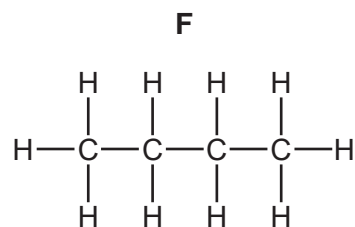
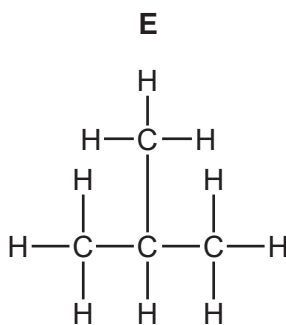
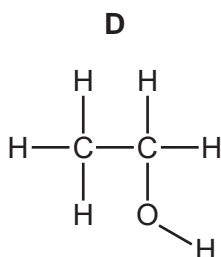
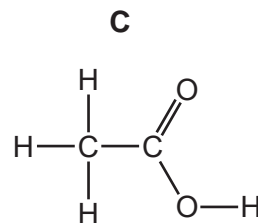
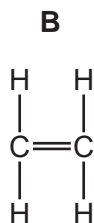
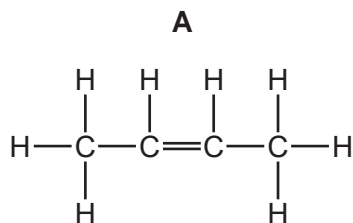


1 The structures of six organic compounds are shown.



(a) Give the name of **F**.

..... [1]

(b) Identify **two** of the compounds that are members of the same homologous series.  
Give the general formula of this homologous series.

compounds .....

general formula .....

[2]

(c) Which **two** compounds are isomers of each other?  
Explain why they are isomers.

compounds .....

explanation .....

.....

[3]

(d) Explain why **B** is an unsaturated hydrocarbon.

.....

.....

..... [2]

(e) Describe how **D** is manufactured from **B**. Give a chemical equation for the reaction.

.....  
.....  
..... [3]

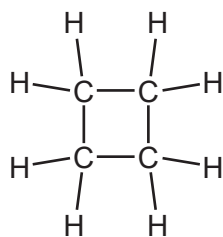
(f) Compound **A** forms an addition polymer.

Draw **two** repeat units of the addition polymer formed from **A**.

[2]

[Total: 13]

2 (a) A hydrocarbon has the following structural formula.



(i) State the molecular formula and the empirical formula of this hydrocarbon.

molecular formula .....

empirical formula .....

[2]

(ii) Draw the structural formula of an isomer of the above hydrocarbon.

[1]

(iii) Explain why these two hydrocarbons are isomers.

.....

..... [2]

(iv) Are these two hydrocarbons members of the same homologous series?  
Give a reason for your choice.

.....

..... [1]

(b) Alkenes can be made from alkanes by cracking.

(i) Explain the term *cracking*.

.....

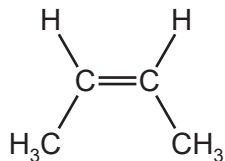
..... [2]

(ii) One mole of an alkane, when cracked, produced one mole of hexane,  $C_6H_{14}$ , and two moles of ethene.

What is the molecular formula of the original alkane?

(c) Alkenes are used in polymerisation reactions and addition reactions.

- (i) Draw the structural formula of the product formed by the addition polymerisation of but-2-ene. Its formula is given below.



[3]

- (ii) Give the name and structural formula of the addition product formed from ethene and bromine.

name .....

structural formula

[2]

[Total: 14]

3 Propanoic acid is a carboxylic acid. Its formula is  $\text{CH}_3\text{-CH}_2\text{-COOH}$ .

(a) Propanoic acid is the third member of the homologous series of carboxylic acids.

(i) Give the name and structural formula of the fourth member of this series.

name .....

formula ..... [2]

(ii) Members of a homologous series have very similar chemical properties.  
State **three** other characteristics of a homologous series.

.....

.....

.....

..... [3]

(b) Carboxylic acids can be made by the oxidation of alcohols.

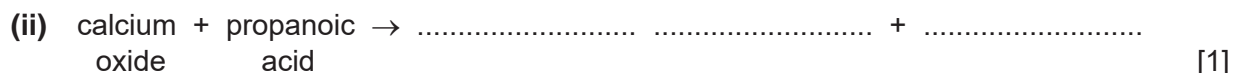
(i) Draw the structural formula of the alcohol which can be oxidised to propanoic acid.  
Show all atoms and bonds.

[1]

(ii) Name a reagent, other than oxygen, which can oxidise alcohols to carboxylic acids.

..... [2]

(c) Complete the following equations for some of the reactions of propanoic acid. The salts of this acid are called propanoates.



(d) A piece of magnesium was added to 100 cm<sup>3</sup> of an aqueous acid. The time taken for the metal to react completely was measured. This experiment was repeated using different aqueous acids. The same volume of acid was used in each experiment and the pieces of magnesium used were identical. In one experiment the reaction was carried out at a different temperature.

experiment	acid	concentration in mol/dm <sup>3</sup>	temperature /°C	time /minutes
<b>A</b>	propanoic	1.0	20	5
<b>B</b>	propanoic	1.0	30	3
<b>C</b>	propanoic	0.5	20	8
<b>D</b>	hydrochloric	1.0	20	1

Explain the following in terms of collision rate between reacting particles.

(i) Why is the rate in experiment **C** slower than the rate in experiment **A**?

.....  
 .....  
 ..... [2]

(ii) Why is the rate in experiment **B** faster than the rate in experiment **A**?

.....  
 .....  
 ..... [2]

(iii) Why is the rate in experiment **D** faster than the rate in experiment **A**?

.....  
 .....  
 ..... [3]

4 The alkanes are a family of saturated hydrocarbons. Their reactions include combustion, cracking and substitution.

(a) What is meant by the term *hydrocarbon*?

..... [1]

(ii) What is meant by the term *saturated*?

..... [1]

(b) What is the general formula for the homologous series of alkanes?

..... [1]

(ii) Calculate the mass of one mole of an alkane with 14 carbon atoms.

.....  
..... [2]

(c) The complete combustion of hydrocarbons produces carbon dioxide and water only.

(i) Write the equation for the complete combustion of nonane,  $C_9H_{20}$ .

..... [2]

(ii)  $20\text{ cm}^3$  of a gaseous hydrocarbon was mixed with an excess of oxygen,  $200\text{ cm}^3$ . The mixture was ignited. After cooling,  $40\text{ cm}^3$  of oxygen and  $100\text{ cm}^3$  of carbon dioxide remained. Deduce the formula of the hydrocarbon and the equation for its combustion. All volumes were measured at r.t.p..

.....  
.....  
.....  
.....  
..... [3]

**(d)** Cracking is used to obtain short-chain alkanes, alkenes and hydrogen from long-chain alkanes.

**(i)** Give a use for each of the three products listed above.

short-chain alkanes .....

alkenes .....

hydrogen ..... [3]

**(ii)** Write an equation for the cracking of decane,  $C_{10}H_{22}$ , which produces two different alkenes and hydrogen as the only products.

..... [1]

**(e)** Chlorine reacts with propane in a substitution reaction to form 1-chloropropane.



**(i)** What is the essential condition for the above reaction?

..... [1]

**(ii)** There is more than one possible substitution reaction between chlorine and propane. Suggest the structural formula of a different product.

..... [1]

[Total: 16]