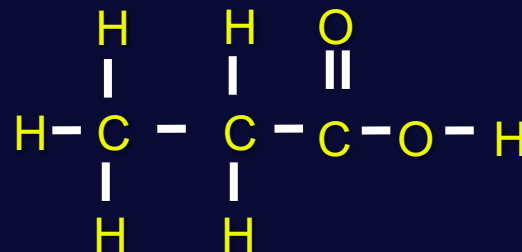
propan-1-ol



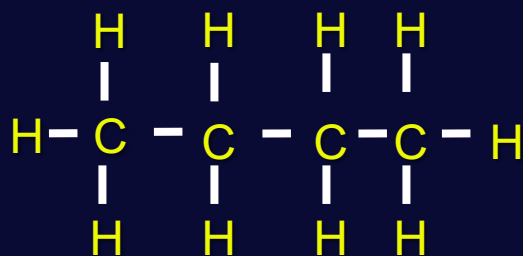
propan-2-ol



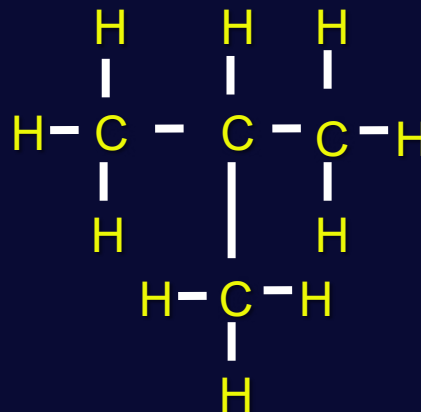
propanoic acid



methyl ethanoate



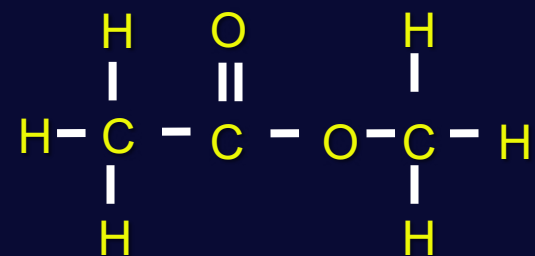
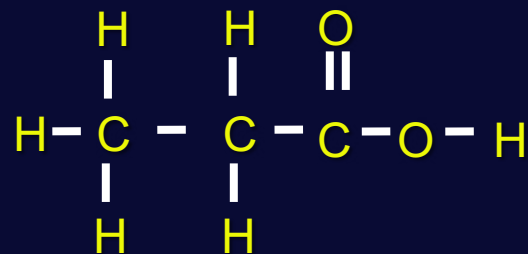
butane



2-methylpropane

Identify two compounds that are functional isomers:

propanoic acid

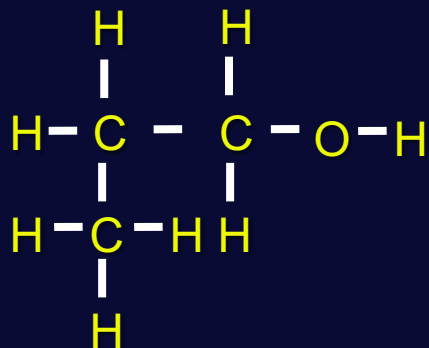


methyl ethanoate

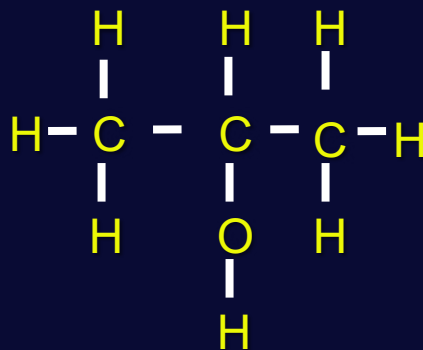


Identify two compounds that are positional isomers:

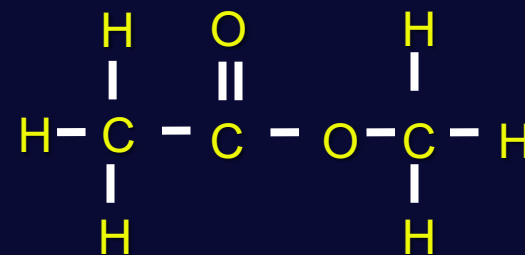
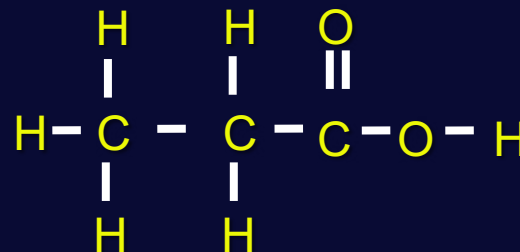
propan-1-ol



