

Kirkcaldy High School



Chemistry

National 5

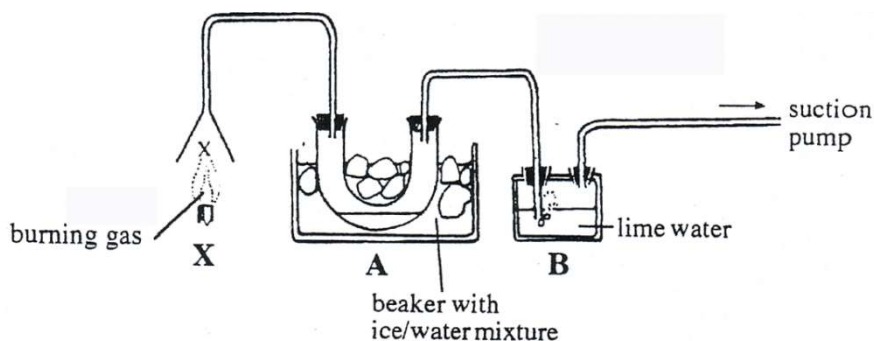
Unit 2 - Nature's Chemistry

TUTORIAL QUESTIONS

(a) Homologous series

(i) Systematic Carbon Chemistry

1. State the definition of
 - (a) Hydrocarbon
 - (b) Homologous series
2. You are given three unlabelled gas jars. Each gas jar contains one of the following gases: oxygen, hydrogen or carbon dioxide. Describe how to find out which gas is contained in each gas jar.
3. Natural gas is a good fuel. Complete combustion of the fuel results in an exothermic reaction producing carbon dioxide and water.
 - (a) What elements must be present in natural gas?
 - (b) What gas in the air is required for complete combustion?
4. A liquid X is made of only 2 elements. It burns to produce 2 products. One is a colourless liquid which freezes at 0°C and boils at 100°C ; the second turns limewater a milky colour.



- (a) Name the 2 products.
 - (b) Name the 2 elements present in element X.
 - (c) What type of substance is liquid X?
5. When coal is burned, the acidic gas sulphur dioxide is produced.
 - (a) What element must be present in the coal?
 - (b) Write the chemical formula for sulphur dioxide.
 - (c) What environmental problem is caused by sulphur dioxide being released into the atmosphere?

6. Some oil was fractionally distilled in a laboratory fume cupboard and the fractions obtained were:

Fraction	Temperature range (°C)
A	<40
B	40-75
C	150-240
D	220-250
E	250-350

(a) What fraction do you think would:

- (i) have the biggest molecules
- (ii) be the most flammable
- (iii) is most viscous (think and gloopy)?

(b) How do the size of molecules in a fuel affect

- (i) flammability?
- (ii) viscosity?

7. Crude oil contains a mixture of chemicals. The table compares the composition of a sample of crude oil from the North sea with one from an oil field in the Middle East.

Chemicals	% of chemicals in two samples of oil	
	North sea crude	Middle East crude
Gases	7	6
Petrol	20	14
Kerosene and diesel	30	25
Residue	43	55

- (a) Use the information in the table to suggest one reason why North Sea crude oil might be more useful than Middle East crude oil for modern day needs.
- (b) Name the process used to separate the different chemicals in crude oil.

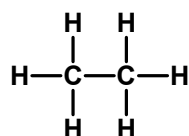
(ii) Alkanes, Alkenes, and Cycloalkanes

1. State the definitions of

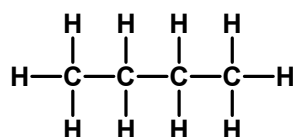
- (a) saturated
- (b) unsaturated
- (c) isomers

2. Name the following alkanes

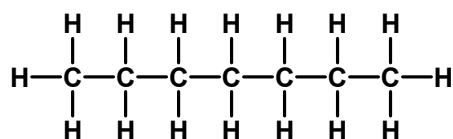
(a)



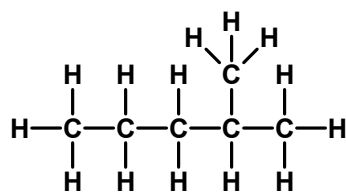
(b)



(c)



(d)



3. Name the straight-chain alkanes that contain

- (a) 1 carbon atom
- (b) 3 carbon atoms.
- (c) 6 carbon atoms
- (d) 8 carbon atoms

4.

