M1.(a) Methane

1

(b) Sea levels rising

1

(c) Burning of fossil fuels

1

(d) carbon dioxide concentration stayed constant from 1850 to 1900

1

carbon dioxide concentration slowly increased from 1900

1

carbon dioxide concentration increased more rapidly from 1965

allow values from 1965 – 1975

1

[6]

M2. (a) (i) bar drawn between 84 and 86

1

(ii) sulfur dioxide linked to acid rain

1

carbon particles linked to global dimming

1

(b) (i) any **one** from:

- plants / trees <u>absorb</u> (carbon dioxide)
- coal '<u>locks up</u>' (carbon dioxide)

1

(ii) it <u>increases</u> the amount (of CO_2)

1

because carbon in coal (forms carbon dioxide)

accept because carbon / coal burns / reacts <u>with oxygen</u> (to produce CO_2)

1

[6]

M3. (a) crust

ignore Earth's

1

core

ignore inner and/or outer

1

(b) bar chart

1

all heights are correct

accept correctly plotted points

1

all labels are correct for nitrogen, oxygen and other / argon

1

(c) (i) decomposed

1

(ii) global warming

1

[7]

M4. (a) sulfur dioxide / SO_2

allow sulfur oxide

1

(b) global dimming

1

(c) oxygen / O_2

1

(d) (oil is a) limited resource / finite / non-renewable

*accept running out of oil **or** wood is sustainable*

*accept (burning oil) increases amount of carbon dioxide in the atmosphere / global warming **or** releases locked up carbon / global dimming / acid rain*

accept the oil (may become) too expensive

1

(e) carbon dioxide produced (from burning wood)

ignore global warming

1

carbon dioxide used by plants / trees **or** for photosynthesis

if no other mark awarded

*allow carbon emissions used by plants / trees **or** for photosynthesis for **1** mark*

1

[6]

M5. (a) acid rain → sulfur dioxide

1

global warming → carbon dioxide

1

global dimming → carbon particles

1

(b) (i) oxygen

1

(ii) carbon monoxide

1

(c) (i) decreasing

accept running out / none left

1

(ii) any **two** from:

it = coal

- world needs (more) energy
  accept population is increasing
  allow (greater) demand for coal / fuels / energy
- plentiful supply
  accept readily available
  allow coal will 'last longer'
- (many) countries have coal
- easy to find / extract
- oil / gas is running out

accept need to use less oil / gas

accept need to use it to replace oil / gas

- cheap **or** cheaper than oil

2

[8]

M6. (a) curve of best fit drawn through

or close to all of the points

1

(b) (i) 313

1

(ii) 1989 +/– 1

1

(c) concentration / amount of carbon dioxide has <u>increased</u>

1

recently the rate of increase is <u>increasing</u>

1

[5]

M7. (a) (i) sulfur dioxide / SO_2

1

(ii) global dimming

1

(iii) carbon dioxide / CO_2

ignore ozone

1

increases the levels (of carbon dioxide)

*accept it is a greenhouse gas **or** causes global warming / greenhouse effect*

1

(b) gas / oil bar <u>correct length</u>

1

coal bar <u>correct length</u>

1

[6]

M8. (a) hydrogen

ignore formulae

1

(b) any **two** from:

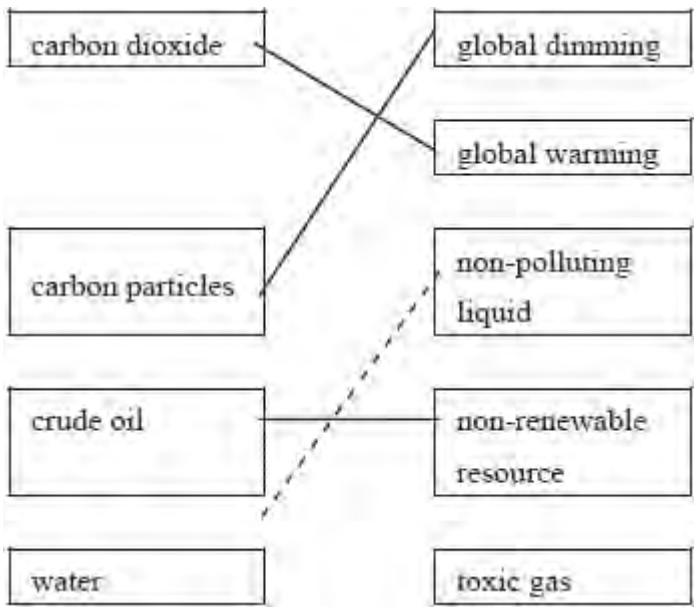
- different sized molecules / more or less (carbon) atoms (in molecules)

  ignore different densities

- fuels have <u>different</u> boiling points
- fuels condense at <u>different</u> temperatures

2

(c)



*all three correct = **3** marks*
*two correct = **2** marks*
*one correct = **1** mark*

3

[6]

M9. (a) respiration

combustion

1 *mark each*

2

(b) methane

water

1 *mark each*

accept steam

do ***not*** *accept natural gas for methane*

do ***not*** *accept hydrogen oxide*

2

(c) greenhouse effect (increased)

accept (global) warming

accept polar ice caps melt

accept rising sea levels

accept problems with climatic change

do ***not*** *accept changes to the weather* ***or*** *acid rain*

1

[5]

Q1. Greenhouse gases affect the temperature of the Earth.

(a) Which gas is a greenhouse gas?

Tick **one** box.

Argon ☐

Methane ☐

Nitrogen ☐

Oxygen ☐

(1)

(b) An increase in global temperature will cause climate change.

What is **one** possible effect of climate change?

Tick **one** box.

Deforestation ☐

Global dimming ☐

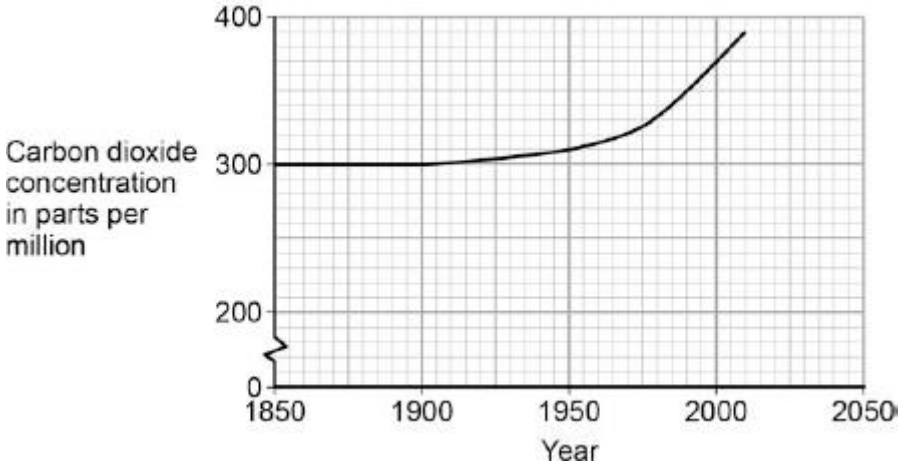
Sea levels rising ☐

Volcanic activity ☐

(1)

(c) Carbon dioxide is also a greenhouse gas.

The figure below shows how the concentration of carbon dioxide in the atmosphere has changed since 1850.



Which process is the reason for the change in carbon dioxide concentration shown on the figure above?

Tick **one** box.

Burning of fossil fuels ☐

Carbon capture ☐

Formation of sedimentary rocks ☐

Photosynthesis ☐

(1)

(d) Give **three** conclusions that can be made from the figure above.

1 .....

.....

2 .....

.....

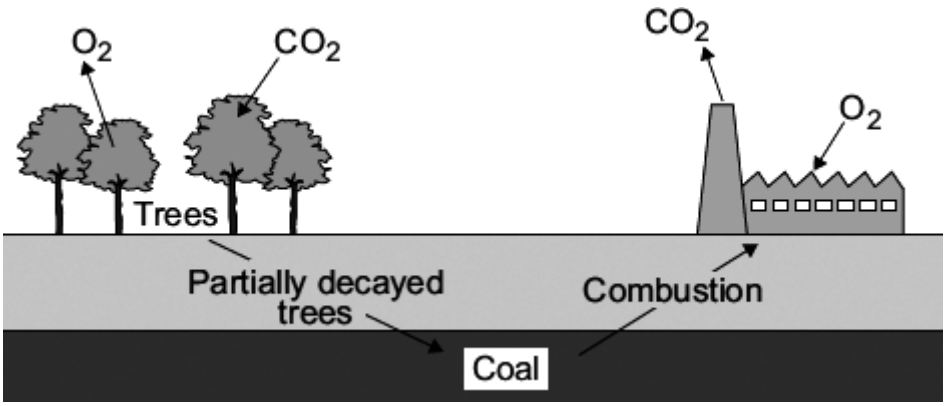
3 .....

.....

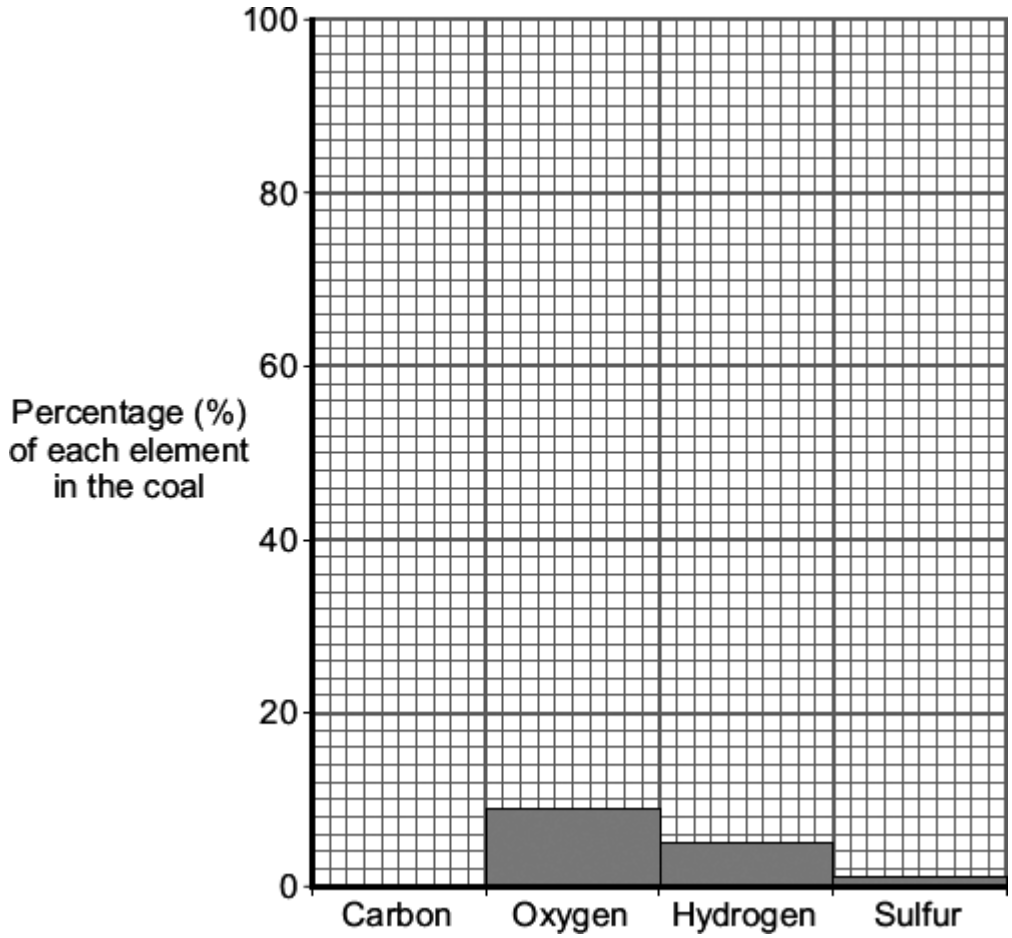
(3)
(Total 6 marks)

Q2. About 3000 million years ago carbon dioxide was one of the main gases in the Earth's early atmosphere.

About 400 million years ago plants and trees grew on most of the land. When the plants and trees died they were covered by sand and slowly decayed to form coal.	Today coal is burned in power stations to release the energy needed by industry.



(a) The bar chart shows the percentage of some of the elements in this coal.



(i) This coal contains 85 % carbon. Draw the bar for carbon on the chart.

(1)

(ii) Coal is burned in the atmosphere to release energy.
Two of the products of burning coal are shown.

Draw **one** line from each product to its environmental impact.

Product	**Environmental impact**
Sulfur dioxide	Acid rain
Carbon particles	Global dimming
	Global warming

(2)

(b) Use the information above and your knowledge and understanding to answer these questions.

(i) How did the formation of coal decrease the amount of carbon dioxide in the Earth's early atmosphere?

.....

.....

(1)

(ii) How does burning coal affect the amount of carbon dioxide in the Earth's atmosphere?
Explain your answer.

.....

.....

.....

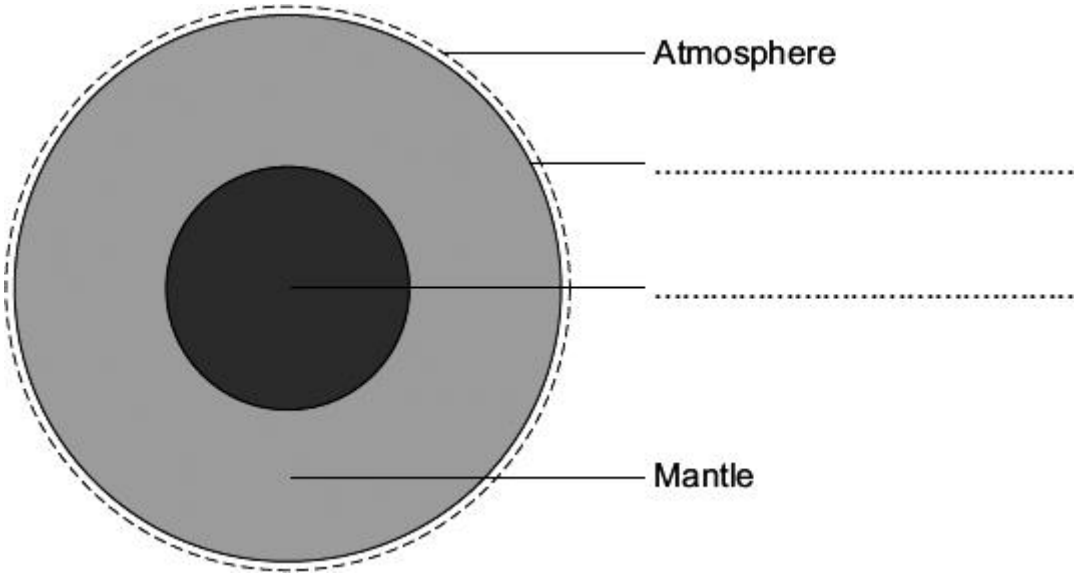
.....

(2)
(Total 6 marks)

Q3. The Earth has a layered structure and is surrounded by an atmosphere.

(a) The diagram shows the layers of the Earth.

Complete the labels on the diagram.

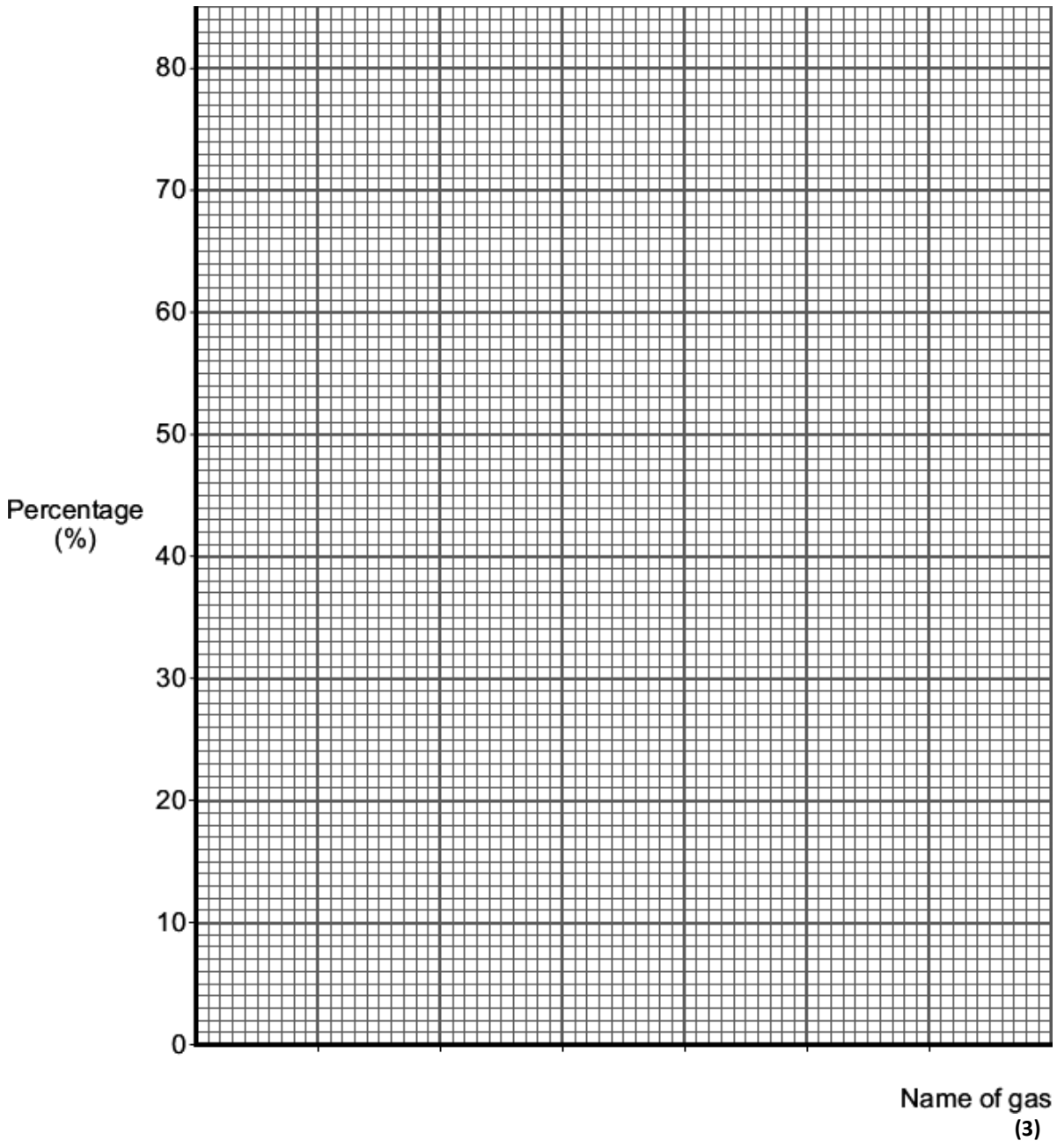


(2)

(b) The data in the table shows the percentages of the gases in the Earth's atmosphere.

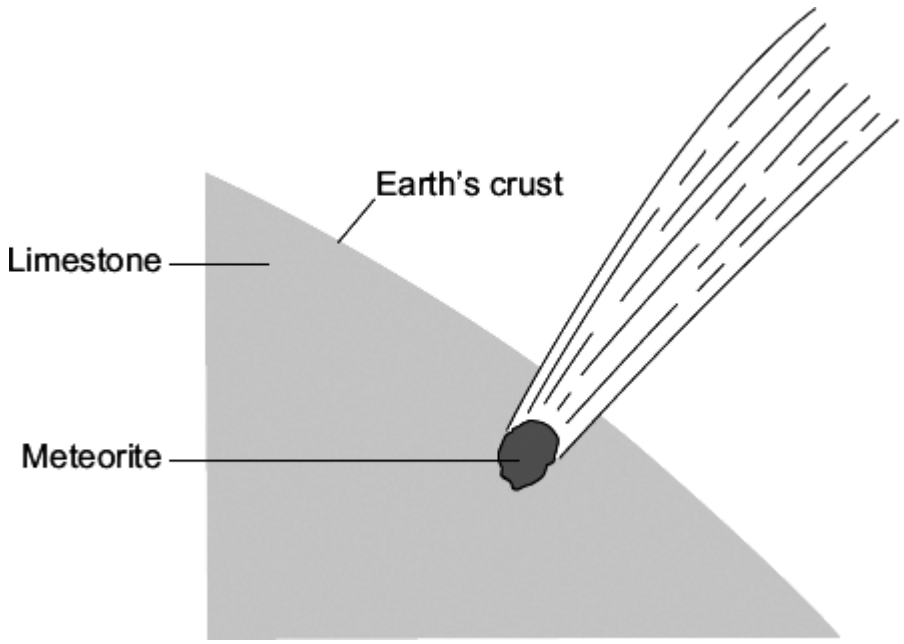
Name of gas	Percentage (%) of gas
Nitrogen	78
Oxygen	21
Other gases	1

Present the data in the table on the grid below.



(3)

(c) Millions of years ago a large meteorite hit the Earth.
The meteorite heated limestone in the Earth's crust to a very high temperature.
The heat caused calcium carbonate in the limestone to release large amounts of carbon dioxide.



Draw a ring round the correct answer to complete each sentence.

(i) Carbon dioxide was released because the calcium carbonate was

decomposed.
evaporated.
reduced.

(1)

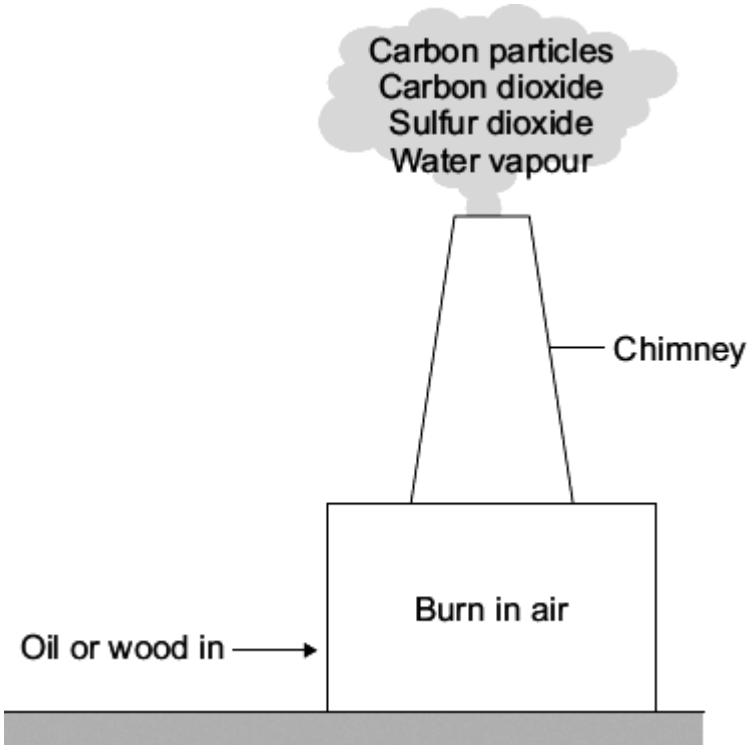
(ii) More carbon dioxide in the Earth's atmosphere causes

acid rain.
global dimming.
global warming.

(1)
(Total 7 marks)

Q4. In the future:

- there will be fewer oil burning power stations
- there may be more wood burning power stations.



(a) Which **one** of the emissions from the chimney can cause acid rain?

.....

(1)

(b) Draw a ring around the correct answer to complete the sentence.

Carbon particles in the Earth's atmosphere cause

acid rain.
global dimming.
global warming.

(1)

(c) Which gas in the air is needed for oil or wood to burn?

.....

(1)

(d) Suggest why there will be **fewer** power stations burning oil in the future.

.....

.....

(1)

(e) Some power stations burn wood.
The wood comes from trees grown in forests.

Suggest why burning wood in power stations is said to be 'carbon-neutral'.

.....

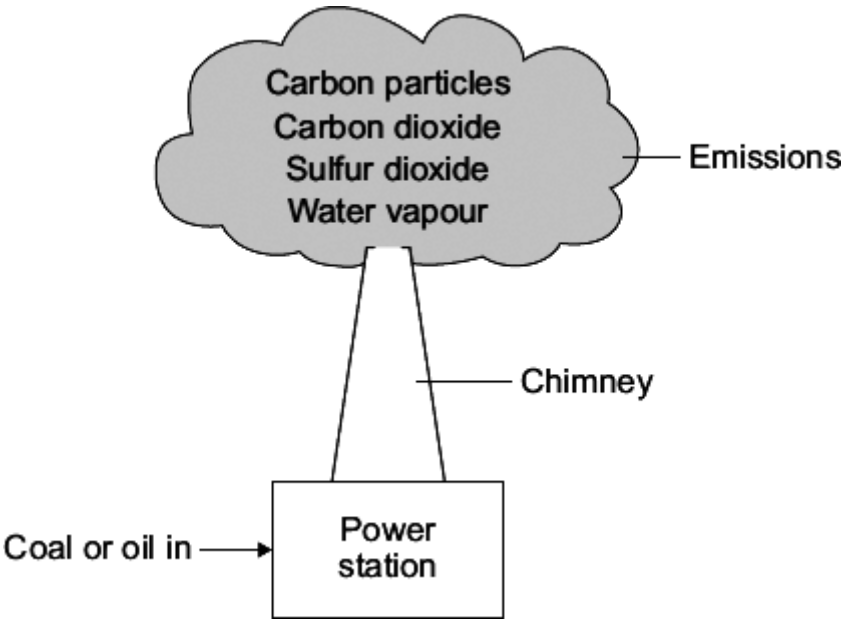
.....

.....

.....

(2)
(Total 6 marks)

Q5. In the future more coal-fired and fewer oil-fired power stations will be used to generate electricity.
When coal and oil are burned they produce the same types of emissions which can cause environmental problems.



(a) Emissions from the chimney can cause acid rain, global dimming and global warming. Draw **one** straight line from each possible environmental problem to the emission that causes it.

Possible environmental problem	**Emission that causes it**
acid rain	carbon particles
global warming	carbon dioxide
global dimming	sulfur dioxide
	water vapour

.....

(3)

(b) Draw a ring around the correct word in the box to complete each sentence.

(i) Incomplete combustion of coal or oil is caused by too little

carbon dioxide.
nitrogen.
oxygen.

(1)

(ii) A gas formed by the incomplete combustion of coal or oil is

carbon monoxide.
hydrogen.
oxygen.

(1)

(c) The table shows the world production for both coal and oil in 2000.

The world production figures after 2000 are predicted.

Year	**World production of coal (billions of tonnes per year)**	**World production of oil (billions of barrels per year)**
2000	3.5	12.5
2050	4.5	5.6
2100	5.0	1.7
2150	5.5	0.5
2200	6.0	0.0

(i) How is the world production of oil predicted to change from 2000 to 2200?

.....

.....

(1)

(ii) Suggest **two** reasons why the world production of coal is predicted to increase.

1 .....

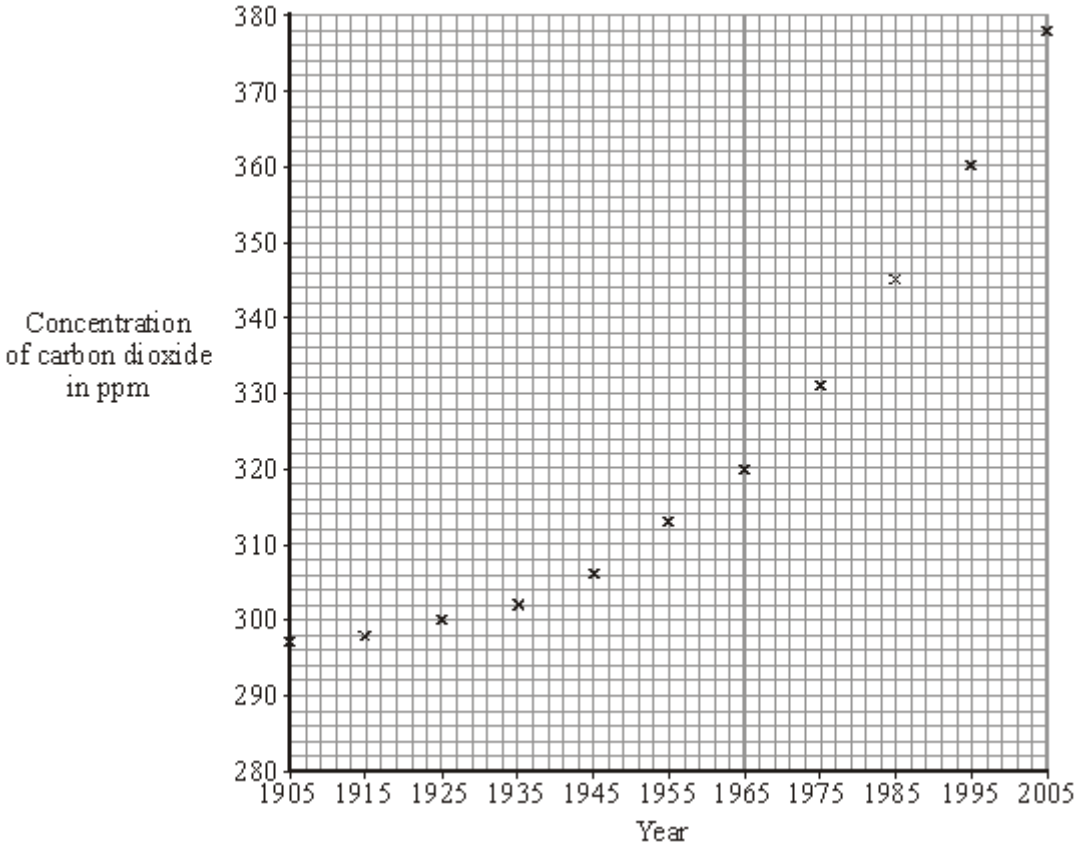
.....

2 .....

.....

(2)
(Total 8 marks)

Q6. Global warming is thought to be happening because of the increased burning of fossil fuels. The concentration of carbon dioxide in the air from 1905 to 2005 has been calculated.



(a) Draw a line of best fit for these points.

(1)

(b) (i) What was the concentration of carbon dioxide in 1955?

..... ppm

(1)

(ii) In what year did the concentration of carbon dioxide reach 350 ppm?

.....

(1)

(c) Use the graph to describe, in as much detail as you can, what happened to the concentration of carbon dioxide from 1905 to 2005.

.....

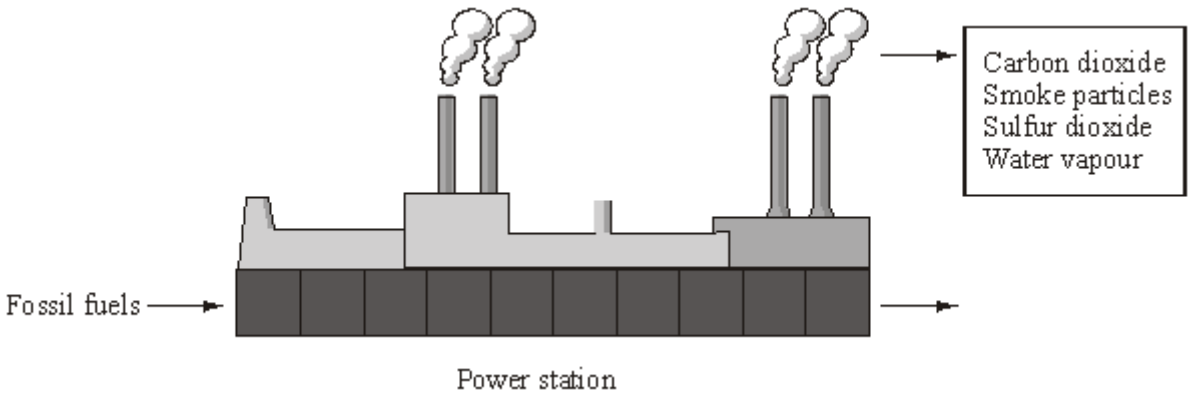
.....

.....

.....

(2)
(Total 5 marks)

Q7. Most electricity in the UK is generated in power stations that burn fossil fuels. The diagram lists some of the substances released into the air when fossil fuels are burned.



(a) (i) Which **one** of the substances released into the air causes acid rain?

.....

(1)

(ii) In the sentence below, draw a ring around the correct answer.

The type of environmental pollution caused by

smoke particle is	global dimming global warming rising sea levels

(1)

(iii) Suggest how the burning of fossil fuels may cause climate change.

.....

.....

.....