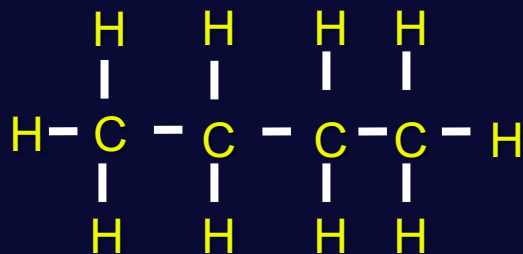
propan-2-ol



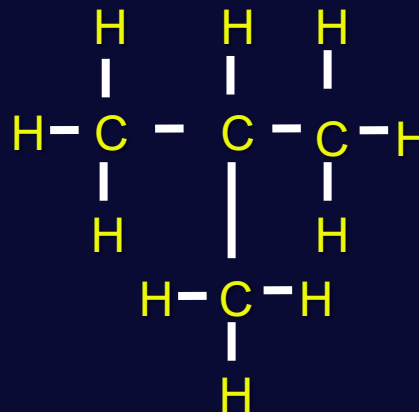
propanoic acid



methyl ethanoate



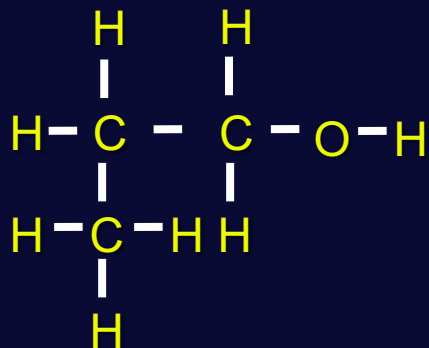
butane



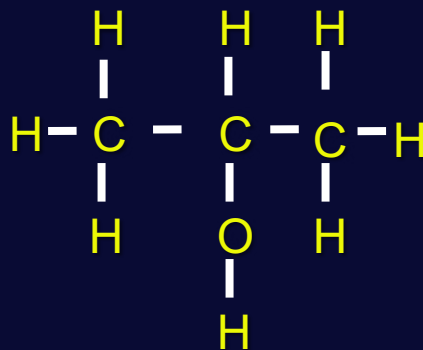
2-methylpropane

Identify two compounds that are positional isomers:

propan-1-ol

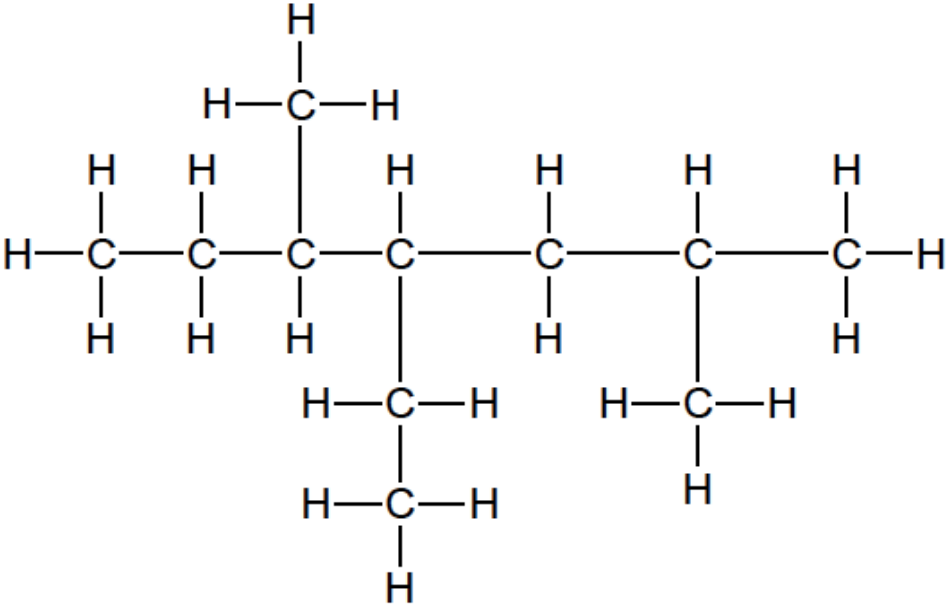
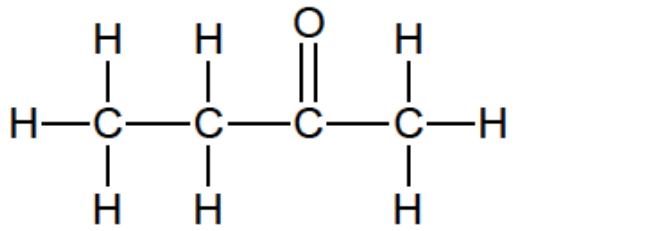
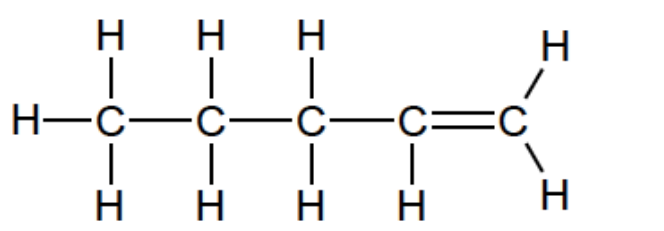