(a) Write the general formula for the alkanes.

(b) Give the molecular formula for each of the following

(i) an alkane with 4 carbon atoms

(ii) an alkane with 1 carbon atom

(iii) an alkane with 8 carbon atoms

(c) Draw a possible structural formula for the above compounds.

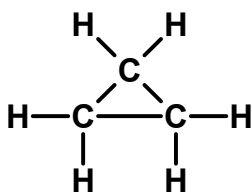
5. Draw a possible structural formula for an alkane with the molecular formula

(a) C_2H_6

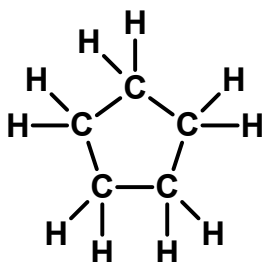
(b) C_4H_{10}

6. Name the following cycloalkanes

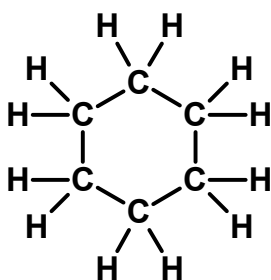
(a)



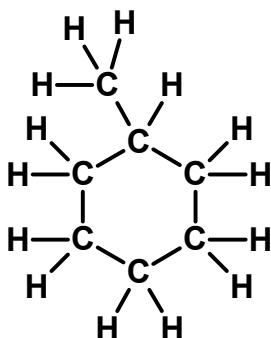
(b)



(c)



(d)



7. Name the non-branched cycloalkanes that contain

(a) 4 carbon atoms

(b) 7 carbon atoms.

(c) 8 carbon atoms

8.

(a) Write the general formula for the cycloalkanes.

(b) Give the molecular formula for each of the following

(i) a cycloalkane with 4 carbon atoms

(ii) a cycloalkane with 3 carbon atom

(iii) a cycloalkane with 8 carbon atoms

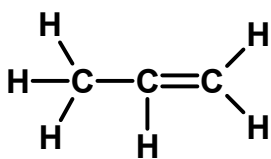
9. Draw a possible structural formula for a cycloalkane with the molecular formula

(a) C_5H_{10}

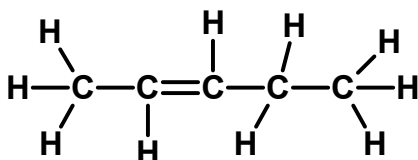
(b) C_7H_{14}

10. Name the following alkenes

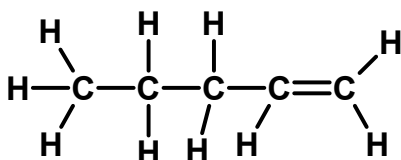
(a)



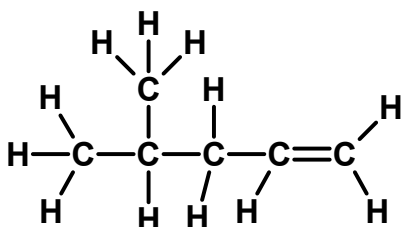
(b)



(c)



(d)



11. Name a possible straight-chain alkene that contains

- (a) 2 carbon atoms
- (b) 4 carbon atoms
- (c) 7 carbon atoms.
- (d) 8 carbon atoms

12.

- (a) Write the general formula for the alkenes.
- (b) Give the molecular formula for each of the following

- (i) an alkene with 4 carbon atoms
- (ii) an alkene with 3 carbon atom
- (iii) an alkene with 8 carbon atoms

13. Draw a possible structural formula for an alkene with the molecular formula

- (a) C_5H_{10}
- (b) C_7H_{14}

14. Write the molecular formula for

- (a) the sixth member of the alkane series.
- (b) The cycloalkane with 5 carbon atoms.
- (c) The fourth member of the alkene series
- (d) An alkene with a total of 27 atoms.

