Alkanes

1. Predict the molecular formula of an alkane with 13 carbon atoms.

.....

[Total 1 mark]

2. The table below lists the boiling points of some alkanes.

alkane	number of carbon atoms	molecular formula	boiling point /°C
butane	4	C_4H_{10}	0
pentane	5	C_5H_{12}	36
hexane	6	C_6H_{14}	69
heptane	7	C_7H_{16}	99
octane	8	C_8H_{18}	
nonane	9	C_9H_{20}	152
decane	10	$C_{10}H_{22}$	175

(i) Predict the boiling point of octane.

.....

[1]

(ii) State and explain the trend in the boiling points of these alkanes.

.....

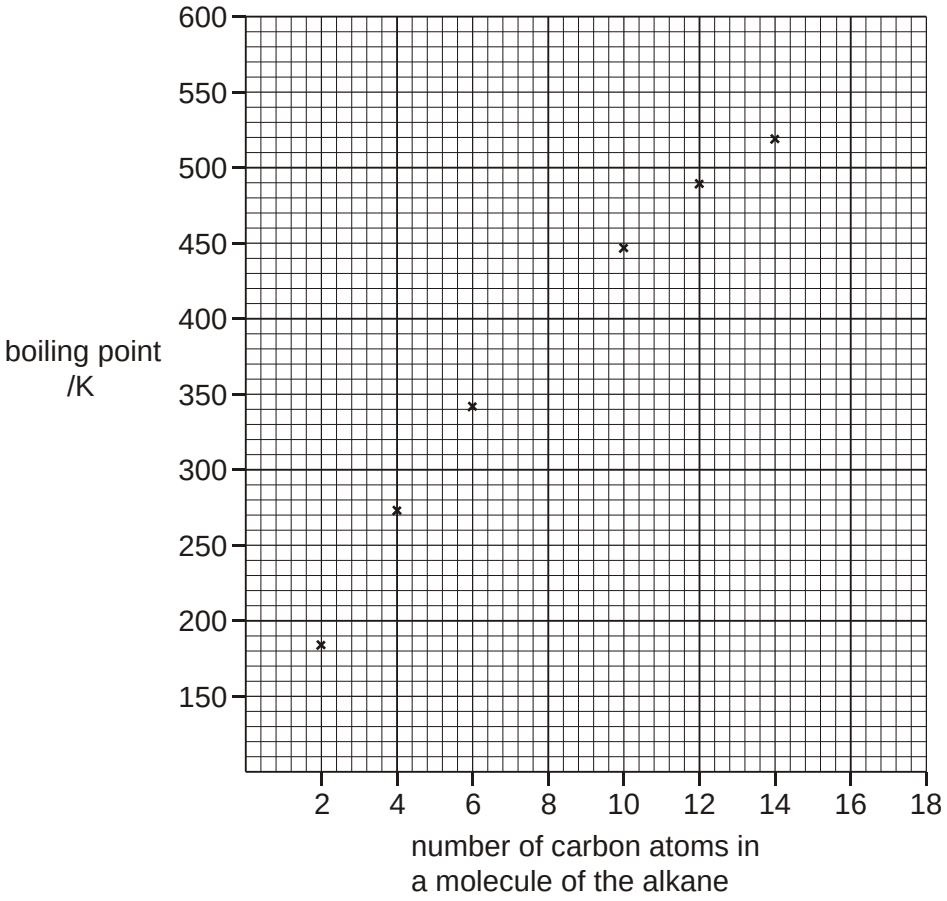
.....

.....

[2]

[Total 3 marks]

3. The graph below shows the boiling points of some alkanes.



(a) Draw a smooth curve through the points on the graph and estimate the boiling points of

octane C_8H_{18}, …… hexadecane, $C_{16}H_{34}$ ……

[2]

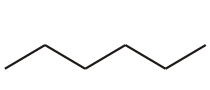
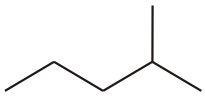
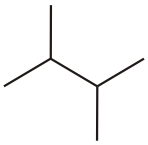
(b) State how decane, $C_{10}H_{22}$, can be separated from a mixture of the alkanes.

.....

[1]

(c) Isomerisation of hexane, C_6H_{14}, produces a mixture of structural isomers, three of which are shown in the boxes below.

(i) Draw, using skeletal formulae, **two** other structural isomers of hexane.

				
isomer **A**	isomer **B**	isomer **C**		

[2]

(ii) Name isomer **B**. .....

[1]

(iii) Isomers **A**, **B** and **C** have different boiling points. In the boxes below, list the isomers **A**, **B** and **C** in order of their boiling points.

lowest boiling point | | | | highest boiling point

[1]

(iv) Explain the order given in **(c) (iii)**.

.....

.....

.....

[2]

(d) Oxygen-containing compounds can be added to improve the efficiency and performance of fuels.

In Formula One racing cars, it is common practice to add oxygen-containing compounds, such as 2-methylpropan-2-ol, $(CH_3)_3COH$. The amount of oxygen-containing compounds added is strictly controlled by the Federation Internationale de l'Automobile, FIA.

(i) Calculate the percentage by mass of oxygen in $(CH_3)_3COH$. Give your answer to three significant figures.

answer ……

[2]

(ii) Write a balanced equation for the complete combustion of $(CH_3)_3COH$.