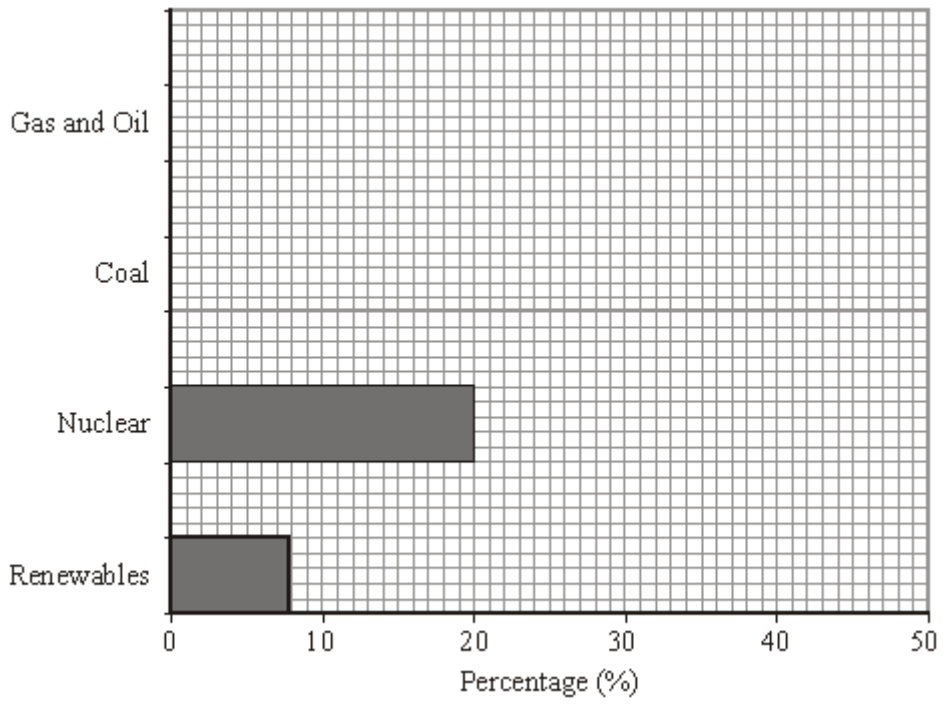
.....

(2)

(b) The table shows the percentage of electricity generated by different energy sources.

Energy sources	Renewables	Nuclear	Coal	Gas and Oil
Percentage (%)	8	20	32	40

Complete the bar chart to show the percentage of electricity generated by coal and by gas and oil.



(2)
(Total 6 marks)

Q8. Crude oil is a natural resource from which useful fuels can be separated.

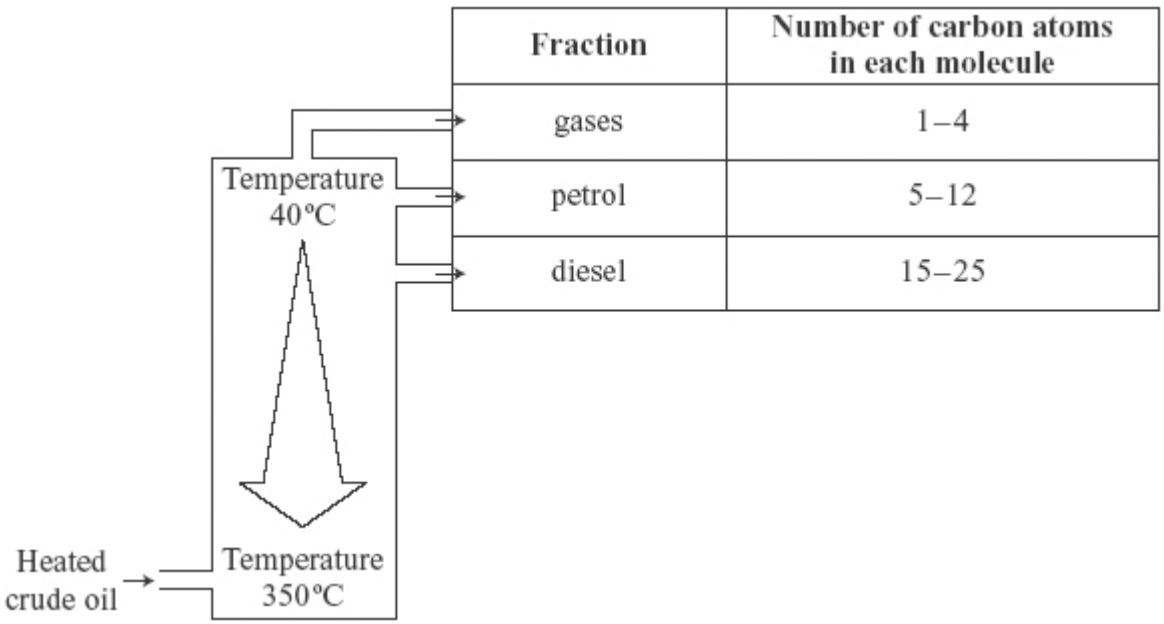
(a) Crude oil is a mixture of hydrocarbons.

Complete the sentence about a hydrocarbon molecule.

A hydrocarbon molecule is made up of ..... and carbon atoms only.

(1)

(b) Many fuels come from crude oil. Some of these fuels are shown in the diagram.



Fraction	Number of carbon atoms in each molecule
gases	1–4
petrol	5–12
diesel	15–25

Suggest **two** properties of these fuels that allow them to be separated from crude oil.

.....

.....

.....

.....

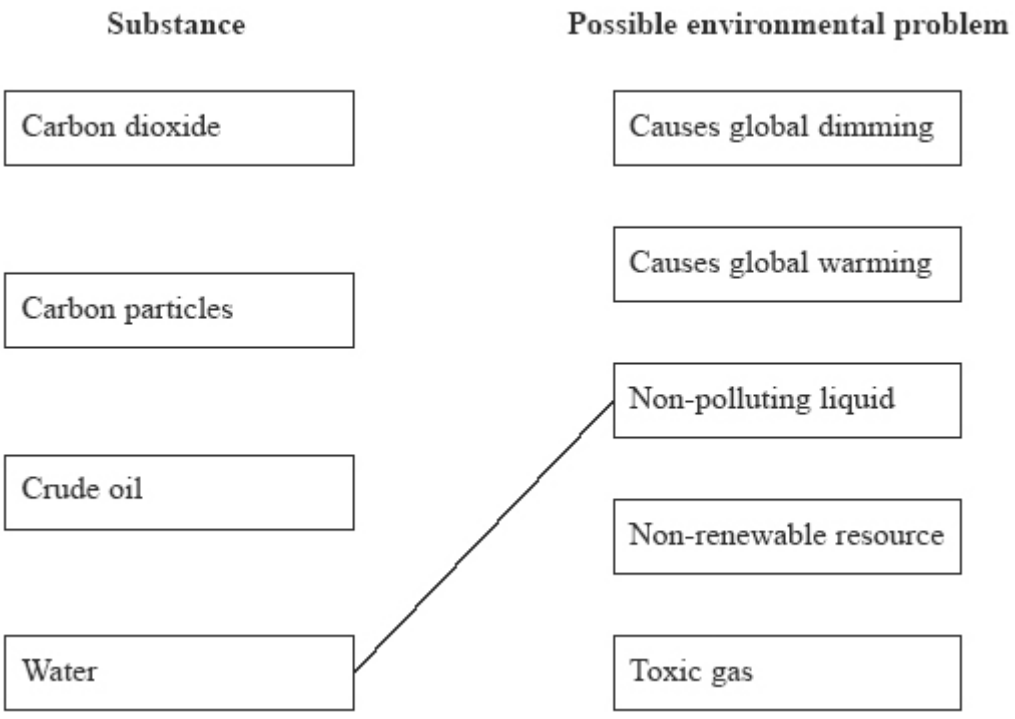
(2)

(c) Fuels from crude oil burn to provide heat energy.

When a fuel burns, it combines with oxygen in the air and produces carbon dioxide and water. When there is not enough oxygen, the fuel burns and also produces carbon monoxide and carbon particles.

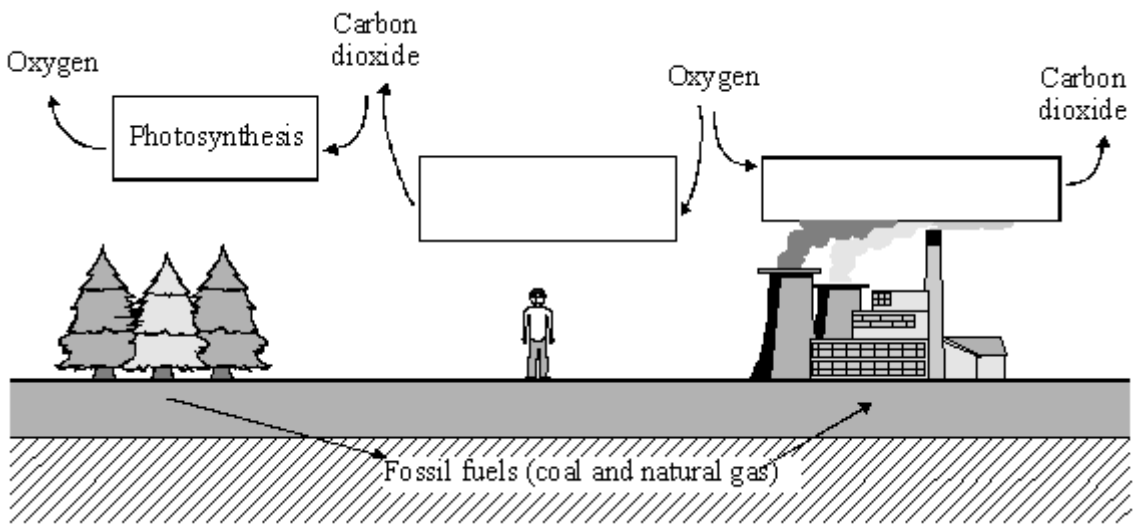
Draw a straight line from each substance that links it to a possible environmental problem.

One has been done for you.



(3)
(Total 6 marks)

Q9. In the carbon cycle the amounts of carbon dioxide and oxygen in the air are changed by several processes.



(a) The names of some processes are given in the box below.

combustion	decomposition	neutralisation
photosynthesis		respiration

Choose the correct process for each box in the diagram. The first one has been done for you.

(2)

(b) Fossil fuels, such as natural gas, react with oxygen.

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

..... + oxygen → carbon dioxide + ...

Complete the word equation for this reaction

(2)

(c) What problem is caused by the formation of large amounts of carbon dioxide?

.....

.....

(1)
(Total 5 marks)

M1. (a) (i) C_7H_{16}

mark answer line first

answer may be given in the table

1

(ii) C_nH_{2n+2}

1

(b) (i) carbon monoxide

*do **not** accept carbon oxide*

*do **not** accept water*

ignore CO

1

(ii) because of partial / incomplete combustion (in reaction 2) **or** complete combustion (in reaction 1)

*allow because there is less / insufficient oxygen (in reaction 2) **or** sufficient oxygen (in reaction 1) allow different amounts of oxygen used (in the reactions) **or** $19O_2$ (in reaction 1) **and** $13O_2$ (in reaction 2)*

ignore air

1

(c) (i) 15 (%)

ignore units

1

(ii) water (vapour)/steam

allow H_2O / OH_2 / hydrogen oxide

1

(iii) sulfur in petrol / crude oil (reacts with oxygen)

it = sulfur dioxide

1

(ii) because nitrogen **and** oxygen (are in the air and) react

*allow nitrogen **and** oxygen burn*

*accept nitrogen + oxygen → nitrogen oxide **or** symbol equation*

ignore air

1

at high temperature (inside a petrol engine)

allow heat / hot (engine)

1

(d) because carbon dioxide / it causes global warming **or**

allow because carbon dioxide / it causes greenhouse effect / climate change

1

because carbon dioxide / it has an impact on oceans

because this carbon dioxide / carbon / it was '<u>locked up</u>' (in fossil fuels) **or**

because the percentage/amount of carbon dioxide / it in the atmosphere is <u>increasing</u>

1

[11]

M2. (a) (i) *use of carbon throughout = **max 1***

burning biodiesel releases CO_2

ignore burning trees

1

CO2 is absorbed / used by the crops/plants (used to produce the biodiesel)

allow CO2 absorbed / used by trees

1

(ii) *allow use of carbon for carbon dioxide throughout*

increases CO2 / greenhouse effect

accept causes global warming

OR

allow causes climate change

less CO2is absorbed (from atmosphere)

ignore other correct effects

1

because burning trees releases CO2

accept fewer trees to absorb CO2

***or** crops / plants do not absorb as much CO2 as trees*

OR

because there is <u>less</u> photosynthesis

ignore habitats / biodiversity

*if no other mark awarded global dimming because of smoke / particles gains **1** mark*

1

(b) any **one** from:

ignore carbon neutral / cost / less harmful / environmentally friendly

- crude oil / fossil fuel is running out / non-renewable

  allow biodiesel is renewable / sustainable

- demand for fuels / energy is increasing

  ignore demand for biodiesel is increasing

- new legislation / protocols

1

(c) (i) uses crops / land that could be used for food

*allow destroys habitats **or** reduces biodiversity*

ignore cost

1

(ii) increases the cost of food / land

ignore cost of machinery / process

ignore cheaper to produce biodiesel

1

[7]

M3. (a) carbon dioxide <u>decreased (by plants / trees)</u>

allow plants / trees absorbed carbon dioxide

1

oxygen <u>increased</u> (by plants / trees)

allow plants / trees released oxygen

if neither of these marks awarded

allow plants / trees

*photosynthesise for **1** mark*

1

because coal 'locks up' / traps / stores carbon dioxide / carbon

allow trees 'locked up' carbon dioxide / carbon

1

(b) carbon / C

hydrogen / H

sulfur / S

*all 3 correct **2** marks*

*1 or 2 correct **1** mark*

allow H2

ignore oxygen

2

(c) (i) 2 2

balancing must be correct

*do **not** accept changed formulae*

1

(ii) <u>increases atmospheric pollution</u>

carbon dioxide / CO2 released

1

from the (thermal) decomposition of calcium carbonate **or**

*accept causes global warming **or** CO2 is a greenhouse gas*

description of this decomposition **or** equation

ignore sulfur dioxide and effects in this part

1

<u>decreases atmospheric pollution</u>

sulfur dioxide / SO2 is removed

accept less acid rain produced

1

by reaction with calcium oxide **or** calcium carbonate

*accept neutralisation **or** forms calcium sulfate*

1

[10]

M4. (a) (i) a reasonable attempt at a smooth curve

allow a curve which is close to but does not necessarily touch all points

1

(ii) any **two** from:

allow thicker / thinner / runny for viscous

- biodiesel is more <u>viscous</u> than petroleum diesel at all / lower temperatures
- biodiesel – as the temperature increases the <u>viscosity</u> decreases or vice versa
- petroleum diesel – the <u>viscosity</u> does not change

if no other mark awarded

*allow **1** mark for any correct conclusion based on time or rate of flow*

2

(iii) does not flow as easily (through pipes / engine)

allow could form a solid / block pipes / engine at low temperatures

or

needs a high temperature to flow

allow more difficult to vaporise / ignite

ignore burning

ignore references to viscosity

1

(b) (i) global dimming

allow correct description

1

(ii) 56 (%)

1

(iii) (increases) acid rain

1

because there is <u>more</u> nitrogen oxide(s)

ignore sulfur dioxide

if no other mark awarded

*allow **1** mark for nitrogen oxide(s) given*

1

(iv) *answer yes or no does not gain credit because the marks are for an explanation*

ignore references to petroleum diesel

allow carbon for carbon dioxide

no

because carbon dioxide (26%) is released / produced

1

this will <u>not</u> all be absorbed by photosynthesis / growing plants for biodiesel

accept growing plants / farming uses machinery / fossil fuels releases carbon dioxide

OR

yes

because although carbon dioxide (26%) is released / produced (1)

this was absorbed by photosynthesis / growing plants (for biodiesel) (1)

allow this will be absorbed by photosynthesis / growing plants for biodiesel

1

[10]

M5. (a) complete diagram with 2 carbon atoms and 5 hydrogen atoms each C–C and each C–H linked by a single line (bond)

1

(b) (i) the greater the number of (carbon) atoms (in an alkane molecule) the greater its boiling point **or** vice versa

allow as the (carbon) chain gets longer the boiling point increases

ignore melting points

*do **not** accept reference to greater number of molecules*

1

(ii) *they = hydrocarbons from the graph*

it = C30H62

any **two** from:

- low boiling point / volatile

  accept they are gases or liquids

- low viscosity

- high flammability

  accept easier to burn / ignite

- small molecules

  accept short chains

  ignore number of carbon atoms

- burn completely

ignore speed of burning

2

(c) (i) 16 (CO_2) + 18 (H_2O)

1

(ii) (carbon dioxide in the Earth's early) atmosphere

accept from volcanoes (millions of years ago)

or *from <u>dead</u> plants / animals*

allow dead sea creatures

ignore shells

1

(iii) <u>increase</u> in burning / use of fossil fuels

1

locked up carbon (carbon dioxide) is released

allow carbon / carbon dioxide from millions of years ago is released

accept extra carbon dioxide is not 'absorbed' (by the carbon cycle)

1

[8]

M6. (a) (thought to cause) global warming / green house (effect) / climate change

ignore other consequences of global warming

*do **not** accept acid rain / ozone layer / global dimming*

1

(b) any **three** from:

- replant trees / renewable / sustainable

  ignore reusable

- carbon (dioxide) used by trees / photosynthesis

  accept trees absorb carbon (dioxide) as they grow

  ignore respiration

- it is a (continuous / carbon) cycle

  accept burning wood is carbon neutral

  or

  carbon (dioxide) goes back into the air

  *for the **second** and **third** bullet points: accept trees use carbon dioxide which is released when (trees / wood are / is) burnt for **2** marks*

- no new carbon (dioxide) is produced

  or

  no locked up carbon (dioxide) is released

  or

  the carbon (dioxide) was absorbed millions of years ago

3

[4]

M7. (a) (i) straight line through the 'points' and extended to C8H18

*do **not** accept multiple lines*

1

(ii) 5500

range 5400 to 5600

accept ecf from their graph

1

(iii) it is a straight line graph

allow directly proportional

accept constant difference between (energy) values

accept C5H12 close to values on the graph

***or** C5H12 comes in middle of the graph*

ignore 'fits the pattern' unqualified

ignore 'line of best fit'

ignore 'positive correlation'

1

(iv) expected ranges for working are:

accept correct numerical answer as evidence of working

(5400 to 5600) – (2800 to 2900) = (2500 to 2800)

or

their value from (a)(ii) – a value from 2800 to 2900

or

(5400 to 5600) / their (a)(ii) divided by 2

or

a value from 2800 to 2900 - 2

1

no / not quite / almost / yes

this mark is only awarded on evidence from their correct working

1

(b) (i) incorrect / no **or** partially correct

ignore references to hydrogen

1

bio-ethanol produces least energy

mark independently

or

bio-ethanol produces 29 kJ

1

(ii) *ignore incorrect / correct*

any **two** from:

- hydrogen produces only H_2O

  accept hydrogen does not produce harmful gases / CO_2 / SO_2

- coal produces SO_2

  allow coal causes acid rain / respiratory problems

- coal produces smoke

  allow coal causes global dimming

- both renewable and non-renewable fuels produce CO_2

  accept bio-ethanol and natural gas / coal produce CO_2 / global warming

- (both) the non-renewable fuels produce CO_2

  accept coal and natural gas produce CO_2 / global warming

- (both) renewable fuels produce no smoke

  accept hydrogen and bio-ethanol do not produce smoke / global dimming

- (both) renewable fuels produce no SO_2

  accept hydrogen and bio-ethanol

  do not produce SO_2 / acid rain

2

[9]

Q1. A mixture of petrol and air is burned in a car engine.
Petrol is a mixture of alkanes. Air is a mixture of gases.

The tables give information about the composition of petrol and the composition of air.

Petrol	
Alkane	**Formula**
hexane	C_6H_{14}
heptane	
octane	C_8H_{18}
nonane	C_9H_{20}
decane	$C_{10}H_{22}$

Air	
Gas	**Percentage (%)**
nitrogen	78
oxygen	21
carbon dioxide	0.035
Small amounts of other gases and water vapour	

(a) Use the information above to answer these questions.

(i) Give the formula for heptane

.....

(1)

(ii) Complete the general formula of alkanes.
n = number of carbon atoms

$$C_nH$$

(1)

(b) Alkanes in petrol burn in air.
The equations represent two reactions of hexane burning in air.

Reaction 1 $2C_6H_{14} + 19O_2 \rightarrow 12CO_2 + 14H_2O$

Reaction 2 $2C_6H_{14} + 13O_2 \rightarrow 12CO + 14H_2O$

Reaction 2 produces a different carbon compound to **Reaction 1.**

(i) Name the carbon compound produced in **Reaction 2.**

.....

(1)

(ii) Give a reason why the carbon compounds produced are different.

.....

.....

(1)

(c) The table shows the percentages of some gases in the exhaust from a petrol engine.

Name of gas	**Percentage (%)**
nitrogen	68
carbon dioxide	15
carbon monoxide	1.0
oxygen	0.75
nitrogen oxides	0.24
hydrocarbons	0.005
sulfur dioxide	0.005
other gases	

(i) What is the percentage of the other gases in the table?

.....

(1)

(ii) What is the name of the compound that makes up most of the other gases?

.....

(1)

(iii) Give a reason why sulfur dioxide is produced in a petrol engine.

.....

.....

(1)

(iv) State how nitrogen oxides are produced in a petrol engine.

.....

.....

.....

.....

(2)

(d) Many scientists are concerned about the carbon dioxide released from burning fossil fuels such as petrol.

Explain why.

.....

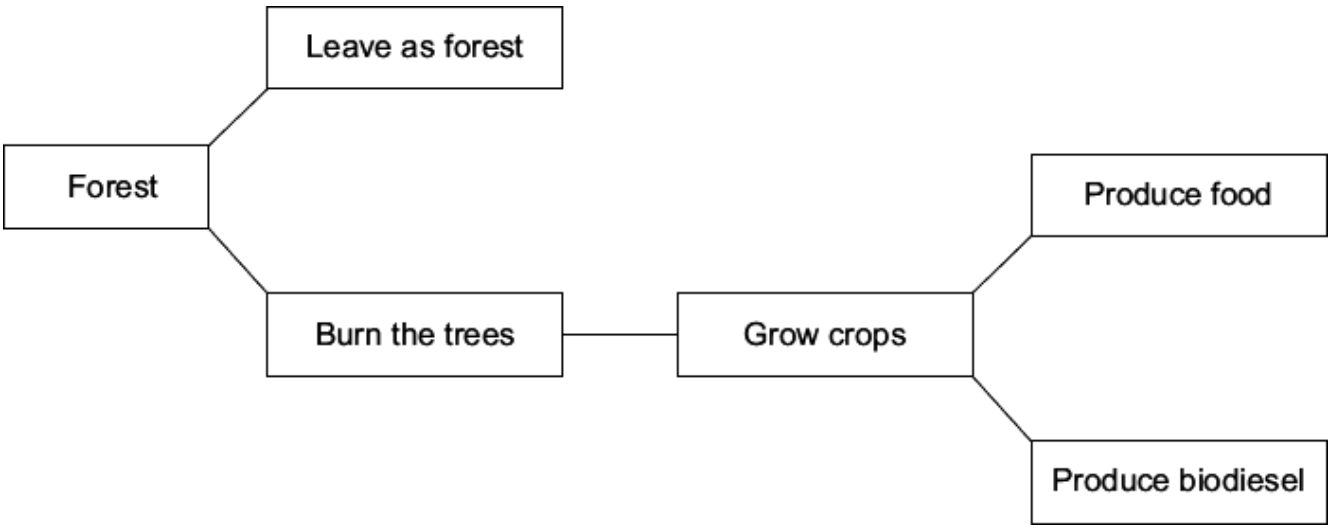
.....

.....

.....

(2)
(Total 11 marks)

Q2. Petroleum diesel is a fuel made from crude oil.
Biodiesel is a fuel made from vegetable oils.
To make biodiesel, large areas of land are needed to grow crops from which the vegetable oils are extracted.
Large areas of forest are cleared by burning the trees to provide more land for growing these crops.



(a) Use this information and your knowledge and understanding to answer these questions.

(i) Carbon neutral means that there is no increase in the amount of carbon dioxide in the atmosphere.

Suggest why adverts claim that using biodiesel is carbon neutral.

.....

.....

.....

.....

.....

.....

(2)

(ii) Explain why clearing large areas of forest has an environmental impact on the atmosphere.

.....

.....

.....

.....

.....

.....

(2)

(b) Why is there an increasing demand for biodiesel?

.....

.....

(1)

(c) Suggest why producing biodiesel from crops:

(i) causes ethical concerns

.....

.....

(1)

(ii) causes economic concerns.

.....

.....

(1)
(Total 7 marks)

Q3. About 3000 million years ago, carbon dioxide was one of the main gases in the Earth's atmosphere.

About 400 million years ago, plants and trees grew on most of the land. When the plants and trees died they were covered by sand and slowly decayed to form coal.

(a) Describe and explain how the composition of the Earth's atmosphere was changed by the formation of coal.

.....

.....

.....

.....

.....

.....

.....

.....

(3)

(b) Today, coal is burned in power stations to release the energy needed by industry. Carbon dioxide, water and sulfur dioxide are produced when this coal is burned.

Name **three** elements that are in this coal.

.....

.....

.....

(2)

(c) In some power stations coal is mixed with calcium carbonate (limestone). The mixture is crushed before it is burned.

(i) Many chemical reactions happen when this mixture is burned. The chemical equation represents one of these reactions.

Balance the chemical equation.

$2CaCO_3(s) + 2SO_2(g) + O_2(g) \rightarrow \ldots\ldots CaSO_4(s) + \ldots\ldots CO_2(g)$

(1)

(ii) Explain how the use of calcium carbonate in the mixture:

increases atmospheric pollution

.....

.....

.....

.....

decreases atmospheric pollution.

.....

.....

.....

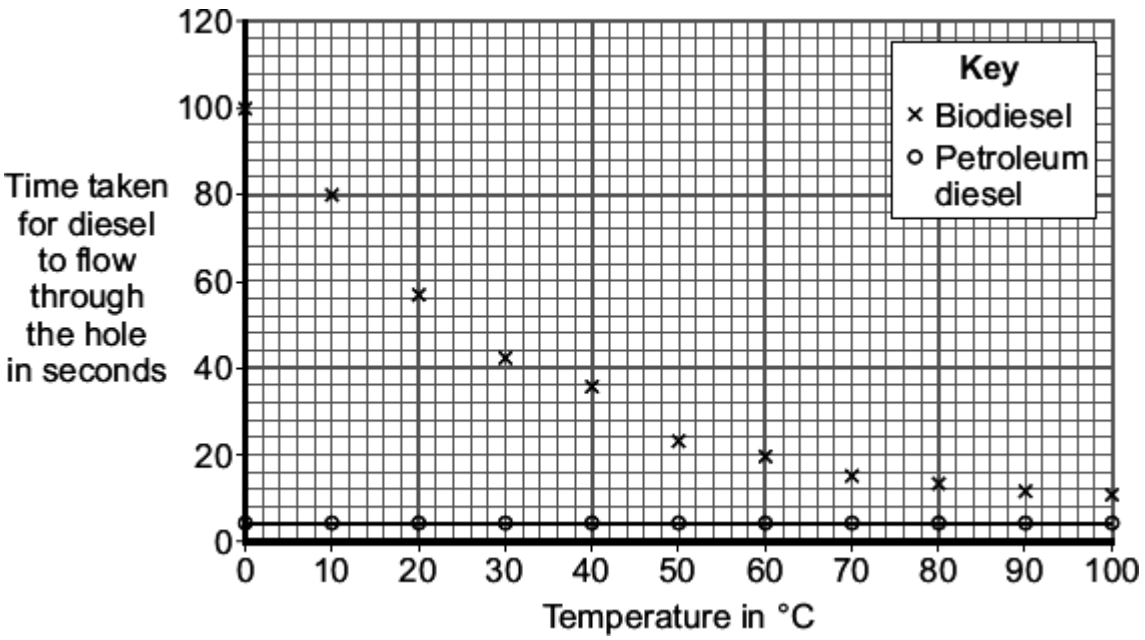
.....

(4)
(Total 10 marks)

Q4. There are two main types of diesel fuel used for cars:

- biodiesel, made from vegetable oils
- petroleum diesel, made from crude oil.

(a) A scientist compared the viscosity of biodiesel with petroleum diesel at different temperatures.
The scientist measured the time for the same volume of diesel to flow through a small hole in a cup.
The scientist's results are plotted on the grid.



(i) Draw a line of best fit for the biodiesel results.

(1)

(ii) What conclusions can the scientist make about the viscosity of biodiesel compared with the viscosity of petroleum diesel at different temperatures?

.....

.....

.....

.....

(2)

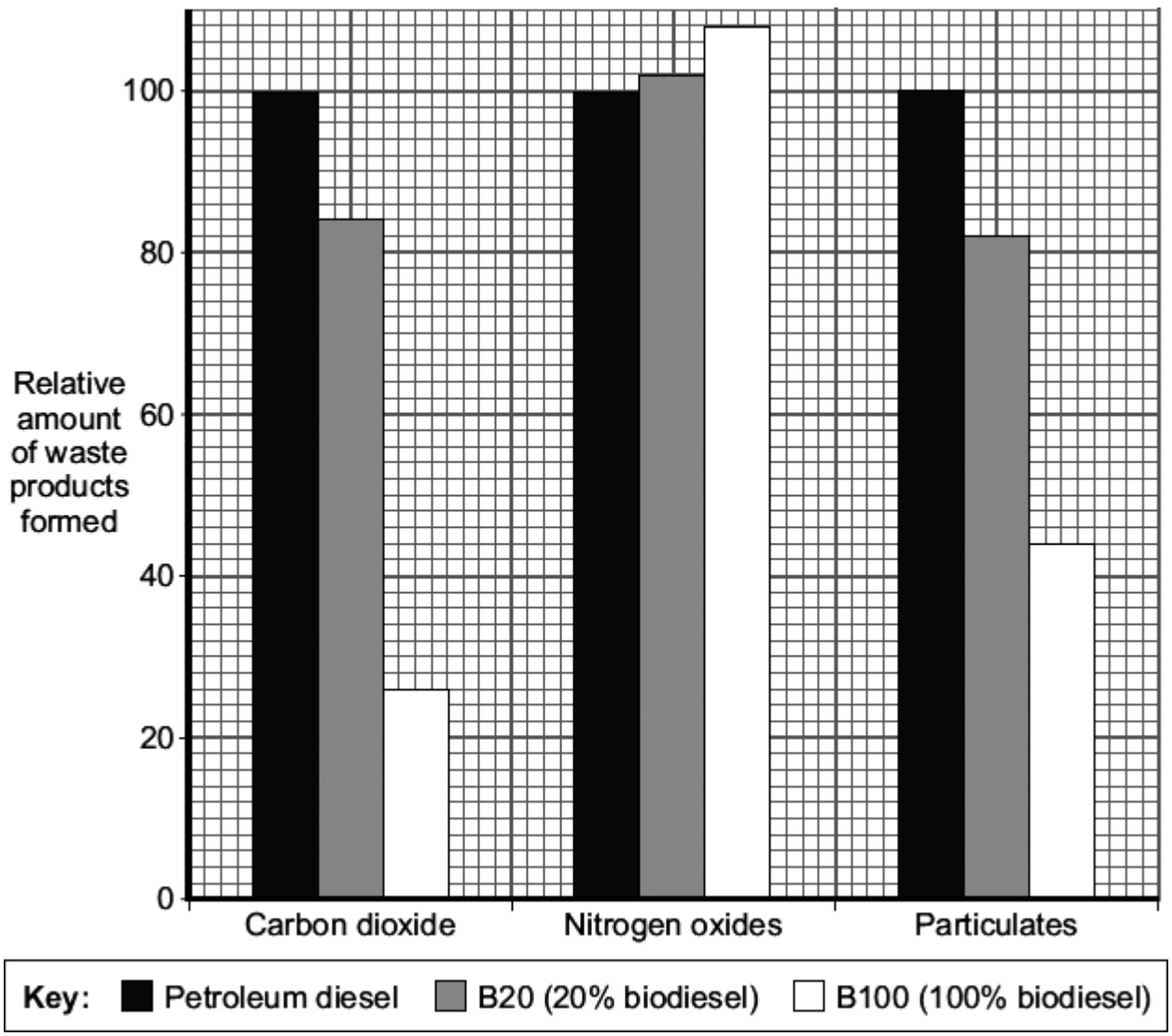
(iii) Biodiesel may be less suitable than petroleum diesel as a fuel for cars.
Use these results to suggest **one** reason why.

.....

.....

(1)

(b) Biodiesel can be mixed with petroleum diesel to make a fuel for cars.
In a car engine, the diesel fuel burns in air.
The waste products leave the car engine through the car exhaust system.
The bar chart compares the relative amounts of waste products made when three different types of diesel fuel burn in a car engine.



Nitrogen oxides and sulfur dioxide cause a similar environmental impact.

(i) What environmental impact do particulates from car exhaust systems cause?

.....

(1)

(ii) What is the percentage reduction in particulates when using B100 instead of petroleum diesel?

..... %

(1)

(iii) Replacing petroleum diesel with biodiesel increases one type of environmental pollution.

Use the bar chart and the information given to explain why.

