C9 Chemistry of the Atmosphere

35 Questions

Name: _____

Class: _____

Date: _____

Time:

Marks:

Comments:

1 This question is about gases in the Earth's atmosphere.

(a) The amount of carbon dioxide in the Earth's atmosphere decreased during the first billion years of the Earth's existence.

Complete the sentences. Use words from the box.

carbonates	**dissolved**	**evaporated**	**melted**	**nitrates**	**sulfates**

The amount of carbon dioxide in the Earth's atmosphere decreased because

the carbon dioxide_____ in the oceans.

Sediments were formed when _____ were produced.

Algae and plants use carbon dioxide and water to produce oxygen.

(2)

(b) What is the name of this process?

Tick **one** box.

Carbon capture ☐

Combustion ☐

Photosynthesis ☐

Polymerisation ☐

(1)

(c) Complete the word equation for this process.

carbon dioxide + _____ → glucose + _____

(1)

(d) Draw **one** line from each gas to the approximate percentage of the gas in the Earth's atmosphere today.

Gas	**Approximate percentage of gas in the Earth's atmosphere today**
	<1
	5
Carbon dioxide	
	10
Nitrogen	20
	50
Oxygen	
	80
	>90

(3)

(e) Carbon dioxide is a greenhouse gas.

Why does increasing the amount of carbon dioxide change the global climate?

_____

(1)

(f) How can countries reduce carbon dioxide emissions?

Tick **one** box.

only burn methane ☐

use renewable energy supplies ☐

use waste plastic bags as fuel ☐

(1)

(g) Give **one** reason why it is difficult for countries to reduce emissions of carbon dioxide.

_____

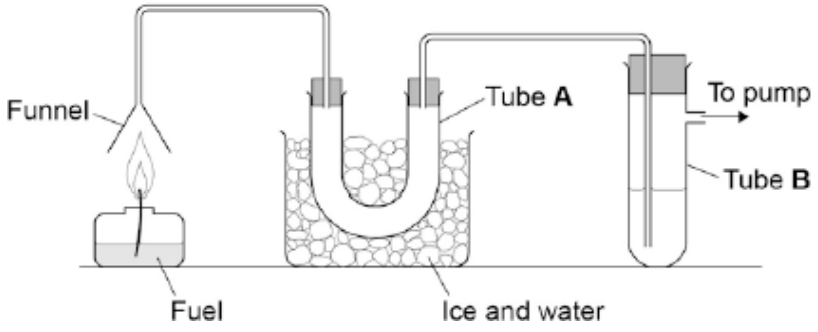
_____

(1)

(Total 10 marks)

2 A student investigated the substances produced when fuels burn.

The figure below shows the apparatus the student used.



(a) The complete combustion of a hydrocarbon produces carbon dioxide and one other substance.

Look at the figure above. What would the student see in tube **A**?

_____

_____

(1)

(b) When the student burned the fuel she saw soot in the funnel.

Explain why soot forms.

_____

_____

_____

_____

(2)

(c) The student burned another fuel which contained impurities.

The substance in tube **B** is water containing universal indicator.

The indicator turned red.

Which gas made the indicator turn red?

Tick **one** box.

Ammonia ☐

Carbon monoxide ☐

Nitrogen ☐

Sulfur dioxide ☐

(1)

(Total 4 marks)

3 There is less carbon dioxide in the Earth's atmosphere now than there was in the Earth's early atmosphere.

(a) The amount of carbon dioxide in the Earth's early atmosphere decreased because it was used by plants and algae for photosynthesis, dissolved in the oceans and formed fossil fuels.

Give **one** other way that the amount of carbon dioxide in the Earth's early atmosphere decreased.

_____

_____

(1)

(b) Carbon dioxide is a greenhouse gas.

Describe the greenhouse effect.

