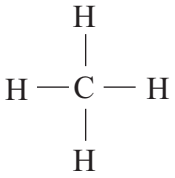
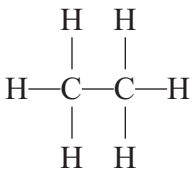
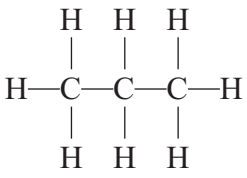
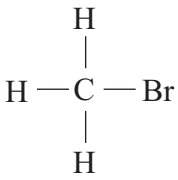
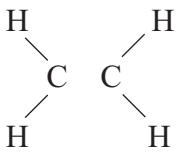
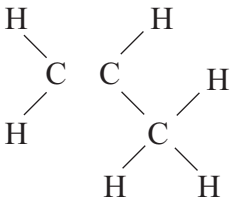
All questions are for both separate science and combined science students

1 These are the displayed formulae of six organic compounds.

		
P	**Q**	**R**
		
S	**T**	**U**

(a) Use the letters above to select

(i) the compound that is **not** a hydrocarbon.

(1)

.....

(ii) **one** compound with the empirical formula CH_2

(1)

.....

(iii) **one** compound that can form a polymer.

(1)

.....

(b) Describe a test that will distinguish between compounds **Q** and **T**, and state the observation made with compound **T**.

(2)

Test .....

.....

Observation with compound **T** .....

.....

(c) Draw the displayed formula of an alkene containing four carbon atoms.

(1)

(d) Three of the compounds belong to the alkane homologous series.
All the alkanes in this homologous series have the same general formula.

(i) What is the general formula of the alkanes?

(1)

.....

(ii) State **two** other features of a homologous series.

(2)

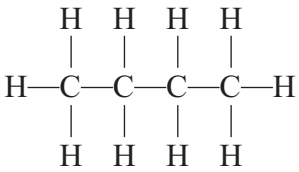
1 .....

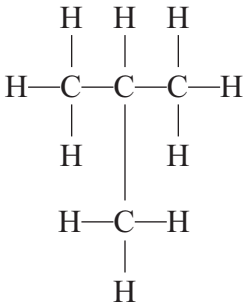
.....

2 .....

.....

(e) The displayed formulae below represent isomers.





Explain what isomers are.

(2)

.....

.....

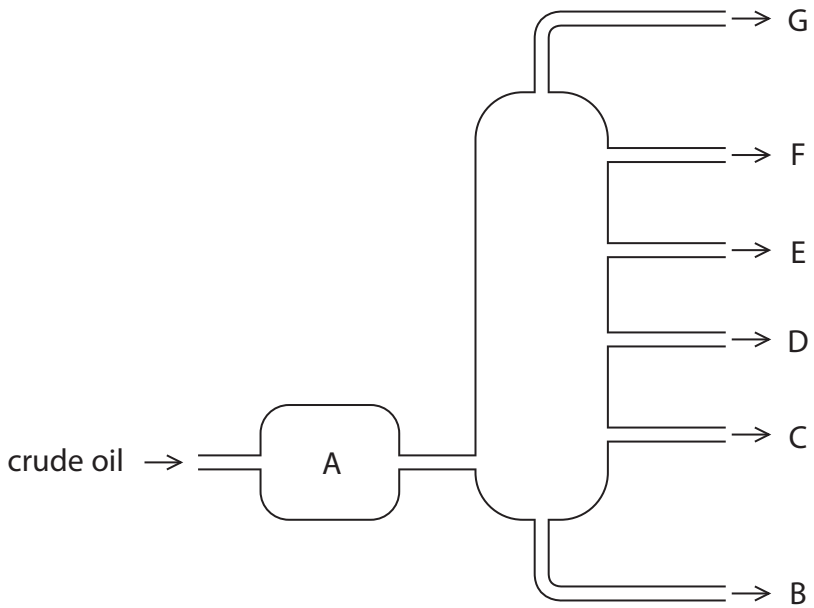
.....

.....

(Total for Question 1 11 marks)

2 Crude oil is an important source of organic compounds.

(a) The diagram shows how crude oil is separated into fractions in the oil industry.



(i) What happens to the crude oil in A?

(1)

.....

.....

.....

(ii) Most of the compounds in crude oil are hydrocarbons.

What is meant by the term **hydrocarbons**?

(2)

.....

.....

(iii) Compare the hydrocarbons in fractions D and F in terms of

- boiling point
- size of molecules
- viscosity

(3)

(b) Some of the fractions are catalytically cracked. The general equation for some reactions in this process is

$$\text{alkane} \rightarrow \text{alkane} + \text{alkene}$$

(i) State two conditions used in catalytic cracking.

(2)

1 .....

.....

2 .....

.....

(ii) How does the bonding in an alkene molecule differ from the bonding in an alkane molecule?

(1)

.....

.....