[2]

[Total 16 marks]

4. The table below lists the boiling points of some alkanes.

alkane	number of carbon atoms	molecular formula	boiling point / °C
butane	4	C_4H_{10}	0
pentane	5	C_5H_{12}	36
hexane	6		69
heptane	7	C_7H_{16}	99
octane	8	C_8H_{18}	
nonane	9	C_9H_{20}	152
decane	10	$C_{10}H_{22}$	175

(a) What is the molecular formula of hexane?.....

[1]

(b) (i) State the trend in the boiling points of the alkanes.

.....

.....

[1]

(ii) Explain the trend in the boiling points of the alkanes.

.....

.....

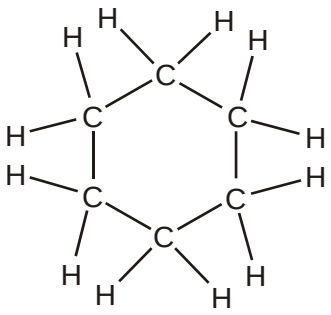
[1]

(iii) Predict the boiling point of octane. ..... °C

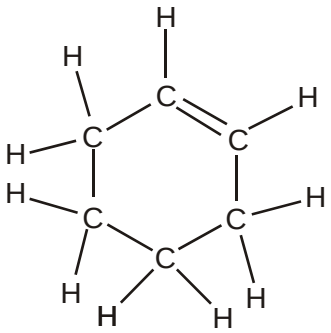
[1]

[Total 4 marks]

5. Cylcohexane and cyclohexene are both cyclic hydrocarbons.



cyclohexane



cyclohexene

(i) What is the molecular formula of cyclohexene? .....

[1]

(ii) What is the empirical formula of cyclohexene? .....

[1]

(iii) Calculate the percentage, by mass, of carbon in cyclohexene. Give your answer to **two** significant figures.

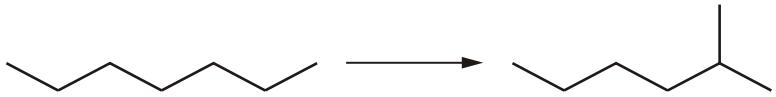
answer .....

[2]

[Total 4 marks]

6. (a) Heptane can be isomerised to produce branched chain alkanes such as 2-methylhexane or 2,3-dimethylpentane.

The equation below shows the isomerisation of heptane into 2-methylhexane.



(i) Using skeletal formulae, complete the balanced equation for the isomerisation of heptane into 2,3-dimethylpentane.

[1]

(ii) The boiling point of 2,3-dimethylpentane is 84 °C.

Predict the boiling point of 2-methylhexane. ..... °C

[1]

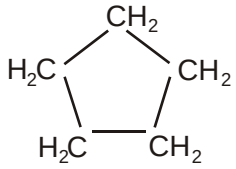
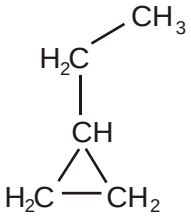
(b) Heptane can be reformed to produce methylcyclohexane which is a cycloalkane. Write a balanced equation to show the reforming of heptane to obtain methylcyclohexane

[2]

[Total 4 marks]

7. There are several **cycloalkanes** that are structural isomers of C_5H_{10}.

(i) Complete the boxes by drawing two other structural isomers of C_5H_{10} that are also **cycloalkanes**.

			
Isomer **L**		**ethylcyclopropane**	

[2]

(ii) Name isomer **L** drawn in (i).

.....

[1]

(iii) Draw the skeletal formula of isomer **L**.

[1]

[Total 4 marks]

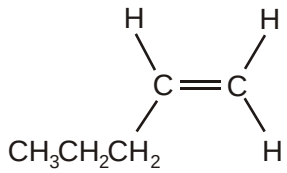
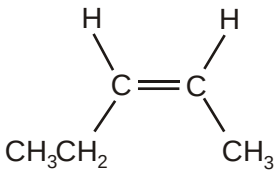
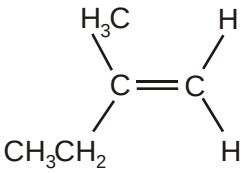
8. (a) Many organic molecules show structural isomerism. State what is meant by the term *structural isomerism*.

.....

.....

[2]

(b) Isomers **1**, **2** and **3**, shown below, are unsaturated structural isomers of C_5H_{10}.

 isomer **1**	 isomer **2**	 isomer **3**

(i) Complete the boxes by drawing two other unsaturated structural isomers of C_5H_{10}.

[2]

(ii) Name isomer **3**.

.....

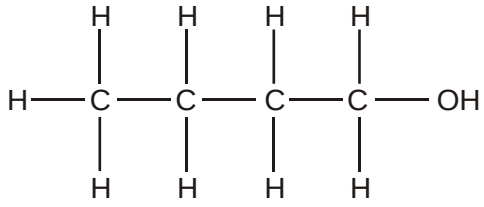
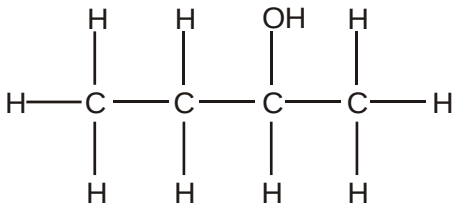
[1]

(iii) Draw the skeletal formula of isomer **2**.

[1]

[Total 6 marks]

9. Four possible structural isomers of $C_4H_{10}O$ are alcohols. Two are shown below.

	
butan-1-ol	butan-2-ol

(i) Draw the other two structural isomers of $C_4H_{10}O$ that are alcohols

isomer 1	isomer 2

[2]

(ii) Name isomer 1. .....

[1]

[Total 3 marks]