_____

_____

_____

_____

_____

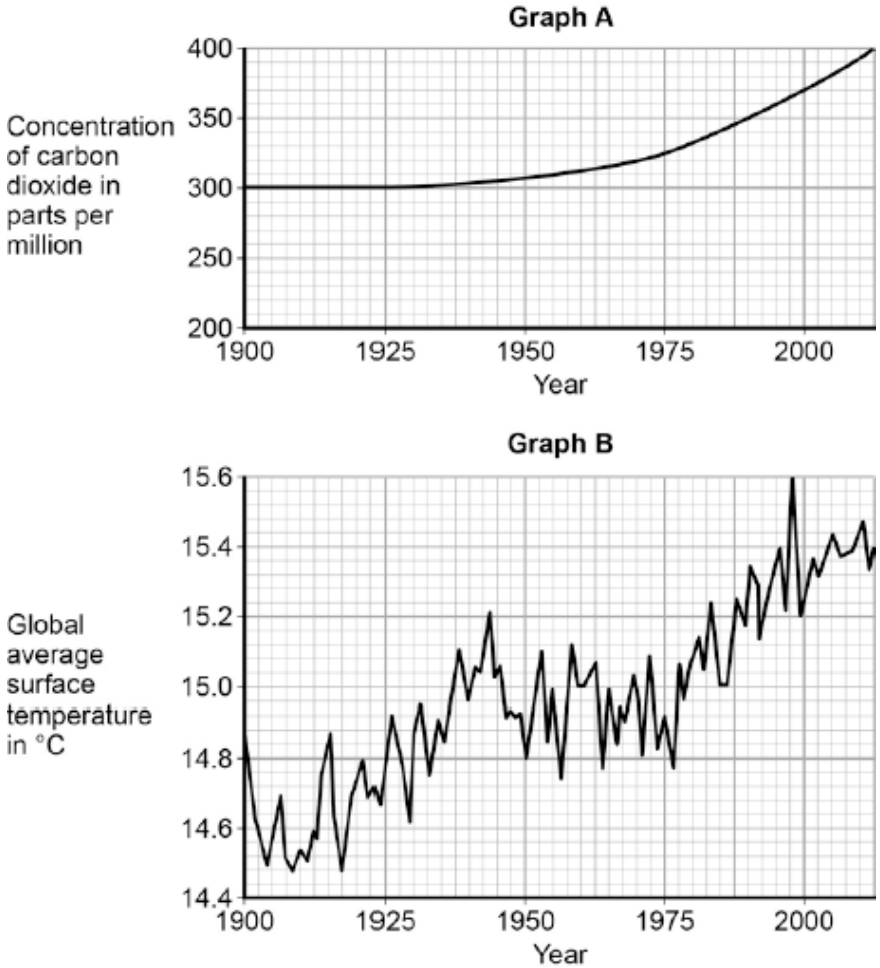
_____

_____

(4)

(c) The graphs in **Figure 1** show the concentration of carbon dioxide in the atmosphere and global average surface temperature since 1900.

Figure 1



Calculate the percentage increase in the concentration of carbon dioxide from 1975 to 2000.

_____ %

(1)

(d) What was the global average surface temperature in 1980?

Global average surface temperature = _____ °C

(1)

(e) A student stated: ‘The graphs show that increasing the concentration of carbon dioxide in the atmosphere causes global temperature increases.’

Discuss why this statement is only partially true.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 11 marks)

4 Millions of years ago the Earth’s atmosphere was probably like the atmosphere of Mars today.

(a) The table below shows percentages of the main gases in the atmospheres of Earth and Mars today.

Gas	**Percentage in atmosphere of Mars today**	**Percentage in atmosphere of Earth today**
Carbon dioxide	95.00	0.04
Nitrogen	3.50	78.00
Oxygen	0.50	21.00

For each gas in the table, suggest a reason for the change in the percentage of the gas in Earth’s atmosphere.

Carbon dioxide _____

_____

Nitrogen _____

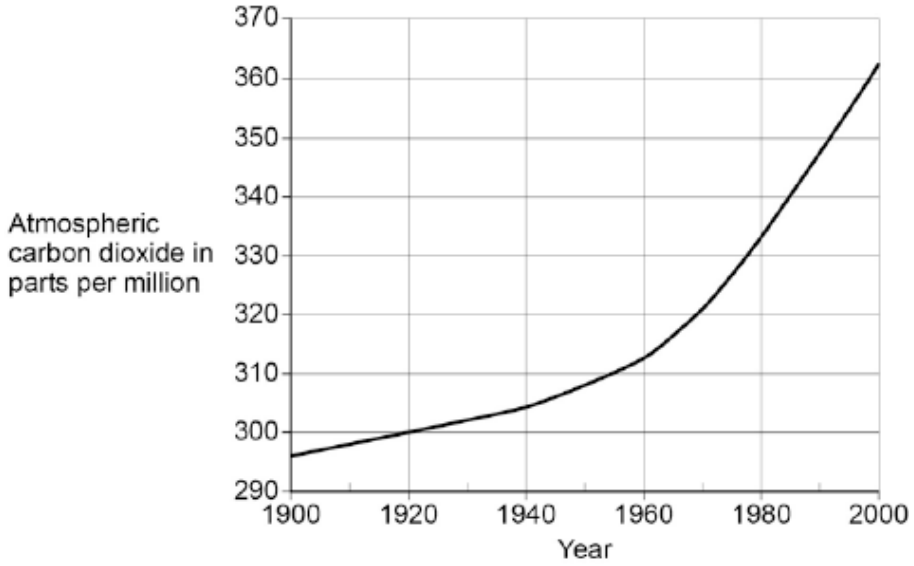
_____

Oxygen _____

_____

(3)

(b) The figure below shows how the concentration of carbon dioxide in the Earth's atmosphere changed between 1900 and 2000.



One of the causes of the increase in carbon dioxide between 1900 and 2000 is increased use of fossil fuels.

Suggest when use of fossil fuels began to increase.

Use data from the figure above to explain your answer.

_____

_____

_____

_____

(2)

(c) What is the percentage increase in carbon dioxide levels between 1970 and 2000?

_____

_____

_____

Increase = _____ %

(3)

(d) Explain how the changes shown in the figure above can have harmful effects on the environment.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 12 marks)

