Hydrocarbons & Homologous Series

N4 & N5 Homework Questions

Answer questions as directed by your teacher.

National 4 level questions are first followed by National 5 level questions.

National 4 Questions

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

   (a) Name the kind of chemical compounds found in crude oil.
   (b) Explain what is meant by the term fraction.
   (c) Which **two** changes of state occur when a fraction is obtained from crude oil?
   (d) The table below 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 crude oil	
	North Sea crude	Middle East crude
gases & gasoline	7	6
petroleum spirit	20	14
kerosine & diesel	30	25
residue chemicals	43	55

   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. (4)

2. Name three alkanes and state a use for each. (3)

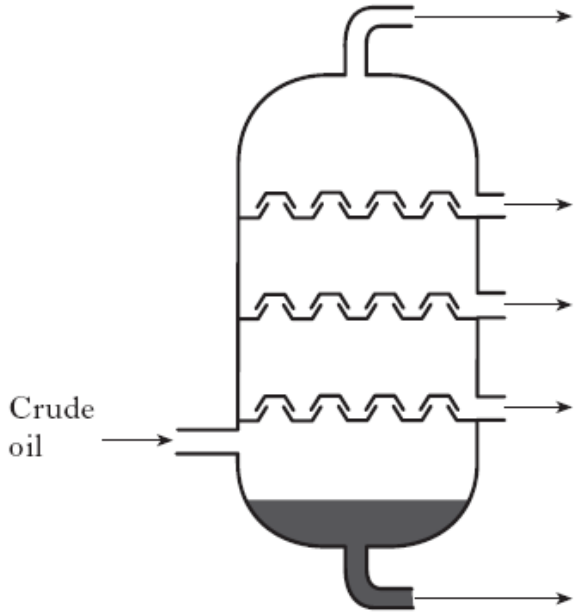
3. For each of the following molecules
   (a) pentene (b) ethane
   (c) butane (d) propene
   (i) draw the full structural formula
   (ii) draw the shortened structural formula (4)

4. State the molecular formula for each of the following hydrocarbons
   (a) hexane
   (b) ethane
   (c) the alkane with 9 carbons
   (d) the alkene with 12 carbons (4)

5. Which of the following hydrocarbons does not belong to the same homologous series as the others?

   A CH_4 B C_3H_8 C C_4H_{10} D C_6H_{12} (1)

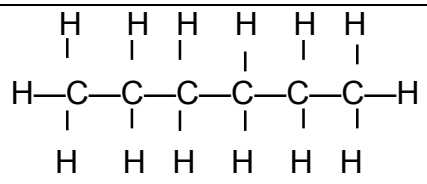
6. The table shows some fractions from crude oil.



Fraction	Boiling range/°C	Name of fraction
A	−160 to 20 °C	Refinery Gas
B	20 to 120 °C	Naphtha
C	120 to 240 °C	Kerosene
D	240 to 350 °C	Gas Oils
E	Over 350 °C	Residue

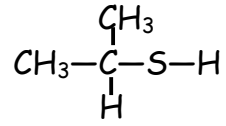
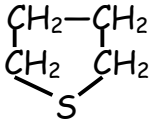
(a) Identify the fraction with the shortest chain length.
(b) Identify the fraction which is used as fuel for aeroplanes.
(c) Identify the fraction which is most viscous.
(d) Which fraction(s) contains molecules which are more flammable than kerosene?
(e) Explain in terms of molecular size which fraction is more volatile, naptha or residue? (6)

The following grid refers to questions 7 and 8.

A. 	B. C_5H_{12}
C. C_5H_{10}	D. $CH_2{=}CHCH_2\,CH_3$

7. Which formula or structure represents butene? (1)
8. Identify the hydrocarbon which has the highest boiling point. (1)
(You may wish to use page 9 of the data booklet)

The following grid refers to questions 9 and 10.

A. $CH_3—S—C_2H_5$	B. $C_2H_5—S—C_2H_5$
C. 	D. 

9. Identify the compound which has the general formula $C_nH_{2n}S$. (1)
10. Identify the compound which has the molecular formula $C_4H_{10}S$. (1)

11. Gases can be liquefied by increasing the pressure, but above a certain temperature it is not possible to do this. This temperature is known as the critical temperature. The critical temperatures of some alkanes are shown below.