.....

.....

.....

.....

(2)

(iv) A carbon neutral fuel does **not** add extra carbon dioxide to the atmosphere.

Is biodiesel a carbon neutral fuel?

Use the bar chart and your knowledge to explain your answer.

.....

.....

.....

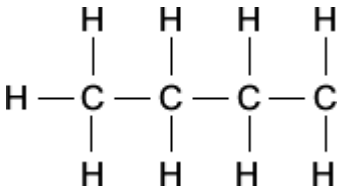
.....

(2)
(Total 10 marks)

Q5. Crude oil is a mixture of hydrocarbons. Most of these hydrocarbons are alkanes.

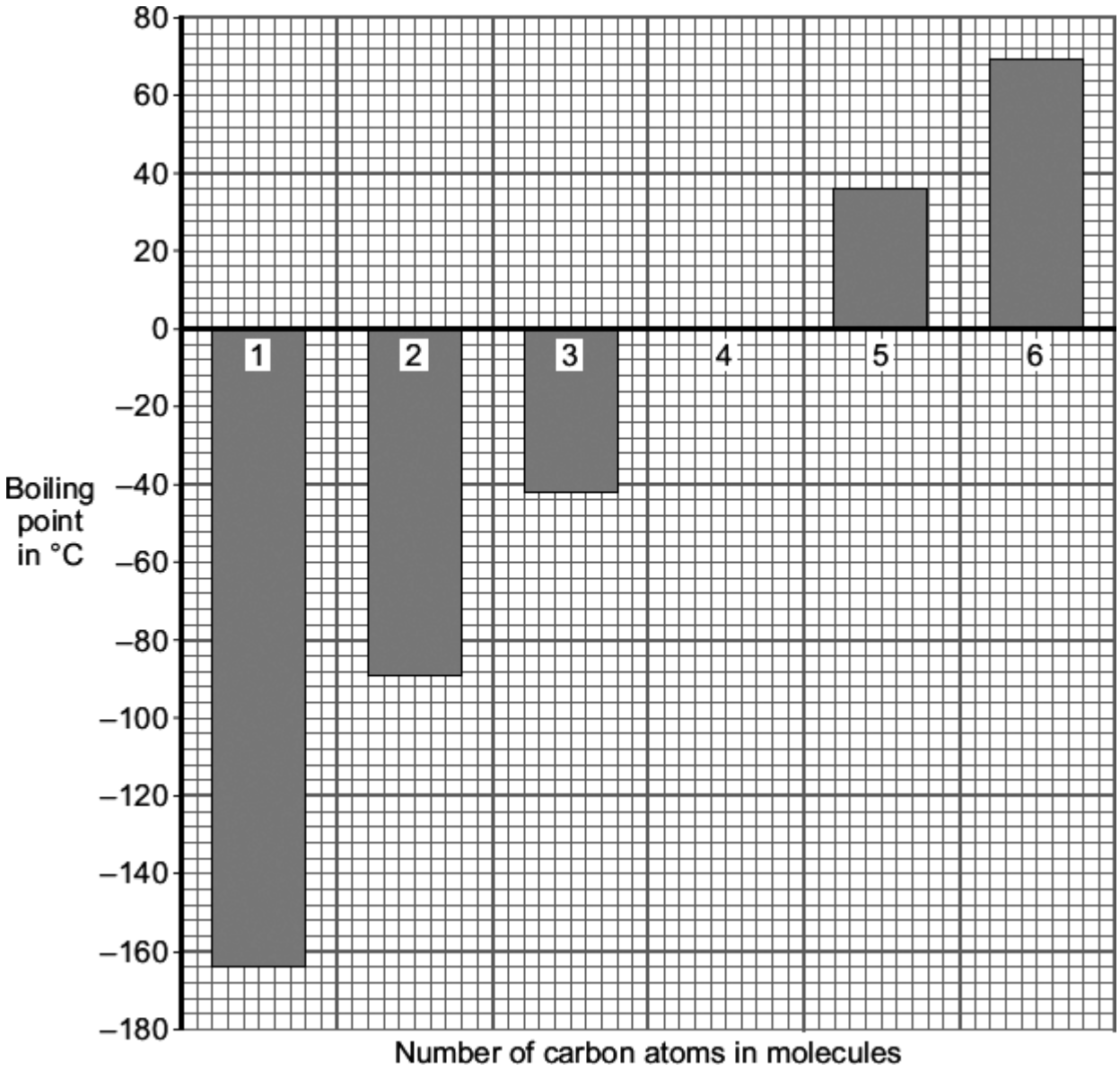
(a) The general formula of an alkane is C_nH_{2n+2}

Complete the structural formula for the alkane that has **six** carbon atoms in its molecules.



(1)

(b) The boiling points of alkanes are linked to the number of carbon atoms in their molecules.



(i) Describe the link between the number of carbon atoms in an alkane molecule and its boiling point.

.....

.....

(1)

(ii) Suggest **two** reasons why all of the alkanes in the bar chart are better fuels than the alkane with the formula $C_{30}H_{62}$

1 .....

.....

2 .....

.....

(2)

(c) During the last 200 million years the carbon cycle has maintained the percentage of carbon dioxide in the atmosphere at about 0.03 %.
Over the last 100 years the percentage of carbon dioxide in the atmosphere has increased to about 0.04 %.
Most of this increase is caused by burning fossil fuels to heat buildings, to generate electricity and to power our transport.
Fossil fuels contain carbon that has been locked up for millions of years.

(i) Burning fossil fuels, such as petrol, releases this locked up carbon. Balance the chemical equation for the combustion of one of the alkanes in petrol.

$2\ C_8H_{18} + 25\ O_2 \longrightarrow$ ..... CO_2 + ... H_2O

(1)

(ii) Where did the carbon that is locked up in fossil fuels come from?

.....

.....

(1)

(iii) The burning of fossil fuels has caused the percentage of carbon dioxide in the atmosphere to increase to above 0.03 %.
Explain why.

.....

.....

.....

.....

.....

.....

(2)
(Total 8 marks)

Q6. Many human activities result in carbon dioxide emissions.
Our carbon footprint is a measure of how much carbon dioxide we each cause to be produced.

(a) Why should we be concerned about our carbon footprint?

.....

.....

.....

(1)

(b) Most power stations in the UK burn coal.
Coal was formed from tree-like plants over millions of years.

Suggest why burning wood instead of coal would help to reduce our carbon footprint.

.....

.....

.....

.....

.....

.....

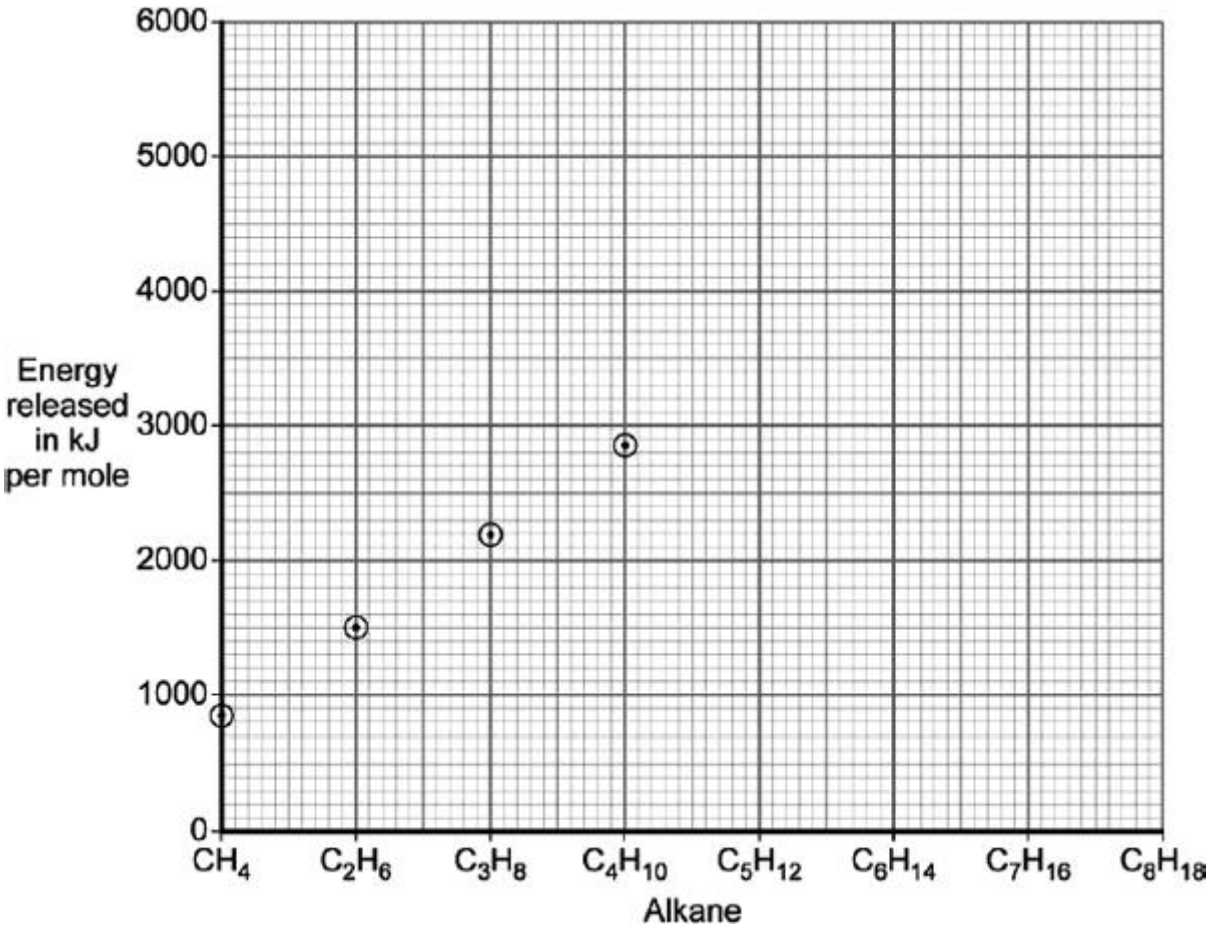
.....

.....

(3)
(Total 4 marks)

Q7. (a) Alkanes are important hydrocarbon fuels. They have the general formula C_nH_{2n+2}

The points on the graph show the amount of energy released when 1 mole of methane (CH_4), ethane (C_2H_6), propane (C_3H_8) and butane (C_4H_{10}) are burned separately.



(i) Draw a line through the points and extend your line to the right-hand edge of the graph.

(1)

(ii) Use the graph to estimate the amount of energy released when 1 mole of octane (C_8H_{18}) is burned.

Energy released = ... kJ

(1)

(iii) Suggest why we can make a good estimate for the energy released by 1 mole of pentane (C_5H_{12}).

.....

.....

(1)

(iv) A student noticed that octane (C_8H_{18}) has twice as many carbon atoms as butane (C_4H_{10}), and made the following prediction:

"When burned, 1 mole of octane releases twice as much energy as 1 mole of butane."

Use the graph to decide if the student's prediction is correct. You **must** show your working to gain credit.

.....

.....

.....

.....

(2)

(b) Some information about four fuels is given in the table.

			Combustion products			
Fuel	**Type**	**Heat released in kJ per g**	**CO_2**	**SO_2**	**H_2O**	**Type of flame**
Bio-ethanol	Renewable	29	✓		✓	Not smoky
Coal	Non-renewable	31	✓	✓	✓	Smoky
Hydrogen	Renewable	142			✓	Not smoky
Natural gas	Non-renewable	56	✓		✓	Not smoky

From this information a student made two conclusions.

For each conclusion, state if it is correct **and** explain your answer.

(i) "Renewable fuels release more heat per gram than non-renewable fuels."

.....

.....

.....

.....

(2)

(ii) "Non-renewable fuels are better for the environment than renewable fuels."

.....

.....

.....

.....

.....

.....

.....

(2)
(Total 9 marks)

M1.(a) any **one** from:

- complex systems
- many different variables
- many alternative theories

1

(b) carbon dioxide allows short wavelength radiation to pass through

allow greenhouse gas(es) for carbon dioxide

1

the atmosphere to the Earth's surface

1

carbon dioxide absorbs outgoing long wavelength radiation

1

(c) general increase in temperature caused by increase in greenhouse gases

1

any **two** human activities correctly linked to a named greenhouse gas

eg

increased burning of fossil fuels causes more carbon dioxide

2

deforestation causes more carbon dioxide

more cattle production causes more methane

use of landfill causes more methane

[7]

M2. any **four** from:

*to gain **4** marks both pros and cons should be given*

Arguments for biodiesel

max **three** from:

- sustainable / renewable
- (carbon neutral) absorbs CO_2 when growing / during photosynthesis
- burning biodiesel produces low amounts particulates / carbon monoxide

  allow burning biodiesel produces little / low amount of global dimming

  ignore sulfur dioxide
- can use waste vegetable oils / fats (from food industry) **or** can use waste plant material
- can be used to conserve crude oil (instead of / mixed with petroleum diesel)
- produced by a low energy / temperature process

  accept produced by a low tech process
- biodegrades (easily)

  ignore engine effects

Arguments against biodiesel

max **three** from:

- creates food shortages

  accept price of food increases
- deforestation to plant more crops leads to loss of habitat / biodiversity **or** deforestation leads to a reduction in absorption of CO_2

  allow burning trees increases CO_2

  allow deforestation increases global warming
- burning biodiesel produces high amounts of nitrogen oxides

  allow increases acid rain
- crops takes time to grow

  allow crops can fail
- vast areas of land needed to grow crops

4

conclusion supported by the argument presented, which must give added value to the points for and against given above

1

[5]

M3. (a) (i) (thermal) decomposition

allow it breaks down

accept symbol equation or in words

allow reaction with SO_2 (to form CO_2)

1

(ii) calcium carbonate / calcium oxide / limestone / quicklime / it <u>reacts</u> with sulfur dioxide / <u>forms</u> calcium sulfate

accept it <u>neutralises</u> sulfur dioxide / <u>neutralisation</u>

ignore references to sulfur

do not accept 'calcium reacts with...'

1

(b) by incomplete / partial combustion (of the fuel)

1

insufficient oxygen / *air* (to burn fuel)

*accept insufficient oxygen / air to burn fuel completely for **2** marks*

if no other marks awarded

*accept $C + CO_2 \rightarrow 2CO$ **or***

*$2C + O_2 \rightarrow 2CO$ **or** in words for **1** mark*

1

(c) (i) any **two** from:

- (CO_2) from the atmosphere
- (CO_2) taken in millions of years ago **or** early (atmosphere)

  allow thousands / billions

  allow rocks formed millions of years ago
- (CO_2) was used to form the shells / skeletons of marine organisms / fossil fuels

  accept sedimentary rocks

  allow used to form correct named fossil fuel

  ignore limestone

2

(ii) any **one** from:

- (increases / enhances) global warming
  allow greenhouse gas / effect
  *do **not** accept ozone layer / acid rain / global dimming*
  ignore consequences of global warming

- is <u>additional</u> carbon dioxide **or** not able to be absorbed by oceans / seas **or** used by (green) plants

- acidification of sea water

1

[7]

M4. (a) (i) acid rain

accept consequences of acid rain

allow asthma / bronchitis

ignore toxic gas

1

(ii) global dimming

accept dimming alone

1

(b) (i) **sustainable:**

maximum **two** from:

- crops (that produce oil) can be grown in most places owtte
- renewable
- use less fossil fuels / diesel
- use (refined) waste oils

low pollution:

maximum **two** from:

ignore references to CO_2 here

- most emissions are lower **or** any two named emissions from CO / SO_2 / PM_{10} are lower
- much / lot less SO_2 emissions (than the others) owtte
- accept spillages / waste is biodegradable
- less new CO_2 **or** (more) carbon neutral

3

(ii) plants / photosynthesis use carbon (dioxide) from the air*

1

it / biodiesel releases carbon (dioxide) from plants / crops / photosynthesis*

*(*) allow **1** mark for biodiesel is (more) carbon neutral*

1

(fossil) diesel releases 'locked up' / new carbon (dioxide) / doesn't absorb CO_2 / absorbed it millions of years ago

1

[8]

M5. (a) any **two** environmental problems with linked explanations

- global warming (1)
  accept effects of global warming

  caused by (formation of) carbon dioxide / greenhouse gas (1)
  ignore greenhouse effect

- acid rain (1)
  accept effects of acid rain
  ignore respiratory problems

  caused by (formation of) sulfur dioxide (1)
  accept sulfur oxide
  ignore sulfuric acid

- global dimming (1)
  ignore respiratory problems

  caused by (formation of) particles / particulates / fires / smoke / carbon / pm 10 (1)

- scarring of landscape (1)

  caused by mining / quarrying of coal (1)
  ignore ozone layer

max 4

(b) any **three** from:

- replant the trees / renewable / sustainable
  ignore reusable

- carbon dioxide is used by the trees / photosynthesis
  accept trees absorb carbon dioxide as they grow
  *do **not** allow respiration*

- it's a (continuous carbon) cycle
  accept 'carbon dioxide goes back into the air'
  accept trees use CO_2 which is released when trees are burnt

- no 'new' carbon (dioxide) is produced **or**
  no locked up carbon (dioxide) is released
  accept no carbon (dioxide) from fossil fuels is produced

3

[7]

M6. (a) **Quality of written communication**

for any two ideas sensibly stated

1

any **three** from:

- plants take in (CO_2)

  accept photosynthesis uses (CO_2)

- converted to glucose / starch / carbohydrates

  ignore carbon compounds by itself

- CO_2 locked up in fossil fuels

  accept coal / oil / <u>natural</u> gas / methane for fossil fuels

- CO_2 reacts with / dissolves (sea)water

  accept ocean removes CO_2

- producing hydrogencarbonates

  accept carbonic acid

- producing carbonates

  accept named carbonates

- marine animals use carbonates to make shells

  *do **not** accept bones*

- forms sedimentary rocks

  accept limestone / chalk
  accept marble
  *do **not** accept sediments alone*

3

(b) any **two** from:

- burning of fossil fuels **or** cars / industry / air travel / power stations

  ignore increase in population
  ignore more use of electricity

- natural processes cannot absorb all the extra CO_2

- deforestation

  accept less photosynthesis

ignore volcanic activity
accept burn trees

2

[6]

M7. (a) (i) burning / breathing / respiration / fuels / food

for 1 mark each

2

(ii) 1. rock is heated / subducted (owtte) / close to magma / melted
1. rock is decomposed / carbon dioxide released through volcanoes

for 1 mark each

2

(b) carbon dioxide reacts / dissolves in sea-water / dissolves in rain water
insoluble carbonates / calcium carbonate are / is formed carbon dioxide turned into shells / coral / limestone / chalk / sediments also soluble hydrogencarbonates (calcium / magnesium) are formed photosynthesis by plants

any three for 1 mark each

3

(c) (i) sea unable to absorb all the extra carbon dioxide being produced
more trees being cut down / deforestation increased burning of fuels / more cars / more industry (*not* more people)

any one for 1 mark

1

(ii) global warming / greenhouse effect or effects such as melting ice caps / rising sea levels / climatic change / more deserts
(*not* changes to ozone layer)

for one mark

1

[9]

M8. (a) any **two** 1 mark each

burning / combustion

fossil fuels **or** (locked up) carbon
accept fuel / named fuel

oxygen used

2

(b) any **three** from

produces (calcium) carbonate

which is insoluble

produces (calcium) hydrogencarbonate

which is soluble

photosynthesis

releases oxygen

3

[5]

Q1. This question is about the temperature of the Earth's atmosphere.

(a) Give **one** reason why it is difficult to produce models for future climate change.

.....

.....

(1)

(b) Describe how carbon dioxide helps to maintain temperatures on Earth.

.....

.....

.....

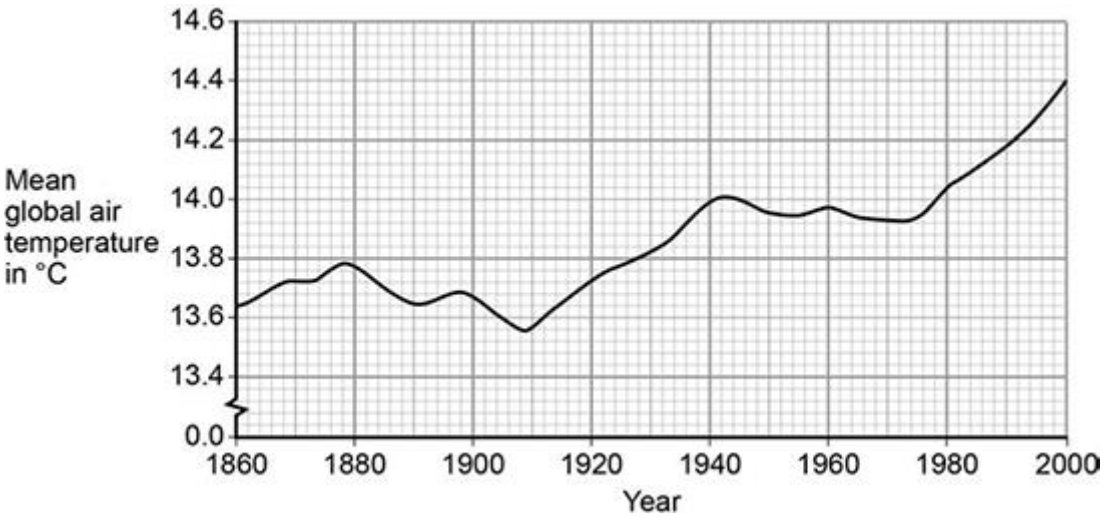
.....

.....

.....

(3)

(c) The figure below shows the change in mean global air temperature from 1860 to 2000.



Explain how human activities have contributed to the main trend shown from 1910 in the figure above.

.....

.....

.....

.....

.....

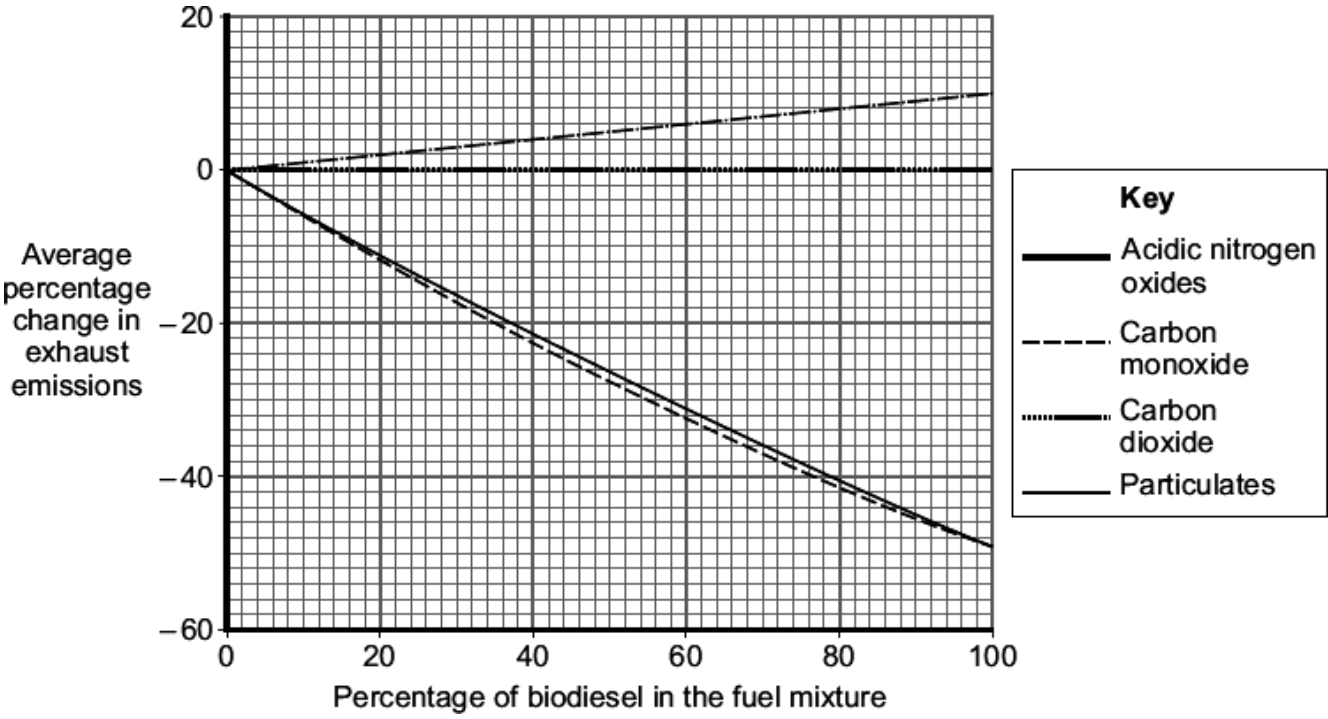
(3)
(Total 7 marks)

Q2. Petroleum diesel is produced from crude oil.

Most vehicles that use petroleum diesel as fuel can also use biodiesel or a mixture of these two fuels. In the UK (in 2010) there must be 5 % biodiesel in all petroleum diesel fuel.

Biodiesel is produced from plant oils such as soya. The crops used to produce biodiesel can also be used to feed humans. The benefit that biodiesel is 'carbon neutral' is outweighed by the increasing demand for crops. This increasing demand is causing forests to be burnt to provide land for crops to produce biodiesel. Only a huge fall in the price of petroleum diesel would halt the increasing use of biodiesel.

The graph shows the average percentage change in exhaust emissions from vehicles using different mixtures of petroleum diesel and biodiesel.



There is no difference in carbon dioxide emissions for all mixtures of petroleum diesel and biodiesel.

Use the information and your knowledge and understanding to evaluate the use of plant oils to produce biodiesel.

Remember to give a conclusion to your evaluation.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

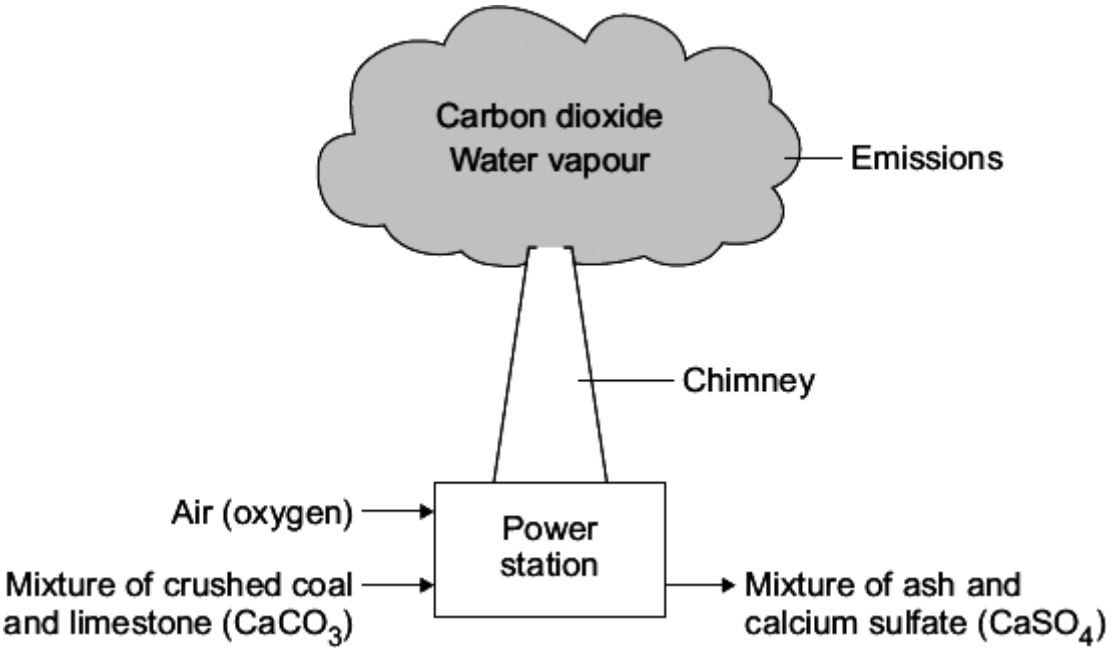
.....

.....

.....

(5)
(Total 5 marks)

Q3. Most power stations burn coal to generate electricity. Burning coal gives off sulfur dioxide gas which can be removed from the waste gases by using limestone.
This prevents sulfur dioxide from entering the atmosphere and causing acid rain.
One disadvantage of using limestone in a power station is that it releases 'locked up carbon dioxide' into the atmosphere.



(a) How does the limestone used in a power station:

(i) release carbon dioxide

.....

.....

(1)

(ii) remove sulfur dioxide?

.....

.....

(1)

(b) The waste gases from the chimney are monitored. One toxic gas that should not be released is carbon monoxide.

Explain how carbon monoxide would be formed.

.....

.....

.....

.....

(2)

(c) The use of limestone in a power station releases 'locked up carbon dioxide' into the atmosphere.

(i) Explain the meaning of 'locked up carbon dioxide'.

.....

.....

.....

.....

(2)

(ii) Why does the release of this carbon dioxide cause an environmental problem?

.....

.....

.....

(1)
(Total 7 marks)

Q4. Since 2000 there has been a lot more research into alternative, environmentally-friendly fuels for road transport.

Several pollutants are found in the exhaust emissions produced when fossil fuels are used for road transport.

Carbon monoxide (CO) interferes with the way that red blood cells carry oxygen. Carbon dioxide (CO_2) increases the level of carbon dioxide in the atmosphere and causes global warming.

Oxides of nitrogen (NO_x) are produced at high temperatures when nitrogen and oxygen from the atmosphere combine.

Sulfur dioxide (SO_2) is produced when sulfur impurities in the fuel combine with oxygen in the atmosphere.

Tiny particles of solids are produced when the fuel does not burn completely.

This increases the level of particulates (PM10) in the atmosphere.

(a) Name the environmental effect caused by:

(i) oxides of nitrogen (NO_x) and sulfur dioxide (SO_2)

.....

(1)

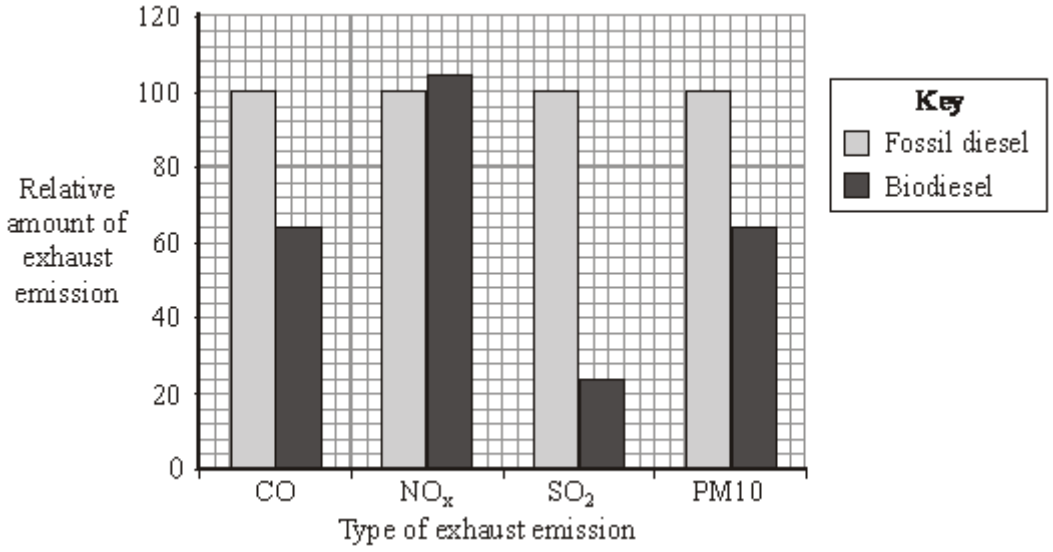
(ii) the increased level of particulates (PM10).

.....

(1)

(b) Diesel obtained from crude oil is often called fossil diesel. Biodiesel can be made from many vegetable oils. One research project compared the exhaust emissions when fossil diesel or biodiesel were used as fuels.

Some of the relative amounts of these exhaust emissions are shown in the bar chart.



(i) Use your knowledge and the information above to explain the environmental benefits of using biodiesel as a sustainable, low pollution fuel.

.....

.....

.....

.....

.....

.....

(3)

(ii) Biodiesel is called a green fuel.

This is because the life-cycle emission of carbon dioxide from biodiesel is less than that from fossil diesel.

Use your knowledge and the information above to explain why biodiesel's contribution to global warming is considered to be much less than that of fossil diesel.

.....

.....

.....