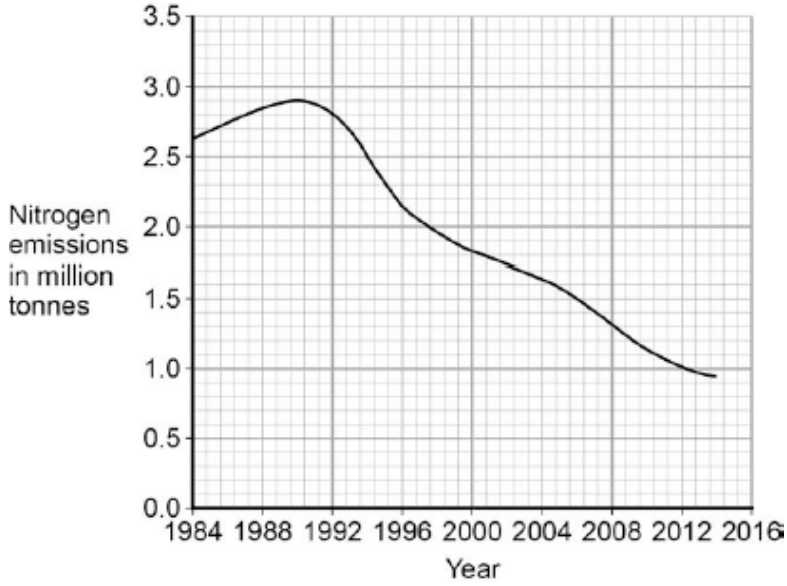
5 Oxides of nitrogen are produced when fuels are burnt.

(a) Write a balanced symbol equation for the production of nitrogen dioxide (NO_2) from nitrogen and oxygen.

_____

(2)

(b) The figure below gives information about emissions of oxides of nitrogen in the UK.



Calculate the percentage decrease in emissions of oxides of nitrogen from 1990 to 2014.

Give your answer to three significant figures.

_____

_____

_____

_____

Percentage decrease = _____ %

(3)

(c) Give **one** advantage of reducing the emissions of oxides of nitrogen.

_____

_____

(1)

(Total 6 marks)

6 In the last 200 years the concentration of carbon dioxide in the Earth's atmosphere has risen.

Explain how a rise in carbon dioxide concentration in the atmosphere can decrease biodiversity.

_____

_____

_____

_____

_____

_____

_____

_____

_____

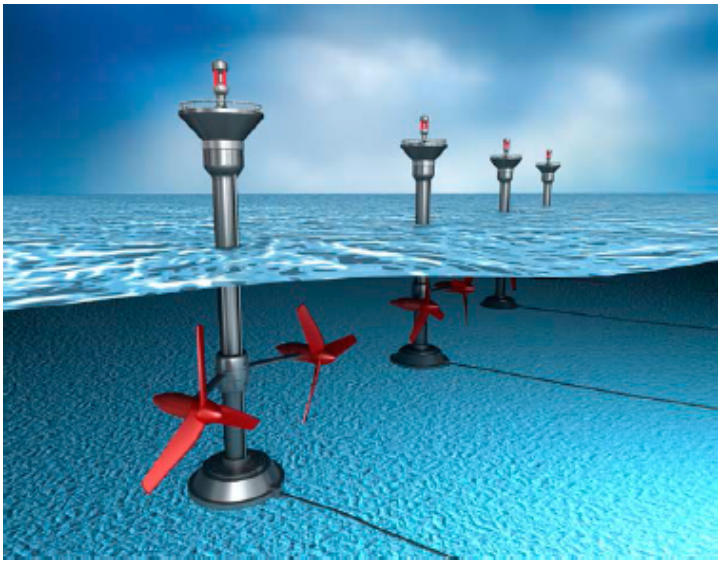
_____

(Total 6 marks)

7 Electricity in the UK is generated in many ways.

The figure below shows an undersea turbine.

The undersea turbine uses tidal energy to generate electricity.



(a) What is the original source of energy for tidal power schemes?

_____

_____

(1)

(b) Explain **two** advantages of using undersea tidal turbines to generate electricity rather than burning fossil fuels.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(c) Some power stations burn wood instead of fossil fuels to generate electricity.

A coal-burning power station burns 6 million tonnes of coal per year.

Coal has an average energy value of 29.25 MJ per kg.

Wood chip from willow trees has an energy value of 13 MJ per kg.

A hectare of agricultural land can produce 9 tonnes of dry willow wood per year.

If this power station burned dry willow wood instead of coal, how much agricultural land would be needed to grow the willow?

_____

_____

_____

_____

_____

Amount of land needed = _____ hectares

(3)

(d) The table below shows the carbon dioxide emissions of four fuels used to generate electricity.

Fuel	Direct CO_2 emissions in kg per MWh	Lifecycle CO_2 emissions in kg per MWh
Coal	460	540
Natural gas	185	215
Oil	264	313
Wood	2 100	58

Direct CO_2 emissions are the amounts of carbon dioxide released when the fuel is burned.

Lifecycle CO_2 emissions is the total amount of carbon dioxide released during all stages from fuel extraction to when the fuel has been used.

Use the data from the table above to explain why wood is considered to be a low carbon dioxide emitting fuel.

_____

_____

_____

_____

_____

_____

(2)

(Total 10 marks)

8 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.

_____

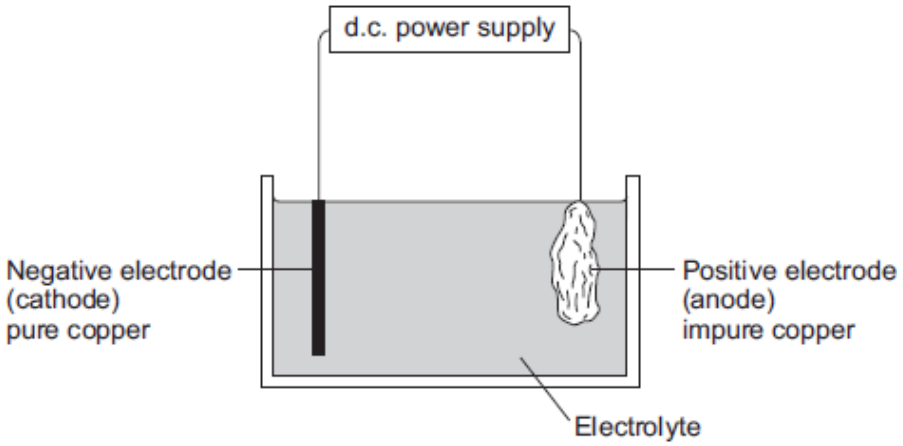
_____

_____

_____

(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.

