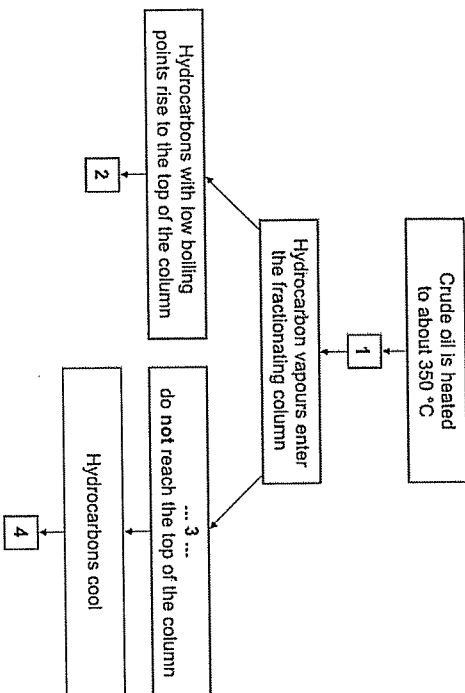


Crude oil and hydrocarbons

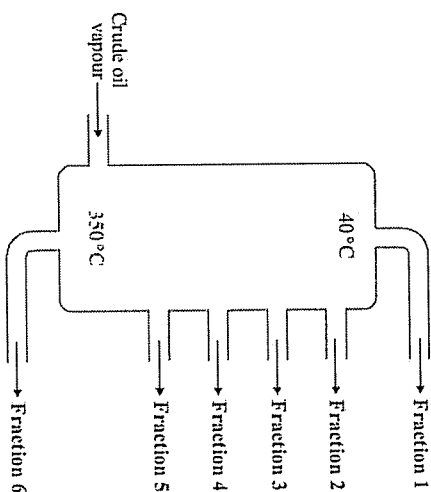
1. The flow chart shows stages in the fractional distillation of crude oil.



Match statements, A, B, C and D, with the numbers 1 – 4 in the flow chart.

- A Hydrocarbons in the crude oil turn to vapour
- B Hydrocarbons collected as gases
- C Hydrocarbons with high boiling points
- D Hydrocarbons condense to form liquids

2. Crude oil vapour can be separated into a number of fractions.



- (a) Crude oil vapour enters the fractionating column.

What happens as the vapour cools?

- 1 The fractions separate because they have different densities.
- 2 The fractions condense at 40 °C.
- 3 The fractions condense at different temperatures.
- 4 The fractions condense at 350 °C.

- (b) Fraction 6 will contain

- 1 alkanes with high boiling points.
- 2 alkanes with a small number of carbon atoms in each molecule.
- 3 only hydrocarbons that are unsaturated.
- 4 only hydrocarbons with low boiling points.

- (c) Fraction 1 contains the alkanes called methane, ethane, propane and butane.

By what process could pure methane be obtained from this fraction?

- 1 evaporation
- 2 electrolysis
- 3 thermal decomposition
- 4 fractional distillation

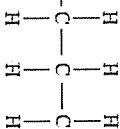
- (d) Which of these statements is correct for the alkanes?
- 1 They are a series of compounds with the general formula C_nH_{2n+1}
 - 2 They are saturated compounds.
 - 3 Most are gases at room temperature (20 °C), some are liquids, none are solids.
 - 4 Their molecules have a carbon : hydrogen ratio of 1 : 4

3. This question is about four alkanes, A, B, C and D.

Alkane	Formula	Boiling point in °C
A	C_2H_6	-89
B	C_3H_8	-42
C	C_4H_{10}	0
D	C_5H_{12}	+36

Match alkanes, A, B, C and D, with the numbers 1 – 4 in the sentences.

The alkane with the structural formula $H-C(H)(H)-C(H)(H)-C(H)(H)-H$ is ... 1.....



The alkane with the highest boiling point is ... 2.....

The alkane that boils at the same temperature as ice melts is ... 3.....

The alkane that is a gas at -50 °C is ... 4.....

4. Crude oil contains a large number of alkanes, which have the general formula C_nH_{2n+2} . Crude oil can be separated into a number of fractions by fractional distillation.

- (a) Crude oil can be separated into fractions in this way because ...
- 1 the alkanes it contains have different boiling points.
 - 2 the alkanes it contains have different densities.
 - 3 alkanes are compounds which are made up of more than one element.
 - 4 all alkanes vapourise easily when they are heated.

(b) Each fraction from the crude oil will contain ...

- 1 a single alkane.
- 2 a mixture of several alkanes.
- 3 alkanes that have the same boiling point.
- 4 alkanes that have the same density.

