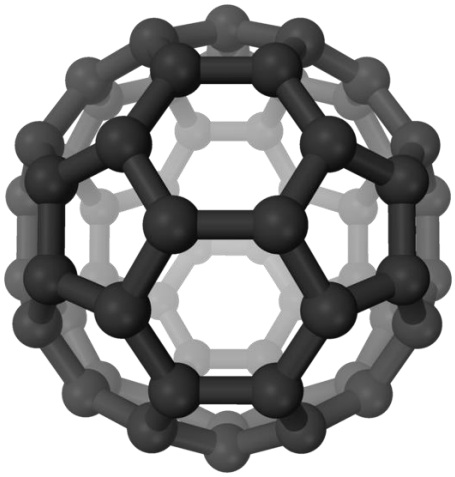
National 4/5 Chemistry



Homework

Unit 2 – Nature's Chemistry

Please do not write on these booklets – questions should be answered in homework jotters.

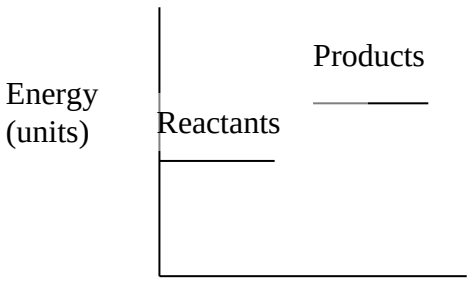
Part 1 – Introduction to Unit 2

1. 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.

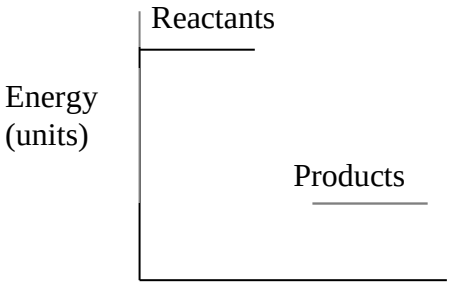
2. Natural gas is a good fuel. Complete combustion of the fuel results in an **exothermic** reaction producing carbon dioxide and water.

   (a) What elements must be present in natural gas?
   (b) What gas in the air is required for complete combustion?
   (c) Which graph below (A) or (B) would best represent this reaction?

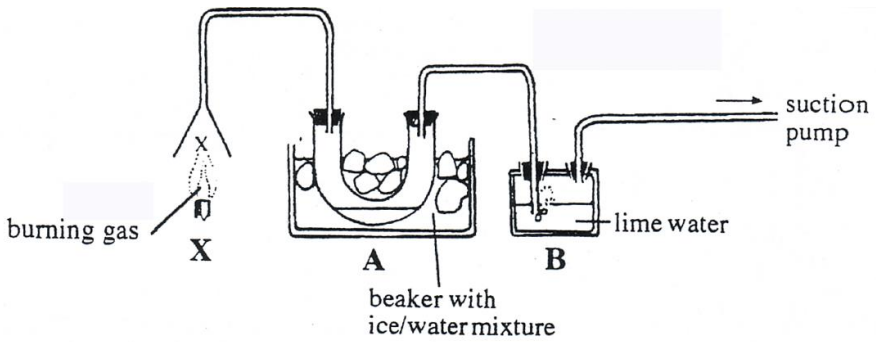
Graph A



Graph B



3. 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?

4. Nitrogen is unreactive, yet nitrogen dioxide is formed in a car's engine.

   (a) Explain how nitrogen dioxide is formed in a car engine.
   (b) What does a catalytic convertor change nitrogen dioxide to?
   (c) What metal element is used in a catalytic convertor?

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. Crude oil is a mixture of **chemical compounds**. Before the compounds can be used, the crude oil must be separated into fractions.

(a) Name the type of compounds found in crude oil.
(b) Explain what is meant by a fraction.
(c) Describe how crude oil is separated into its fractions.

7. The following questions refer to properties of fractions, collected over the temperature ranges shown:

Fraction	Temperature range (^{0}C)
1	**<40**
2	**40-75**
3	**150-240**
4	**220-250**
5	**250-350**

Decide whether each of the following statements about the fractions is **TRUE** or **FALSE.**
(a) Fraction 3 is more viscous than fraction 5
(b) Fraction 2 changes to a gas more readily than 4
(c) Fraction 3 is less flammable than fraction 4.
(d) Fraction 5 is thicker than fraction 3.
(e) Fraction 1 has a higher boiling point than fraction 5.
(f) Fraction 2 burns more easily than fraction 5

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

Fraction	Temperature range (^{0}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?
(b) How do the size of molecules in a fuel affect (i) flammability?
(ii) viscosity?

9. 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.

Part 2 – Carbon Compounds

(a) Alkanes, Alkenes, Cycloalkanes and Reactions

1. Name the alkanes that contain

(a) 1 carbon atom and (b) 4 carbon atoms.

2 .

(a) Write the general formula for the alkanes.
(b) Give the molecular formula for each of the following (i) butane (ii)methane (iii) octane
(c) Draw the full structural formula for the above compounds.