_____

_____

_____

_____

_____

_____

_____

_____

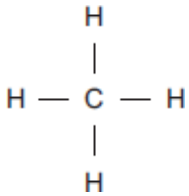
Empirical formula = _____

(4)

(Total 16 marks)

9 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. ☐

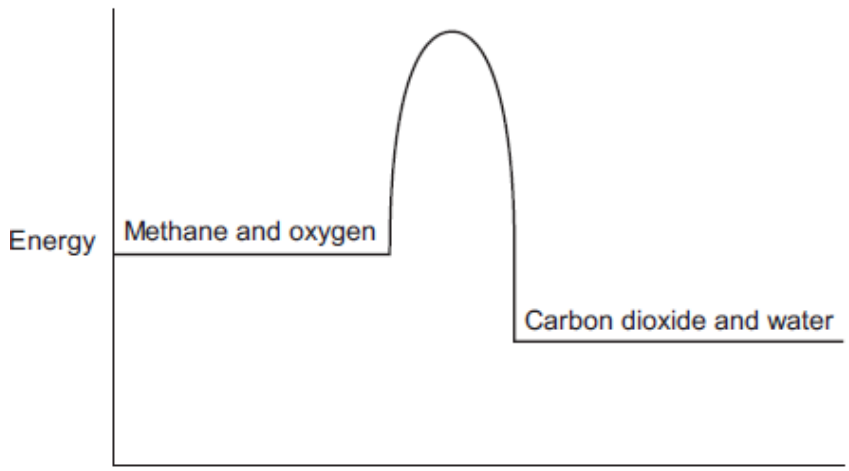
(1)

(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.

$$CH_4 + \_\_\_\_\_ \longrightarrow CO_2 + \_\_\_\_\_$$

(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)

10 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)

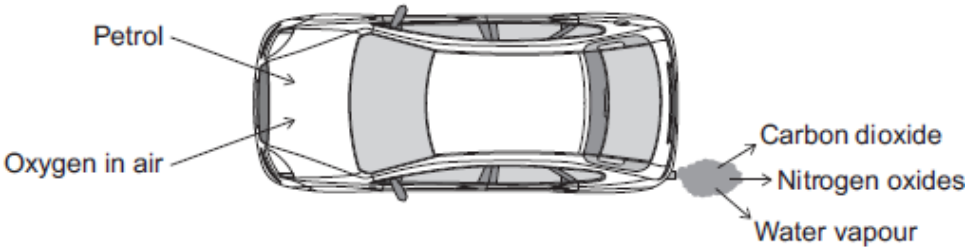
(iii) Crude oil is separated by fractional _____ .

(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:

$$\underset{\text{decane}}{C_{10}H_{22}} \longrightarrow \underset{\text{propane}}{C_3H_8} + \underset{\text{ethene}}{C_2H_4} + \underset{\text{pentene}}{C_5H_{10}}$$

(i) Why is propane useful?

Tick (✓) **one** box.

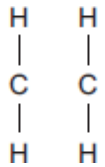
Propane is a polymer. ☐

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)

11 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.

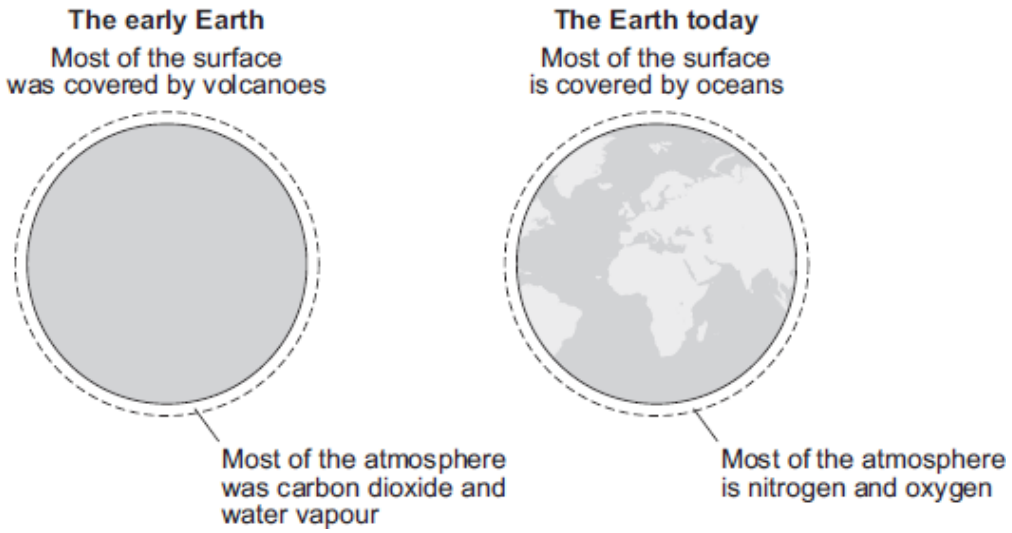
_____

_____

(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)

12 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**.