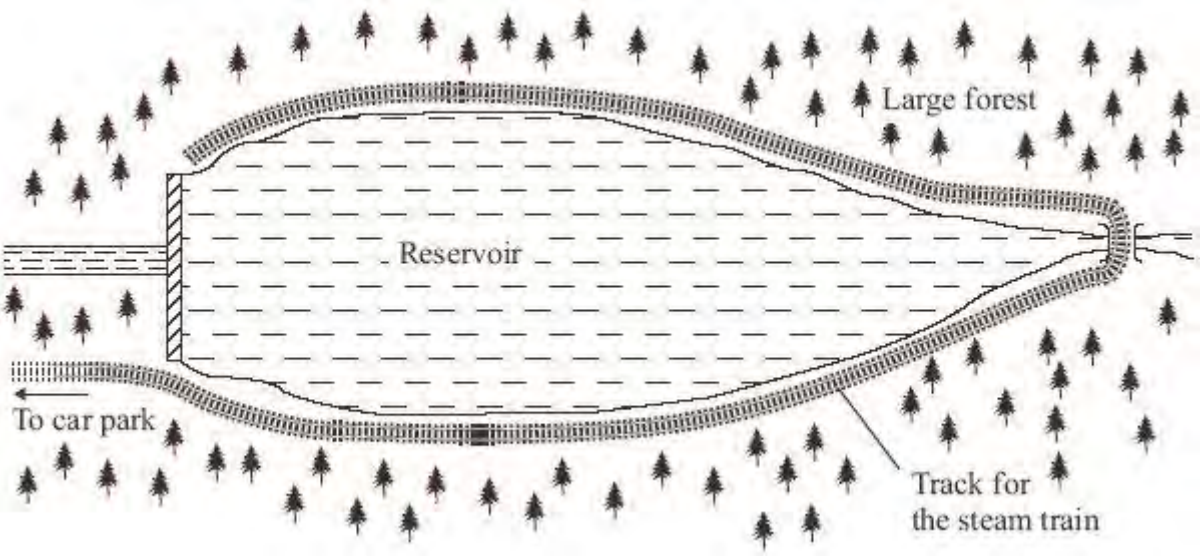
.....

.....

.....

(3)
(Total 8 marks)

Q5. A large reservoir is surrounded by trees. Planners need to protect the environment. The distance around the reservoir is many kilometres. There will be only one road access to a car park a few kilometres from the reservoir. From the car park people would be transported to accommodation, activities or places of interest by steam train.



(a) Coal contains carbon and small amounts of sulfur. The steam train would cause environmental problems if coal were used as the fuel.

Explain why.

.....

.....

.....

.....

.....

.....

.....

.....

(4)

(b) The planners have stated that, as a result of using the steam train, there must be no overall increase of carbon dioxide added to the atmosphere. The steam train would be considered as 'carbon neutral' if wood, from the surrounding forest, were used as the fuel.

Suggest why.

.....

.....

.....

.....

.....

.....

(3)
(Total 7 marks)

Q6. (a) For the last 200 million years the amount of carbon dioxide in the atmosphere has remained almost the same.

Describe the natural processes which remove carbon dioxide from the atmosphere.

To gain full marks in this question you should write your ideas in good English.
Put them into a sensible order and use the correct scientific words.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(4)

(b) The amount of carbon dioxide in the atmosphere has increased over the last one hundred years. Suggest **two** reasons why this has happened.

1 .....

.....

2 .....

.....

(2)
(Total 6 marks)

Q7. For 200 million years the proportions of the different gases in the atmosphere have been much the same as today. Over the past 150 years the amount of carbon dioxide in the atmosphere has increased from 0.03% to 0.04%.

(a) Describe how carbon dioxide is released into the atmosphere:

(i) by human and industrial activity;

.....

.....

.....

.....

(2)

(ii) from carbonate rocks by geological activity.

.....

.....

.....

.....

(2)

(b) Explain how the seas and oceans can decrease the amount of carbon dioxide in the atmosphere.

.....

.....

.....

.....

.....

.....

(3)

(c) (i) Give **one** reason why the amount of carbon dioxide in the atmosphere is increasing gradually.

.....

.....

(1)

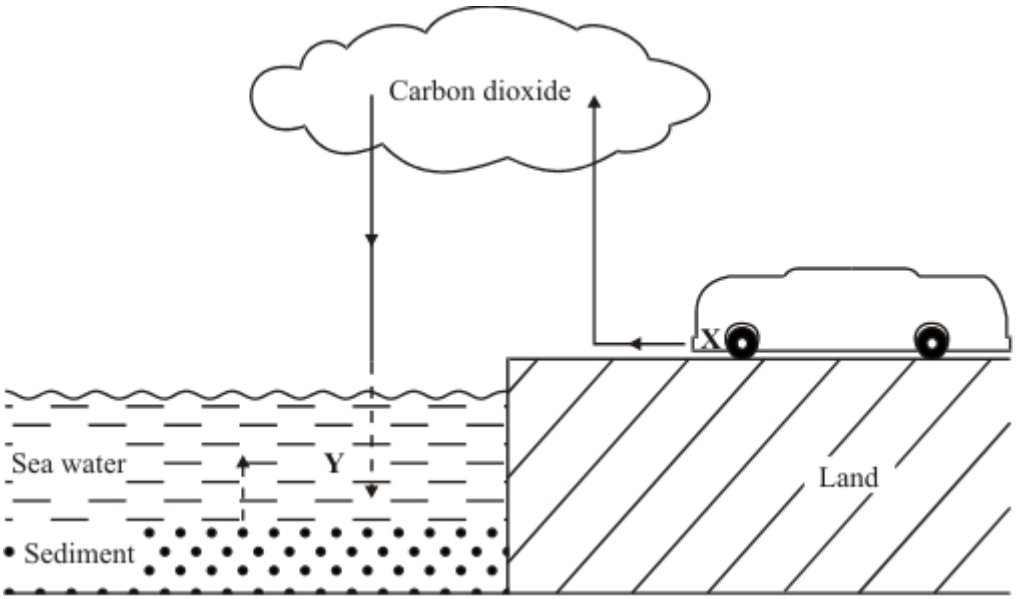
(ii) Give **one** effect that increasing levels of carbon dioxide in the atmosphere may have on the environment.

.....

.....

(1)
(Total 9 marks)

Q8. The amount of carbon dioxide in the atmosphere is increased by reactions that occur in internal combustion engines (**X**) and is decreased by reactions in sea water (**Y**).



Describe, in as much detail as you can, the reactions which take place at **X** and **Y**.

(a) **X** .....

.....

.....

.....

(2)

(b) **Y** .....

.....

.....

.....

(3)
(Total 5 marks)

M1.(a) C_5H_{12}

1

(b) Alkanes

1

(c) (3) CO_2

1

(4) H_2O

1

*allow for **1** mark*

4 CO_2 + 3 H_2O

(d) contains hydrogen and carbon

1

(hydrogen and carbon) only

1

(e) *(diesel)*
produces more oxides of nitrogen

allow converse answers in terms of petrol

1

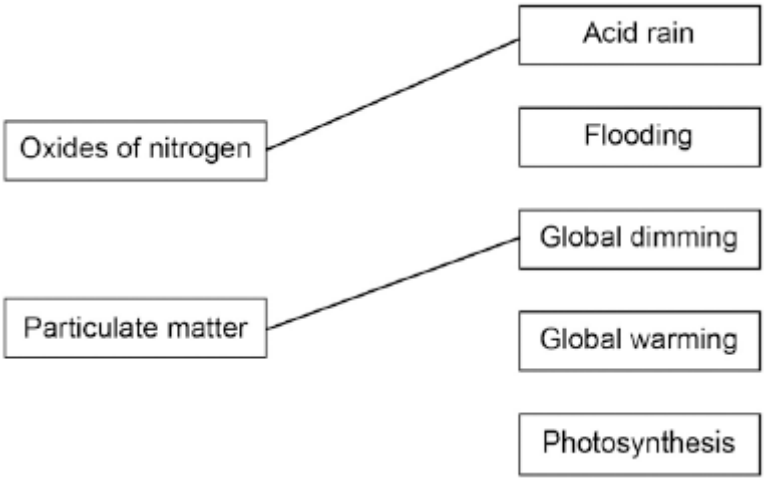
produces (more) particulate matter

1

produces less carbon dioxide

1

(f)



2

[11]

M2.(a) (i) mixture (of different substances)

1

(ii) boiling (points)

1

(iii) distillation

1

(b) (i) combustion

1

(ii) (reactant)

oxygen

allow correct formulae

1

(products)

products in any order

carbon dioxide

allow carbon or carbon monoxide

and

water

allow water vapour or steam or hydrogen oxide

1

(iii) (burning sulfur) produces sulfur dioxide / SO_2

allow it / sulfur reacts with oxygen ignore sulfur oxide

1

causes acid rain

1

(c) (i) propane is a fuel

1

(ii) double bond drawn between carbon atoms

do not allow any other bonds or symbols

1

(iii) orange to colourless

1

(iv) poly(pentene)

allow polymer(s)

1

[12]

M3. (a) (i) bar drawn between 84 and 86

1

(ii) sulfur dioxide linked to acid rain

1

carbon particles linked to global dimming

1

(b) (i) any **one** from:

- plants / trees <u>absorb</u> (carbon dioxide)
- coal '<u>locks up</u>' (carbon dioxide)

1

(ii) it <u>increases</u> the amount (of CO_2)

1

because carbon in coal (forms carbon dioxide)

accept because carbon / coal burns / reacts <u>with oxygen</u> (to produce CO_2)

1

[6]

M4. (a) (i) increase

1

(ii) energy is given out to the surroundings

1

(b) (i) NO

allow 2NO

ignore nitrogen oxide

*do **not** allow equations*

1

(ii) harmful / poisonous (owtte)

allow dangerous

ignore reference to pollution / global warming

*do **not** accept references to ozone layer*

1

(c) a catalyst can speed up a chemical reaction

1

different reactions need different catalysts

1

(d) (i) smaller

accept less / tiny / very small

allow 10^{-9}

*do **not** allow small unless qualified*

1

(ii) reduce cost (owtte) **or**

ignore references to energy

save resources / raw materials (owtte)

1

[8]

M5. (a) sulfur dioxide / SO_2

allow sulfur oxide

1

(b) global dimming

1

(c) oxygen / O_2

1

(d) (oil is a) limited resource / finite / non-renewable

*accept running out of oil **or** wood is sustainable*

*accept (burning oil) increases amount of carbon dioxide in the atmosphere / global warming **or** releases locked up carbon / global dimming / acid rain*

accept the oil (may become) too expensive

1

(e) carbon dioxide produced (from burning wood)

ignore global warming

1

carbon dioxide used by plants / trees **or** for photosynthesis

if no other mark awarded

*allow carbon emissions used by plants / trees **or** for photosynthesis for **1** mark*

1

[6]

M6. (a) acid rain → sulfur dioxide

1

global warming → carbon dioxide

1

global dimming → carbon particles

1

(b) (i) oxygen

1

(ii) carbon monoxide

1

(c) (i) decreasing

accept running out / none left

1

(ii) any **two** from:

it = coal

- world needs (more) energy
  accept population is increasing
  allow (greater) demand for coal / fuels / energy
- plentiful supply
  accept readily available
  allow coal will 'last longer'
- (many) countries have coal
- easy to find / extract
- oil / gas is running out

accept need to use less oil / gas

accept need to use it to replace oil / gas

- cheap **or** cheaper than oil

2

[8]

M7. (a) good (electrical) conductor

allow low reactivity / resistance to corrosion

*do **not** accept heat conductor*

1

(b) a mixture of metals

accept contains more than one type of metal

1

(c) (i) any **one** from:

- eyesore
- destruction of habitats
- pollution of water
- dust pollution
- noise
- traffic pollution

1

(ii) acid rain

allow sulfur dioxide is a pollutant

1

(d) (i) running out of copper (ores)

1

(ii) any **two** from:

- any <u>specific example</u> of using less copper
- reuse / recycle
  *allow do **not** throw copper / brass away*
- use low-grade copper ores
- use other metals / materials in place of copper

2

[7]

Q1. This question is about hydrocarbons.

(a) The names and formulae of three hydrocarbons in the same homologous series are:

Ethane	C_2H_6
Propane	C_3H_8
Butane	C_4H_{10}

The next member in the series is pentane.

What is the formula of pentane?

.....

(1)

(b) Which homologous series contains ethane, propane and butane?

Tick **one** box.

Alcohols ☐

Alkanes ☐

Alkenes ☐

Carboxylic acids ☐

(1)

(c) Propane (C_3H_8) is used as a fuel.

Complete the equation for the complete combustion of propane.

C_3H_8 + $5O_2$ → 3 ..... + 4 .....

(2)

(d) Octane (C_8H_{18}) is a hydrocarbon found in petrol.

Explain why octane is a hydrocarbon.

.....

.....

(2)

(e) The table below gives information about the pollutants produced by cars using diesel or petrol as a fuel.

Fuel	**Relative amounts of pollutants**		
	Oxides of Nitrogen	**Particulate matter**	**Carbon dioxide**
Diesel	31	100	85
Petrol	23	0	100

Compare the pollutants from cars using diesel with those from cars using petrol.

.....

.....

.....

.....

.....

.....

(3)

(f) Pollutants cause environmental impacts.

Draw **one** line from each pollutant to the environmental impact caused by the pollutant.

Pollutant	**Environmental impact caused by the pollutant**

	Acid rain
Oxides of nitrogen	Flooding
	Global dimming
Particulate matter	Global warming
	Photosynthesis

(2)
(Total 11 marks)

Q2. Crude oil is a fossil fuel.

(a) To make crude oil more useful it is separated into fractions.

Use the correct word from the box to complete each sentence.

boiling	**compound**	**decomposition**	**distillation**
filtration	**mixture**	**molecule**	

(i) Crude oil is a ..... of different substances.

(1)

(ii) The substances in crude oil have different

..... points.

(1)

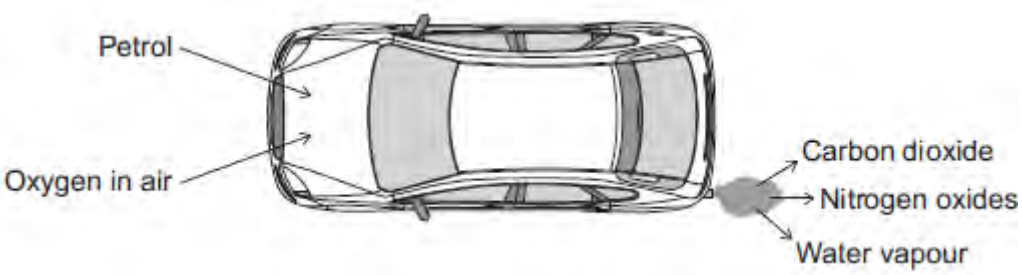
(iii) Crude oil is separated by fractional ..... .

(1)

(b) Petrol is one of the fractions produced from crude oil.

Car engines use a mixture of petrol and air.

The diagram shows some of the gases produced.



(i) What type of reaction happens to petrol in a car engine?

Tick (✓) **one** box.

combustion ☐

decomposition ☐

neutralisation ☐

(1)

(ii) Petrol contains octane (C_8H_{18}).

Complete the word equation for the reaction of octane with oxygen.

octane + ... ⟶ ..... + ...

(2)

(iii) Cars use sulfur-free petrol as a fuel.

Describe why sulfur should be removed from petrol.

.....

.....

.....

.....

(2)

(c) Some fractions from crude oil contain large hydrocarbon molecules.

These molecules can be cracked to produce smaller, more useful molecules.

An equation for cracking decane is:

$C_{10}H_{22}$	⟶	C_3H_8	+	C_2H_4	+	C_5H_{10}
decane		propane		ethene		pentene

(i) Why is propane useful?

Tick (✓) **one** box.

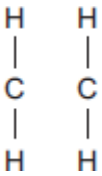
Propane is a polymer. ☐

Propane is an alloy. ☐

Propane is a fuel. ☐

(1)

(ii) Draw bonds to complete the displayed structure of ethene.



(1)

(iii) What is the colour change when bromine water reacts with ethene?

Tick (✓) **one** box.

Orange to colourless ☐

Orange to green ☐

Orange to red ☐

(1)

(iv) Complete the sentence.

Pentene is useful because many pentene molecules can join together

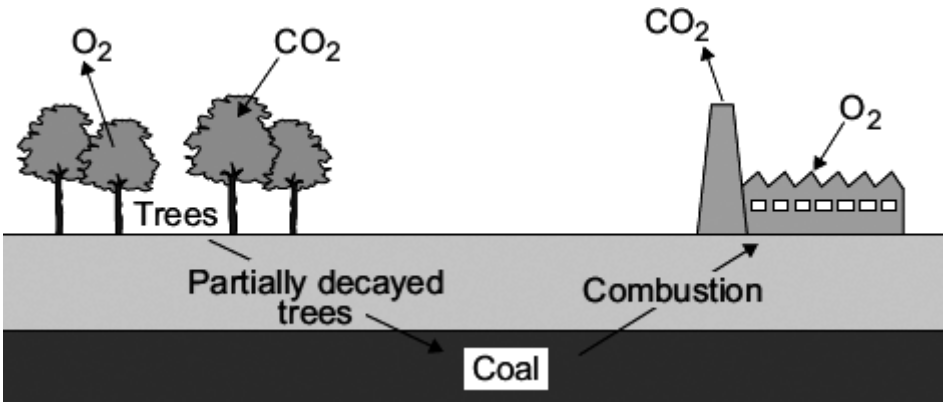
to form ..... .

(1)

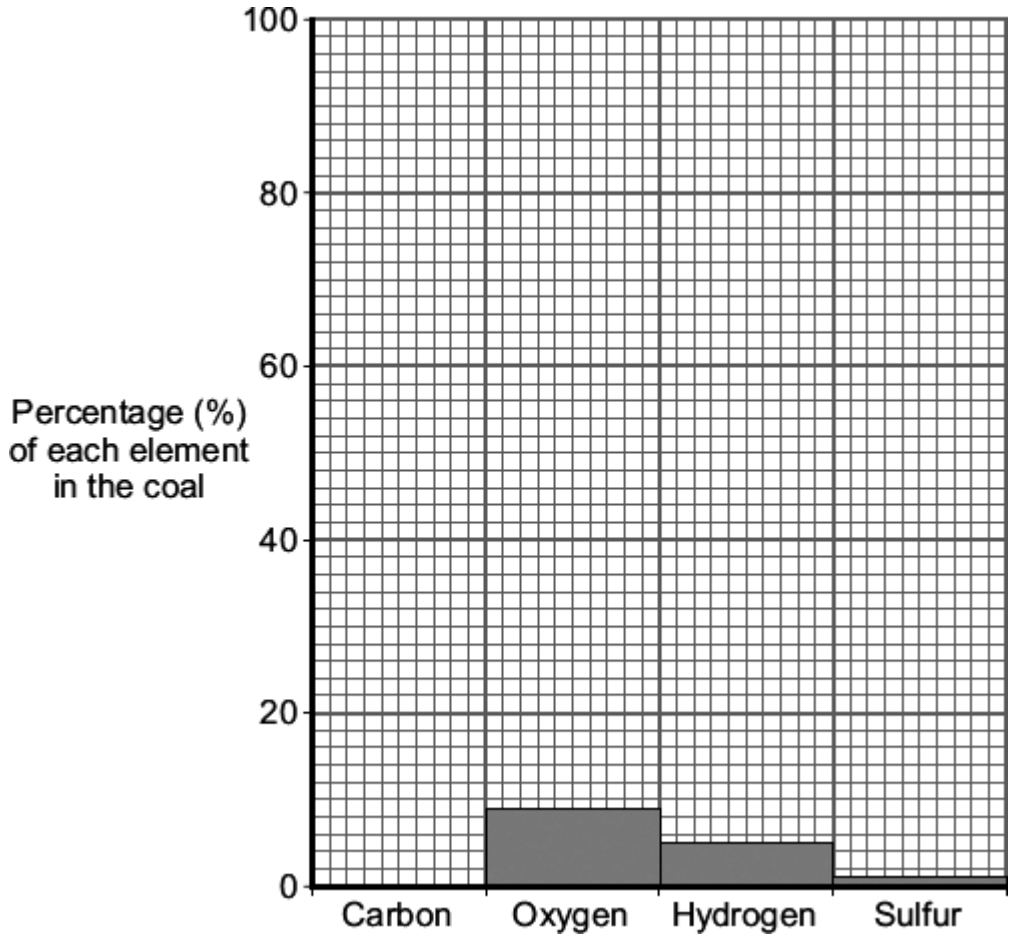
(Total 12 marks)

Q3. About 3000 million years ago carbon dioxide was one of the main gases in the Earth's early atmosphere.

About 400 million years ago plants and trees grew on most of the land. When the plants and trees died they were covered by sand and slowly decayed to form coal.	Today coal is burned in power stations to release the energy needed by industry.



(a) The bar chart shows the percentage of some of the elements in this coal.



(i) This coal contains 85 % carbon. Draw the bar for carbon on the chart.

(1)

(ii) Coal is burned in the atmosphere to release energy.
Two of the products of burning coal are shown.

Draw **one** line from each product to its environmental impact.

Product	**Environmental impact**
Sulfur dioxide	Acid rain
Carbon particles	Global dimming
	Global warming

(2)

(b) Use the information above and your knowledge and understanding to answer these questions.

(i) How did the formation of coal decrease the amount of carbon dioxide in the Earth's early atmosphere?

.....

.....

(1)

(ii) How does burning coal affect the amount of carbon dioxide in the Earth's atmosphere?
Explain your answer.

.....

.....

.....

.....

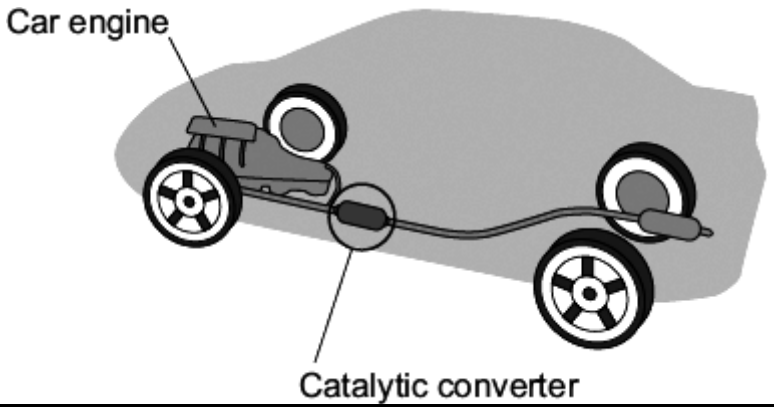
(2)
(Total 6 marks)

Q4. Read the information about car engines.

Burning petrol in air is an exothermic reaction. This reaction is used in car engines.

When petrol burns it produces harmful substances such as nitrogen oxides and carbon monoxide.

A catalytic converter stops these harmful substances being released into the air.



(a) Draw a ring around the correct answer to complete each sentence.

(i) The exothermic reaction makes the temperature of the engine

decrease.

increase.

stay the same.

(1)

(ii) This is because during exothermic reactions

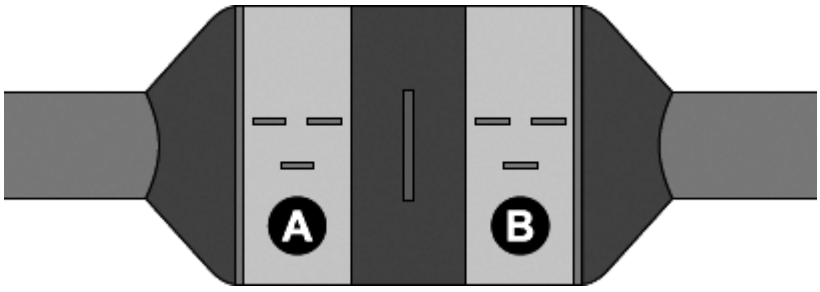
energy is taken in from the surroundings.

energy is given out to the surroundings.

there is no energy change.

(1)

(b) The diagram shows a catalytic converter which removes harmful substances.
The catalytic converter has two parts, **A** and **B**, which contain different catalysts.



(i) The equation for the reaction that takes place in part **A** is:

$2NO \rightarrow N_2 + O_2$

Which **one** of the substances shown in the equation is a compound?

Give the formula of this compound.

.....

(1)

(ii) The equation for the reaction that takes place in part **B** is:

$2CO + O_2 \rightarrow 2CO_2$

Why is it important to stop carbon monoxide (CO) from being released into the air?

.....

.....

(1)

(c) The table lists some statements about catalysts. Only **two** statements are correct.

Tick (✓) the **two** correct statements.

Statement	Tick (✓)
A catalyst can speed up a chemical reaction.	
A catalyst is used up in a chemical reaction.	
Different reactions need different catalysts.	
A catalyst does **not** change the rate of a chemical reaction.	

(2)

(d) Modern catalytic converters contain nanosized particles of catalyst.
Less catalyst is needed when nanosized catalyst particles are used.

(i) Complete the sentence.

The size of nanosized particles is ..... than normal sized particles.

(1)

(ii) The catalysts contain platinum.

Suggest why a manufacturer of catalytic converters would want to use less catalyst.

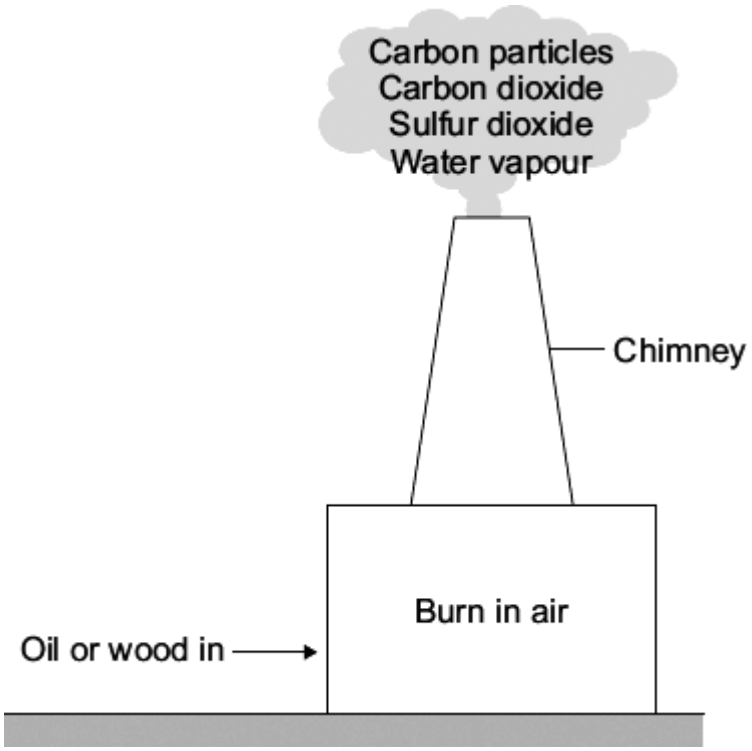
.....

.....

(1)
(Total 8 marks)

Q5. In the future:

- there will be fewer oil burning power stations
- there may be more wood burning power stations.



(a) Which **one** of the emissions from the chimney can cause acid rain?

.....

(1)

(b) Draw a ring around the correct answer to complete the sentence.

Carbon particles in the Earth's atmosphere cause

acid rain.
global dimming.
global warming.

(1)

(c) Which gas in the air is needed for oil or wood to burn?

.....

(1)

(d) Suggest why there will be **fewer** power stations burning oil in the future.

.....

.....

(1)

(e) Some power stations burn wood.
The wood comes from trees grown in forests.

Suggest why burning wood in power stations is said to be 'carbon-neutral'.

.....

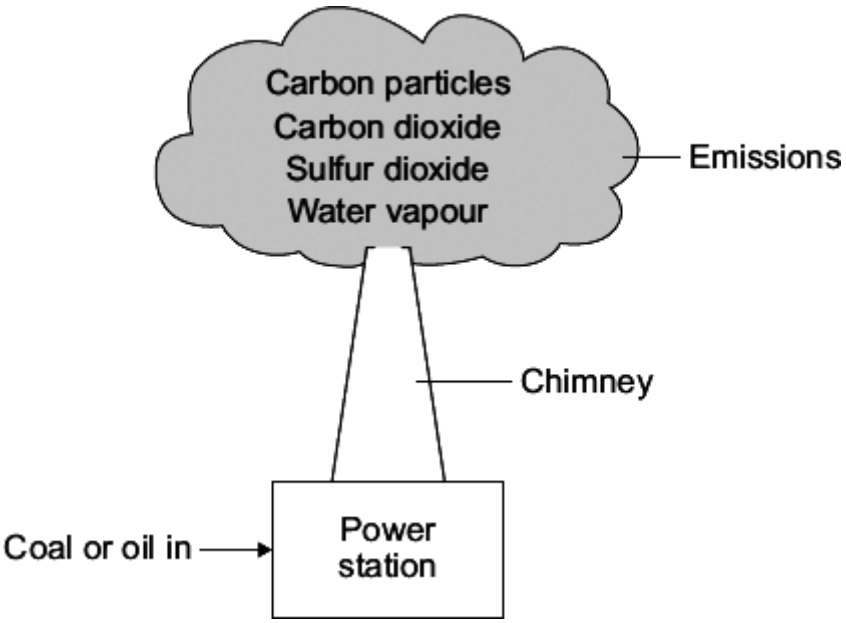
.....

.....

.....

(2)
(Total 6 marks)

Q6. In the future more coal-fired and fewer oil-fired power stations will be used to generate electricity.
When coal and oil are burned they produce the same types of emissions which can cause environmental problems.



(a) Emissions from the chimney can cause acid rain, global dimming and global warming. Draw **one** straight line from each possible environmental problem to the emission that causes it.

Possible environmental problem	**Emission that causes it**
acid rain	carbon particles
global warming	carbon dioxide
global dimming	sulfur dioxide
	water vapour

.....

(3)

(b) Draw a ring around the correct word in the box to complete each sentence.

(i) Incomplete combustion of coal or oil is caused by too little

carbon dioxide.
nitrogen.
oxygen.

(1)

(ii) A gas formed by the incomplete combustion of coal or oil is

carbon monoxide.
hydrogen.
oxygen.

(1)

(c) The table shows the world production for both coal and oil in 2000.

The world production figures after 2000 are predicted.

Year	**World production of coal (billions of tonnes per year)**	**World production of oil (billions of barrels per year)**
2000	3.5	12.5
2050	4.5	5.6
2100	5.0	1.7
2150	5.5	0.5
2200	6.0	0.0

(i) How is the world production of oil predicted to change from 2000 to 2200?

.....

.....

(1)

(ii) Suggest **two** reasons why the world production of coal is predicted to increase.

1 .....

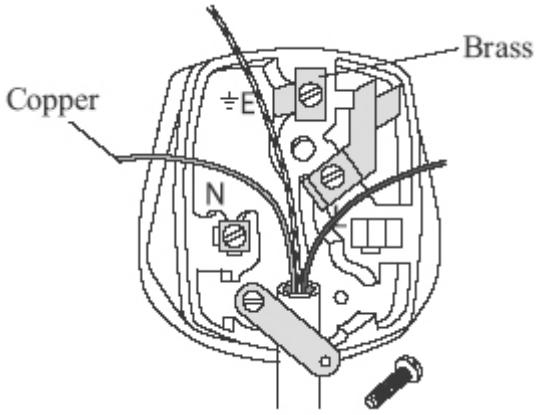
.....

2 .....

.....

(2)
(Total 8 marks)

Q7. Copper metal is used for electric wires.
An alloy of copper, called brass, is used for pins and terminals of electric plugs.



(a) Copper metal is relatively soft and flexible.

Give another reason why copper is used for electric wires.

.....

.....

(1)

(b) Brass is an *alloy*.

What is an *alloy*?

.....

.....

(1)

(c) Open-cast mining of copper ore makes a very large hole.

(i) Suggest **one** environmental problem that is caused by open-cast mining of copper ore.

.....

.....

(1)

(ii) Some copper ores contain copper sulfide, CuS.

Copper sulfide is heated in air to produce copper and sulfur dioxide.

$$CuS + O_2 \rightarrow Cu + SO_2$$

Suggest **one** environmental problem caused by heating copper sulfide in air.

.....

.....

(1)

(d) The amount of copper-rich ores is estimated to last only a few more years. New houses

need several kilometres of copper wire.

(i) Explain why the need to use so much copper will cause a problem in the future.

.....

.....

(1)

(ii) Suggest **two** ways in which society could overcome this problem.

1 .....

.....

2 .....

.....