3. Write the shortened structural formula for (a) C_2H_6 (b) C_4H_{10}

4. Write the general formula for the cycloalkanes.

5. Draw the (i) full structural formula (ii) molecular formula for

(a) cyclopropane
(b) cyclopentane

6. Write the general formula for the alkenes.

7. Name the alkene with the number of C atoms stated (a) 3 (b) 5 (c) 6

8. Draw the (i) full structural formula (ii) molecular formula for

(a) Propene
(b) butene

9. 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 27atoms.

10.

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

11. 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

12. 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 CH_3Cl CH_2Cl_2 $CHCl_3$	None Weak Moderate 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.

13. Class 3H, 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)

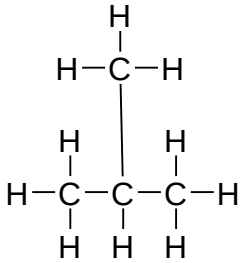
14. Draw the extended structural formula for

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

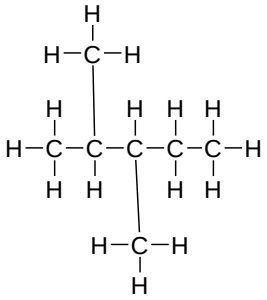
15. Write the names for

(a) $CH_3\ CH_2\ CH{=}\ CH\ CH_2\ CH_3$ (b) $CH_3\ CH_2\ CH_2\ CH{=}\ CH_2$

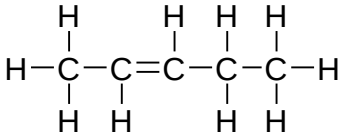
16. Write the molecular formula for the following hydrocarbons.



(a)

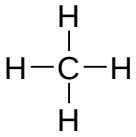
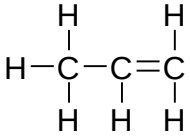


(b)



(c)

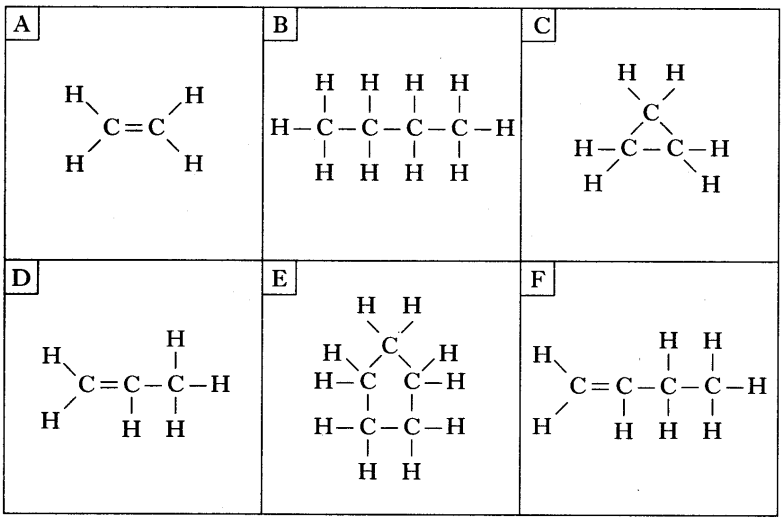
17. Each box in the grid below shows the name or the formula of a compound

A 	B butane	C cyclopentane
D ethene	E 	F cyclopropane

Identify the box(es) which show

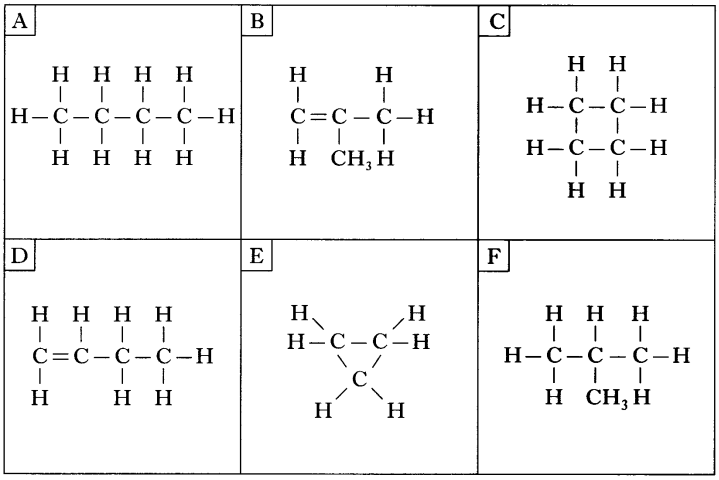
(a) an alkene (2 boxes) (b) an alkane (2 boxes) (c) an isomer of box E

18.



(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.

19.