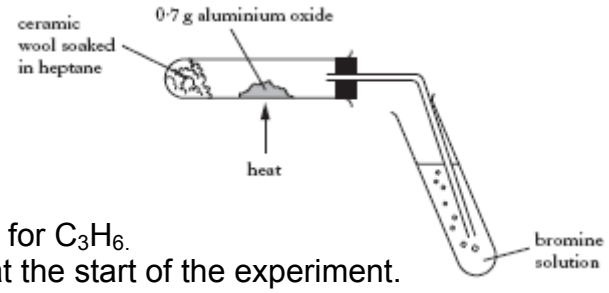
Alkane	**Critical Temperature (^oC)**
Propane	97
Butane	152
Pentane	197
Hexane	234

(a) Describe the trend in critical temperatures for the alkanes. (1)
(b) Predict the critical temperature for Heptane. (1)

12. Heptane can be cracked using aluminium oxide as the catalyst.

One of the reactions taking place is:

$C_7H_{16} \longrightarrow C_3H_6 + \mathbf{X}$



(a) Identify **X**.
(b) The product C_3H_6 is an alkene.
Name and draw the full structural formula for C_3H_6.
(c) 0.7g of the catalyst was put into the tube at the start of the experiment.
What mass of catalyst will be present at the end? (4)

13. Fractional distillation of crude oil produces a number of different fractions.
Which of the following properties apply to a fraction containing large molecules?

A High viscosity and low flammability
B Low viscosity and low flammability
C High viscosity and high flammability
D Low viscosity and high flammability (1)

14. The grid shows the names of some hydrocarbons.

A methane	B hexane	C pentane
D ethene	E butene	F propane

(a) Identify the hydrocarbon with six carbons in the molecule.
(b) Identify the two hydrocarbons that are alkenes. (2)

15. $C_8H_{18} \xrightarrow{\text{Process X}}$ Ethene + Compound Y

Which line in the table correctly identifies Process X and Compound Y?

	Process X	Compound Y
A	cracking	hexane
B	cracking	hexene
C	distillation	hexane
D	distillation	hexene

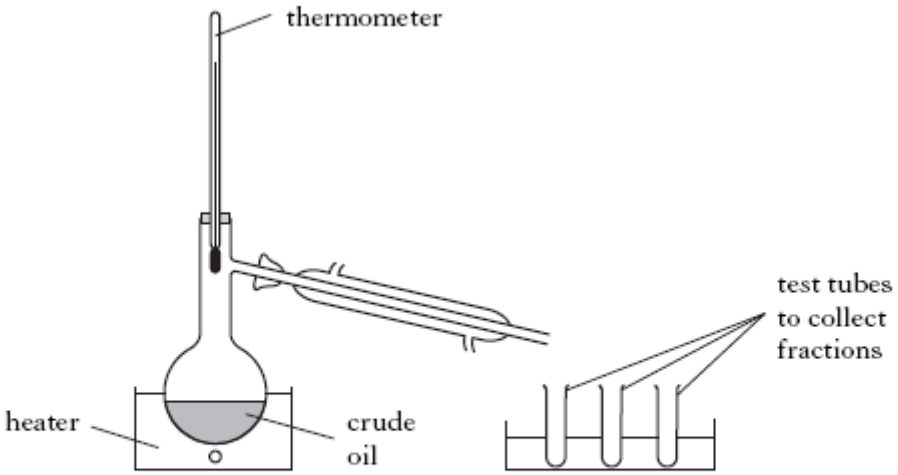
(1)

16. Crude oil can be separated into fractions.
(a) One of the fractions contains alkane molecules with chain lengths from five to eight carbons. Using information in the data booklet, state the boiling point range for this fraction. (1)
(b) The table gives information about some alkanes.