(2)
(Total 7 marks)

M1.(a) C_6H_{14}

1

(b) **A**

1

(c) **B**

1

(d) **C**

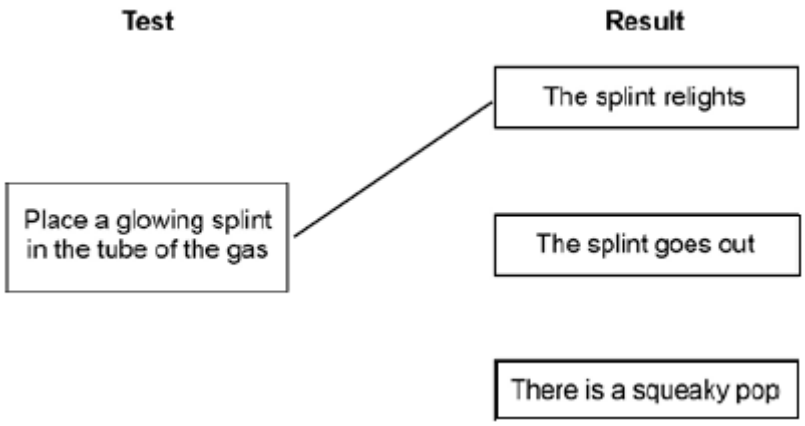
1

(e) Propanol

1

[5]

M2.(a)



more than one line from test negates the mark

1

(b) (i) place a lighted splint at the mouth of the tube

1

there is a squeaky pop

dependent on correct test

1

(ii) hydrogen is less reactive than magnesium

accept converse

accept magnesium is too reactive

1

(c) (i) any **one** from:

- to improve appearance or make it look nice
- to prevent corrosion
- to make it more durable
- cheaper than solid silver

1

(ii) solution must be silver nitrate **or** contain silver ions

1

otherwise copper will be deposited **or** silver will not be deposited

1

spoon must be the negative electrode / cathode

1

because silver ions have a positive charge **or** go to negative electrode **or** are discharged at the negative electrode.

1

(iii) because (plastic is an) insulator **or** does not conduct electricity

accept does not contain mobile electrons

1

[10]

M3.(a) (i) exothermic

accept combustion
*allow burning **or** oxidation **or***
redox

1

(ii) carbon monoxide / *CO* (is produced)

allow monoxide (is produced) ignore carbon oxide

1

because there is incomplete / partial combustion (of the fuel)

accept because there is insufficient oxygen / air (to burn the fuel)

1

(b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking guidance.

0 marks No relevant content.

Level 1 (1-2 marks) There is a statement that crude oil is heated **or** that substances are cooled. However there is little detail and any description may be confused or inaccurate.

Level 2 (3-4 marks) There is some description of heating / evaporating crude oil **and either** fractions have different boiling points **or** there is an indication of a temperature difference in the column.

Level 3 (5-6 marks) There is a reasonable explanation of how petrol is or fractions are separated from crude oil using evaporating **and** condensing.

If cracking is given as a preliminary or subsequent process to fractional distillation then ignore.

However, if cracking / catalyst is given as part of the process, maximum is **level 2**.

Examples of chemistry points made in the response could include:

- Some / most of the hydrocarbons (or petrol) evaporate / form vapours or gases
- When some of / a fraction of the hydrocarbons (or petrol) cool to their boiling point they condense
- Hydrocarbons (or petrol) that have (relatively) low boiling points and are collected near the top of the fractionating column or hydrocarbons with (relatively) high boiling points are collected near the bottom of the fractionating column
- The process is fractional distillation
- Heat the crude oil / mixture of hydrocarbons or crude oil / mixture is heated to about 350°C
- Some of the hydrocarbons remain as liquids
- Liquids flow to the bottom of the fractionating column
- Vapours / gases rise up the fractionating column
- Vapours / gases cool as they rise up the fractionating column
- The condensed fraction (or petrol) separates from the vapours / gases and flows out through a pipe
- Some of the hydrocarbons remain as vapours / gases
- Some vapours / gases rise out of the top of the fractionating column
- There is a temperature gradient in the fractionating column or the fractionating column is cool at the top and hot at the bottom

6

[9]

M4. (a) (i) C_7H_{16}

mark answer line first

answer may be given in the table

1

(ii) C_nH_{2n+2}

1

(b) (i) carbon monoxide

*do **not** accept carbon oxide*

*do **not** accept water*

ignore CO

1

(ii) because of partial / incomplete combustion (in reaction 2) **or** complete combustion (in reaction 1)

*allow because there is less / insufficient oxygen (in reaction 2) **or** sufficient oxygen (in reaction 1) allow different amounts of oxygen used (in the reactions) **or** $19O_2$ (in reaction 1) **and** $13O_2$ (in reaction 2)*

ignore air

1

(c) (i) 15 (%)

ignore units

1

(ii) water (vapour)/steam

allow H_2O / OH_2 / hydrogen oxide

1

(iii) sulfur in petrol / crude oil (reacts with oxygen)

it = sulfur dioxide

1

(ii) because nitrogen **and** oxygen (are in the air and) react

*allow nitrogen **and** oxygen burn*

*accept nitrogen + oxygen → nitrogen oxide **or** symbol equation*

ignore air

1

at high temperature (inside a petrol engine)

allow heat / hot (engine)

1

(d) because carbon dioxide / it causes global warming **or**

allow because carbon dioxide / it causes greenhouse effect / climate change

1

because carbon dioxide / it has an impact on oceans

because this carbon dioxide / carbon / it was '<u>locked up</u>' (in fossil fuels) **or**

because the percentage/amount of carbon dioxide / it in the atmosphere is <u>increasing</u>

1

[11]

M5. (a) carbon dioxide <u>decreased (by plants / trees)</u>

allow plants / trees absorbed carbon dioxide

1

oxygen <u>increased</u> (by plants / trees)

allow plants / trees released oxygen

if neither of these marks awarded

allow plants / trees

*photosynthesise for **1** mark*

1

because coal 'locks up' / traps / stores carbon dioxide / carbon

allow trees 'locked up' carbon dioxide / carbon

1

(b) carbon / C

hydrogen / H

sulfur / S

*all 3 correct **2** marks*

*1 or 2 correct **1** mark*

allow H_2

ignore oxygen

2

(c) (i) 2 2

balancing must be correct

*do **not** accept changed formulae*

1

(ii) <u>increases atmospheric pollution</u>

carbon dioxide / CO_2 released

1

from the (thermal) decomposition of calcium carbonate **or**

*accept causes global warming **or** CO_2 is a greenhouse gas*

description of this decomposition **or** equation

ignore sulfur dioxide and effects in this part

1

<u>decreases atmospheric pollution</u>

sulfur dioxide / SO_2 is removed

accept less acid rain produced

1

by reaction with calcium oxide **or** calcium carbonate

*accept neutralisation **or** forms calcium sulfate*

1

[10]

M6. (a) (i) a reasonable attempt at a smooth curve

allow a curve which is close to but does not necessarily touch all points

1

(ii) any **two** from:

allow thicker / thinner / runny for viscous

- biodiesel is more <u>viscous</u> than petroleum diesel at all / lower temperatures
- biodiesel – as the temperature increases the <u>viscosity</u> decreases or vice versa
- petroleum diesel – the <u>viscosity</u> does not change

if no other mark awarded

*allow **1** mark for any correct conclusion based on time or rate of flow*

2

(iii) does not flow as easily (through pipes / engine)

allow could form a solid / block pipes / engine at low temperatures

or

needs a high temperature to flow

allow more difficult to vaporise / ignite

ignore burning

ignore references to viscosity

1

(b) (i) global dimming

allow correct description

1

(ii) 56 (%)

1

(iii) (increases) acid rain

1

because there is <u>more</u> nitrogen oxide(s)

ignore sulfur dioxide

if no other mark awarded

*allow **1** mark for nitrogen oxide(s) given*

1

(iv) *answer yes or no does not gain credit because the marks are for an explanation*
ignore references to petroleum diesel
allow carbon for carbon dioxide

no

because carbon dioxide (26%) is released / produced

1

this will <u>not</u> all be absorbed by photosynthesis / growing plants for biodiesel

accept growing plants / farming uses machinery / fossil fuels releases carbon dioxide

OR

yes

because although carbon dioxide (26%) is released / produced (1)

this was absorbed by photosynthesis / growing plants (for biodiesel) (1)

allow this will be absorbed by photosynthesis / growing plants for biodiesel

1

[10]

Q1. This question is about organic compounds.

Hydrocarbons can be cracked to produce smaller molecules.

The equation shows the reaction for a hydrocarbon, $C_{18}H_{38}$

$C_{18}H_{38} \rightarrow C_6H_{14} + C_4H_8 + 2\,C_3H_6 + C_2H_4$

(a) Which product of the reaction shown is an alkane?

Tick **one** box.

C_2H_4 ☐

C_3H_6 ☐

C_4H_8 ☐

C_6H_{14} ☐

(1)

(b) The table below shows the boiling point, flammability and viscosity of $C_{18}H_{38}$ compared with the other hydrocarbons shown in the equation.

	Boiling point	**Flammability**	**Viscosity**
A	highest	lowest	highest
B	highest	lowest	lowest
C	lowest	highest	highest
D	lowest	highest	lowest

Which letter, **A**, **B**, **C** or **D**, shows how the properties of $C_{18}H_{38}$ compare with the properties of C_2H_4, C_3H_6, C_4H_8 and C_6H_{14}?

Tick **one** box.

A ☐

B ☐

C ☐

D ☐

(1)

(c) The hydrocarbon C_4H_8 was burnt in air.

Incomplete combustion occurred.

Which equation, **A**, **B**, **C** or **D**, correctly represents the incomplete combustion reaction?

A $C_4H_8 + 4O \rightarrow 4CO + 4H_2$

B $C_4H_8 + 4O_2 \rightarrow 4CO + 4H_2O$

C $C_4H_8 + 6O_2 \rightarrow 4CO_2 + 4H_2O$

D $C_4H_8 + 8O \rightarrow 4CO_2 + 4H_2$

Tick **one** box.

A ☐

B ☐

C ☐

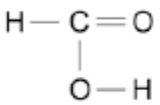
D ☐

(1)

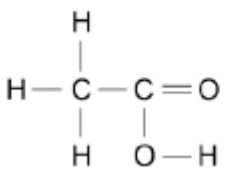
(d) Propanoic acid is a carboxylic acid.

Which structure, **A**, **B**, **C** or **D**, shows propanoic acid?

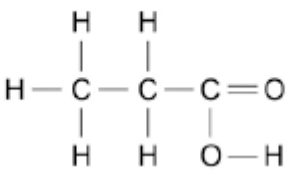
A



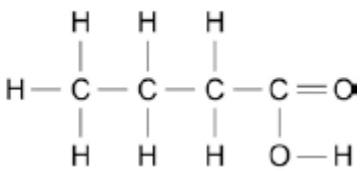
B



C



D



Tick **one** box.

A ☐

B ☐

C ☐

D ☐

(1)

(e) Propanoic acid is formed by the oxidation of which organic compound?

Tick **one** box.

Propane ☐

Propene ☐

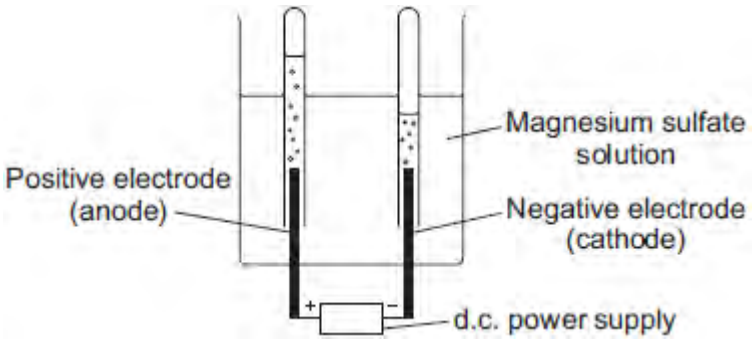
Propanol ☐

Polyester ☐

(1)
(Total 5 marks)

Q2.Diagram 1 shows the apparatus used to electrolyse magnesium sulfate solution.

Diagram 1



Gases were given off at both electrodes.

(a) The gas collected at the anode was oxygen.

Draw **one** line from the test for oxygen to the correct result.

Test	Result
	The splint relights
Place a glowing splint in the tube of the gas	The splint goes out
	There is a squeaky pop

(1)

(b) (i) The gas collected at the cathode was hydrogen.

Describe how to test the gas to show that it is hydrogen.

Test .....

.....

Result .....

.....

(2)

(ii) Why is hydrogen, and **not** magnesium, produced at the cathode?

.....

.....

(1)

(c) A student wanted to use electrolysis to silver plate a metal spoon.

(i) Give **one** reason why metal spoons are sometimes silver plated.

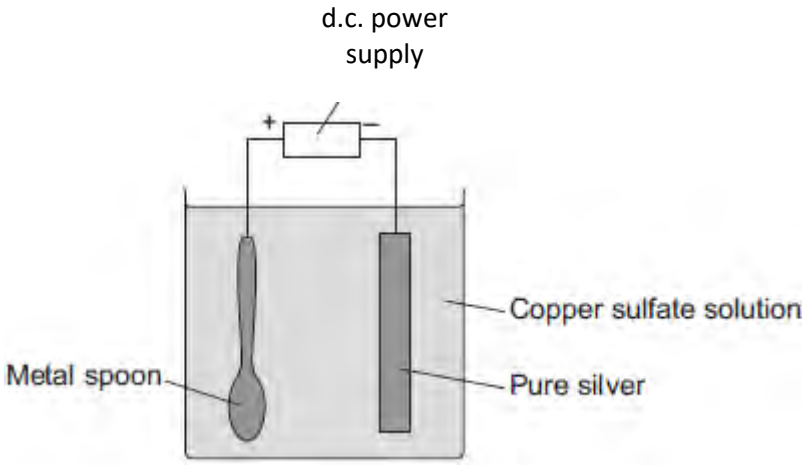
.....

.....

(1)

(ii) **Diagram 2** shows the apparatus the student used. The student did **not** set the apparatus up correctly.

Diagram 2



The student found that the metal spoon eroded and a thin layer of copper formed on the pure silver electrode.

Suggest **two** changes that the student must make to his apparatus to be able to silver plate the metal spoon. Give a reason for each change.

.....

.....

.....

.....

.....

.....

.....

(4)

(iii) Why is it difficult to electroplate plastic spoons?

.....

.....

(1)
(Total 10 marks)

Q3. Crude oil is a mixture of many different chemical compounds.

(a) Fuels, such as petrol (gasoline), can be produced from crude oil.

(i) Fuels react with oxygen to release energy.

Name the type of reaction that releases energy from a fuel.

.....

(1)

(ii) Fuels react with oxygen to produce carbon dioxide.
The reaction of a fuel with oxygen can produce a different oxide of carbon.

Name this different oxide of carbon and explain why it is produced.

.....

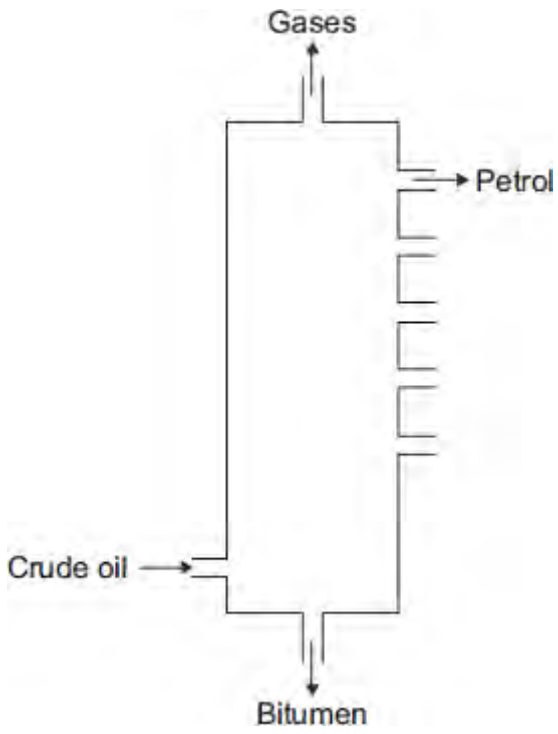
.....

.....

.....

(2)

(b) Most of the compounds in crude oil are hydrocarbons.
Hydrocarbons with the smallest molecules are very volatile.



In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Describe and explain how **petrol** is separated from the mixture of hydrocarbons in crude oil.

Use the diagram and your knowledge to answer this question.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6)
(Total 9 marks)

Q4. A mixture of petrol and air is burned in a car engine.
Petrol is a mixture of alkanes. Air is a mixture of gases.

The tables give information about the composition of petrol and the composition of air.

Petrol	
Alkane	**Formula**
hexane	C_6H_{14}
heptane	
octane	C_8H_{18}
nonane	C_9H_{20}
decane	$C_{10}H_{22}$

Air	
Gas	**Percentage (%)**
nitrogen	78
oxygen	21
carbon dioxide	0.035
Small amounts of other gases and water vapour	

(a) Use the information above to answer these questions.

(i) Give the formula for heptane

.....

(1)

(ii) Complete the general formula of alkanes.
n = number of carbon atoms

C_nH

(1)

(b) Alkanes in petrol burn in air.
The equations represent two reactions of hexane burning in air.

Reaction 1 $2C_6H_{14} + 19O_2 \rightarrow 12CO_2 + 14H_2O$

Reaction 2 $2C_6H_{14} + 13O_2 \rightarrow 12CO + 14H_2O$

Reaction 2 produces a different carbon compound to **Reaction 1.**

(i) Name the carbon compound produced in **Reaction 2.**

.....

(1)

(ii) Give a reason why the carbon compounds produced are different.

.....

.....

(1)

(c) The table shows the percentages of some gases in the exhaust from a petrol engine.

Name of gas	Percentage (%)
nitrogen	68
carbon dioxide	15
carbon monoxide	1.0
oxygen	0.75
nitrogen oxides	0.24
hydrocarbons	0.005
sulfur dioxide	0.005
other gases	

(i) What is the percentage of the other gases in the table?

.....

(1)

(ii) What is the name of the compound that makes up most of the other gases?

.....

(1)

(iii) Give a reason why sulfur dioxide is produced in a petrol engine.

.....

.....

(1)

(iv) State how nitrogen oxides are produced in a petrol engine.

.....

.....

.....

.....

(2)

(d) Many scientists are concerned about the carbon dioxide released from burning fossil fuels such as petrol.

Explain why.

.....

.....

.....

.....

(2)
(Total 11 marks)

Q5. About 3000 million years ago, carbon dioxide was one of the main gases in the Earth's atmosphere.

About 400 million years ago, plants and trees grew on most of the land. When the plants and trees died they were covered by sand and slowly decayed to form coal.

(a) Describe and explain how the composition of the Earth's atmosphere was changed by the formation of coal.

.....

.....

.....

.....

.....

.....

.....

.....

(3)

(b) Today, coal is burned in power stations to release the energy needed by industry. Carbon dioxide, water and sulfur dioxide are produced when this coal is burned.

Name **three** elements that are in this coal.

.....

.....

.....

(2)

(c) In some power stations coal is mixed with calcium carbonate (limestone). The mixture is crushed before it is burned.

(i) Many chemical reactions happen when this mixture is burned. The chemical equation represents one of these reactions.

Balance the chemical equation.

$2CaCO_3(s) + 2SO_2(g) + O_2(g) \rightarrow \ldots\ldots CaSO_4(s) + \ldots\ldots CO_2(g)$

(1)

(ii) Explain how the use of calcium carbonate in the mixture:

increases atmospheric pollution

.....

.....

.....

.....

decreases atmospheric pollution.

.....

.....

.....

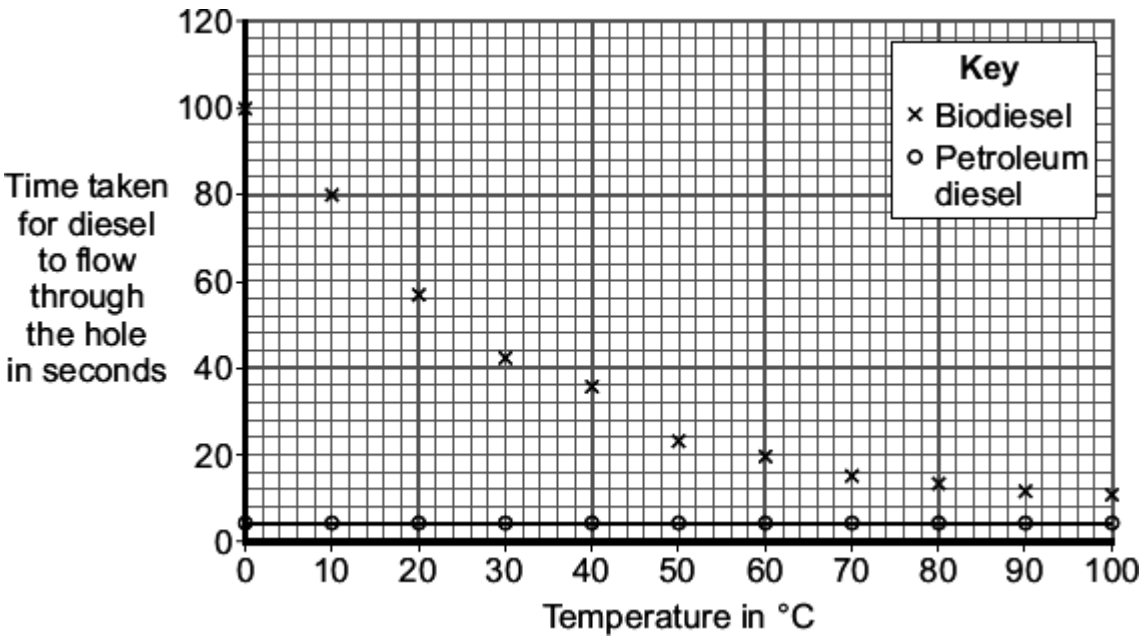
.....

(4)
(Total 10 marks)

Q6. There are two main types of diesel fuel used for cars:

- biodiesel, made from vegetable oils
- petroleum diesel, made from crude oil.

(a) A scientist compared the viscosity of biodiesel with petroleum diesel at different temperatures.
The scientist measured the time for the same volume of diesel to flow through a small hole in a cup.
The scientist's results are plotted on the grid.



(i) Draw a line of best fit for the biodiesel results.

(1)

(ii) What conclusions can the scientist make about the viscosity of biodiesel compared with the viscosity of petroleum diesel at different temperatures?

.....

.....

.....

.....

(2)

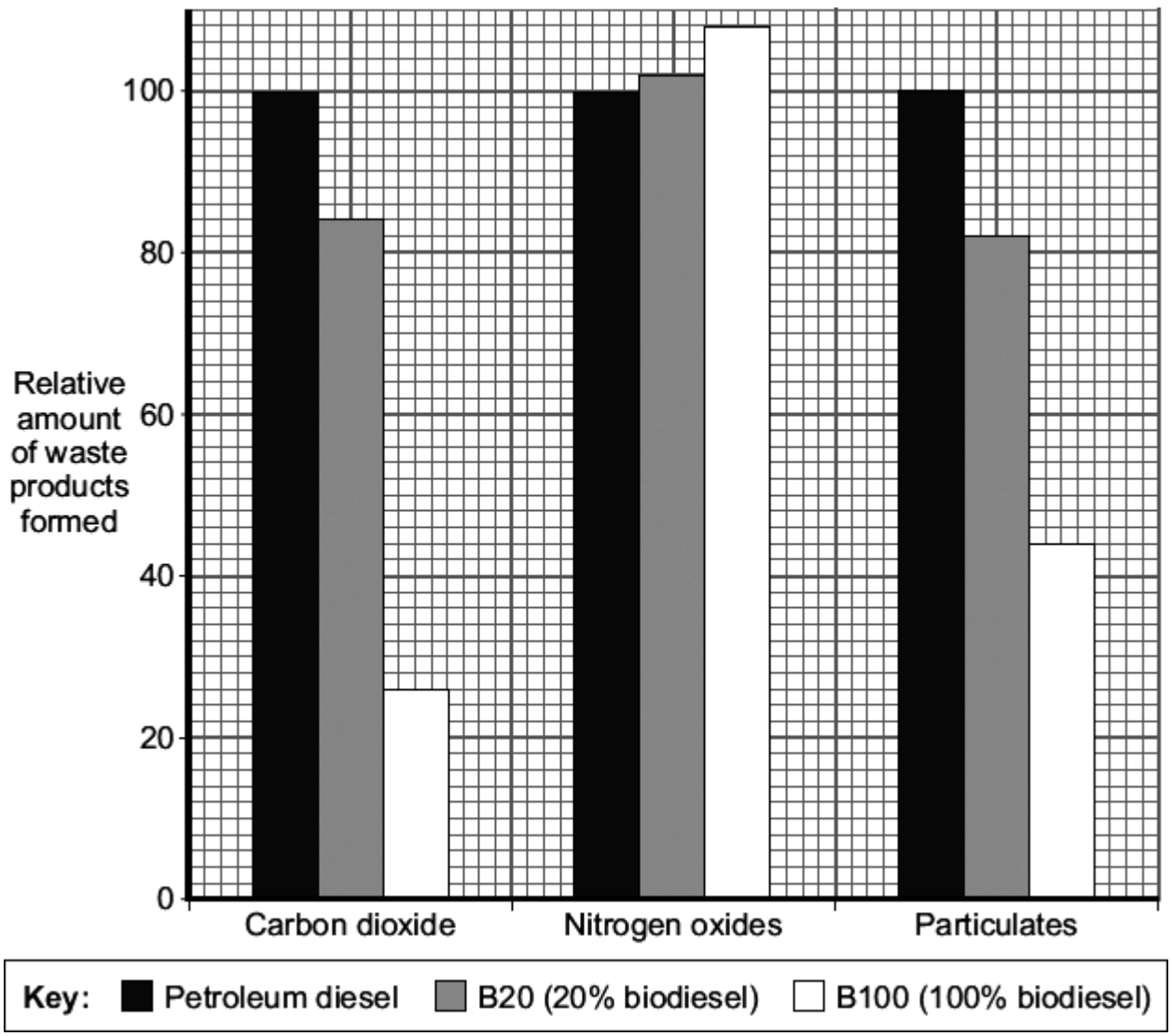
(iii) Biodiesel may be less suitable than petroleum diesel as a fuel for cars.
Use these results to suggest **one** reason why.

.....

.....

(1)

(b) Biodiesel can be mixed with petroleum diesel to make a fuel for cars.
In a car engine, the diesel fuel burns in air.
The waste products leave the car engine through the car exhaust system.
The bar chart compares the relative amounts of waste products made when three different types of diesel fuel burn in a car engine.



Nitrogen oxides and sulfur dioxide cause a similar environmental impact.

(i) What environmental impact do particulates from car exhaust systems cause?

.....

(1)

(ii) What is the percentage reduction in particulates when using B100 instead of petroleum diesel?

..... %

(1)

(iii) Replacing petroleum diesel with biodiesel increases one type of environmental pollution.

Use the bar chart and the information given to explain why.

.....

.....

.....

.....

(2)

(iv) A carbon neutral fuel does **not** add extra carbon dioxide to the atmosphere.

Is biodiesel a carbon neutral fuel?

Use the bar chart and your knowledge to explain your answer.

.....

.....

.....

.....

(2)
(Total 10 marks)

M1.(a) because sulfur dioxide causes <u>acid rain</u>

1

which kills fish / aquatic life **or** dissolves / damages statues / stonework **or** kills / stunts growth of trees

if no other mark awarded then award 1 mark for sulfur dioxide is toxic or causes breathing difficulties.

1

(b) (i) <u>electrons</u> are lost

1

(ii) $Cu^{2+} + 2e^{-} \rightarrow Cu$

allow $Cu^{2+} \rightarrow Cu - 2e^{-}$

ignore state symbols

1

(iii) copper sulfate

allow any ionic copper compound

1

(c) (lattice of) positive ions

1

delocalised electrons

accept sea of electrons

1

(electrostatic) attraction between the positive ions and the electrons

1

electrons can move through the metal / structure **or** can flow

allow electrons can carry charge through the metal / structure

if wrong bonding named or described or attraction between oppositely charged ions then do not award M1 or M3 − MAX 2

1

(d) (copper compounds are absorbed / taken up by) plants

allow crops

1

which are burned

1

the ash contains the copper compounds

do not award M3 if the ash contains copper (metal)

1

(e)

/ A_r	55.6 / 63.5	16.4 / 56	28.0 / 32
moles	0.876	0.293	0.875
ratio	3	1	3
formula	Cu_3FeS_3		

*award **4** marks for Cu_3FeS_3 with some correct working*

*award **3** marks for Cu_3FeS_3 with **no** working*

*if the answer is not Cu_3FeS_3 award up to **3** marks for correct steps from the table apply ecf*

*if the student has inverted the fractions award **3** marks for an answer of $CuFe_3S$*

4

[16]

M2.(a) circle round any one (or more) of the covalent bonds

any correct indication of the bond – the line between letters

1

(b) Methane contains atoms of two elements, combined chemically

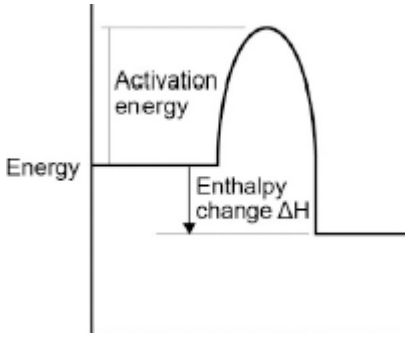
1

(c) (i) activation energy labelled from level of reagents to highest point of curve

ignore arrowheads

1

enthalpy change labelled from reagents to products



*arrowhead **must** go from reagents to products only*

1

(ii) 2 O_2

1

2 H_2O

*if not fully correct, award **1** mark for all formulae correct.*

ignore state symbols

1

(iii) carbon monoxide is made

1

this combines with the blood / haemoglobin **or** prevents oxygen being carried in the blood / round body **or** kills you **or** is toxic **or** poisonous

dependent on first marking point

1

(iv) energy is taken in / required to break bonds

accept bond breaking is endothermic

1

energy is given out when bonds are made

accept bond making is exothermic

1

the energy given out is greater than the energy taken in

this mark only awarded if both of previous marks awarded

1

(d) (i) energy to break bonds = 1895

calculation with no explanation max = 2

1

energy from making bonds = 1998

1

1895 − 1998 (= −103)
or
energy to break bonds = 656
energy from making bonds = 759
656 − 759 (= −103)

allow:

bonds broken − bonds made =

413 + 243 − 327 − 432 = -103 for 3 marks.

1

(ii) The C — Br bond is weaker than the C — Cl bond

1

[15]

M3.(a) any **four** from:

- (crude oil is) heated
- to evaporate / vaporise / boil (the substances / hydrocarbons)
- the column is hotter at the bottom or is cooler at the top
- (vapours / fractions) condense
- at their boiling points or at different levels.

marks can be taken from a diagram

max 3 marks for reference to cracking

allow fractional distillation allow vapours (enter the column)

allow temperature gradient or (vapours) cool as they rise

allow description e.g. vapour turns to liquid)

allow they have different boiling points

4

(b) acid rain is caused by

allow consequences of acid rain

1

sulfur dioxide or oxides of nitrogen

second marking point is dependent on first marking point

1

they react with / are neutralised by calcium carbonate or limestone

OR

global warming is caused by

carbon dioxide

carbon dioxide will react or dissolve in suspension of limestone

allow greenhouse effect is caused by or allow consequences of global warming

1

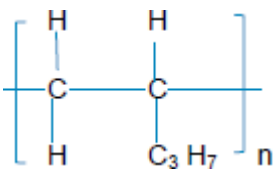
(c) (i) C_2H_4

must be formula

ignore any name

1

(ii) a single bond between carbon atoms



would score 3 marks

1

other four bonds linking hydrogen atoms and C_3H_7 group plus two trailing / connecting bonds

1

n at the bottom right hand corner of the bracket

1

(iii) has a shape memory

or

(a smart polymer) can return to original shape (when conditions change)

1

[12]

M4.(a) Sulfur dioxide causes acid rain.

1

(b) red / orange / yellow

*do **not** accept any other colours*

1

because sulfur dioxide (when in solution) is an acid

1

(c) (there are) <u>weak</u> forces (of attraction)

*do **not** accept any reference to covalent bonds breaking*

1

between the molecules

*do **not** accept any other particles*

1

(these) take little energy to overcome

award third mark only if first mark given

1

(d) Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.

0 marks
No relevant content

Level 1 (1 – 2 marks)
A relevant comment is made about the data.

Level 2 (3 – 4 marks)
Relevant comparisons have been made, and an attempt made at a conclusion.

Level 3 (5 – 6 marks)
Relevant, detailed comparisons made and a justified conclusion given.

examples of the points made in the response

effectiveness

- W removes the most sulfur dioxide
- D removes the least sulfur dioxide

material used

- Both W and D use calcium carbonate
- Calcium carbonate is obtained by quarrying which will create scars on landscape / destroy habitats
- D requires thermal decomposition, this requires energy
- D produces carbon dioxide which may cause global warming / climate change
- S uses sea water, this is readily available / cheap

waste materials

- W product can be sold / is useful
- W makes carbon dioxide which may cause global warming / climate change
- D waste fill landfill sites
- S returned to sea / may pollute sea / easy to dispose of

6

[12]

Q1. This question is about copper.

(a) Copper can be extracted by smelting copper-rich ores in a furnace.

The equation for one of the reactions in the smelting process is:

$$Cu_2S(s) + O_2(g) \longrightarrow 2\,Cu(s) + SO_2(g)$$

Explain why there would be an environmental problem if sulfur dioxide gas escaped into the atmosphere.

.....