propan-2-ol



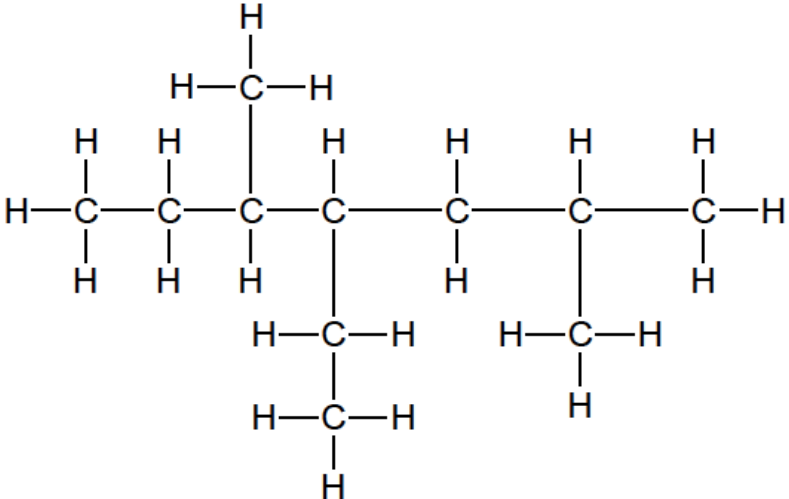
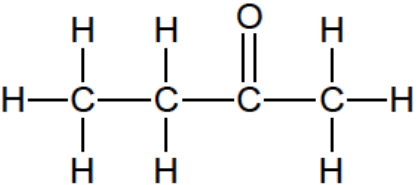
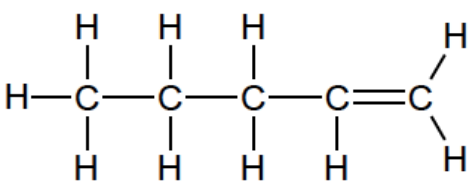
QUESTION 5

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

A	$C_4H_{10}O$	B	 <p>The structure shows a five-carbon main chain. The second carbon from the left has two methyl groups attached. The fourth carbon from the left has one methyl group attached. All other carbon valencies are filled with hydrogen atoms.</p>
C	 <p>The structure shows a four-carbon chain. The third carbon is double-bonded to an oxygen atom and single-bonded to a hydrogen atom, forming a carboxyl group at the end of the chain.</p>	D	 <p>The structure shows a four-carbon chain with a double bond between the first and second carbons from the right.</p>
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.