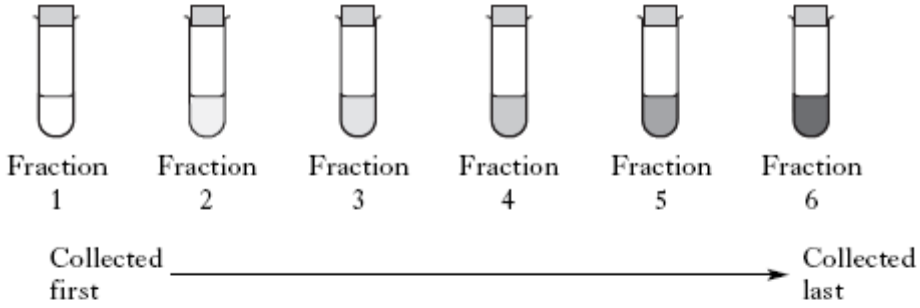
Name	Density g/cm^3
pentane	0·626
hexane	0·659
heptane	0·684
octane	0·703

Predict the density of the alkane with nine carbons. (1)

17. The fractional distillation of crude oil was demonstrated to a class.



Six fractions were numbered in the order they were collected.



Identify the **two** correct statements.

A	Fraction 6 evaporates most easily.
B	Fraction 5 is less viscous than fraction 4.
C	Fraction 2 is more flammable than fraction 3.
D	Fraction 1 has a lower boiling range than fraction 2.
E	The molecules in fraction 3 are larger than those in fraction 4.

(2)

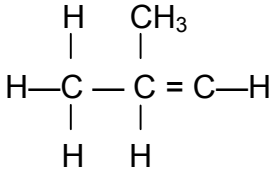
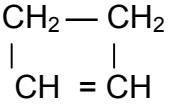
National 5 Questions

1. (a) Why are cyclopropane and cylopentane members of the same homologous series? (1)
   (b) Draw the full structural formula for a cycloalkane which has the molecular formula C_6H_{12}. (1)

2. Which of the following compounds belongs to the same homologous series as the compound with the molecular formula C_3H_8.

   A. Cyclobutane
   B. $CH_3CH=CHCH_3$
   C. $CH_3CH=CH_2$
   D. Butane (1)

3. The two isomers of butene are $CH_2=CHCH_2CH_3$ and $CH_3CH=CHCH_3$.
   Which of the following structures could be a third isomer of butene?

   A. $CH_3CH_2CH=CH_2$
   B. $CH_2=CHCH=CH_2$
   C.
   
   D.
   
   (1)

4. Which of the following could be a cycloalkane?.

   A. C_7H_{16} B. C_7H_{14} C. C_7H_{12} D. C_7H_{10} (1)

5. Which of the following hydrocarbons has a higher boiling point than pentane?

   A. Pent-1-ene
   B. Hex–1-ene
   C. Cyclobutane
   D. Propane (1)

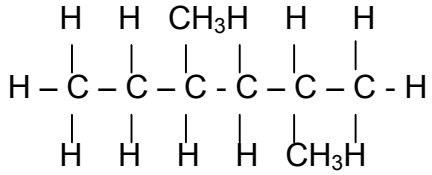
6. Which of the following compounds has an isomer?

   A. CH_3CH_3
   B. $CH_2=CH_2$
   C. $CH_3CH_2CH_3$
   D. $CH_2=CHCH_3$ (1)

7. Draw the full structural formula and give the systematic name for each of the following hydrocarbons:

   (a) $CH_3CH_2C(CH_3)_2CH_2CH_3$
   (b) $(CH_3)_4C$
   (c) $CH_3C(CH_3)_2CHCH_2$ (6)