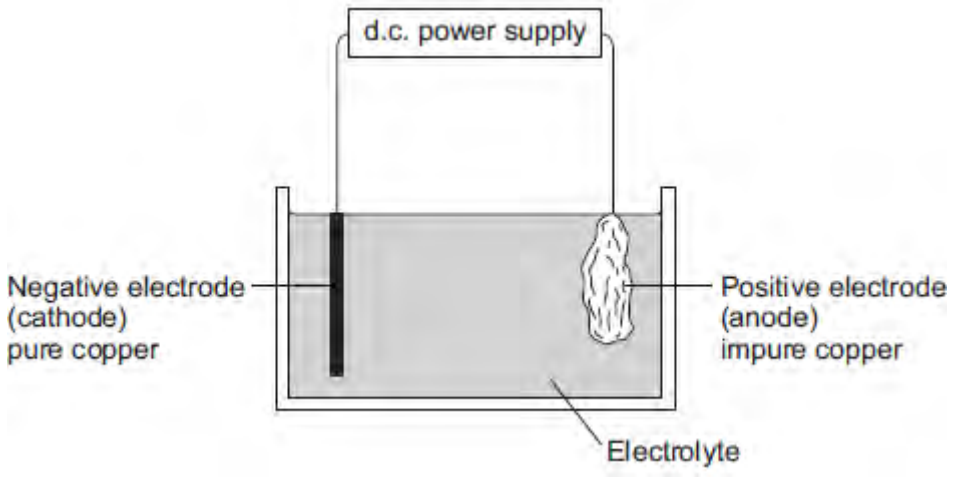
.....

.....

.....

(2)

(b) The impure copper produced by smelting is purified by electrolysis, as shown below.



Copper atoms are oxidised at the positive electrode to Cu^{2+} ions, as shown in the half equation.

$$Cu(s) \longrightarrow Cu^{2+}(aq) + 2e^-$$

(i) How does the half equation show that copper atoms are oxidised?

.....

.....

(1)

(ii) The Cu^{2+} ions are attracted to the negative electrode, where they are reduced to produce copper atoms.

Write a balanced half equation for the reaction at the negative electrode.

.....

(1)

(iii) Suggest a suitable electrolyte for the electrolysis.

.....

(1)

(c) Copper metal is used in electrical appliances.

Describe the bonding in a metal, and explain why metals conduct electricity.

.....

.....

.....

.....

.....

.....

.....

.....

.....

(4)

(d) Soil near copper mines is often contaminated with low percentages of copper compounds.

Phytomining is a new way to extract copper compounds from soil.

Describe how copper compounds are extracted by phytomining.

.....

.....

.....

.....

.....

.....

(3)

(e) A compound in a copper ore has the following percentage composition by mass:

55.6% copper, 16.4% iron, 28.0% sulfur.

Calculate the empirical formula of the compound.

Relative atomic masses (A_r): S = 32; Fe = 56; Cu = 63.5

You must show all of your working.

.....

.....

.....

.....

.....

.....

.....

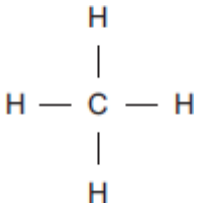
.....

Empirical formula = ...

(4)
(Total 16 marks)

Q2. Methane (CH_4) is used as a fuel.

(a) The displayed structure of methane is:



Draw a ring around a part of the displayed structure that represents a covalent bond.

(1)

(b) Why is methane a compound?

Tick (✓) **one** box.

Methane contains atoms of two elements, combined chemically. ☐

Methane is not in the periodic table. ☐

Methane is a mixture of two different elements. ☐

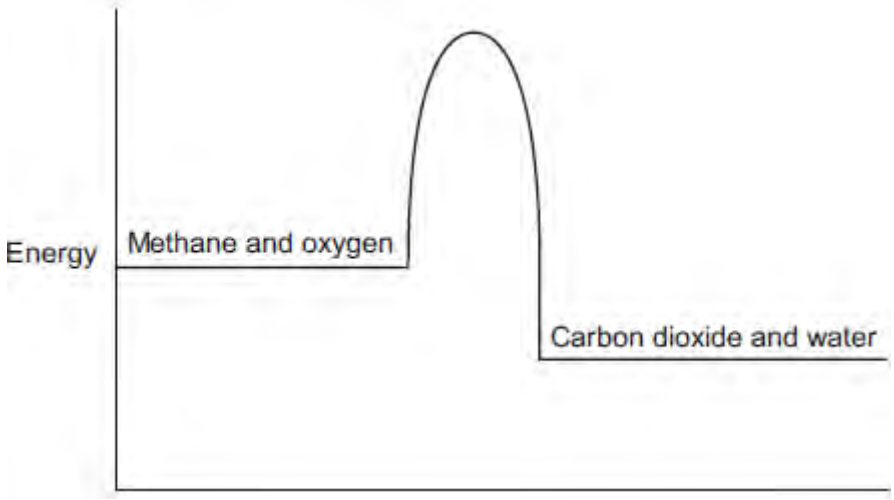
(1)

(c) Methane burns in oxygen.

(i) The diagram below shows the energy level diagram for the complete combustion of methane.

Draw and label arrows on the diagram to show:

- the activation energy
- the enthalpy change, ΔH.



(2)

(ii) Complete and balance the symbol equation for the complete combustion of methane.

CH_4 + ... ⟶ CO_2 + ...

(2)

(iii) Explain why the **incomplete** combustion of methane is dangerous.

.....

.....

.....

.....

(2)

(iv) Explain why, in terms of the energy involved in bond breaking and bond making, the combustion of methane is exothermic.

.....

.....

.....

.....

.....

.....

(3)

(d) Methane reacts with chlorine in the presence of sunlight.

The equation for this reaction is:

Some bond dissociation energies are given in the table.

Bond	**Bond dissociation energy in kJ per mole**
C–H	413
C–Cl	327
Cl–Cl	243
H–Cl	432

(i) Show that the enthalpy change, ΔH, for this reaction is −103 kJ per mole.

.....

.....

.....

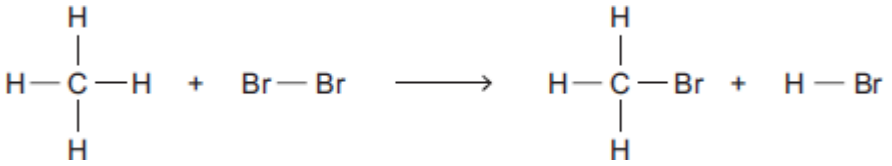
.....

.....

.....

(3)

(ii) Methane also reacts with bromine in the presence of sunlight.



This reaction is less exothermic than the reaction between methane and chlorine.

The enthalpy change, ΔH, is −45 kJ per mole.

What is a possible reason for this?

Tick (✓) **one** box.

CH_3Br has a lower boiling point than CH_3Cl ☐

The C−Br bond is weaker than the C−Cl bond. ☐

The H−Cl bond is weaker than the H−Br bond. ☐

Chlorine is more reactive than bromine. ☐

(1)

(Total 15 marks)

Q3. Crude oil is a fossil fuel.

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(4)

(b) Fuel oil is one of the fractions from crude oil.

Power stations burn fuel oil to generate electricity. The waste gases from the combustion of fuel oil contain carbon dioxide, water vapour, sulfur dioxide and oxides of nitrogen.

The waste gases are passed through a suspension of limestone in water. Limestone is mainly calcium carbonate.

Suggest how the use of a suspension of limestone decreases one of the environmental impacts that the waste gases would cause.

.....

.....

.....

.....

.....

.....

.....

(3)

(c) Some fractions from crude oil contain large hydrocarbon molecules.

(i) Hydrocarbon molecules, such as decane, can be cracked to produce smaller, more useful molecules.

Write the correct formula of the third product to complete the chemical equation.

You do not need to give the name of this product.

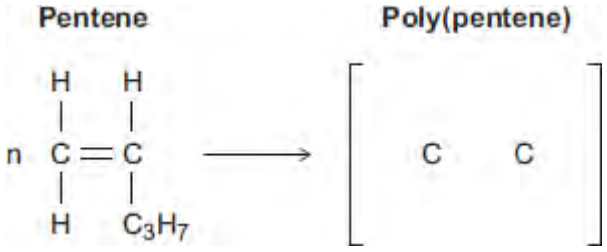
$C_{10}H_{22} \longrightarrow C_5H_{10} + C_3H_8 + ...$

decane pentene propane

(1)

(ii) Pentene is used to produce poly(pentene).

Complete the equation and the displayed structure of poly(pentene).



(3)

(iii) Some polymers are described as smart polymers.

Suggest **one** property of a smart polymer that is different to that of an ordinary polymer.

.....

.....

(1)

(Total 12 marks)

Q4. Sulfur is a non-metal.

Sulfur burns in the air to produce sulfur dioxide, SO_2

(a) Why is it important that sulfur dioxide is **not** released into the atmosphere?

Tick (✔) **one** box.

Sulfur dioxide causes acid rain. ☐

Sulfur dioxide causes global dimming. ☐

Sulfur dioxide causes global warming. ☐

(1)

(b) Sulfur dioxide dissolves in water.

What colour is universal indicator in a solution of sulfur dioxide?
Give a reason for your answer.

.....

.....

.....

.....

(2)

(c) Sulfur dioxide is a gas at room temperature.

The bonding in sulfur dioxide is covalent.

Explain, in terms of its structure and bonding, why sulfur dioxide has a low boiling point.

.....

.....

.....

.....

.....

.....

(3)

(d) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

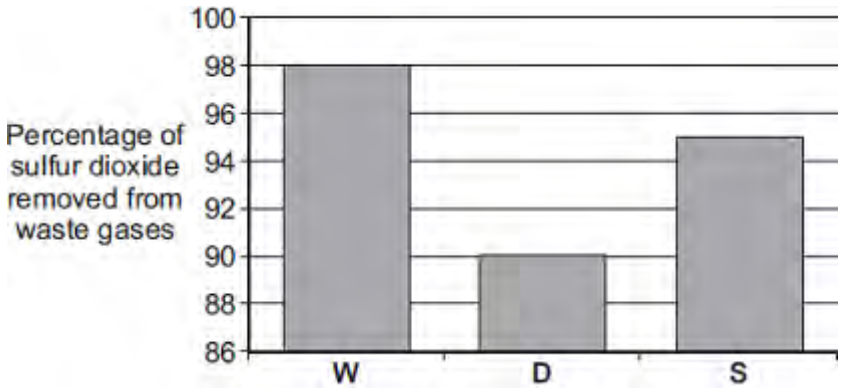
Sulfur dioxide is produced when fossil fuels are burned.

It is important that sulfur dioxide is not released into the atmosphere.

Three of the methods used to remove sulfur dioxide from gases produced when fossil fuels are burned are:

- wet gas desulfurisation (**W**)
- dry gas desulfurisation (**D**)
- seawater gas desulfurisation (**S**).

Information about the three methods is given in the bar chart and in **Table 1** and **Table 2**.



Method of removing sulfur dioxide

Table 1

Method	Material used	How material is obtained
W	Calcium carbonate, $CaCO_3$	Quarrying

D	Calcium oxide, CaO	Thermal decomposition of calcium carbonate: $CaCO_3 \longrightarrow CaO + CO_2$
S	Seawater	From the sea

Table 2

Method	What is done with waste material
W	Solid waste is sold for use in buildings. Carbon dioxide is released into the atmosphere.
D	Solid waste is sent to landfill.
S	Liquid waste is returned to the sea.

Evaluate the three methods of removing sulfur dioxide from waste gases.

Compare the three methods and give a justified conclusion.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6)
(Total 12 marks)

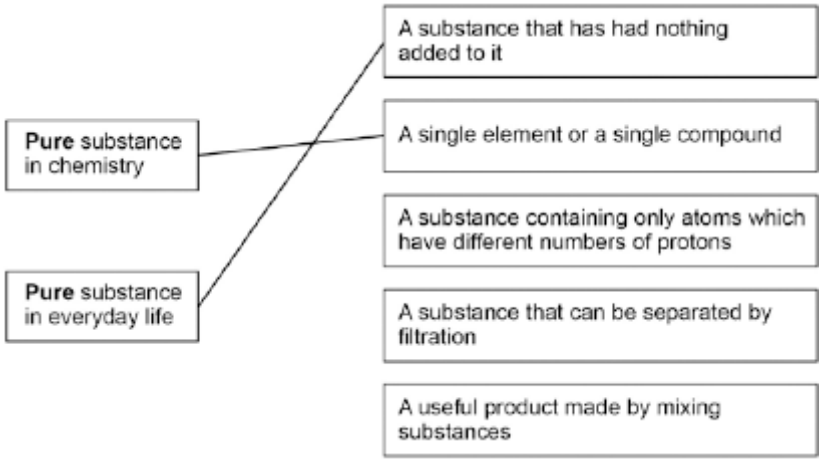
M1.(a) Air

2

Steel

1

(b)



Allow **1** mark for the correct meanings linked to context but incorrect way around

1

1

(c) Damp litmus paper turns white

1

(d) Iron(III)

1

[6]

M2.(a) argon / Ar

1

(b) (i) 0

1

(ii) unreactive

1

(c) (i) 94.96(%)

1

(ii) any **two** from:

- plants or photosynthesis
- absorbed in oceans / *seas*

  *allow oceans store **or** take in **or** dissolve carbon dioxide*
- locked up in (sedimentary) rocks
- locked up in fossil fuels

2

[6]

M3. (a) bar drawn correctly 78 – 80 (%)

1

(b) (i) (Mars has) no (green / living) plants / trees

1

(ii) (argon) is unreactive / inert

accept argon is a noble gas

ignore it is in Group 0

1

(c) (the amount of carbon dioxide has decreased because it has been) absorbed / used by (green / living) plants / trees **or** used for photosynthesis

accept dissolved / absorbed by oceans or locked up in fossil fuels / carbonate rocks

1

(d) the eruption of volcanoes

1

[5]

M4. (a) crust

ignore Earth's

1

core

ignore inner and/or outer

1

(b) bar chart

1

all heights are correct

accept correctly plotted points

1

all labels are correct for nitrogen, oxygen and other / argon

1

(c) (i) decomposed

1

(ii) global warming

1

[7]

M5. (a) (i) nitrogen / N_2

1

(ii) carbon dioxide / CO_2

1

(b) (i) humans / scientists had not evolved

accept it was billions / millions of years ago

allow too long ago

1

(ii) temperature is above 100°C **or** any water would evaporate / boil

accept Venus is too hot

1

(c) any **three** from:

- used by <u>plants</u>
- used for <u>photosynthesis</u>

  *accept <u>plants take in carbon dioxide and give out oxygen</u> for the first two bullet points ie **2** marks*
- <u>dissolves</u> in oceans / seas

  allow absorbs into oceans / seas
- used to form the shells / skeletons of marine organisms
- <u>locked up</u> as limestone / carbonates
- <u>locked up</u> as fossil fuels / oil / coal

3

[7]

M6. (a) core

ignore outer or inner

1

mantle

1

(b) (i) carbon dioxide

accept formula CO_2

1

oxygen

accept formulae O_2 / O

1

(ii) 4%

1

(iii) carbon dioxide has <u>decreased</u> / from 95% to 0%

1

oxygen has <u>increased</u> / from 0% to 21%

1

any **one** from:

(carbon dioxide decrease)

- carbon dioxide used during photosynthesis / by plants
- carbon dioxide dissolves in oceans
- carbon dioxide is locked up in rocks / carbonates / fossil fuels

(oxygen increase)

- oxygen released during photosynthesis / by plants

1

[8]

M7. (a) (i) water <u>vapour</u> given out from volcano

accept steam
not hydrogen and oxygen combining
to form water

1

condensed

accept rain / clouds formed just 'cools' is insufficient

1

(b) nitrogen (left) N_2

*do **not** accept N*

1

oxygen (right) O_2

*do **not** accept O*

1

[4]

M8. (a) respiration

combustion

1 *mark each*

2

(b) methane

water

1 *mark each*

accept steam

*do **not** accept natural gas for methane*

*do **not** accept hydrogen oxide*

2

(c) greenhouse effect (increased)

accept (global) warming

accept polar ice caps melt

accept rising sea levels

accept problems with climatic change

*do **not** accept changes to the weather **or** acid rain*

1

[5]

M9. (a) (i) nitrogen (gas) **or** N_2

if only the formula is given it must be correct in every detail

1

(ii) argon (gas) **or** Ar

1

(iii) oxygen (gas) **or** O_2

1

(b) vapour

1

evaporating

1

sea(s)

1

condenses

1

(c) volcanoes **or** volcanic activity **or** the sea(s)

allow carbonates(s) (rocks)

do not credit inside

1

[8]

-

Q1. This question is about mixtures and analysis.

(a) Which **two** substances are mixtures?

Tick **two** boxes.

Air	☐
Carbon dioxide	☐
Graphite	☐
Sodium Chloride	☐
Steel	☐

(2)

(b) Draw **one** line from each context to the correct meaning.

Context	Meaning
	A substance that has had nothing added to it
Pure substance in chemistry	A single element or a single compound
	A substance containing only atoms which have different numbers of protons
Pure substance in everyday life	A substance that can be separated by filtration
	A useful product made by mixing

substances

(2)

(c) What is the test for chlorine gas?

Tick **one** box.

A glowing splint relights ☐

A lighted splint gives a pop ☐

Damp litmus paper turns white ☐

Limewater turns milky ☐

(1)

(d) A student tested a metal chloride solution with sodium hydroxide solution.

A brown precipitate formed.

What was the metal ion in the metal chloride solution?

Tick **one** box.

Calcium ☐

Copper(II) ☐

Iron(II) ☐

Iron(III) ☐

(1)
(Total 6 marks)

Q2. Some theories suggest that the Earth's early atmosphere was the same as Mars' atmosphere today.

The table below shows the percentage of four gases in the atmosphere of Mars today and the atmosphere of Earth today.

Gases	**The atmosphere of**	
	Mars today	**Earth today**
Carbon dioxide	95.00%	0.04%
Nitrogen	3.50%	78.00%
Argon	1.00%	0.96%
Oxygen	0.50%	21.00%

(a) Which **one** of the gases in the table is a noble gas?

.....

(1)

(b) Draw a ring around the correct answer to complete each sentence.

(i) Noble gases are in Group

0

1

7

(1)

(ii) Noble gases are

slightly reactive.

unreactive.

very reactive.

(1)

(c) The percentage of carbon dioxide in the Earth's early atmosphere was 95.00%.
It is 0.04% in the Earth's atmosphere today.

(i) Calculate the decrease in the percentage of carbon dioxide in the Earth's atmosphere.

.....

.....

Decrease in percentage = ...%

(1)

(ii) Give **two** reasons for this decrease.

.....

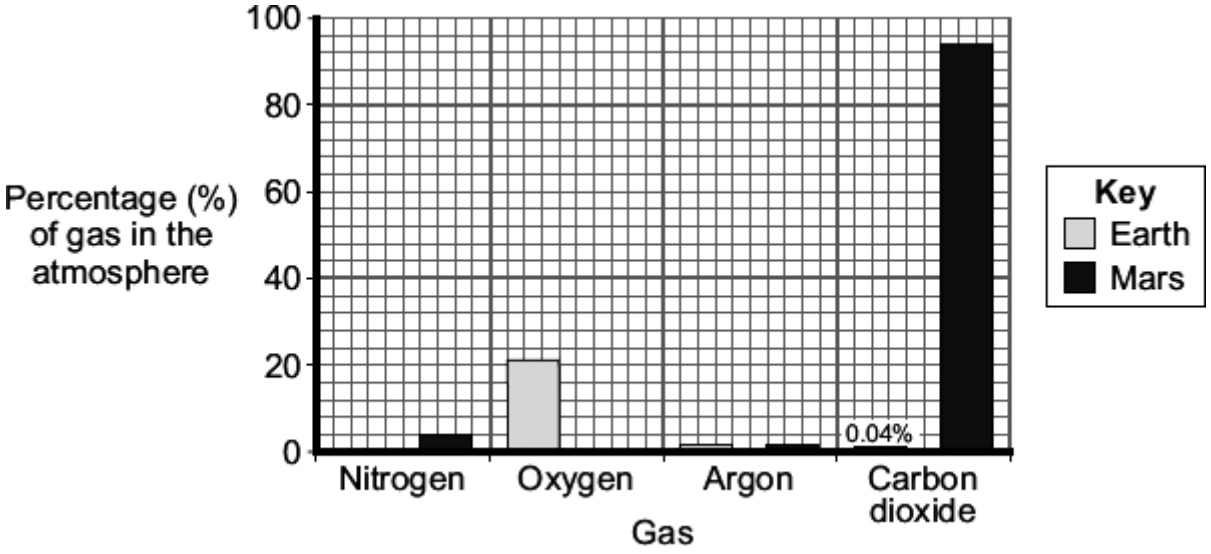
.....

.....

.....

(2)
(Total 6 marks)

Q3. The bar chart shows some of the gases in the atmospheres of Earth today and Mars today.



(a) Complete the bar chart to show the percentage of nitrogen in the Earth's atmosphere today.

(1)

(b) Some scientists suggest that the Earth's early atmosphere was like the atmosphere of Mars today.

(i) There is **not** much oxygen in the atmosphere of Mars.

Suggest why.

.....

.....

(1)

(ii) The percentage of argon in the Earth's atmosphere today is the same as it was in the Earth's early atmosphere.

Suggest why.

.....

.....

(1)

(c) Compared with the percentage of carbon dioxide in the Earth's early atmosphere there is **not** much carbon dioxide in the Earth's atmosphere today.

Give **one** reason for this change.

.....

.....

(1)

(d) Draw a ring around the correct answer to complete the sentence.

Some theories suggest that the Earth's early atmosphere was

made by

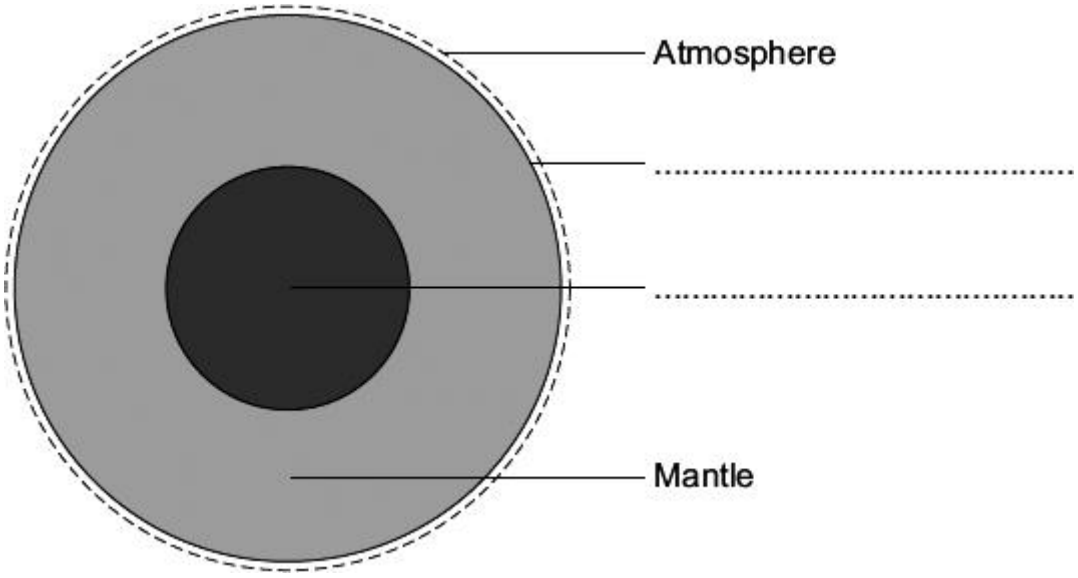
burning fossil fuels.
the formation of oceans.
the eruption of volcanoes.

(1)
(Total 5 marks)

Q4. The Earth has a layered structure and is surrounded by an atmosphere.

(a) The diagram shows the layers of the Earth.

Complete the labels on the diagram.

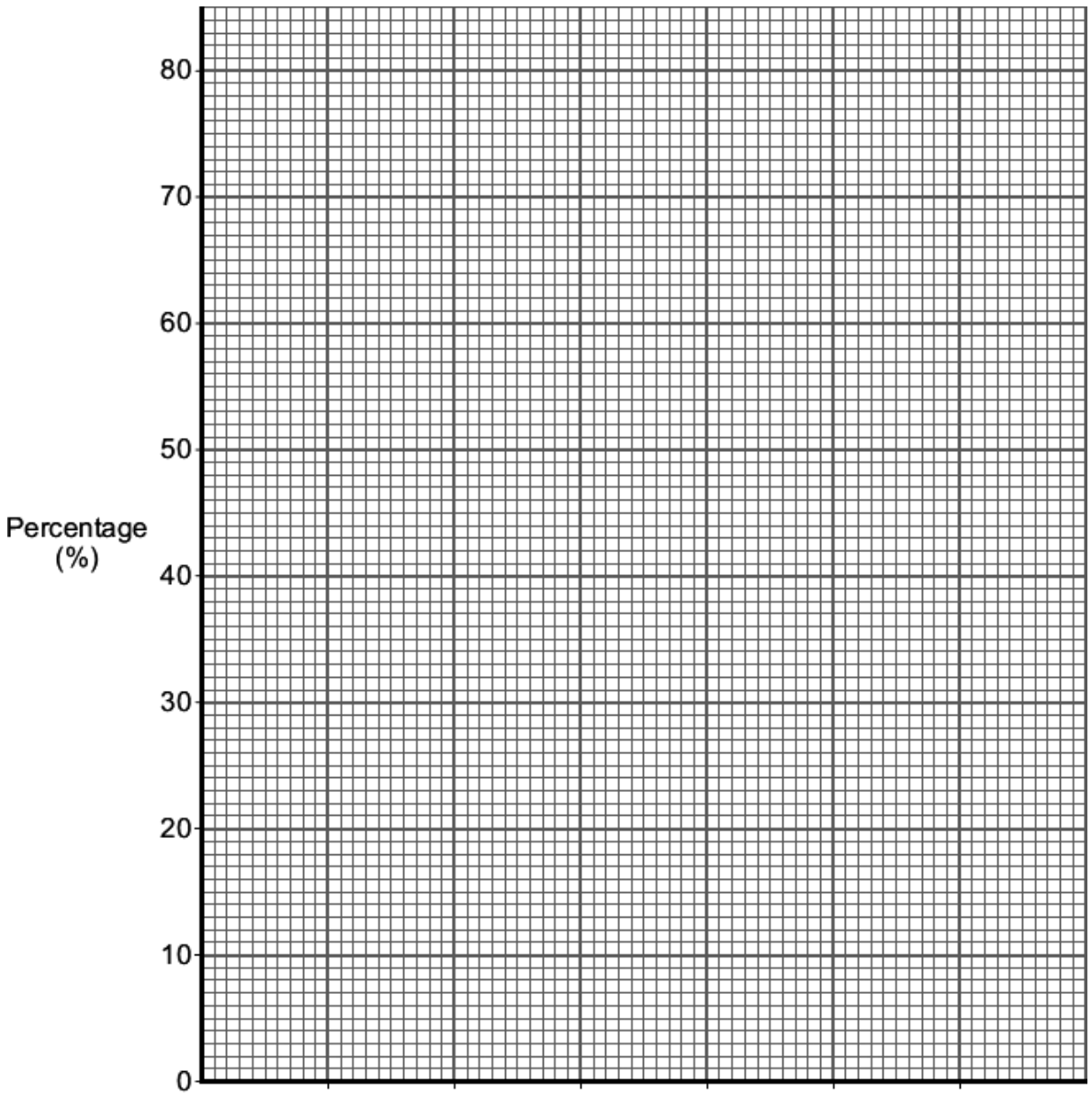


(2)

(b) The data in the table shows the percentages of the gases in the Earth's atmosphere.

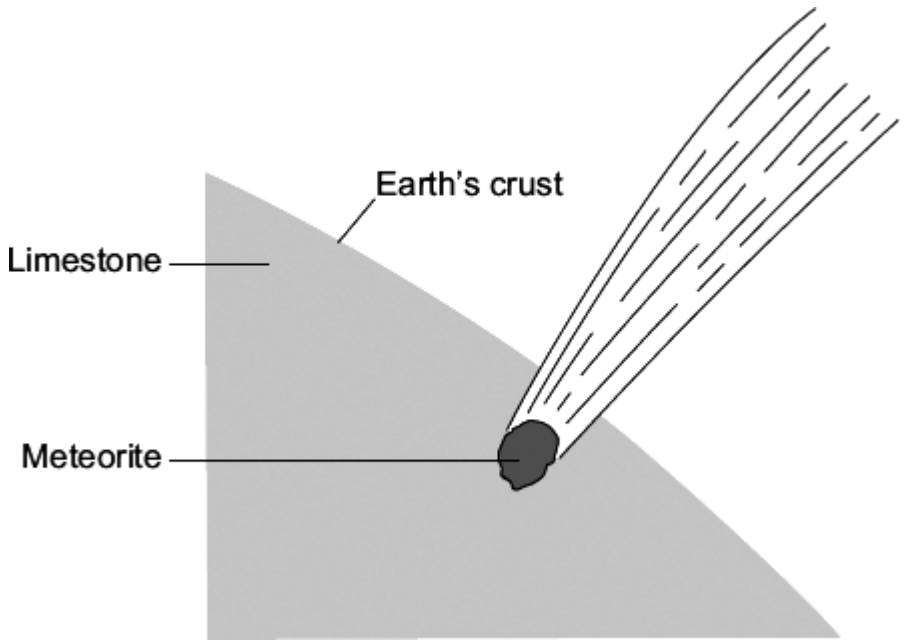
Name of gas	Percentage (%) of gas
Nitrogen	78
Oxygen	21
Other gases	1

Present the data in the table on the grid below.



(3)

(c) Millions of years ago a large meteorite hit the Earth.
The meteorite heated limestone in the Earth's crust to a very high temperature.
The heat caused calcium carbonate in the limestone to release large amounts of carbon dioxide.



Draw a ring round the correct answer to complete each sentence.

(i) Carbon dioxide was released because the calcium carbonate was

decomposed.
evaporated.
reduced.

(1)

(ii) More carbon dioxide in the Earth's atmosphere causes

acid rain.
global dimming.
global warming.

(1)
(Total 7 marks)

Q5. Billions of years ago, the Earth's early atmosphere was probably like the atmosphere of Venus today.

The table shows a comparison of the atmospheres of the Earth and Venus today.

	Percentage composition of atmosphere	
Name of gas	**Earth today**	**Venus today**
Nitrogen	78	3.5
Oxygen	21	a trace
Argon	0.97	a trace
Carbon dioxide	0.03	96.5
Average surface temperature	20 ºC	460 ºC

(a) Use the names of gases from the table to complete the sentences.

(i) In the Earth's atmosphere today, the main gas is ..... .

(1)

(ii) In the Earth's atmosphere billions of years ago, the main gas was

..... .

(1)

(b) (i) Scientists do **not** know the accurate composition of the Earth's early atmosphere. Suggest why.

.....

.....

(1)

(ii) Use information from the table to answer this question.

Water vapour is present in the atmospheres of the Earth and Venus today. The Earth's surface is mainly covered by water.

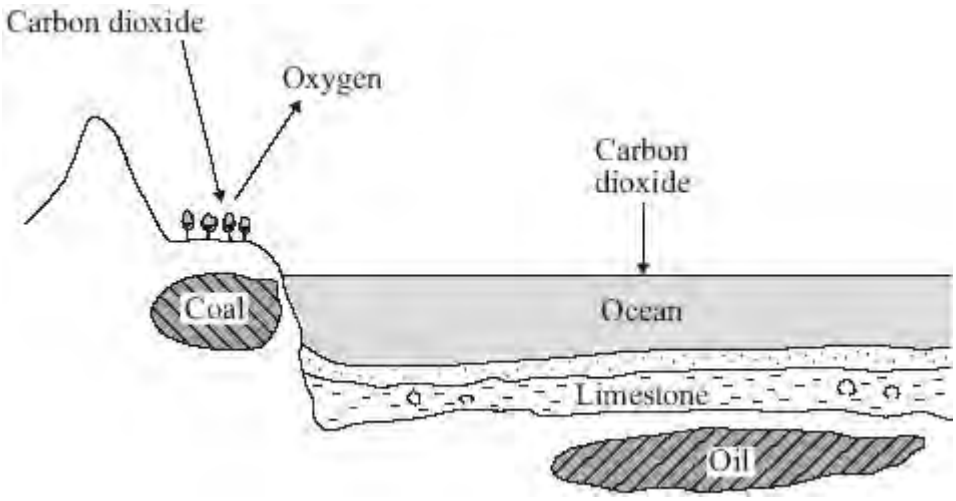
Suggest why there is no water on the surface of Venus.

.....

.....

(1)

(c) The diagram shows how carbon dioxide is removed from the Earth's atmosphere.



Describe what happened to the carbon dioxide in the Earth's early atmosphere. Use the diagram to help you.

.....

.....

.....

.....

.....