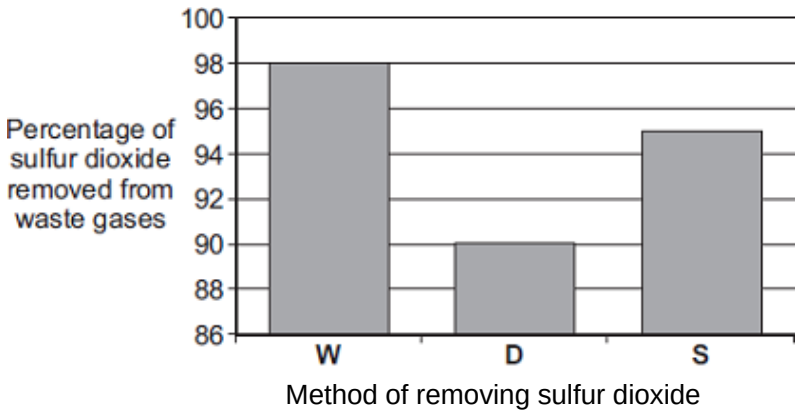


Table 1

Method	Material used	How material is obtained
W	Calcium carbonate, $CaCO_3$	Quarrying
D	Calcium oxide, CaO	Thermal decomposition of calcium carbonate: $CaCO_3 \rightarrow CaO + CO_2$
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.

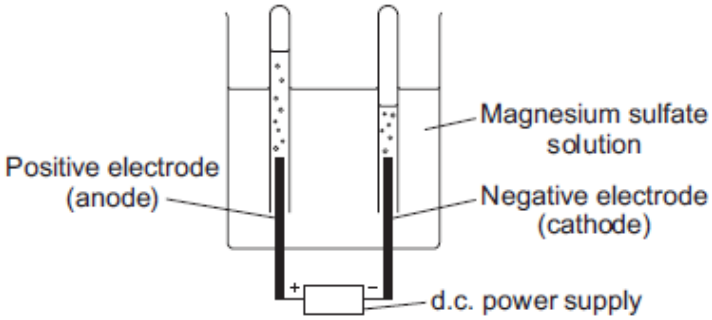
Compare the three methods and give a justified conclusion.

(6)

(Total 12 marks)

13 **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.

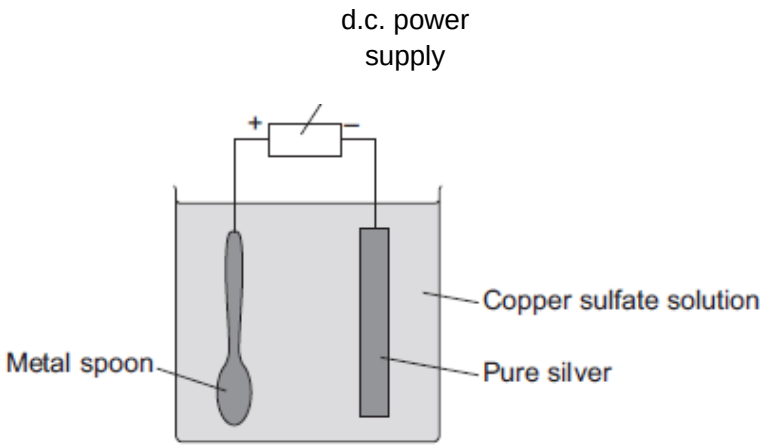
_____

_____

(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?

_____

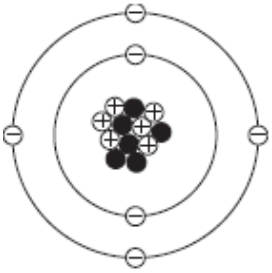
_____

(1)

(Total 10 marks)

14 Fossil fuels contain carbon.

(a) The figure below represents a carbon atom.



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

(i) The name of the particle with a positive charge is

an electron.
a neutron.
a proton.

(1)

(ii) The centre of the atom is called the

energy level.
molecule.
nucleus.

(1)

(iii) Use the Chemistry Data Sheet to help you to answer this question.

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

4	**6**	**8**	**10**	**12**

The mass number of this carbon atom is ☐

In the periodic table, carbon is in Group ☐

(b) Coal is a fossil fuel.

A piece of coal contains:

- 80% carbon
- 9% oxygen
- 1% sulfur
- 5% hydrogen.

The rest of the coal is other elements.

(i) What is the percentage of other elements in this piece of coal?

_____ %

(1)

(ii) Coal burns in air to produce carbon dioxide, sulfur dioxide and water.

Draw **one** line from each product to the type of pollution caused by each product.

Product	**Type of pollution**
	Acid rain
Carbon dioxide	
	Global dimming
Sulfur dioxide	
	Global warming
Water	
	No pollution

(3)

(Total 8 marks)

15 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.

_____

_____

_____

_____

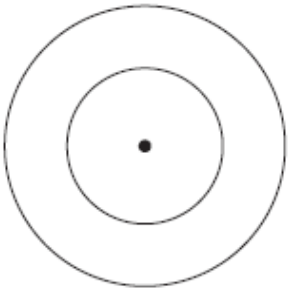
(2)

(Total 6 marks)

16 Fossil fuels contain carbon and hydrogen.

(a) (i) Use the Chemistry Data Sheet to help you to answer this question.