(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) <u>Alkanols, Alkanoic Acids, Esters and Reactions</u>

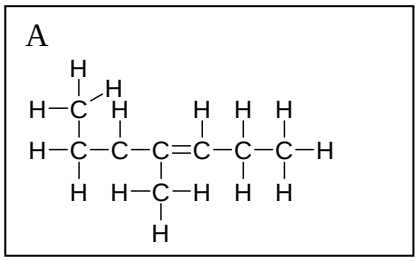
1. (a) Draw full structural formula for the following compounds:

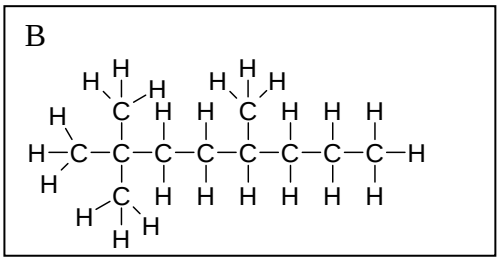
(i) propan-1-ol
(ii) 2,2 dimethylhexane
(iii) ethanol
(iv) methyl ethanoate
(v) butanoic acid
(vi) butyl propanate
(vii) the product of the reaction between (iii) and (v)
(viii) propanoic acid

2. Draw full structural formula for

(a) 2,2-dimethylpentane (b) 2-methyl-3-ethylhexane.

2. Give the systematic name for the following hydrocarbons:



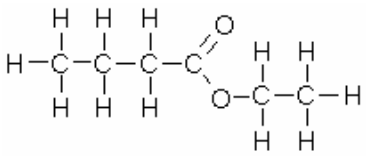


3. Which of the following compounds is **not** an isomer of heptane?

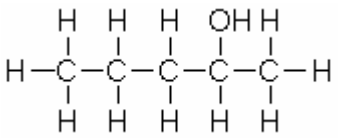
(a) 2,3-dimethylbutane (b) 2,3-dimethylpentane
(c) 2,2-dimethylpentane (d) 2-methylhexane

4. Name the following compounds

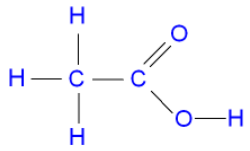
A



B



C



5. When making the ester ethyl butanoate, an alcohol and carboxylic acid are added, along with a catalyst.

(a) Draw a labelled diagram to show how an ester can be made in the lab.

(b) Name the catalyst used.

(c) Explain why a water bath must be used for heating rather than a Bunsen burner.

6. Describe 2 uses of esters and explain why esters are useful for these purposes.

(c) Fermentation and Distillation

1.

(a) Name the two products formed from the fermentation of glucose.
(b) Zymase is the enzyme used for fermentation. Where is it found?
(c) How is the alcohol, ethanol, separated from the fermentation mixture?
(d) Why is this method suitable for separating alcohol from water?
(e) Explain why the maximum percentage of alcohol obtained by fermentation is never more than about 15%.
(f) What method is used to increase the % of alcohol in high strength alcoholic drinks?

(c) Calculations: Enthalpy and Reacting Quantities

Reacting Quantities:

1.

Using the balanced equation: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
Calculate the mass of carbon dioxide formed when 70g of methane reacts with excess oxygen.

2.

Using the balanced equation: $C_2H_6 + 3O_2 \rightarrow 2CO_2 + 3H_2O$
Calculate the mass of oxygen required to react with 100g of ethane.

3.

Using the balanced equation: $N_2 + 2O_2 \rightarrow N_2O_4$

Calculate the mass of dinitrogen tetroxide formed when 400kg of nitrogen is reacted with excess oxygen.

4.

Using the balanced equation: $H_2 + Cl_2 \rightarrow 2HCl$
Calculate the mass of chlorine required to react with 400g of hydrogen.

5.

Using the balanced equation: $H_2 + Cl_2 \rightarrow 2HCl$
Calculate the mass of hydrogen required to react with 355g of chlorine.

6. $C + O_2 \rightarrow CO$

Calculate the mass of CO produced when excess C is burned in 64g of oxygen

7. $S + O_2 \rightarrow SO_2$

Calculate the mass of sulphur dioxide formed when 300tonnes of sulphur is reacted with excess oxygen.

8. $Li + H_2O \rightarrow LiOH$

Calculate the mass of water needed to react with 350kg of Li.

<u>Enthalpy:</u>

1. In one experiment the burning of 0.980g of ethanol, resulted in the temperature of 400cm^3 of water rising from 14.2^oC to 31.6^oC.

Use the information to calculate the energy released during the reaction.

2.

A student dissolved 10.0g of ammonium chloride in 200cm^3 of water and found that the temperature of the solution fell from 23.2^oC to 19.8^oC.

Calculate the enthalpy change for the reaction.

3.

0.19 g of methanol, CH_3OH, is burned and the heat energy given out increased the temperature of 100g of water from 22^oC to 32^oC.

Calculate the enthalpy change.

4.

8g of ammonium nitrate, NH_4NO_3, is dissolved in 200cm^3 of water. The temperature of the water falls from 20^oC to 17.1^oC.

Calculate the enthalpy change for this reaction.

5.

When 74.5g of KCl is dissolved in water the enthalpy change is + 16.75kJ mol^{-1}.

What will be the temperature change when 14.9g of potassium chloride is dissolved in 150cm^3 of water?