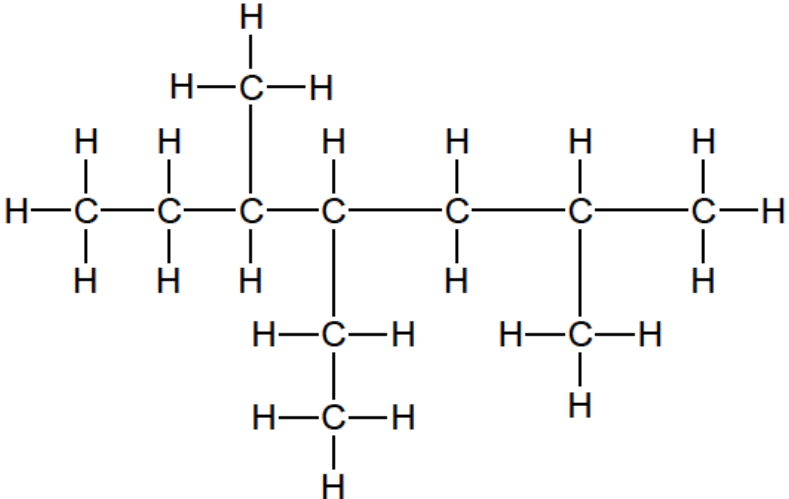
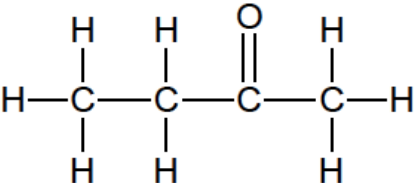
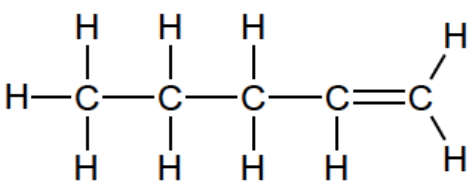
A	$C_4H_{10}O$	B	
C		D	
E	3,4-dimethylpentan-2-ol	F	$CH_3(CH_2)_2COOH$
G	Ethyl ethanoate	H	Pentan-3-one

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

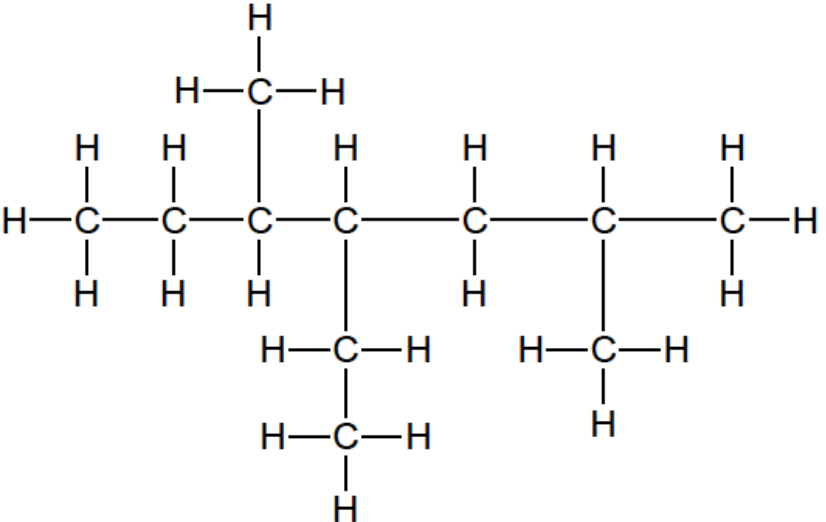
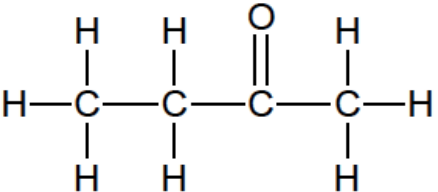
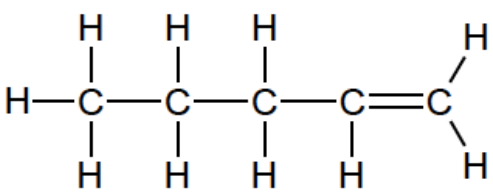
5.2 Write down the following:

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

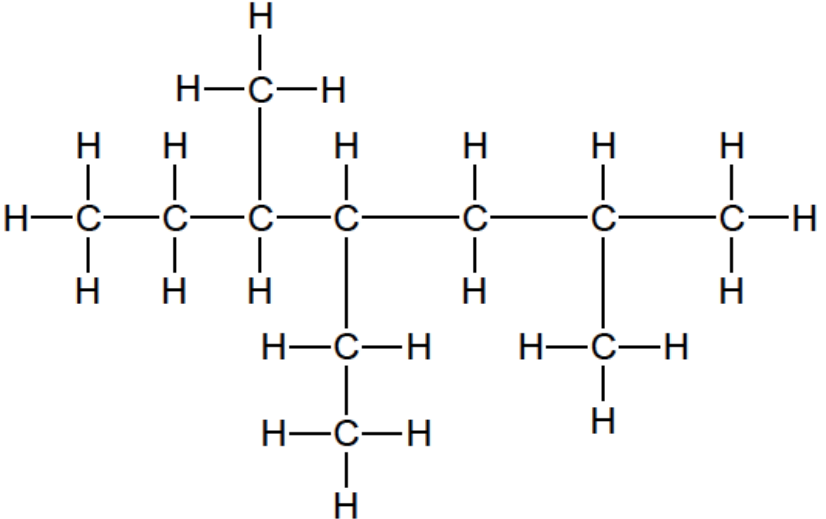
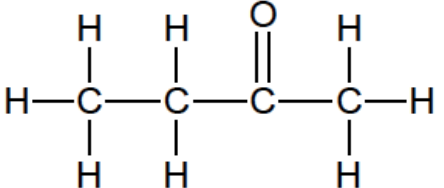
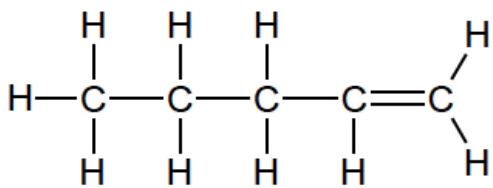
5.2 Write down the following:

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.

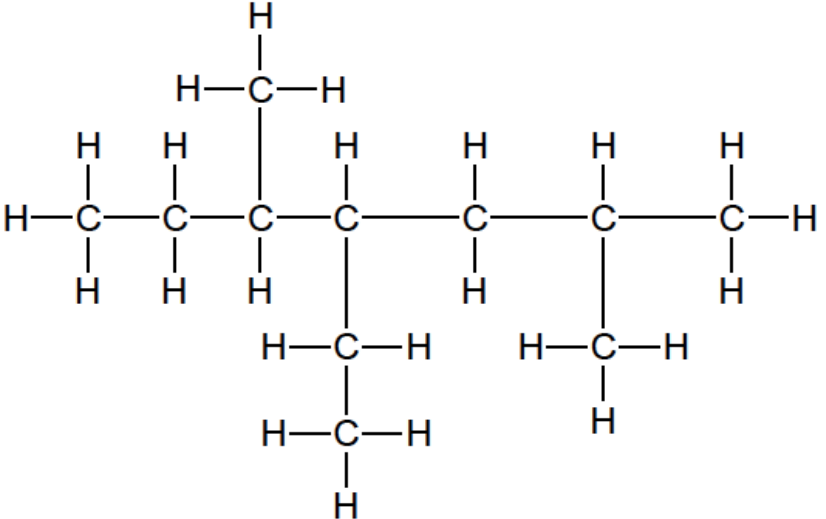
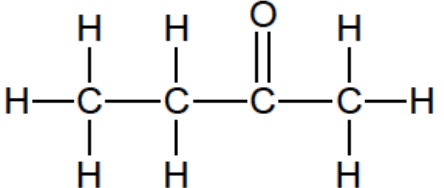
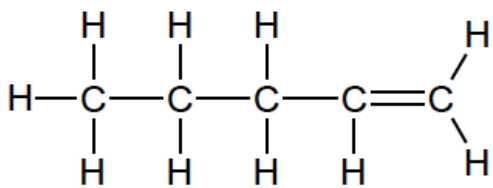
A	$C_4H_{10}O$	B	
C		D	
E	3,4-dimethylpentan-2-ol	F	$CH_3(CH_2)_2COOH$
G	Ethyl ethanoate	H	Pentan-3-one