The alkanes are a series of compounds.

The first ten alkanes in the series range from methane, CH_4 , to decane, $C_{10}H_{22}$

(c) The difference between the formulae of successive alkanes is ...

- 1 C
- 2 H_2
- 3 CH
- 4 CH_2

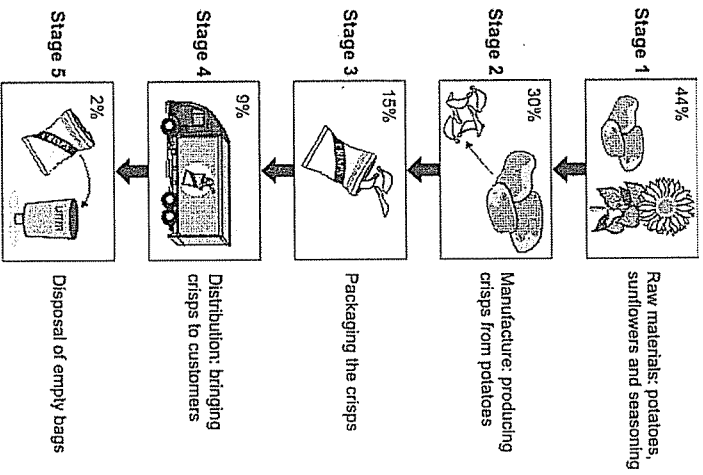
(d) Which of the following changes in the alkane series, from methane to decane?

- 1 the general formula
- 2 the number of bonds on each carbon atom
- 3 the ratio of carbon atoms to hydrogen atoms
- 4 the number of elements present

Hydrocarbon fuels

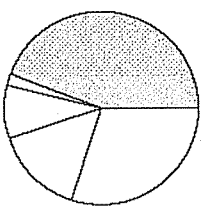
1. The carbon footprint of a food product is the amount of carbon dioxide that is produced in its preparation, distribution and disposal.

The diagram shows the percentage (%) of the carbon footprint for each stage for a bag of crisps.



- (a) How is most of the carbon dioxide produced in Stage 4?
- 1 It is produced when the lorries use fuel.
 - 2 It is breathed out by the driver.
 - 3 It escapes from the crisp bags.
 - 4 It escapes from the tyres of the lorries.

- (b) Which stage on the diagram corresponds to the shaded area on the pie chart?



Percentage (%) of carbon footprint for a bag of crisps

- 1 Stage 1
 - 2 Stage 2
 - 3 Stage 3
 - 4 Stage 4
- (c) If the company reduces the carbon footprint for a bag of crisps, this will help to . . .
- 1 reduce the acid rain that it causes.
 - 2 meet government targets on global warming.
 - 3 reduce the sale of crisps which contribute to obesity.
 - 4 reduce the use of sunflower oil.
- (d) Which of the following changes would reduce the carbon footprint for the bag of crisps?
- 1 increase the sales of the crisps
 - 2 change the colour of the crisp bags
 - 3 pack many more bags of crisps into each lorry
 - 4 increase the size of the lorry fleet

2. Hydrocarbon fuels, K, L, M and N, were burned and the products were collected and identified. The results are shown in the table below.

Products of burning	Hydrocarbon fuels			
	K	L	M	N
Carbon monoxide	✓	✓	✓	X
Carbon dioxide	✓	✓	✓	✓
Water vapour	✓	✓	✓	✓
Soot	✓	✓	X	X
Sulphur dioxide	X	X	✓	✓

- Key:
- ✓ indicates that the substance is one of the products
 - X indicates that the substance is not one of the products.

(a) The results show that combustion was only complete for . . .

- 1 hydrocarbon fuel K
- 2 hydrocarbon fuel L
- 3 hydrocarbon fuel M
- 4 hydrocarbon fuel N

(b) The table of results shows that the hydrocarbon fuels that do not contain sulfur are . . .

- 1 M and N
- 2 K and L
- 3 L and M
- 4 K and M

(c) When hydrocarbon fuels are burned, some of the products cause problems.

Which one of the following statements correctly describes a problem that is caused by the products of burning?

- 1 Sulfur dioxide in the air causes heavier rainfall.
- 2 Releasing large amounts of carbon dioxide into the atmosphere produces 'acid rain'.
- 3 A build-up of particles in the air causes 'global dimming'.
- 4 Releasing large amounts of carbon dioxide into the atmosphere causes 'global dimming'.

(d) Ethanol is a compound of carbon, hydrogen and oxygen.