Complete the figure below to show the electronic structure of a carbon atom.



(1)

(ii) Complete the word equation for the oxidation of hydrogen.

hydrogen + oxygen ⟶ _____

(1)

(b) Coal is a fossil fuel.

Coal contains the elements hydrogen, sulfur, oxygen and carbon.

Name **two** products of burning coal that have an impact on the environment.

What impact does each of the products you named have on the environment?

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 6 marks)

17 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.

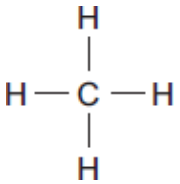
_____

(1)

(Total 5 marks)

18 Saturated hydrocarbons, for example methane and octane, are often used as fuels.

(a) Methane can be represented as:



(i) The formula of methane is _____ .

(1)

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

In a saturated hydrocarbon molecule all of the bonds are

double.
ionic.
single.

(1)

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

The homologous series that contains methane and octane is called the

alcohols.
alkanes.
alkenes.

(1)

(b) (i) The complete combustion of petrol produces carbon dioxide, water vapour and sulfur dioxide.

Name **three** elements petrol must contain.

1. _____

2. _____

3. _____

(3)

(ii) The exhaust gases from cars can contain oxides of nitrogen.

Complete the sentence.

Nitrogen in the oxides of nitrogen comes from _____ .

(1)

(iii) The sulfur dioxide and oxides of nitrogen from cars cause an environmental problem.

Name the problem and describe **one** effect of the problem.

Name of problem _____

Effect of problem _____

_____

(2)

(c) When a fuel burns without enough oxygen, there is incomplete combustion.

One gaseous product of incomplete combustion is carbon monoxide.

Name **one** solid product of incomplete combustion.

_____

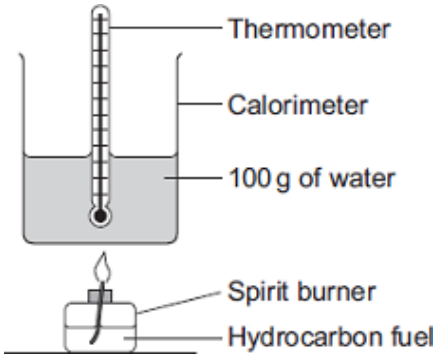
(1)

(d) A student investigated how well different hydrocarbon fuels would heat up 100 g of water.

Her hypothesis was:

The more carbon atoms there are in a molecule of any fuel, the better the fuel is.

The apparatus the student used is shown in the diagram.



She burned each hydrocarbon fuel for 2 minutes.

Her results are shown in the table.

Name of hydrocarbon fuel	Number of carbon atoms in a molecule of hydrocarbon fuel	Temperature change of water in °C after 2 minutes	Temperature change per g of fuel burned	Observations
Pentane	5	30	60	no smoke
Hexane	6	40	57	very small amount of smoke
Octane	8	55	55	small amount of smoke
Decane	10	57	52	large amount of smoke
Dodecane	12	60	43	very large amount of smoke

The student investigated only hydrocarbons.

Look carefully at her results.

How well do the student's results support her hypothesis?

The more carbon atoms there are in a molecule of any fuel, the better the fuel is.

Give reasons for your answer.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(e) A 0.050 mol sample of a hydrocarbon was burned in excess oxygen.

The products were 3.60 g of water and 6.60 g of carbon dioxide.

(i) Calculate the number of moles of carbon dioxide produced.

Relative atomic masses: C = 12; O = 16.

_____

_____

Moles of carbon dioxide = _____

(2)

(ii) When the hydrocarbon was burned 0.20 mol of water were produced.

How many moles of hydrogen atoms are there in 0.20 mol of water?

_____

Moles of hydrogen atoms = _____

(1)

(iii) The amount of hydrocarbon burned was 0.050 mol.

Use this information and your answers to parts **(e) (i)** and **(e) (ii)** to calculate the molecular formula of the hydrocarbon.

If you could not answer parts **(e) (i)** or **(e) (ii)** use the values of 0.20 moles carbon dioxide and 0.50 moles hydrogen. These are **not** the answers to parts **(e) (i)** and **(e) (ii)**.

_____

_____

_____

_____

Formula = _____

(2)

(Total 19 marks)

19 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.

_____

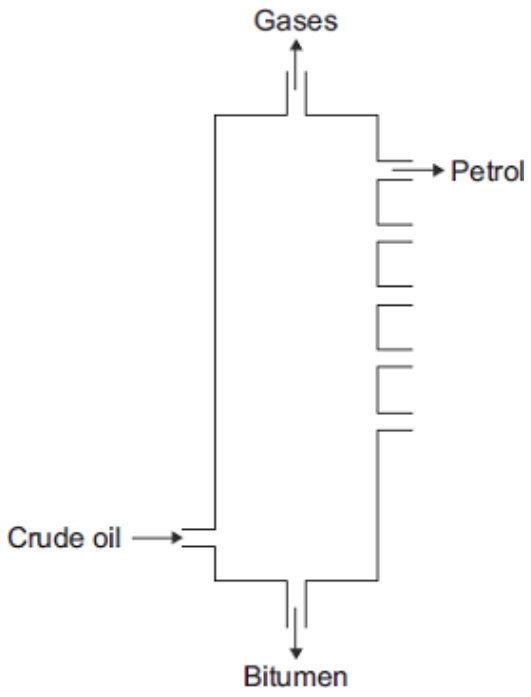
_____

_____

_____

(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)

20 The amount of carbon dioxide in the Earth's atmosphere has changed since the Earth was formed.
The amount of carbon dioxide continues to change because of human activities.

