Fractional Distillation of Crude Oil

Q1 Circle the correct words to complete these sentences.

a) Crude oil is a **mixture / compound** of different molecules.

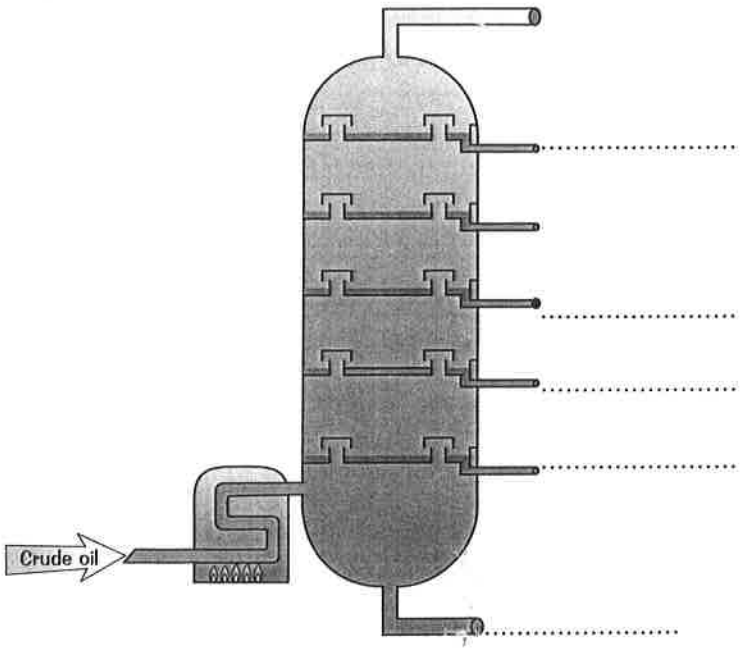
b) Most of the compounds in crude oil are **carbohydrate / hydrocarbon** molecules.

c) The molecules in crude oil **are / aren't** chemically bonded to each other.

d) Physical methods **can / can't** be used to separate out the molecules in crude oil.

Q2 The molecules listed below are in the order of **smallest** to **largest** from left to right.
Label this diagram of a **fractionating column** to show where these substances can be collected.

petrol **kerosene** **diesel** **oil** **bitumen**



Q3 What is the connection between the **size** of the **molecules** in crude oil and their **condensing** (or **boiling**) points?

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Q4 Explain why distillation is a good way to **separate** the liquids in crude oil.

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Properties and Uses of Crude Oil

Q1 **Crude oil** is a mixture of **hydrocarbons**. These **hydrocarbons** are mostly **alkanes**.

a) Draw the structures of the first three alkanes and name each alkane you have drawn.

1. 2. 3.

....

b) Which of these alkanes would you expect to have the highest boiling point?

.....

Q2 There are some basic **trends** in the way that **alkanes** behave.
Circle the correct words to complete these sentences.

a) The longer the alkane molecule the **more / less** viscous (gloopy) it is.

b) The shorter the alkane molecule the **lower / higher** its boiling point.

c) The shorter the alkane molecule the **more / less** flammable it is.

Q3 **a)** What is the **general** formula for **alkanes**?

If you can't remember it you can work it out by looking at the diagrams you have drawn at the top of the page.

.....

b) **Eicosane** is a hydrocarbon that can be used to make candles. Each molecule of eicosane contains **20 carbon** atoms. What is the **chemical formula** for eicosane?

.....

Q4 Each hydrocarbon molecule in engine oil has a **long** string of carbon atoms.

a) Explain why this type of oil is good for using as a **lubricant** in an engine.

.....

b) Engines get very **hot** when they are in use. Why would oil molecules with short carbon chains be unsuitable for use as lubricants?

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Using Crude Oil as a Fuel

Q1 As crude oil is a **non-renewable** resource people are keen to find **alternative** energy sources. Suggest a problem with each of these ways of using alternative fuels.

a) **Solar** energy for cars: .....

b) **Wind** energy to power an oven: .....

c) **Nuclear** energy for buses: .....

Q2 Forty years ago some scientists predicted that there would be no oil left by the year 2000, but obviously they were **wrong**. One reason is that modern engines are more **efficient** than ones in the past, so they use less fuel. Give two other reasons why the scientists' prediction was wrong.