15. Page 9 of the data book contains a list of hydrocarbons and their melting/boiling points.

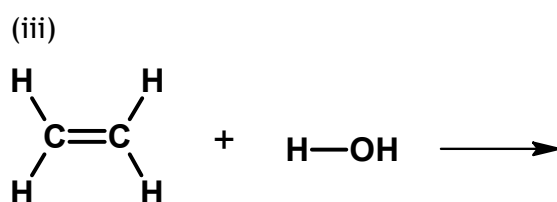
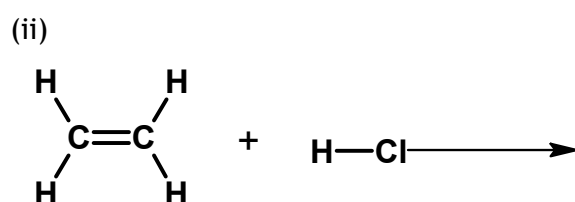
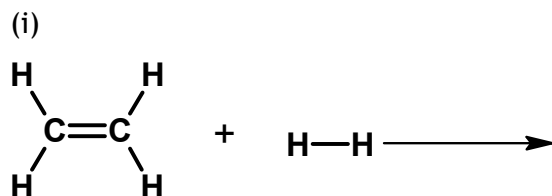
- (a) State the boiling point of methane
- (b) State the melting point of propane
- (c) State the boiling point of 2-methylpropene
- (d) Complete this sentence by selecting the correct word

As the molecular size increases, the boiling point $\begin{cases} \text{increases} \\ \text{decreases} \end{cases}$

- (e) Explain why pentane has a higher melting than propane.

16.

- (a) State the two homologous series that have the same general formula.
- (b) State a chemical test, including the result, that could be used to distinguish these homologous series.
- (c) State the name of this type of chemical reaction.
- (d) Draw a structural formula of the product for each of these reactions.



- (e) Name the type of addition reaction in (d)(i) and (d)(iii).

17.

- (a) Explain the meaning of the term “isomer”.
- (b) Draw two isomers with the chemical formula C_4H_{10}
- (c) Draw two isomers with the chemical formula C_3H_6 , one of which is saturated and the other unsaturated.
- (d) Explain the meaning of the term “saturated” and “unsaturated.”

18. C_4H_8 could be two different types of hydrocarbon. Name the homologous series of hydrocarbons they could belong to and draw two possible structures

19. One of the first anaesthetics to be used was chloroform (CHCl_3). The table below shows the anaesthetic effect of methane and some chlorine compounds (like chloroform) which was based on methane.

Compound	Anaesthetic effect
CH_4	None
CH_3Cl	Weak
CH_2Cl_2	Moderate
CHCl_3	Strong

- (a) Using the information in the table, what general statement can be made about the compounds and their anaesthetic effect?
- (b) Methane can be made to react with chlorine gas to give chloroform and hydrogen chloride. Use symbols and formulae to write an equation for this reaction.

20. Class 3^{Ch3}, were studying hydrocarbons. Here are some statements from the pupils' notes.

A	It has no isomers
B	It has the general formula C_nH_{2n}
C	It contains only single carbon to carbon bonds.
D	It is a hydrocarbon

- (a) which statement can be applied to both butane and cyclobutane? (2 boxes)
- (b) which statement can be applied to propane but not to butane (1 box)

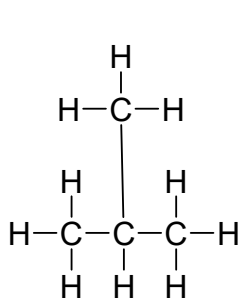
21. Draw a structural formula for

- (a) Propene
- (b) cyclopropane
- (c) butane
- (d) ethene

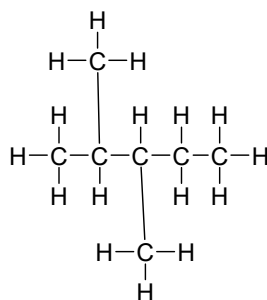
22. Write the names for

- (a) $\text{CH}_3\text{CH}_2\text{CH}=\text{CHCH}_2\text{CH}_3$
- (b) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}=\text{CH}_2$

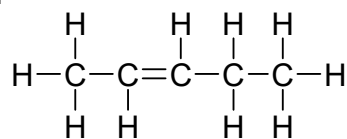
23. Write the molecular formula for the following hydrocarbons.