(a) Cement is produced when a mixture of calcium carbonate and clay is heated in a rotary kiln. The fuel mixture is a hydrocarbon and air.

Hydrocarbons react with oxygen to produce carbon dioxide.
Calcium carbonate decomposes to produce carbon dioxide.

(i) Complete each chemical equation by writing the formula of the other product.

$$CH_4 + 2O_2 \longrightarrow 2\ \ldots\ldots\ldots\ldots + CO_2$$

$$CaCO_3 \longrightarrow \ldots\ldots\ldots + CO_2$$

(2)

(ii) Hydrocarbons and calcium carbonate contain *locked up* carbon dioxide.

What is *locked up* carbon dioxide?

_____

_____

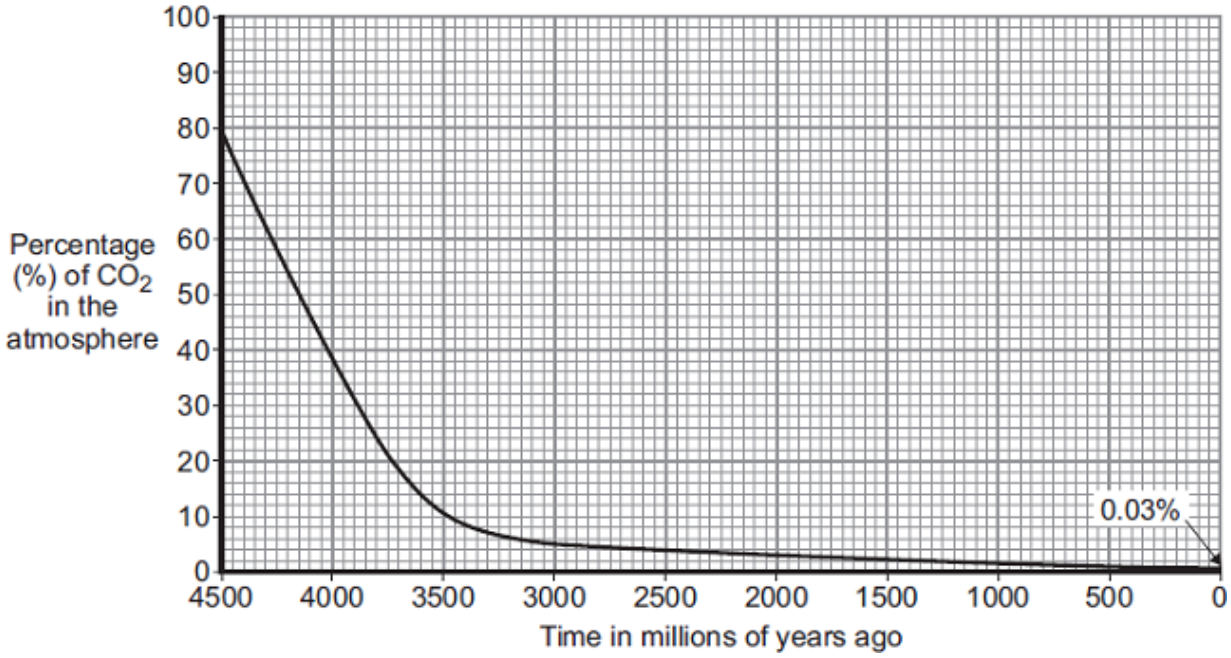
_____

_____

(2)

(b) **Graph 1** shows how the percentage of carbon dioxide in the atmosphere changed in the last 4500 million years.

Graph 1



Use information from **Graph 1** to answer these questions.

(i) Describe how the percentage of carbon dioxide has changed in the last 4500 million years.

_____

_____

_____

_____

(2)

(ii) Give **two** reasons why the percentage of carbon dioxide has changed.