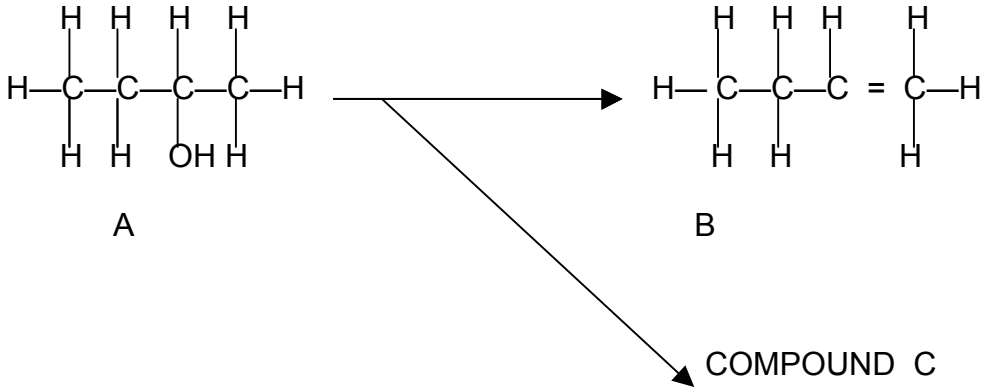
8. The systematic name of



is

A. 3,5-dimethylhexane
B. 3,5-dimethylpentane
C. 3-ethyl,3,5-dimethylbutane
D. 2,4-dimethylhexane (1)

9. Alkenes can be made by dehydrating an organic compound called an alcohol. This is the removal of water from the alcohol to give the alkene.



(a) What homologous series does compound B belong to? (1)
(b) Compound C belongs to the **same** homologous series as compound B.
Draw a possible structure for compound C. (1)

10. The germanes are a homologous series of germanium hydrides, similar to the alkanes. The first member of the series is monogermane, GeH_4.

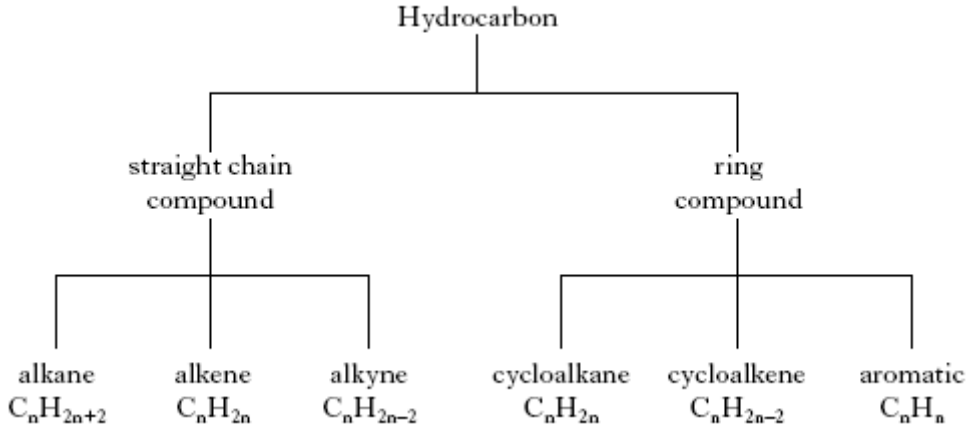
(a) One of the products of the complete combustion of monogermane is germanium dioxide. Predict the name of the other product. (1)
(b) Draw a **structural formula** for trigermane, the third member of the series. (1)

11. Heptane can be cracked. One of the reactions that can take place is

$$C_7H_{16} \longrightarrow C_4H_{10} + C_3H_6$$

(a) The product C_3H_6 decolourises bromine solution quickly.
(i) What word is used to describe a molecule that decolorises bromine solution quickly? (1)
(ii) Draw the structural formula for an isomer of C_3H_6, which would not decolourise bromine solution quickly. (1)
(b) Aluminium oxide is used as the catalyst in cracking. Write the chemical **and** ionic formula for aluminium oxide. (2)