(a)



(b)



(c)

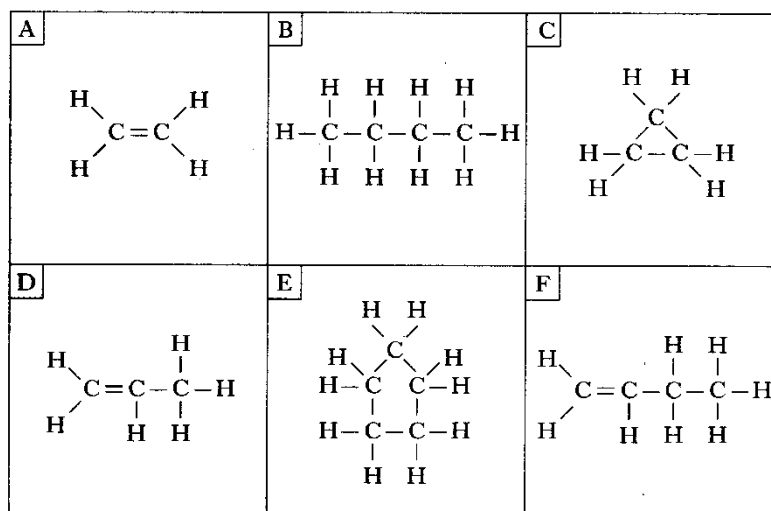
24. Each box in the grid below shows the name or the formula of a compound

<p>A</p> $ \begin{array}{c} \text{H} \\ \\ \text{H} - \text{C} - \text{H} \\ \\ \text{H} \end{array} $	<p>B</p> <p>butane</p>	<p>C</p> <p>cyclopentane</p>
<p>D</p> <p>ethene</p>	<p>E</p> $ \begin{array}{c} \text{H} & & \text{H} \\ & & \\ \text{H} - \text{C} & - \text{C} = \text{C} \\ & & \\ \text{H} & \text{H} & \text{H} \end{array} $	<p>F</p> <p>cyclopropane</p>

Identify the box(es) which show

- (a) an alkene (2 boxes)
- (b) an alkane (2 boxes)
- (c) an isomer of box E

25.



- (a) Identify the hydrocarbon which reacts with hydrogen to form butane.
- (b) Identify the 2 isomers.
- (c) Identify the hydrocarbon(s) which is (are) the first member(s) of a homologous series.

26.

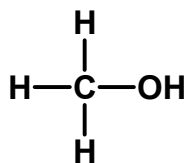
<p>A</p> <pre> H H H H H - C - C - C - C - H H H H H </pre>	<p>B</p> <pre> H H C = C - C - H H CH₃ H </pre>	<p>C</p> <pre> H H H - C - C - H H - C - C - H H H </pre>
<p>D</p> <pre> H H H H C = C - C - C - H H H H </pre>	<p>E</p> <pre> H H \ / C - C - H / \ H H </pre>	<p>F</p> <pre> H H H H - C - C - C - H H CH₃ H </pre>

- (a) Identify the 2 hydrocarbons which would quickly decolourise bromine solution.
- (b) Identify the isomer of the hydrocarbon in box D which belongs to a different homologous series.