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Q3 Using oil products as fuels causes some **environmental** problems. Explain the environmental problems that are associated with each of the following:

a) **Transporting** crude oil across the sea in tankers.

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b) **Burning** oil products to release the energy they contain.

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Q4 Write a short paragraph summarising why crude oil is the most **common source** of fuel even though **alternatives** are available.

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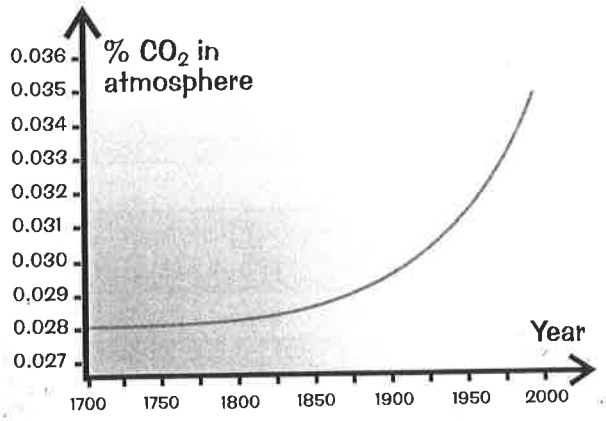
More Environmental Problems

Q1 Look at the graph and then answer the questions below.



a) Describe the trend shown by the graph.

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b) What is the main cause of this trend?

.....

.....

c) What effect is the trend shown in the graph having on the Earth's average temperature?

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Q2 What is **global dimming** and what is thought to **cause** it?

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.....

Q3 **Hydrogen** is often talked about as the 'fuel of the future'.

a) What is the **only product** produced when **hydrogen** is burned?

.....

b) Why is it better for the **environment** if we burn hydrogen rather than petrol?

.....

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c) Currently, most of the vehicles that can use hydrogen as a fuel are demonstration vehicles that are being developed by scientists. Explain the problems that will have to be overcome before the public will be able to use hydrogen-powered vehicles on a large scale.

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Think about storage of hydrogen and the costs involved.

More Environmental Problems

Q4 In Brazil **ethanol** produced by **fermenting** sugar cane is a popular fuel for vehicles. The ethanol is mixed with **petrol** before it is used.

a) What products are produced when **ethanol** (C_2H_5OH) is completely burnt?

.....

b) Give **one** problem with the use of **ethanol** as a fuel.

.....

Q5 Biodiesel is a fuel made from vegetable oil.
A litre of biodiesel contains **90%** of the energy found in a litre of normal diesel.

Normal diesel contains 37 megajoules (37 000 000 J) of energy per litre.
How much energy does a litre of biodiesel contain?

.....

.....

Q6 Scientists are working hard to develop new **technologies** that are **environmentally friendly**.

a) List some ways that people can alter their lifestyles so that they cause less environmental damage.

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b) Do you think it is solely the responsibility of scientists to find ways of reducing environmental damage or should people be prepared to change their lifestyles too? Explain your answer.

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Top Tips: If a question asks you what you think, you can say whatever you want (as long as it answers the question) but you'll have to back up your argument by saying **why** you think that. The examiner is looking for your **reasons** so make sure they're logical and realistic.

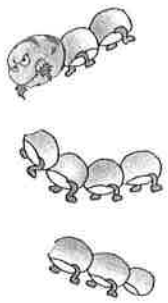
Cracking Crude Oil

Q1 Fill in the gaps with the words below.

high	shorter	long	catalyst	cracking	diesel	molecules	petrol

There is more need for ..... chain fractions of crude oil such as ..... than for longer chains such as ..... .

Heating ..... hydrocarbon molecules to ..... temperatures with a ..... breaks them down into smaller ..... . This is called ..... .



Q2 Diesel is **cracked** to produce products that are more in demand.

a) Suggest three useful substances that are produced when diesel is cracked.

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b) What type of reaction is cracking?

.....

Q3 After cracking both **alkenes** and **alkanes** are present.

a) Bromine water is used to test whether a substance is an alkane or alkene. Alkenes decolourise bromine water, but alkanes don't.