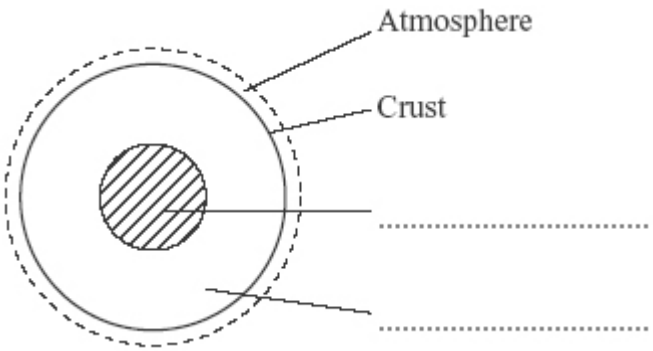
.....

.....

(3)
(Total 7 marks)

Q6. The Earth is shaped like a ball and is surrounded by an atmosphere.

(a) The diagram shows the layered structure of the Earth.



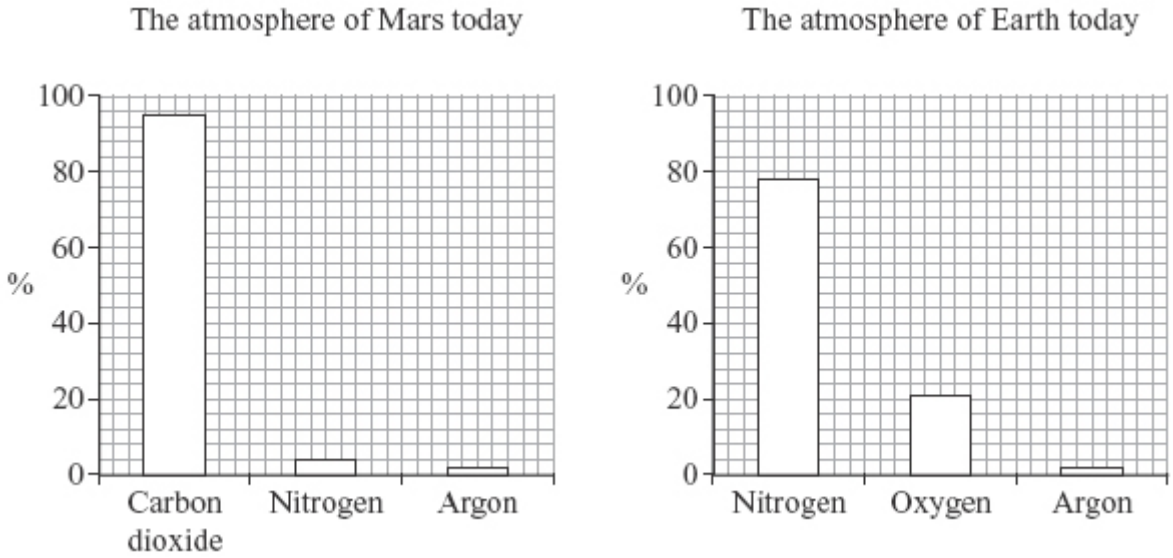
Choose words from the box to complete the labels on the diagram.

core	**mantle**	**plate**

(2)

(b) Some theories suggest that the Earth's early atmosphere was like the atmosphere of Mars today.

The bar charts show the three most common gases in each atmosphere today.



(i) Use the bar charts to complete the sentence by writing in the correct gases.

In the atmosphere of Mars today there is mainly ..... and no

..... .

(2)

(ii) Use the bar charts to complete the sentence by writing in the correct number.

These theories suggest that there was about ..... % nitrogen in the Earth's early atmosphere.

(1)

(iii) The atmosphere of the Earth today has much more nitrogen than in the early atmosphere. Denitrifying bacteria released most of this nitrogen into the atmosphere.

There are other differences between the Earth's early atmosphere and the atmosphere of the Earth today.

Use the bar charts to describe and explain **two** of these other differences.

.....

.....

.....

.....

.....

.....

(3)

(Total 8 marks)

Q7. (a) During the first billion years of the Earth's existence, there were many active volcanoes. The volcanoes released the gases that formed the early atmosphere.

Describe how volcanoes caused the oceans to be formed.

.....

.....

.....

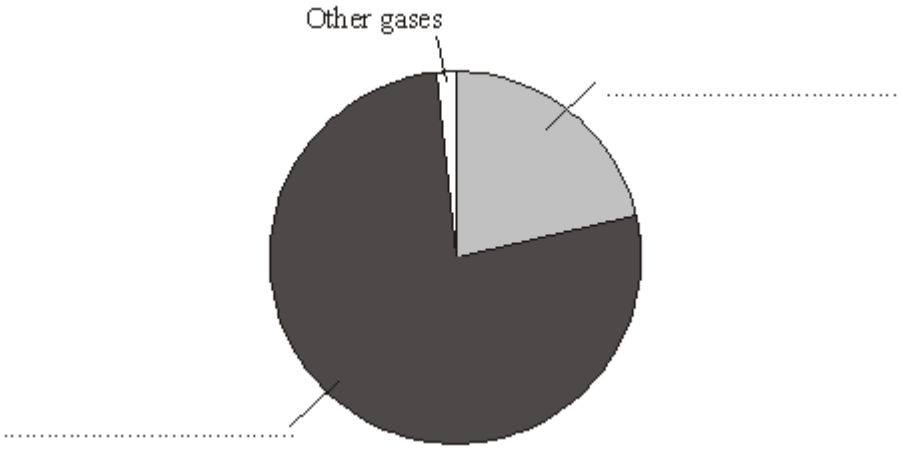
.....

(2)

(b) The atmosphere on Earth today is very different from the early atmosphere.

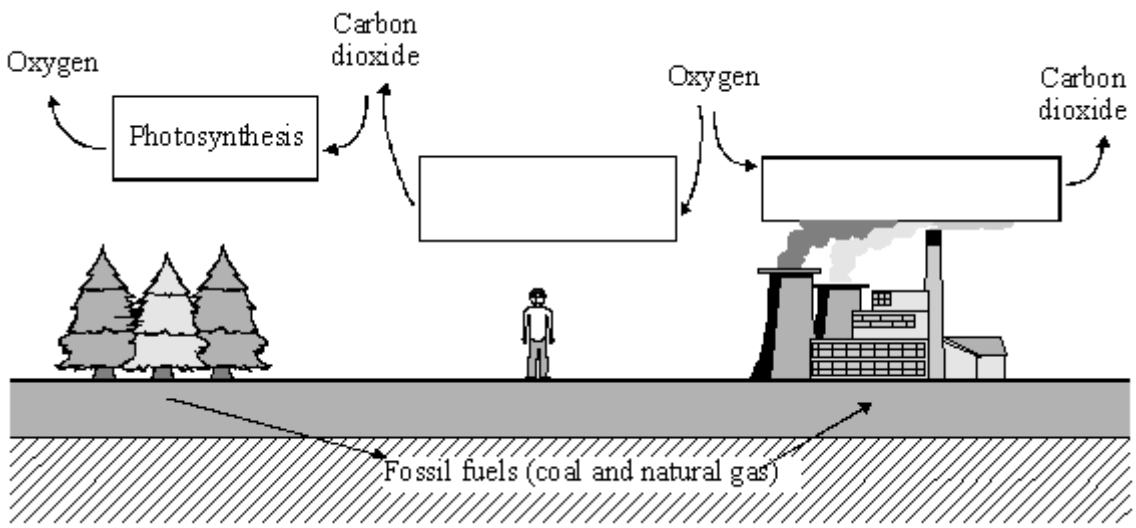
The pie chart shows the amounts of different gases in the air today. Choose gases from the box to label the pie chart.

argon	**carbon dioxide**	**hydrogen**	**nitrogen**	**oxygen**



(2)
(Total 4 marks)

Q8. In the carbon cycle the amounts of carbon dioxide and oxygen in the air are changed by several processes.



(a) The names of some processes are given in the box below.

combustion	decomposition	neutralisation
photosynthesis		respiration

Choose the correct process for each box in the diagram. The first one has been done for you.

(2)

(b) Fossil fuels, such as natural gas, react with oxygen.

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

..... + oxygen → carbon dioxide + ...

Complete the word equation for this reaction

(2)

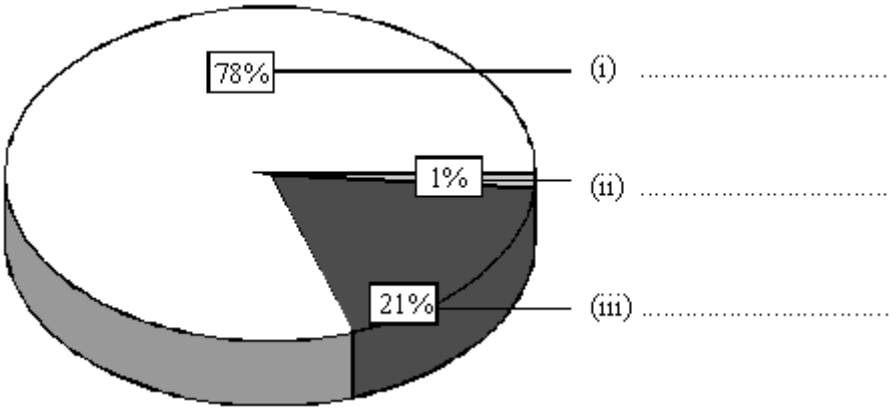
(c) What problem is caused by the formation of large amounts of carbon dioxide?

.....

.....

(1)
(Total 5 marks)

Q9. (a) Air is a mixture of gases. The pie chart shows the percentages, by volume, of the main gases in dry air. Complete the chart by adding the names of these **three** gases.



(3)

(b) Complete each of the **four** spaces in the sentences by choosing the best word from the box.

condenses	**condensing**	**evaporates**	**evaporating**
melts	**sea**	**trees**	**vapour**

The air in the atmosphere above this country always contains ..... .

Most of this is the result of water ..... from the surface of the

..... . Some of it ..... to form millions of tiny

drops of water in clouds.

(4)

(c) Thousands of millions of years ago the Earth's early atmosphere was formed. Complete the following sentence.

The carbon dioxide in this early atmosphere probably came from .....

..... .

(1)

(Total 8 marks)

M1.(a) any **one** from:

- not enough evidence or proof

  allow no evidence or no proof
- (life and the Earth were created) billions of years ago

  allow a long time ago

  ignore different beliefs or no one was there.

1

(b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking Guidance and apply a 'best–fit' approach to the marking.

0 marks
No relevant content

Level 1 (1–2 marks)
Statements based on diagrams

Level 2 (3–4 marks)
Description of how one change occurred

Level 3 (5–6 marks)
Descriptions of how at least two changes occurred

Examples of chemistry points made in the response could include:

Main changes

- oxygen increased because plants / algae developed and used carbon dioxide for photosynthesis / growth producing oxygen; carbon dioxide decreased because of this
- carbon dioxide decreased because oceans formed and dissolved / absorbed carbon dioxide; carbon dioxide became locked up in sedimentary / carbonate rocks and / or fossil fuels
- oceans formed because the Earth / water vapour cooled and water vapour in the atmosphere condensed
- continents formed because the Earth cooled forming a supercontinent / Pangaea which formed the separate continents
- volcanoes reduced because the Earth cooled forming a crust.

Other changes

- nitrogen has formed because ammonia in the Earth's early atmosphere reacted with oxygen / denitrifying bacteria.

6

[7]

M2. (a) carbon dioxide <u>decreased (by plants / trees)</u>

allow plants / trees absorbed carbon dioxide

1

oxygen <u>increased</u> (by plants / trees)

allow plants / trees released oxygen

if neither of these marks awarded

allow plants / trees

*photosynthesise for **1** mark*

1

because coal 'locks up' / traps / stores carbon dioxide / carbon

allow trees 'locked up' carbon dioxide / carbon

1

(b) carbon / C

hydrogen / H

sulfur / S

*all 3 correct **2** marks*

*1 or 2 correct **1** mark*

allow H_2

ignore oxygen

2

(c) (i) 2 2

balancing must be correct

*do **not** accept changed formulae*

1

(ii) <u>increases atmospheric pollution</u>

carbon dioxide / CO_2 released

1

from the (thermal) decomposition of calcium carbonate **or**

*accept causes global warming **or** CO_2 is a greenhouse gas*

description of this decomposition **or** equation

ignore sulfur dioxide and effects in this part

1

<u>decreases atmospheric pollution</u>

sulfur dioxide / SO_2 is removed

accept less acid rain produced

1

by reaction with calcium oxide **or** calcium carbonate

*accept neutralisation **or** forms calcium sulfate*

1

[10]

M3. (a) (i) any **two** from:

- used by plants
  allow specific plants and algae
- used for photosynthesis
  ignore oxygen released / respiration
- absorbed / dissolved in oceans
  ignore oceans formed
- locked up in fossil fuels / limestone / sedimentary rocks

2

(ii) calcium carbonate / $CaCO_3$

1

decomposed / thermal decomposition
*do **not** allow reaction with oxygen*
accept quicklime / calcium oxide produced
*$CaCO_3 \rightarrow CaO + CO_2$ gains **2** marks*

1

(b) increasing (CO_2 or global warming)

1

more rapid increase recently

1

carbon dioxide causes global warming
*accept greenhouse gas **or***
climate change / sea level rising
***or** ice caps melting*
*do **not** accept ozone layer or acid rain or global dimming*

1

(c) (i) any **one** from:

- Wegener had no evidence / proof
  accept movement too slow to measure
- other scientists had different ideas / views
  accept continents / plates fixed or land bridge
- did not respect Wegener as a scientist / geologist

1

(ii) any **three** from:

- plates (move)
  ignore continents
- heat energy / radioactivity (causes)
- convection currents
- in mantle

3

[11]

M4. (a) complete diagram with 2 carbon atoms and 5 hydrogen atoms each C–C and each C–H linked by a single line (bond)

1

(b) (i) the greater the number of (carbon) atoms (in an alkane molecule) the greater its boiling point **or** vice versa

allow as the (carbon) chain gets longer the boiling point increases

ignore melting points

*do **not** accept reference to greater number of molecules*

1

(ii) *they = hydrocarbons from the graph*

it = $C_{30}H_{62}$

any **two** from:

- low boiling point / volatile
  accept they are gases or liquids
- low viscosity
- high flammability
  accept easier to burn / ignite
- small molecules
  accept short chains
  ignore number of carbon atoms
- burn completely
  ignore speed of burning

2

(c) (i) 16 (CO_2) + 18 (H_2O)

1

(ii) (carbon dioxide in the Earth's early) atmosphere

accept from volcanoes (millions of years ago)

***or** from <u>dead</u> plants / animals*

allow dead sea creatures

ignore shells

1

(iii) <u>increase</u> in burning / use of fossil fuels

1

locked up carbon (carbon dioxide) is released

allow carbon / carbon dioxide from millions of years ago is released

accept extra carbon dioxide is not 'absorbed' (by the carbon cycle)

1

[8]

M5. (a) (thought to cause) global warming / green house (effect) / climate change

ignore other consequences of global warming

*do **not** accept acid rain / ozone layer / global dimming*

1

(b) any **three** from:

- replant trees / renewable / sustainable

  ignore reusable

- carbon (dioxide) used by trees / photosynthesis

  accept trees absorb carbon (dioxide) as they grow

  ignore respiration

- it is a (continuous / carbon) cycle

  accept burning wood is carbon neutral

  or

  carbon (dioxide) goes back into the air

  *for the **second** and **third** bullet points: accept trees use carbon dioxide which is released when (trees / wood are / is) burnt for **2** marks*

- no new carbon (dioxide) is produced

  or

  no locked up carbon (dioxide) is released

  or

  the carbon (dioxide) was absorbed millions of years ago

3

[4]

M6. (a) (i) *it = water vapour*

condensed

accept temperature went <u>below</u> <u>100</u>°C / boiling point of water

allow <u>cooled to form liquid</u> / water / rain

*do **not** accept evaporated*

1

formed the oceans / seas

ignore rain

*accept (water vapour) cooled and formed the ocean / sea for **2** marks*

1

(ii) any **two** from:

ignore oxygen / nitrogen increased

ignore reference to volcanoes / respiration

- <u>used by</u> (green) plants / *algae*
  accept photosynthesis / plants give out oxygen
- <u>changed</u> into oxygen
- dissolved in oceans / seas
  accept (locked up) in shells / skeletons (of animals)
- (locked up) in carbonates / sedimentary rocks
- (locked up) in fossil fuels / named fossil fuel

2

(b) (i) cannot get to / reach / drill to / see the core

accept the core is (too) far down (into the Earth) / do not know what happens under the crust / Earth's surface

accept it is (too) hot / radioactive

ignore lack of evidence unqualified

1

(ii) any **three** from:

- heat / *energy* released
- from radioactive decay / processes
  accept radioactivity / nuclear reactions
- (causing) convection currents
- in the mantle

3

[8]

M7. (a) (i) (gases from) volcanoes

1

(ii) 100 allow 99

1

(iii) any **two** from:

- photosynthesis
- carbon dioxide used
  allow carbon dioxide decreased
- oxygen produced
  allow oxygen increased
  ignore nitrogen / respiration
  they = plants

2

(b) (i) any **one** from:

- sea floor spreading
  accept oceanic ridges / magnetic stripes
- periodic measurements between continents
  accept continents move a few centimetres each year
- evidence from rocks / fossils on different continents
  accept continents fit together
- new mountain ranges
  accept new islands

1

(ii) in the mantle

any **two** from:

- convection (currents) / movement
  *do **not** accept movement of the plates*
- radioactivity / radioactive decay / nuclear reactions

1

- releases heat / thermal energy
  accept heat from core

2

[8]

Q1. This question is about life, the Earth and its atmosphere.

(a) There are many theories about how life was formed on Earth.

Suggest **one** reason why there are many theories.

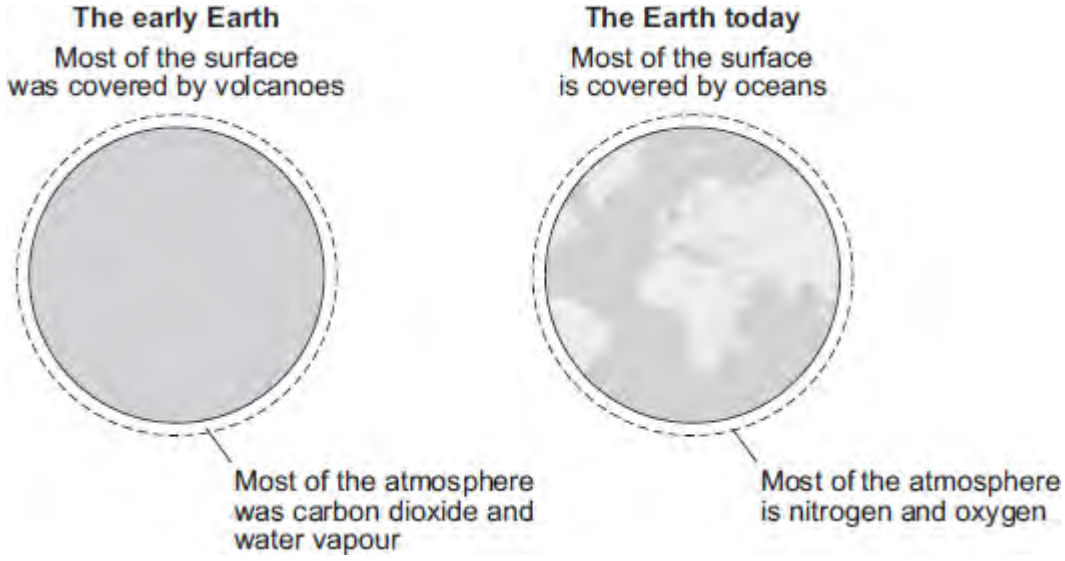
.....

.....

(1)

(b) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

This Earth and its atmosphere today are not like the early Earth and its atmosphere.



Describe and explain how the surface of the early Earth and its atmosphere have changed to form the surface of the Earth and its atmosphere today.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6)
(Total 7 marks)

Q2. About 3000 million years ago, carbon dioxide was one of the main gases in the Earth's atmosphere.

About 400 million years ago, plants and trees grew on most of the land. When the plants and trees died they were covered by sand and slowly decayed to form coal.

(a) Describe and explain how the composition of the Earth's atmosphere was changed by the formation of coal.

.....

.....

.....

.....

.....

.....

.....

.....

(3)

(b) Today, coal is burned in power stations to release the energy needed by industry. Carbon dioxide, water and sulfur dioxide are produced when this coal is burned.

Name **three** elements that are in this coal.

.....

.....

.....

(2)

(c) In some power stations coal is mixed with calcium carbonate (limestone). The mixture is crushed before it is burned.

(i) Many chemical reactions happen when this mixture is burned. The chemical equation represents one of these reactions.

Balance the chemical equation.

$2CaCO_3(s) + 2SO_2(g) + O_2(g) \rightarrow \ldots\ldots CaSO_4(s) + \ldots\ldots CO_2(g)$

(1)

(ii) Explain how the use of calcium carbonate in the mixture:

increases atmospheric pollution

.....

.....

.....

.....

decreases atmospheric pollution.

.....

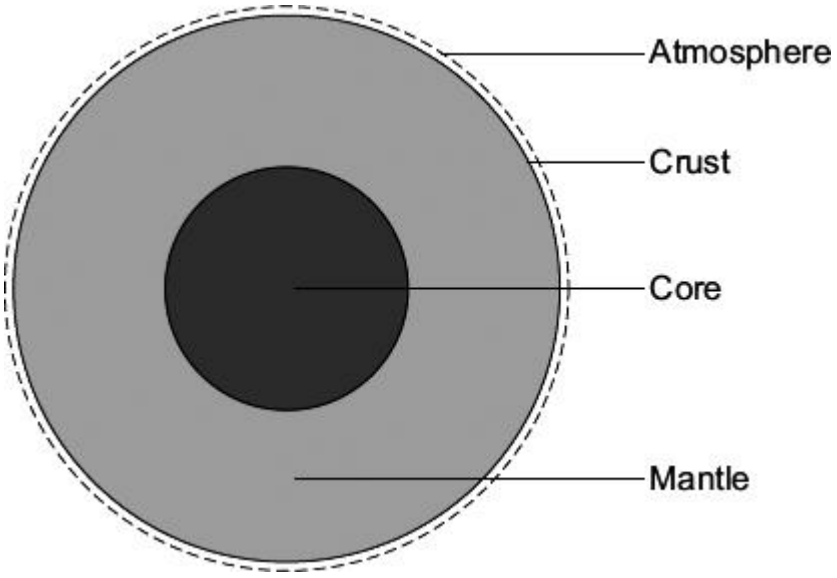
.....

.....

.....

(4)
(Total 10 marks)

Q3. The Earth has a layered structure and is surrounded by an atmosphere.



(a) Scientists believe that the Earth's atmosphere was formed by volcanoes releasing gases. This early atmosphere was about 95 % carbon dioxide.
The composition of the Earth's atmosphere is always changing.

(i) The Earth's atmosphere today contains about 0.035 % carbon dioxide.

What happened to most of the carbon dioxide that was in the Earth's early atmosphere?

.....

.....

.....

.....

(2)

(ii) About 60 million years ago a large meteorite hit the Earth.
This meteorite heated limestone in the Earth's crust causing the release of large amounts of carbon dioxide.

Explain how carbon dioxide is released from limestone.

.....

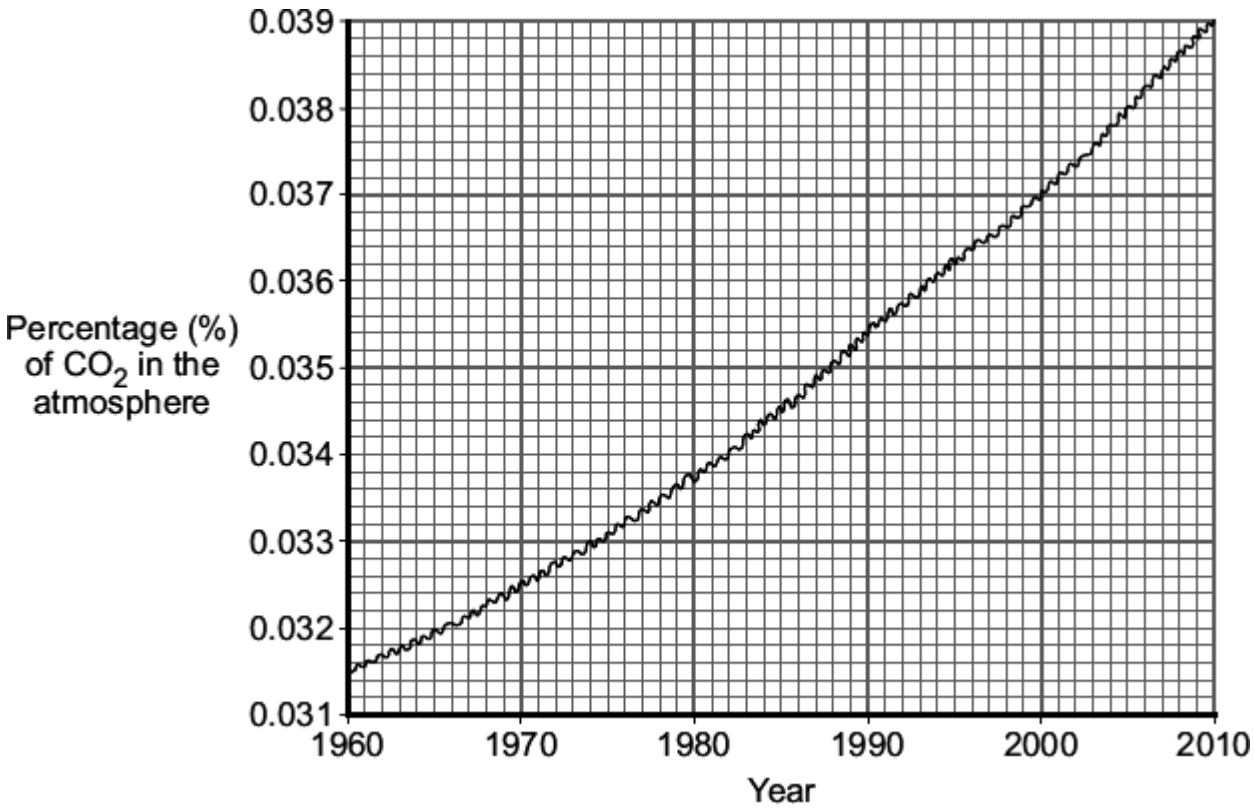
.....

.....

.....

(2)

(b) The graph shows the percentage of carbon dioxide in the Earth's atmosphere over the last 50 years.



Explain, as fully as you can, why we should be concerned about the information displayed on this graph.

.....

.....

.....

.....

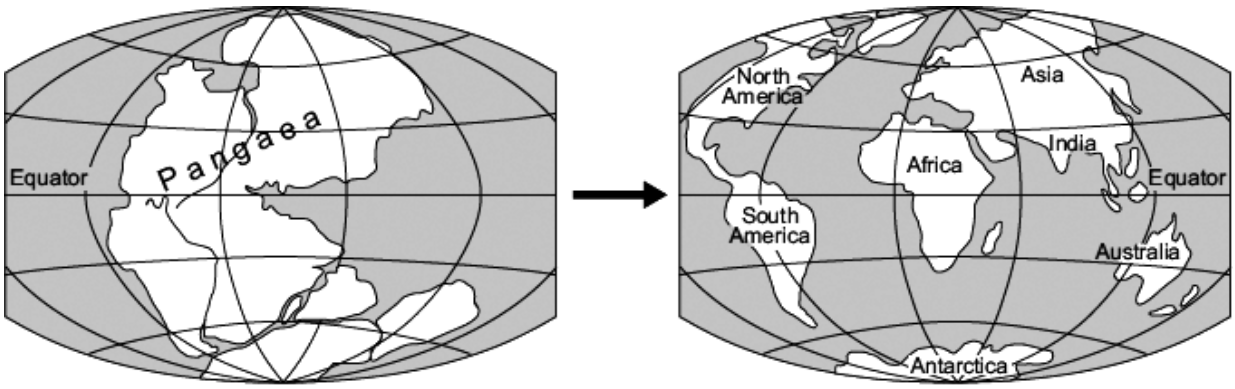
.....

.....

.....

(3)

(c) Scientists believe that all the continents of the Earth were once joined together.
The huge 'supercontinent' was called Pangaea.



200 million years ago **Today**

In 1915, Alfred Wegener had an idea that the change shown in the diagram was caused by *continental drift.* Most scientists could not accept his idea.

(i) Suggest why most scientists in 1915 could not accept Wegener's idea of *continental drift.*

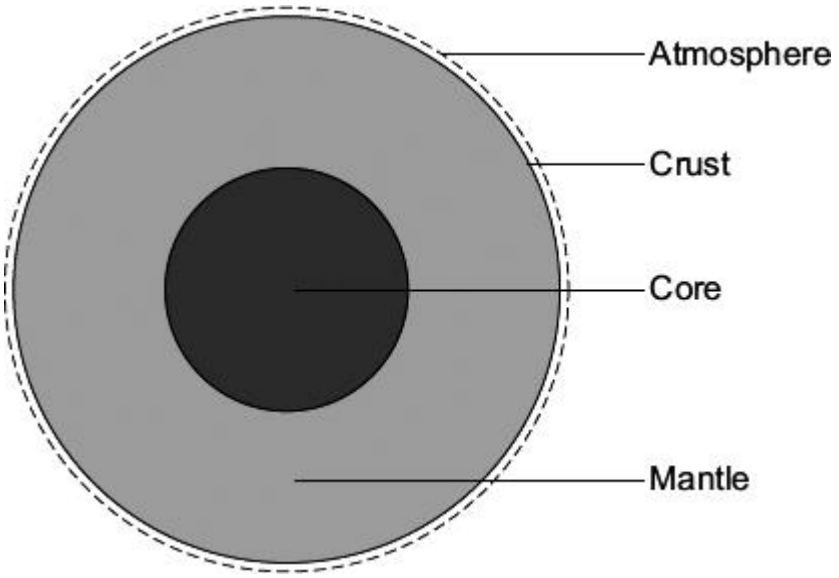
.....

.....

(1)

To help you with this question, the information and diagram from the beginning of the question are reproduced here.

The Earth has a layered structure and is surrounded by an atmosphere.



(ii) Use this information and your knowledge and understanding to explain how continents move.

.....

.....

.....

.....

.....

.....

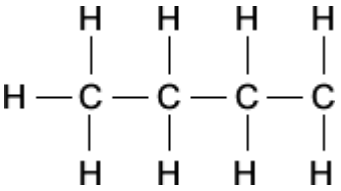
(3)

(Total 11 marks)

Q4. Crude oil is a mixture of hydrocarbons. Most of these hydrocarbons are alkanes.

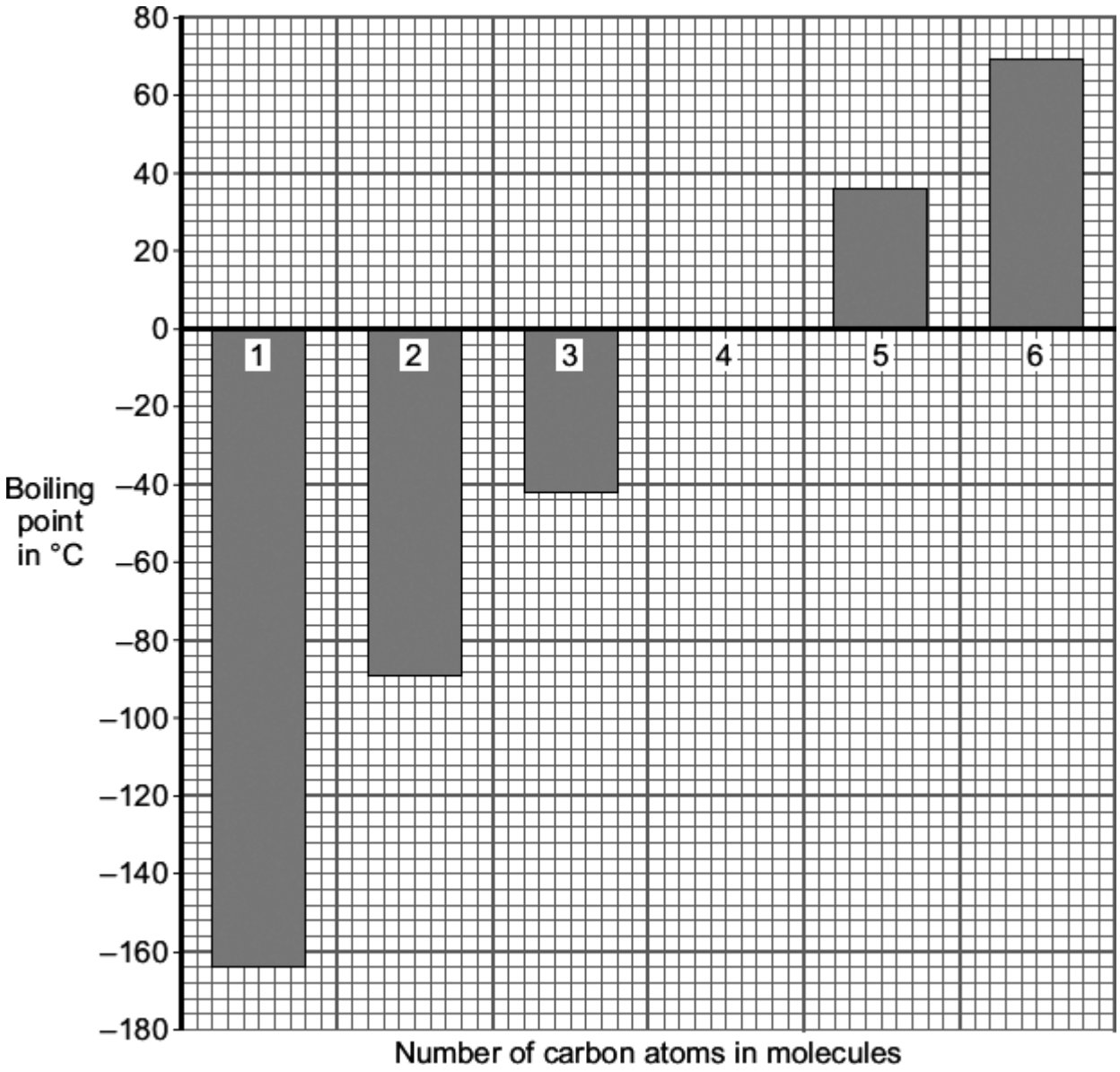
(a) The general formula of an alkane is C_nH_{2n+2}

Complete the structural formula for the alkane that has **six** carbon atoms in its molecules.