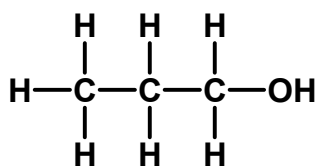
(b) Everyday Consumer Products

1. Name the following alcohols

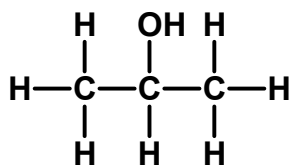
(a)



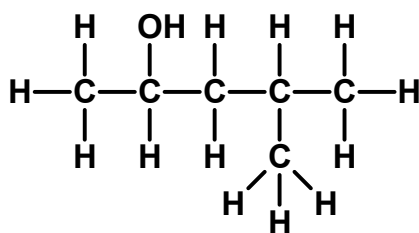
(b)



(c)



(d)



2. Name a straight-chain alcohol that contains

- (a) 2 carbon atoms
- (b) 4 carbon atoms.
- (c) 7 carbon atoms
- (d) 8 carbon atoms

3.

(a) Write the general formula for the alcohols.

(b) Give the molecular formula for each of the following

(i) an alcohol with 4 carbon atoms

(ii) an alcohol with 1 carbon atom

(iii) an alcohol with 8 carbon atoms

(c) Draw a possible structural formula for the above compounds.

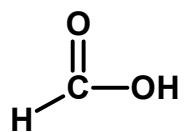
4. Draw a possible structural formula for an alcohol with the molecular formula

(a) $\text{C}_2\text{H}_5\text{OH}$

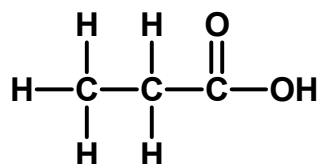
(b) $\text{C}_4\text{H}_9\text{OH}$

5. Name the following carboxylic acids

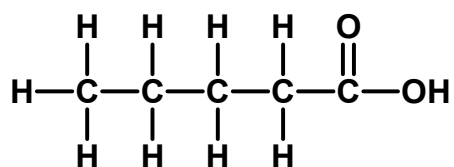
(a)



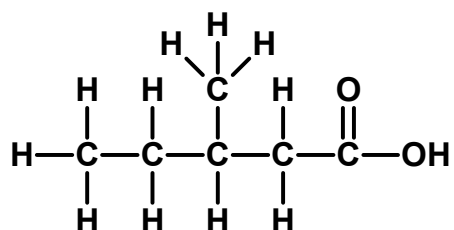
(b)



(c)



(d)



6. Name a straight-chain carboxylic acid that contains

- (a) 2 carbon atoms
- (b) 4 carbon atoms.
- (c) 7 carbon atoms
- (d) 8 carbon atoms

7.

(a) Write the general formula for the carboxylic acid.

(b) Give the molecular formula for each of the following

(i) a carboxylic acid with 4 carbon atoms

(ii) a carboxylic acid with 1 carbon atom

(iii) a carboxylic acid with 8 carbon atoms

(c) Draw a possible structural formula for the above compounds.

8. Draw a possible structural formula for a carboxylic acid with the molecular formula

(a) $\text{C}_2\text{H}_5\text{COOH}$

(b) $\text{C}_4\text{H}_9\text{COOH}$

9.

(a) Name the two products formed when a carboxylic acid reacts with a base.

(b) State the name of the salt formed from these reactions

(i) Sodium hydroxide and ethanoic acid

(ii) Potassium hydroxide and propanoic acid

(iii) Lithium and butanoic acid

10. Draw a structural formula for the following compounds:

(a) propan-1-ol

(b) 2,2 dimethylhexane

(c) ethanol

(d) butanoic acid

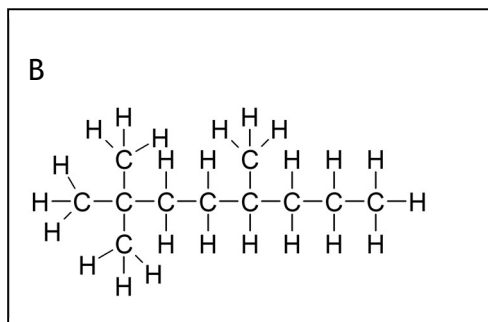
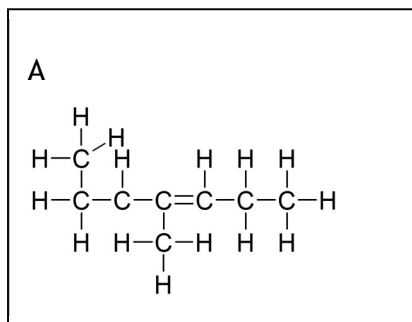
(e) propanoic acid

11. Draw a structural formula for

(a) 2,2-dimethylpentane

(b) 2-methyl-3-ethylhexane.