Which of the following would decolourise bromine water?

☐ propane ☐ ethene ☐ ethane

b) Put the steps of the cracking process in the correct order by writing numbers in the boxes.

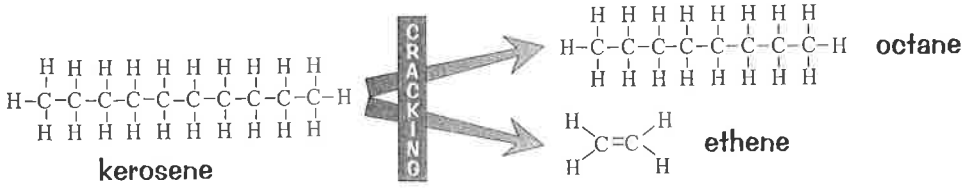
☐ The vapour is passed over a catalyst at a high temperature.

☐ The long-chain molecules are heated.

☐ The molecules are cracked on the surface of the catalyst.

☐ They are vaporised (turned into a gas).

Q4 Change this diagram into a **word equation** and a **symbol equation**.



a) Word equation: ..... → ..... + ...

b) Symbol equation: ..... → ..... + ...

Alkenes and Ethanol

Q1 Complete this table showing the molecular and displayed formulas of some alkenes.

Alkene	Formula	Displayed formula
Ethene	**a)**	**b)**
c)	C_3H_6	**d)**

The displayed formula just shows how all the atoms are arranged.

Q2 The general formula for alkenes is C_nH_{2n}. Use it to write down the formulas of these alkenes.

a) pentene (5 carbons) .....

b) hexene (6 carbons) .....

c) octene (8 carbons) .....

d) dodecene (12 carbons) .....

Q3 True or false?

		True	False
a)	Alkenes have double bonds between the hydrogen atoms.	☐	☐
b)	Alkenes are unsaturated.	☐	☐
c)	Alkenes are not very useful.	☐	☐
d)	Ethene has two carbon atoms.	☐	☐

Q4 Fill in the gaps with the words below. You might need to use some words more than once.

orange **bromine water** **colourless** **decolourise**

You can test for alkenes by adding them to ..... .

An alkene will ..... the ....., turning it from ..... to ..... .

Alkenes and Ethanol

Q5 There are two ways of making ethanol:

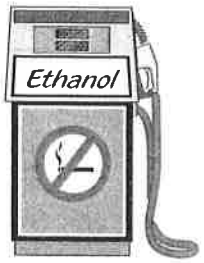
Method A	**Sugar → ethanol + carbon dioxide**
Method B	**Ethene + steam → ethanol**

a) Which of the methods describes making ethanol by **fermentation**? .....

b) Draw lines to match up the boxes.

Method A	**Uses a catalyst**
Method B	**Uses yeast**

c) Ethanol can be used as a fuel. In some countries the fermentation method is often used to produce it. Give two reasons why this method is chosen.



1. .....

2. .....

d) Give a disadvantage of the fermentation method.

.....

.....

Q6 Explain why producing ethanol from ethene could become **problematic** in the future.

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Top Tips: It's a cracking idea getting alkenes from crude oil because they're pretty useful for making things, like ethanol. You probably wouldn't want to drink the ethanol you get from reacting ethene with steam though. On the other hand, the ethanol you get from fermenting sugar is pretty multipurpose — it's good for anything from your old man's pint to fuelling his car.

Using Alkenes to Make Polymers

Q1 Tick the box next to the **true** statement below.

We bring you gold, frankincense... and poly-myrrh

- ☐ The monomer of poly(ethene) is ethene.
- ☐ The polymer of poly(ethene) is ethane.
- ☐ The monomer of poly(ethene) is ethane.

Q2 Polymers have many uses, for example, in LYCRA® fibre for tights.

Give three other uses of polymers.

1. .....

2. .....

3. .....

Q3 Most polymers are **not** biodegradable.

Biodegradable means that something can rot.

a) What problems does this cause for the environment?

.....

.....

b) How can you minimise this environmental problem when using objects made from polymers?

.....

.....

c) Things are often made from plastics because they are cheap. Why might this change in the future?

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Think about what plastics are made from.