(iii) The chemical equation for one cracking reaction is

$$C_{16}H_{34} \rightarrow C_8H_{18} + 2C_3H_6 + \text{compound Q}$$

Deduce the molecular formula of Q.

(1)

.....

(c) The compound with molecular formula C_3H_6 can be used to make a polymer.

(i) Give the name of the compound C_3H_6

(1)

.....

(ii) Complete the table of information about this compound.

(3)

Type of formula	Formula
molecular	$_3H_6$
	C_nH_{2n}
	CH_2
displayed	

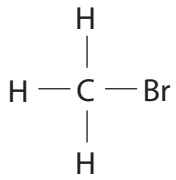
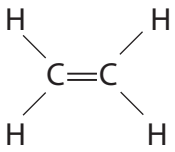
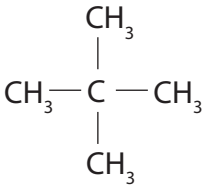
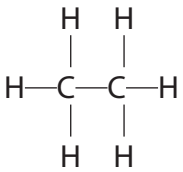
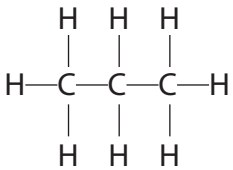
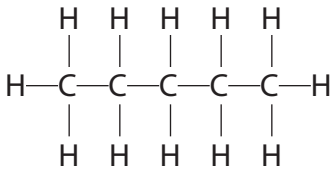
(iii) Complete this structure to show the part of the polymer formed from two molecules of C_3H_6

(2)

——C——C——C——C——

(Total for Question 2 = 16 marks)

3 The table shows the structures of six organic compounds, A to F.

A 	**B** 	**C** 
D 	**E** 	**F** 

(a) The letter of the compound in the table that is **not** shown as a displayed formula is .....

(1)

(b) (i) State what is meant by the term hydrocarbon, and give the letter of one compound in the table that is **not** a hydrocarbon.

(3)

Hydrocarbon .....

.....

Letter .....

(ii) State what is meant by the term unsaturated, and give the letter of one compound in the table that is unsaturated.

(2)

Unsaturated .....

.....

Letter .....

(iii) State what is meant by the term isomers, and give the letters of two compounds in the table that are isomers of each other.

(3)

Isomers .....

.....

Letters ..... and .....

(c) Some of the compounds in the table are members of the same homologous series.

(i) One feature of a homologous series is that adjacent members have formulae that differ by CH_2

State two other features of members of the same homologous series.

(2)

1 .....

.....

2 .....

.....

(ii) Give the letters of two adjacent members of the same homologous series shown in the table.

(1)

Letters ..... and .....

(d) (i) Compound G has the molecular formula $C_2H_4Br_2$

It can be made from a compound in the table by a reaction that does **not** need UV light.

Draw the displayed formula of compound G.

(1)

(ii) Compound H reacts with bromine to form one of the compounds in the table. The reaction needs UV light.

Draw the displayed formula of compound H.

(1)

(Total for Question 3 = 14 marks)

4 The alkanes are a homologous series of hydrocarbons obtained from the fractions in crude oil.

(a) Describe how crude oil is separated into fractions in industry.

(4)

(b) (i) State the general formula of the alkanes.

(1)

(ii) State two characteristics, other than having the same general formula, of members of a homologous series.

(2)

1

2

(c) Propane is an alkane used as a fuel.

Balance the equation for the complete combustion of propane.

(1)

C_3H_8 + ...O_2 → .....CO_2 + ...H_2O

(d) Incomplete combustion of propane leads to the formation of a poisonous gas.

(i) Identify this gas.

(1)

.....

(ii) Explain why the gas is poisonous.

(1)

.....

.....

(iii) During the combustion of propane at high temperatures, gases represented by the formula NO_x can form.

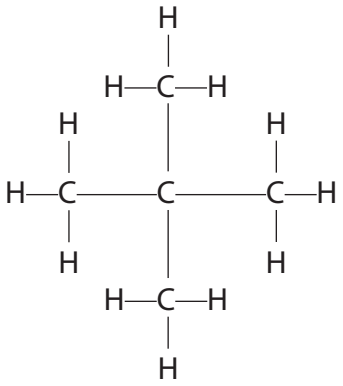
Which two elements combine to form these gases?

(1)

..... and .....

(e) The alkane C_5H_{12} has three isomers.

The displayed formula of one of these isomers is



Draw the displayed formulae of the other two isomers.

(2)

(f) Methane is used in many countries as a fuel in houses. It has no smell, so substances are mixed with it to allow any leaks to be identified.

One of these substances is compound X which has this composition by mass.

C = 53.3%, H = 11.1% and S = 35.6%

(i) Use this information to calculate the empirical formula of X.

(3)

empirical formula of X.....

(ii) The relative formula mass of X is 90

What is the molecular formula of X?

(1)

molecular formula of X.....

(Total for Question 4 = 17 marks)