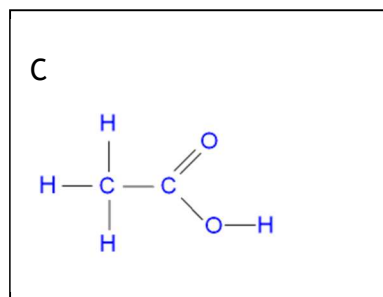
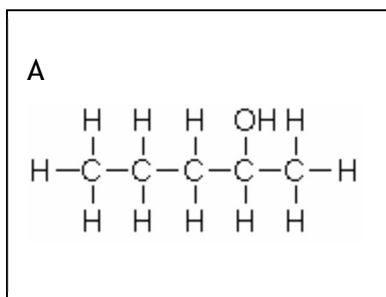
12. Give the systematic name for the following hydrocarbons:



13. Which of the following compounds is not an isomer of heptane?

- A 2,3-dimethylbutane
- B 2,3-dimethylpentane
- C 2,2-dimethylpentane
- D 2-methylhexane

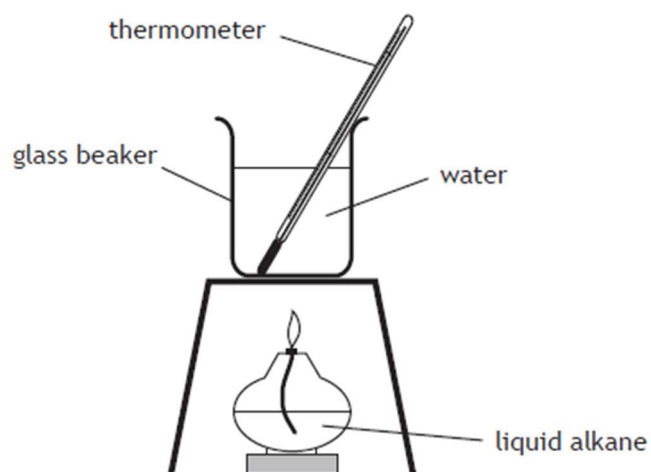
14. Name the following compounds



(c) Energy from Fuels

1. In one experiment the burning of ethanol, resulted in the temperature of 400cm^3 of water rising from $14.2\text{ }^{\circ}\text{C}$ to $31.6\text{ }^{\circ}\text{C}$. Use the information to calculate the energy released during the reaction.
2. Ammonium chloride was dissolved in 200 cm^3 of water and the temperature of the solution fell from $23.2\text{ }^{\circ}\text{C}$ to $19.8\text{ }^{\circ}\text{C}$. Calculate the energy released for the reaction.
3. Methanol, CH_3OH , is burned and the heat energy given out increased the temperature of 100 g of water from $22\text{ }^{\circ}\text{C}$ to $32\text{ }^{\circ}\text{C}$. Calculate the energy released.
4. Ammonium nitrate, NH_4NO_3 , is dissolved in 200 cm^3 of water. The temperature of the water falls from $20\text{ }^{\circ}\text{C}$ to $17.1\text{ }^{\circ}\text{C}$. Calculate the energy released for this reaction.
5. When KCl is dissolved in water the energy released is $+16.75\text{ kJ mol}^{-1}$. Calculate the temperature change when this reaction is used to heat 150 cm^3 of water.

6. A student investigated the amount of energy released when an alkane burns using the apparatus shown.



The student recorded the following data.

Mass of alkane burned	1 g
Volume of water	200 cm ³
Initial temperature of water	15 °C
Final temperature of water	55 °C

- (a) Calculate the energy released, in kJ. **Show your working clearly.**
- (b) Suggest a way in which the experiment could be improved.