Ethanol can be used as a fuel in vehicles together with, or in place of, hydrocarbon fuels.

- An advantage of ethanol as a fuel is that when it burns . . .
- 1 no carbon dioxide is produced.
 - 2 carbon dioxide and water are produced.
 - 3 no sulfur dioxide is produced.
 - 4 only water is produced.

3. Environmentalists say that the introduction of low-sulfur fuels is essential because it gives cleaner emissions from vehicles.

Scientists disagree about the emissions of carbon dioxide from low-sulfur fuels. Some claim that low-sulfur fuels give higher emissions of carbon dioxide. Other scientists suggest that the improved fuel consumption from these fuels means that less carbon dioxide is released.

- (a) Vehicle emissions would be cleaner using low-sulfur fuels because they would definitely produce less . . .
- 1 carbon dioxide.
 - 2 carbon monoxide.
 - 3 nitrogen oxides.
 - 4 sulfur dioxide.

(b) Scientists disagree about the emissions of carbon dioxide from low-sulfur fuels because . . .

- 1 they cannot repeat the results of their investigation.
- 2 simple experiments do not give accurate results.
- 3 there are not enough variables in their investigations.
- 4 the data they are using is too simple for a complex problem.

Oil companies are concerned about the cost of removing more sulfur from fuels. They claim that more dinitrogen oxide (N_2O) is produced by these fuels when catalytic converters are running at low temperatures. Dinitrogen oxide is 310 times more powerful than carbon dioxide as a greenhouse gas.

(c) Oil companies do not want to remove more sulfur from fuels because . . .

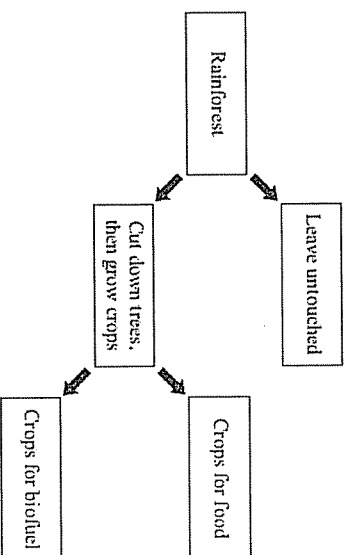
- 1 increased production costs would put up the price of their fuels.
- 2 they would sell less fuel because of improved fuel consumption.
- 3 they do not agree that the emissions from low-sulfur fuels are cleaner.
- 4 customers do not believe that the fuels are any better for the environment.

(d) The oil companies claim that more dinitrogen oxide is produced when low-sulfur fuels are used. How could this be verified?

- 1 The oil companies should repeat their investigations.
- 2 Independent scientists should carry out further investigations.
- 3 Government scientists should measure the levels of dinitrogen oxide near motorways.
- 4 University students should research the effects of dinitrogen oxide when it is released into the atmosphere.

4. Rainforests have an important global role in absorbing carbon dioxide. They are also a habitat for many endangered species.

Many countries have to make difficult decisions about the use of land. This is summarised in the flow chart. Biofuels that are produced include biodiesel and bioethanol. The trees that are cut down are not always replaced.



➤ **Progress check**

Unit C1, C1.4.3

- (a) Why is there a large worldwide demand for biofuels?
- 1 The carbon dioxide produced by the use of the fuel is completely matched by the carbon dioxide taken in when the fuel is grown.
 - 2 They are a renewable source of energy.
 - 3 Their use is always sustained.
 - 4 No greenhouse gases are produced.

- (b) Which row in the table correctly shows two likely consequences of a long-term increase in the demand for biofuel?

1	fewer crops will be grown for food	more species will be endangered
2	fewer trees in rainforests will be cut down	more land will be used for crops
3	less carbon dioxide will be absorbed by the rainforests	more crops will be grown for food
4	land will not be used and will be returned to rainforest	fossil fuel reserves will run out sooner

- (c) Scientists have been asked to carry out research to produce evidence about the consequences of developing the use of biofuels.
Which row in the table gives the correct description of an issue and its impact?

	Issue	Impact
1	ethical	effect on endangered species
2	social	effect on price of fossil fuels
3	environmental	effect on price of wood
4	economic	effect on levels of oxygen in the atmosphere

- (d) Some of the vegetable oils grown as a food crop are reacted with hydrogen at 60 °C using a nickel catalyst.
The purpose of this process is to . . .
- 1 remove single carbon carbon bonds in the oil.
 - 2 add double carbon carbon bonds to the oil.
 - 3 change the oil so that its melting point is higher than room temperature.
 - 4 make the chemicals in the oil detectable with bromine.