12. The key below shows the name and general formula of some homologous series' of hydrocarbons.



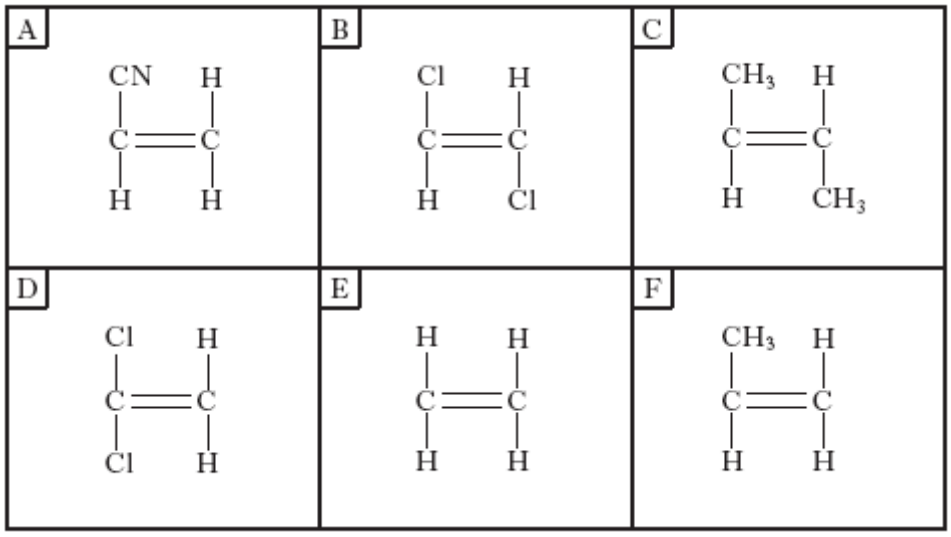
(a) (i) Butyne is an alkyne with 4 carbons atoms.
Using the key write the molecular formula for butyne. (1)

(ii) Hydrocarbon X is a ring compound with molecular formula C_6H_6.
Using the key, name the homologous series to which it belongs. (1)

(b) Draw a structural formula for cyclopentane. (1)

(c) Describe the chemical test, including result, which shows that an alkene is unsaturated. (1)

13. The grid shows the structural formulae of some compounds.



(a) Identify the compound that reacts with hydrogen to form ethane. (1)

(b) Identify the two isomers. (1)

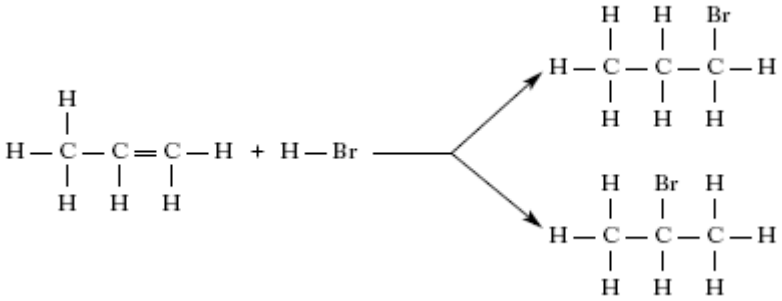
(c) Give the systematic name for the compound in box C. (1)

14. Which of the following hydrocarbons could be cyclohexane?

Hydrocarbon	Molecular formula	Observations on adding bromine solution
A	C_6H_{14}	no colour change
B	C_6H_{12}	rapid decolourisation
C	C_6H_{12}	no colour change
D	C_6H_{10}	rapid decolourisation

(1)

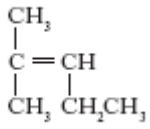
15. When propene undergoes an addition reaction with hydrogen bromide, two products are formed.

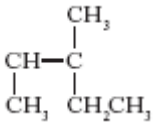


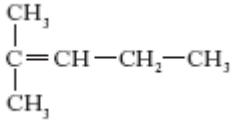
Which of the following alkenes will also produce two products when it undergoes an addition reaction?

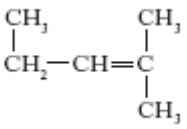
A ethene B but-1-ene C but-2-ene D hex-3-ene (1)

16. Which of the following hydrocarbons is an isomer of 2-methylpent-2ene? (1)

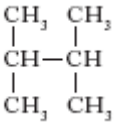
A 

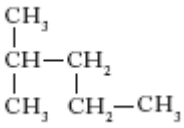
B 

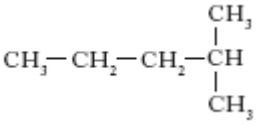
C 

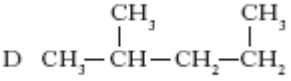
D 

17. Which of the following hydrocarbons is an isomer of 2-methylpentane? (1)

A 

B 

C 

D 

18. Which of the folowing hydrocarbons always gives the same product when one of its hydrogen atoms is replaced by a chlorine atom?

A hexane B hex-1-ene C cyclohexane D cyclohexene

19. Draw the full structural formula for each of the following and give the systematic name:

(a) the **three** isomers of C_5H_{12} (6)

(b) the **five** isomers of C_4H_8 (10)