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

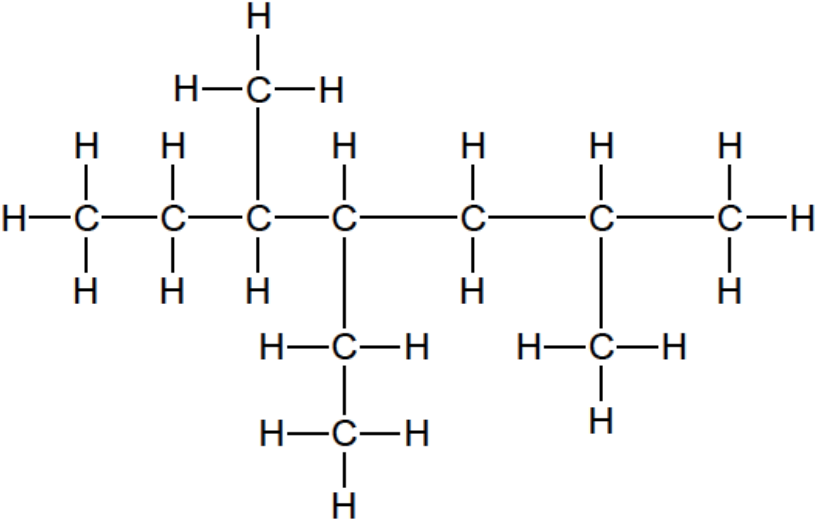
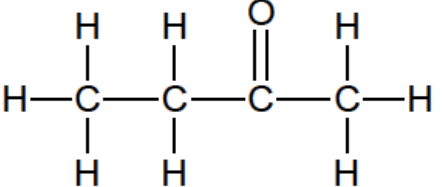
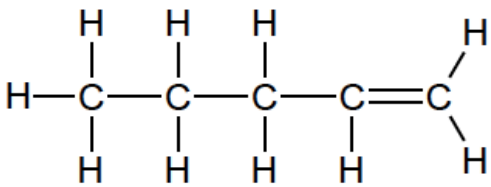
5.2 Write down the following:

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

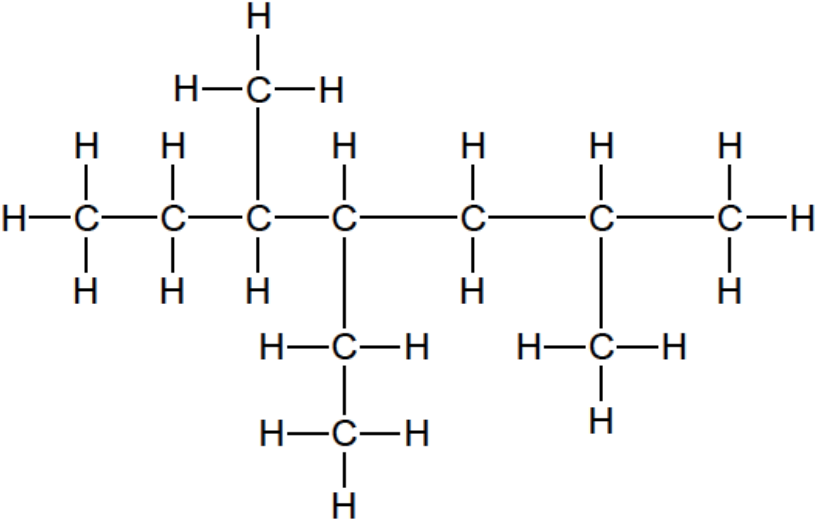
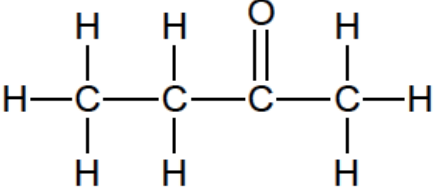
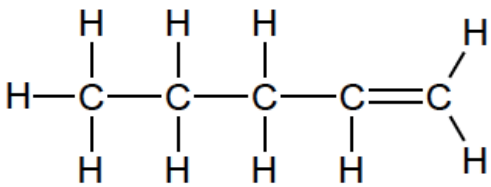
5.2 Write down the following:

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

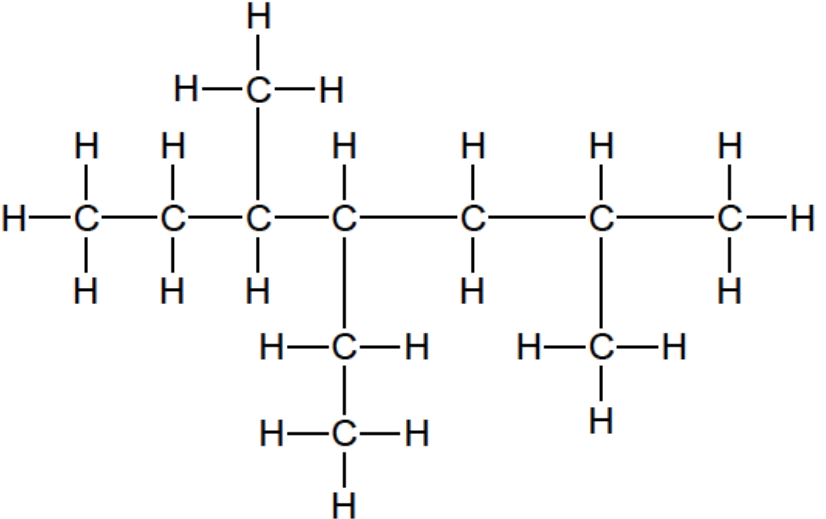
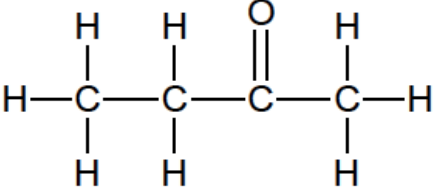
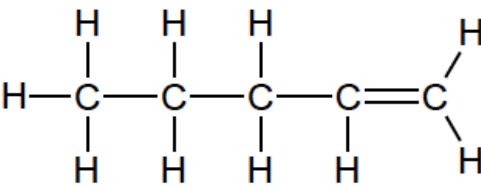
5.4 For compound **E**:

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	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$	138
B	$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$	96
C	$\text{CH}_3\text{CH}_2\text{OH}$	77
D	CH_3OH	64



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 ₃ CH ₂ CH ₂ CH ₂ CH ₂ OH	138
B	CH ₃ CH ₂ CH ₂ OH	96
C	CH ₃ CH ₂ OH	77
D	CH ₃ OH	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.

Compound	Condensed structural formula	Boiling point (°C)
A	CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ OH	138
B	CH ₃ CH ₂ CH ₂ OH	96
C	CH ₃ CH ₂ OH	77
D	CH ₃ OH	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.

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B	$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$	96
C	$\text{CH}_3\text{CH}_2\text{OH}$	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 ₃ CH ₂ CH ₂ CH ₂ CH ₂ OH	138
B	CH ₃ CH ₂ CH ₂ OH	96
C	CH ₃ CH ₂ OH	77
D	CH ₃ OH	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	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$	138
B	$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$	96
C	$\text{CH}_3\text{CH}_2\text{OH}$	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-etiesel-2,5-dimetieselheptaan (3)

Marking criteria / Nasienriglyne:

- Correct stem, i.e. heptane ✓
Korrekte stam, d.i. heptaan
- Substituents (ethyl & methyl) correctly identified. ✓
Substituente/sykettings (etiesel & metiesel) 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)

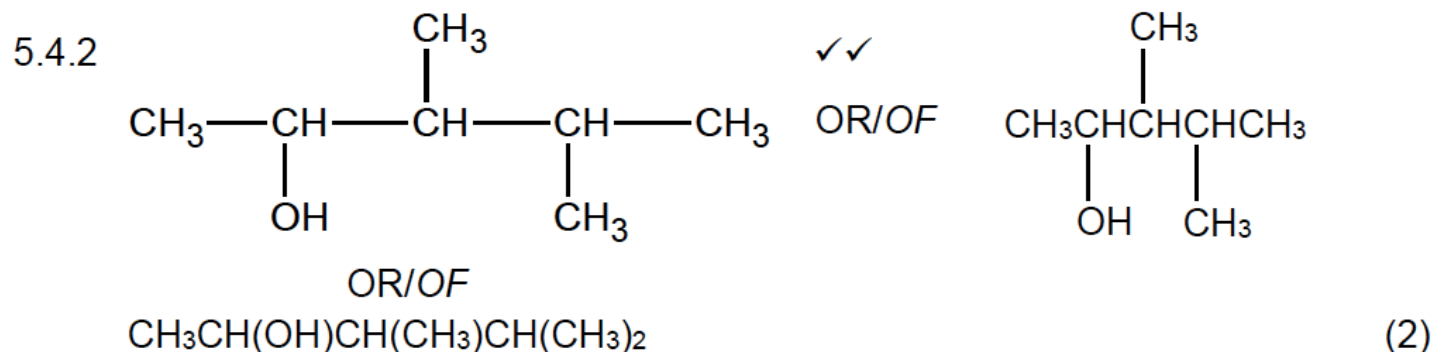
5.2.4 Carbonyl (group) ✓ Karboniel(groep) (1)

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 CH₂ 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)



5.4.3 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 molekule.

(2)
[12]