(1)

(b) The boiling points of alkanes are linked to the number of carbon atoms in their molecules.



(i) Describe the link between the number of carbon atoms in an alkane molecule and its boiling point.

.....

.....

(1)

(ii) Suggest **two** reasons why all of the alkanes in the bar chart are better fuels than the alkane with the formula $C_{30}H_{62}$

1 .....

.....

2 .....

.....

(2)

(c) During the last 200 million years the carbon cycle has maintained the percentage of carbon dioxide in the atmosphere at about 0.03 %.
Over the last 100 years the percentage of carbon dioxide in the atmosphere has increased to about 0.04 %.
Most of this increase is caused by burning fossil fuels to heat buildings, to generate electricity and to power our transport.
Fossil fuels contain carbon that has been locked up for millions of years.

(i) Burning fossil fuels, such as petrol, releases this locked up carbon. Balance the chemical equation for the combustion of one of the alkanes in petrol.

$2\ C_8H_{18} + 25\ O_2 \longrightarrow$ ..... CO_2 + ... H_2O

(1)

(ii) Where did the carbon that is locked up in fossil fuels come from?

.....

.....

(1)

(iii) The burning of fossil fuels has caused the percentage of carbon dioxide in the atmosphere to increase to above 0.03 %.
Explain why.

.....

.....

.....

.....

.....

.....

(2)
(Total 8 marks)

Q5. Many human activities result in carbon dioxide emissions.
Our carbon footprint is a measure of how much carbon dioxide we each cause to be produced.

(a) Why should we be concerned about our carbon footprint?

.....

.....

.....

(1)

(b) Most power stations in the UK burn coal.
Coal was formed from tree-like plants over millions of years.

Suggest why burning wood instead of coal would help to reduce our carbon footprint.

.....

.....

.....

.....

.....

.....

.....

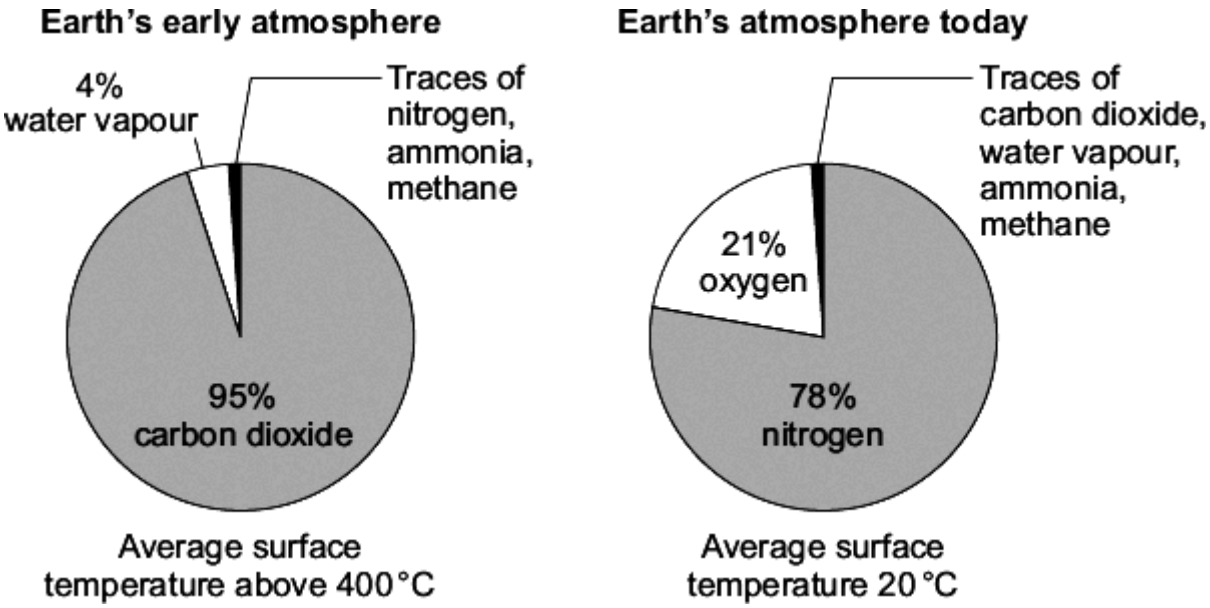
.....

(3)
(Total 4 marks)

Q6. (a) Scientists have suggested that:

- the Earth formed as a molten ball of rock and minerals
- the rock and minerals cooled slowly
- the surface of the Earth was covered by volcanoes
- the volcanoes released gases that formed the Earth's early atmosphere.

The pie charts show the approximate percentages of gases in the Earth's early atmosphere and in the Earth's atmosphere today.



(i) Explain what has happened to most of the water vapour in the Earth's early atmosphere.

.....

.....

.....

.....

(2)

(ii) Give **two** reasons why the percentage of carbon dioxide in the Earth's early atmosphere decreased.

1 .....

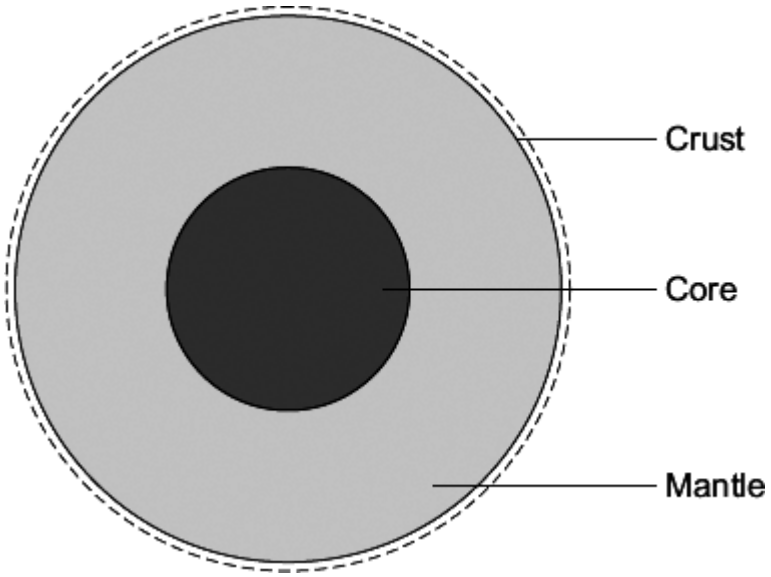
.....

2 .....

.....

(2)

(b) Scientists have suggested that the Earth consists of a core, mantle and crust.



A 'traditional' theory is that the core is made of iron and nickel.

A 'controversial' theory is that the core is like a nuclear reactor made of the radioactive elements uranium and plutonium.

(i) Why can scientists **not** prove which theory about the core is correct?

.....

.....

(1)

(ii) How can the 'controversial' theory be used to explain why the Earth's tectonic plates move?

.....

.....

.....

.....

.....

.....

(3)
(Total 8 marks)

Q7. There are many ideas about the formation of the Earth and its atmosphere from a molten ball of rock and minerals.

(a) One idea is that the Earth's early atmosphere and average surface temperature were probably like that of Venus today.

The table shows information about the Earth and Venus today.

	Percentage composition of atmosphere	
Name of gas	**Earth today**	**Venus today**
Nitrogen	78	3.5
Oxygen	21	a trace
Argon	0.97	a trace
Carbon dioxide	0.03	96.5
Average surface temperature	20 °C	460 °C

There is a variable amount of water vapour in both atmospheres.

(i) How was the Earth's early atmosphere formed?

.....

.....

(1)

(ii) The Earth's average surface temperature decreased over time. At what temperature would oceans have started to form?

Temperature = ... °C

(1)

(iii) Describe how the evolution of plants changed the Earth's atmosphere.

.....

.....

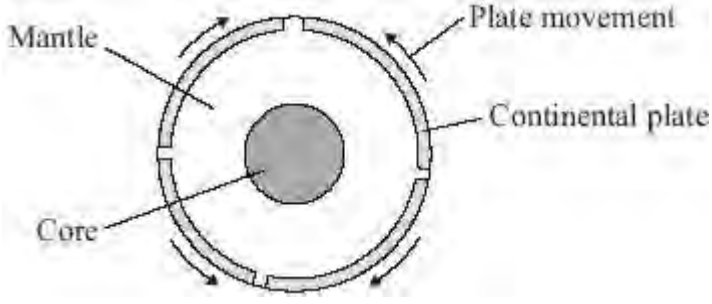
.....

.....

(2)

(b) Another idea was that the Earth's mountains and continents formed in fixed positions as the molten ball of rock and minerals cooled and wrinkled.

Wegener, in 1915, had the idea that the Earth's crust and the upper part of the mantle had cracked into plates that were able to move. His idea meant that the mountains and continents were not in fixed positions.



(i) Give **one** piece of evidence that led to Wegener's idea being accepted.

.....

.....

(1)

(ii) Describe what causes the Earth's tectonic plates to move.

.....

.....

.....

.....

.....

.....

(3)
(Total 8 marks)

M1.(a) any **two** from:

asks for cause therefore no marks for just describing the change
must link reason to a correct change in a gas

carbon dioxide has decreased due to:

accept idea of 'used' to indicate a decrease

- plants / microorganisms / bacteria / vegetation / trees
- photosynthesis

  ignore respiration
- 'locked up' in (sedimentary) rocks / carbonates / fossil fuels
- dissolved in oceans

  ignore volcanoes

oxygen has increased due to:

accept idea of 'given out / produced'

- plants / bacteria / microorganisms / vegetation / trees
- photosynthesis

  ignore respiration

nitrogen increased due to:

accept idea of 'given out / produced'

- ammonia reacted with oxygen
- bacteria / micro organisms

  ignore (increase in) use of fossil fuels / deforestation

2

(b) (because methane's) boiling point is greater than the average / surface temperature
or Titan's (average / surface) temperature is below methane's boiling point

*ignore references to nitrogen **or** water*

1

any methane that evaporates will condense

accept boils for evaporates

accept cooling and produce rain for condensing

1

(c) C_nH_{2n}

1

[5]

M2. (a) (i) (thermal) decomposition

allow it breaks down

accept symbol equation or in words

allow reaction with SO_2 (to form CO_2)

1

(ii) calcium carbonate / calcium oxide / limestone / quicklime / it <u>reacts</u> with sulfur dioxide / <u>forms</u> calcium sulfate

accept it <u>neutralises</u> sulfur dioxide / <u>neutralisation</u>

ignore references to sulfur

do not accept 'calcium reacts with...'

1

(b) by incomplete / partial combustion (of the fuel)

1

insufficient oxygen / *air* (to burn fuel)

*accept insufficient oxygen / air to burn fuel completely for **2** marks*

if no other marks awarded

*accept $C + CO_2 \rightarrow 2CO$ **or***

*$2C + O_2 \rightarrow 2CO$ **or** in words for **1** mark*

1

(c) (i) any **two** from:

- (CO_2) from the atmosphere
- (CO_2) taken in millions of years ago **or** early (atmosphere)

  allow thousands / billions

  allow rocks formed millions of years ago
- (CO_2) was used to form the shells / skeletons of marine organisms / fossil fuels

  accept sedimentary rocks

  allow used to form correct named fossil fuel

  ignore limestone

2

(ii) any **one** from:

- (increases / enhances) global warming
  allow greenhouse gas / effect
  *do **not** accept ozone layer / acid rain / global dimming*
  ignore consequences of global warming

- is <u>additional</u> carbon dioxide **or** not able to be absorbed by oceans / seas **or** used by (green) plants

- acidification of sea water

1

[7]

M3. (a) any **two** from:

asks for cause therefore no marks for just describing the change

must link reason to a correct change in a gas

carbon dioxide has <u>decreased</u> due to:

accept idea of 'used' to indicate a decrease

- plants / micro organisms / bacteria / vegetation / trees
- photosynthesis

  ignore respiration
- 'locked up' in (sedimentary) rocks / carbonates / fossil <u>fuels</u>
- dissolved in oceans

  ignore volcanoes

oxygen has <u>increased</u> due to:

accept idea of 'given out / produced'

- plants / bacteria / micro organisms / vegetation / trees
- photosynthesis

  ignore respiration

nitrogen <u>increased</u> due to:

accept idea of 'given out / produced'

- ammonia reacted with oxygen
- bacteria / micro organisms

  ignore (increase in) use of fossil fuels / deforestation

2

(b) (because methane's) boiling point is greater than the average / surface temperature **or** Titan's (average / surface) temperature is below methane's boiling point

*ignore references to nitrogen **or** water*

1

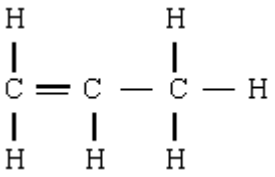
any methane that evaporates will condense

accept boils for evaporates

accept cooling and produce rain for condensing

1

(c) (i)



bonds must be displayed correctly

ignore bond angles

1

(ii) poly(propene) / polypropene / polypropylene

*do **not** allow polypropane*

any **two** from:

- double bonds open up / break / become single(*)
- propene molecules / monomers / they join / undergo <u>addition</u> polymerisation(*)

1

- form chains / long molecules(*)

*(*)correct chemical equation gains **2** marks*

ignore large

*using monomer incorrectly max **2** marks*

2

[8]

M4. (a) **Quality of written communication**

for any two ideas sensibly stated

1

any **three** from:

- plants take in (CO_2)

  accept photosynthesis uses (CO_2)

- converted to glucose / starch / carbohydrates

  ignore carbon compounds by itself

- CO_2 locked up in fossil fuels

  accept coal / oil / <u>natural</u> gas / methane for fossil fuels

- CO_2 reacts with / dissolves (sea)water

  accept ocean removes CO_2

- producing hydrogencarbonates

  accept carbonic acid

- producing carbonates

  accept named carbonates

- marine animals use carbonates to make shells

  *do **not** accept bones*

- forms sedimentary rocks

  accept limestone / chalk
  accept marble
  *do **not** accept sediments alone*

3

(b) any **two** from:

- burning of fossil fuels **or** cars / industry / air travel / power stations

  ignore increase in population
  ignore more use of electricity

- natural processes cannot absorb all the extra CO_2

- deforestation

  accept less photosynthesis
  ignore volcanic activity

accept burn trees

2

[6]

M5. (a) 95% (1 mark for working)

2

(b) Much less carbon dioxide
Much more nitrogen

2

(c) Plants take up CO_2
plants give out oxygen
when they die trap CO_2 in rocks and fossil fuels
methane and ammonia reacted with oxygen
nitrogen gas produced
by reaction of oxygen and ammonia
and by denitryfying bacteria
formation of ozone layer

any 4 for 1 mark each

4

[8]

M6. (a) amount of CO_2 (much) lower
amount of O_2 (much) higher
amount of N_2 (much) higher (owtte.)
less other gases/less NH_3/less CH_4
any 2 for 2 marks

2

(b) 4 points from:
plants (evolved)/photosynthesis/algae
take in CO_2
give out O_2
water vapour condensed
ozone formed from oxygen
less CO_2 is produced now from volcanic activity
CO_2 from air trapped in sedimentary rocks or fossil fuels
nitrogen produced by bacteria/living organisms/microbes/decay of dead organisms (**not** nitrifying bacteria, nitrogen fixing 4 bacteria)
nitrogen produced by reaction of NH_3 with O_2/decomposition of NH_3
nitrogen builds up because it is unreactive
(Assume answer refers to today's atmosphere)
any 4 for 1 mark each

4

[6]

M7. (a) (i) burning / breathing / respiration / fuels / food

for 1 mark each

2

(ii) 1. rock is heated / subducted (owtte) / close to magma / melted
1. rock is decomposed / carbon dioxide released through volcanoes

for 1 mark each

2

(b) carbon dioxide reacts / dissolves in sea-water / dissolves in rain water
insoluble carbonates / calcium carbonate are / is formed carbon dioxide turned into shells / coral / limestone / chalk / sediments also soluble hydrogencarbonates (calcium / magnesium) are formed photosynthesis by plants

any three for 1 mark each

3

(c) (i) sea unable to absorb all the extra carbon dioxide being produced
more trees being cut down / deforestation increased burning of fuels / more cars / more industry (*not* more people)

any one for 1 mark

1

(ii) global warming / greenhouse effect or effects such as melting ice caps / rising sea levels / climatic change / more deserts
(*not* changes to ozone layer)

for one mark

1

[9]

M8. (a) any **two** 1 mark each

burning / combustion

fossil fuels **or** (locked up) carbon
accept fuel / named fuel

oxygen used

2

(b) any **three** from

produces (calcium) carbonate

which is insoluble

produces (calcium) hydrogencarbonate

which is soluble

photosynthesis

releases oxygen

3

[5]

Q1. Scientists study the atmosphere on planets and moons in the Solar System to understand how the Earth's atmosphere has changed.

(a) Millions of years ago the Earth's atmosphere was probably just like that of Mars today.

The table shows data about the atmosphere of Mars and Earth today.

Mars today		**Earth today**	
nitrogen	3%	nitrogen	78%
oxygen	trace	oxygen	21%
water	trace	water	trace
Carbon dioxide	95%	Carbon dioxide	trace
Average surface temperature −23°C		Average surface temperature 15°C	

The percentages of some gases in the Earth's atmosphere of millions of years ago have changed to the percentages in the Earth's atmosphere today.

For **two** of these gases describe how the percentages have changed **and** suggest what caused this change.

.....

.....

.....

.....

(2)

(b) Titan is the largest moon of the planet Saturn.
Titan has an atmosphere that contains mainly nitrogen.
Methane is the other main gas.

Main gases in Titan's atmosphere	**Percentage (%)**	**Boiling point in °C**
Nitrogen	95	−196
Methane	5	−164

Average surface temperature −178°C

When it rains on Titan, it rains methane!

Use the information above and your knowledge and understanding to explain why.

.....

.....

.....

.....

.....

.....

(2)

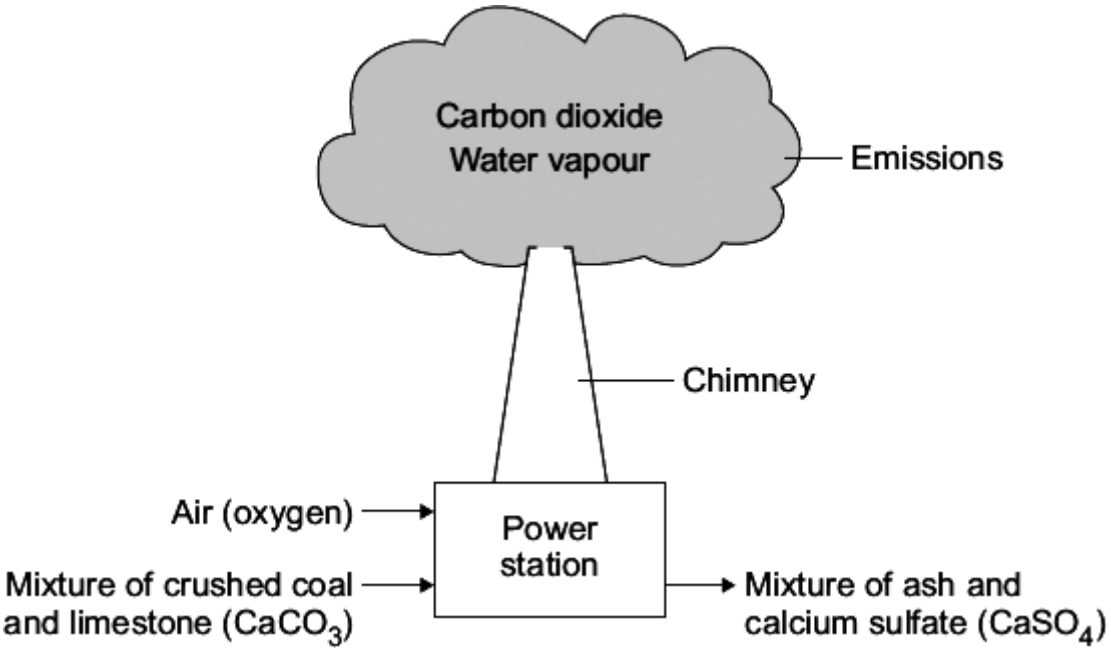
(c) Ultraviolet radiation from the Sun produces simple alkenes, such as ethene (C_2H_4) and propene (C_3H_6) from methane in Titan's atmosphere.

State the general formula for alkenes.

.....

(1)
(Total 5 marks)

Q2. Most power stations burn coal to generate electricity. Burning coal gives off sulfur dioxide gas which can be removed from the waste gases by using limestone.
This prevents sulfur dioxide from entering the atmosphere and causing acid rain.
One disadvantage of using limestone in a power station is that it releases 'locked up carbon dioxide' into the atmosphere.



(a) How does the limestone used in a power station:

(i) release carbon dioxide

.....

.....

(1)

(ii) remove sulfur dioxide?

.....

.....

(1)

(b) The waste gases from the chimney are monitored. One toxic gas that should not be released is carbon monoxide.

Explain how carbon monoxide would be formed.

.....

.....

.....

.....

(2)

(c) The use of limestone in a power station releases 'locked up carbon dioxide' into the atmosphere.

(i) Explain the meaning of 'locked up carbon dioxide'.

.....

.....

.....

.....

(2)

(ii) Why does the release of this carbon dioxide cause an environmental problem?

.....

.....

.....

(1)
(Total 7 marks)

Q3. Scientists study the atmosphere on planets and moons in the Solar System to understand how the Earth's atmosphere has changed.

(a) Millions of years ago the Earth's atmosphere was probably just like that of Mars today.

The table shows data about the atmospheres of Mars and Earth as they are now.

Mars		**Earth**	
nitrogen	3%	nitrogen	78%
oxygen	trace	oxygen	21%
water	trace	water	trace
carbon dioxide	95%	carbon dioxide	trace
Average surface temperature –23 °C		Average surface temperature 15 °C	

Suggest what has caused the main gases in the Earth's atmosphere of millions of years ago to change to the present-day atmosphere.

.....

.....

.....

.....

(2)

(b) Titan is the largest moon of the planet Saturn. It has an atmosphere that, like the Earth's, contains mainly nitrogen. Methane is the other main gas.

Main gases in Titan's atmosphere	**Percentage (%)**	**Boiling point in °C**
Nitrogen	95	–196
Methane	5	–164
Average surface temperature –178 °C		

When it rains on Titan, it rains methane! Explain why.

.....

.....

.....

(2)

(c) Ultraviolet radiation from the Sun produces simple alkenes, such as ethene and propene, from methane in Titan's atmosphere.

(i) Draw the structure of propene, C_3H_6, to show the covalent bonds.

(1)

(ii) Explain how propene molecules form a polymer. You should name the polymer formed.

.....

.....

.....

.....

.....

.....

(3)
(Total 8 marks)

Q4. (a) For the last 200 million years the amount of carbon dioxide in the atmosphere has remained almost the same.

Describe the natural processes which remove carbon dioxide from the atmosphere.

To gain full marks in this question you should write your ideas in good English.
Put them into a sensible order and use the correct scientific words.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(4)

(b) The amount of carbon dioxide in the atmosphere has increased over the last one hundred years. Suggest **two** reasons why this has happened.

1 .....

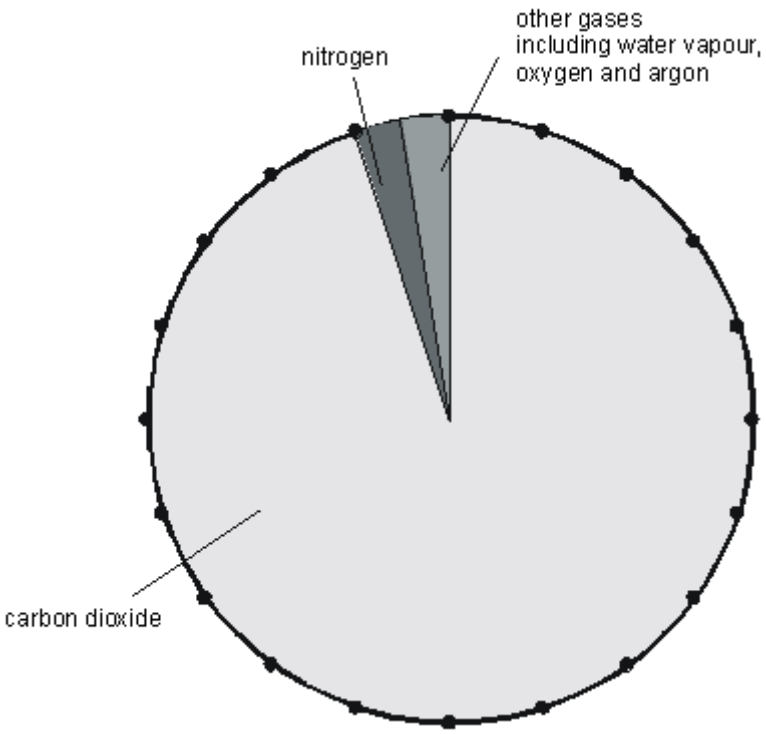
.....

2 .....

.....

(2)
(Total 6 marks)

Q5. The pie chart below shows the composition of the atmosphere on the planet Mars.



(a) Use the pie chart above to calculate the percentage of carbon dioxide in the atmosphere on Mars.

.....

.....

..... %

(2)

(b) The atmosphere on Earth is very different from that on Mars. One important difference is that the Earth's atmosphere contains a large amount of oxygen.

Give **two** other ways in which the Earth's atmosphere is different from the atmosphere on Mars.

1. .....

.....

2. .....

.....

(2)

(c) When the Earth was formed its atmosphere is thought to have been similar to the atmosphere on Mars. Explain how green plants and other organisms have changed the composition of the Earth's atmosphere.

.....

.....

.....

.....

.....

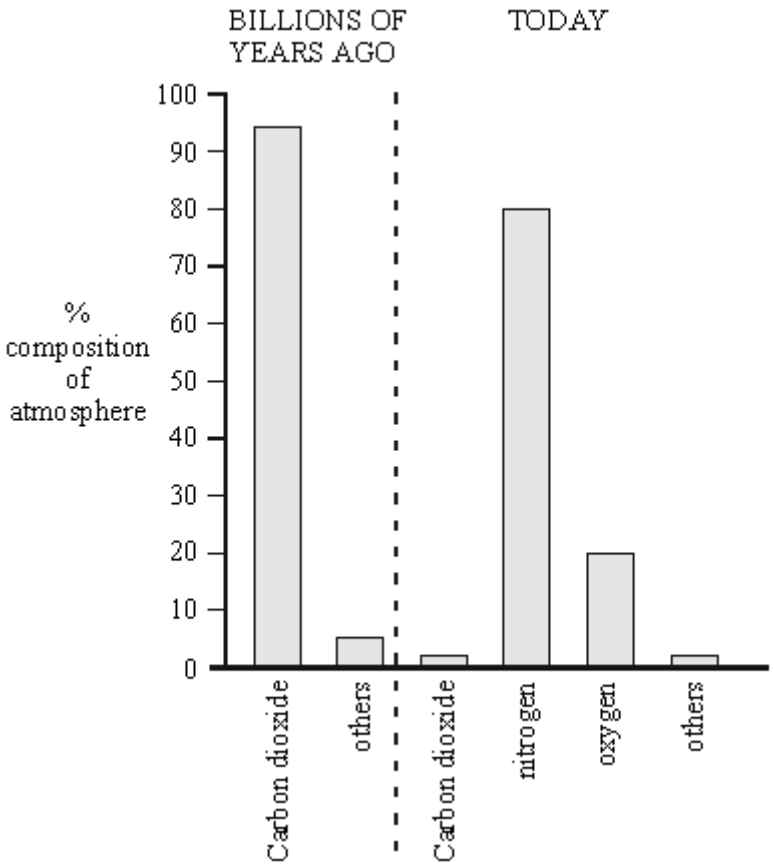
.....

.....

.....

(4)
(Total 8 marks)

Q6. The bar chart shows the composition of the Earth's atmosphere today, and as it was billions of years ago.



(a) Use information from the bar chart to describe how the atmosphere today is different from the atmosphere of billions of years ago.

.....

.....

.....

.....

(2)

(b) Describe the processes which have brought about the changes in the proportions of these gases in the air over billions of years.

.....

.....

.....

.....

.....

.....

(4)
(Total 6 marks)

Q7. For 200 million years the proportions of the different gases in the atmosphere have been much the same as today. Over the past 150 years the amount of carbon dioxide in the atmosphere has increased from 0.03% to 0.04%.

(a) Describe how carbon dioxide is released into the atmosphere:

(i) by human and industrial activity;

.....

.....

.....

.....

(2)

(ii) from carbonate rocks by geological activity.

.....

.....

.....

.....

(2)

(b) Explain how the seas and oceans can decrease the amount of carbon dioxide in the atmosphere.

.....

.....

.....

.....

.....

.....

(3)

(c) (i) Give **one** reason why the amount of carbon dioxide in the atmosphere is increasing gradually.

.....

.....

(1)

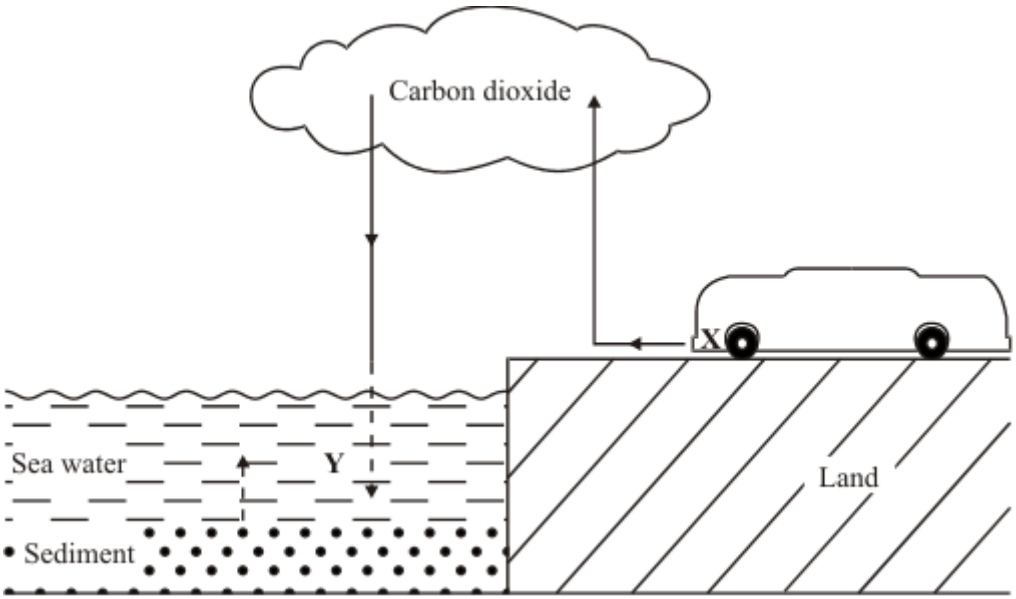
(ii) Give **one** effect that increasing levels of carbon dioxide in the atmosphere may have on the environment.

.....

.....

(1)
(Total 9 marks)

Q8. The amount of carbon dioxide in the atmosphere is increased by reactions that occur in internal combustion engines (**X**) and is decreased by reactions in sea water (**Y**).



Describe, in as much detail as you can, the reactions which take place at **X** and **Y**.

(a) **X** .....

.....

.....

.....

(2)

(b) **Y** .....

.....

.....

.....

(3)
(Total 5 marks)