_____

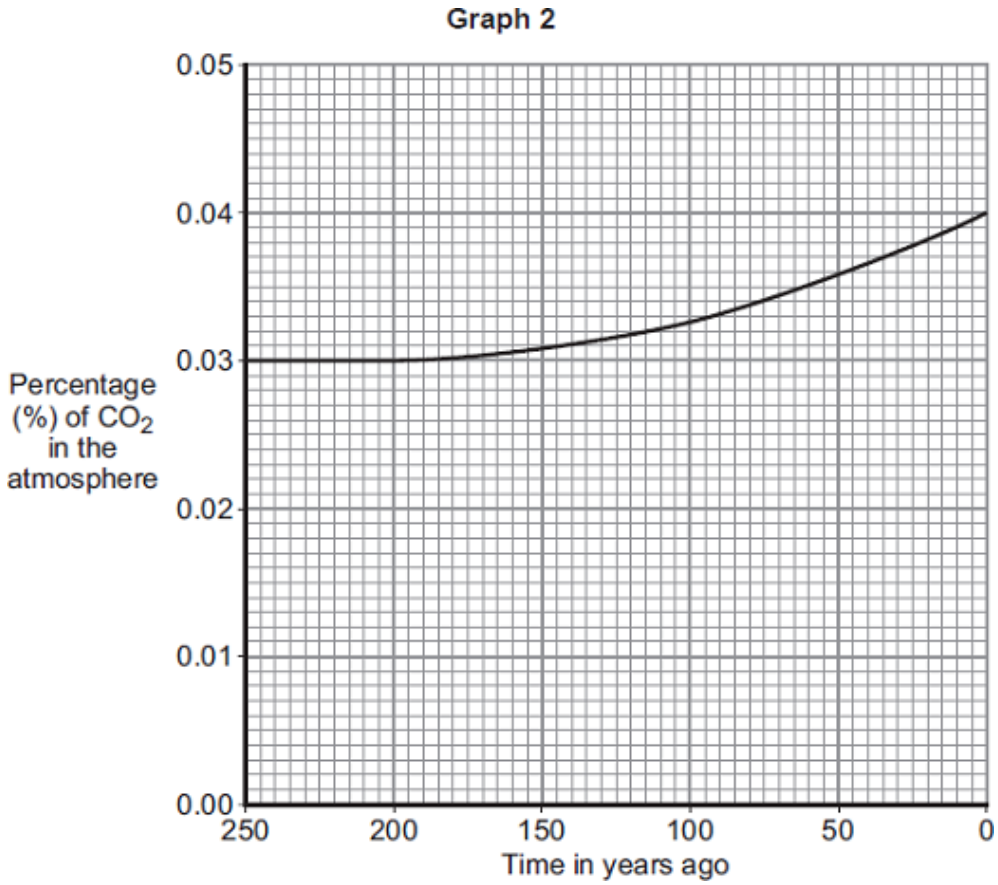
_____

_____

_____

(2)

(c) **Graph 2** shows how the percentage of carbon dioxide in the atmosphere changed in the last 250 years.



Should we be concerned about this change in the percentage of carbon dioxide?

Explain your answer.

_____

_____

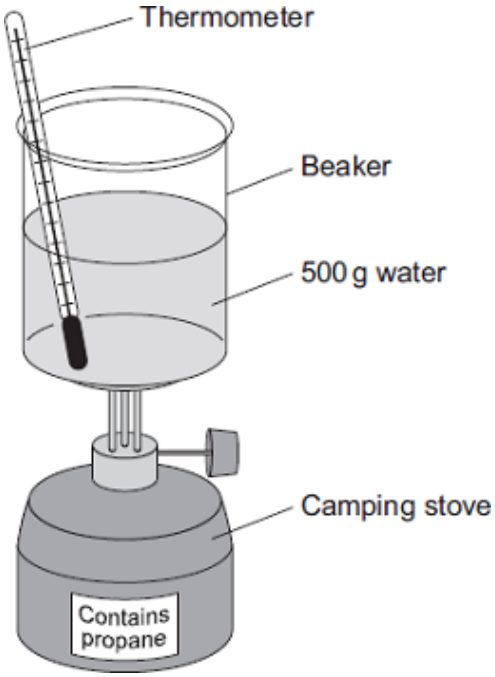
_____

_____

(2)

(Tota 10 marks)

21 A camping stove uses propane gas.



(a) A student did an experiment to find the energy released when propane is burned.

The student:

- put 500 g water into a beaker
- measured the temperature of the water
- heated the water by burning propane for 1 minute
- measured the temperature of the water again.

The student found the temperature change was 20 °C.

The student can calculate the energy released, in joules (J), using the equation:

energy released (J) = mass of water (g) × 4.2 × temperature change (°C)

(i) Use the student's result to calculate the energy released in joules (J).

_____

_____

Energy released = _____ J

(2)

(ii) State **two** safety precautions that the student should take during the experiment.

1. _____

_____

2. _____

_____

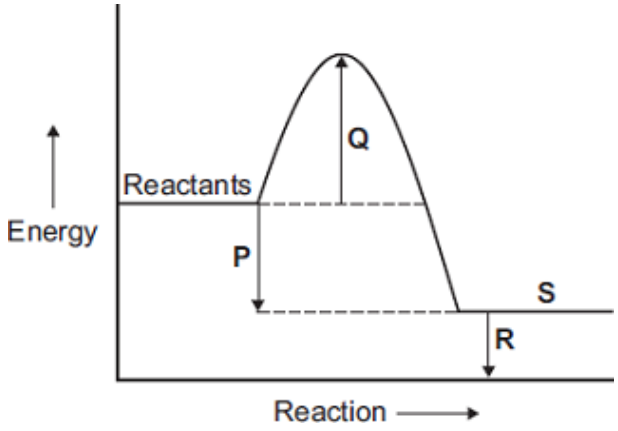
(2)

(iii) Tick (✓) **two** boxes which describe how the student could make his result more accurate.

	Tick (✓)
Stir the water before measuring the temperature.	
Heat the water until it boils.	
Place a lid on the beaker.	
Use a larger beaker for the water.	

(2)

(b) The change in energy when propane is burned can be shown in an energy level diagram.



Draw **one** line from each description to the correct letter.

Description	**Letter**
	P
products	
	Q
activation energy	
	R
energy released by the reaction	
	S

(3)

(c) Propane and hydrogen are both used as fuels.

Some information about propane and hydrogen is given in the table.

Fuel	Resource	Products formed when fuel burned
propane	crude oil	carbon dioxide and water
hydrogen	water	water

Use the information in the table to suggest **two** disadvantages that propane has as a fuel compared to hydrogen.

1. _____

_____

2. _____

_____

(2)

(Total 11 marks)

22 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.

_____

_____

_____

_____

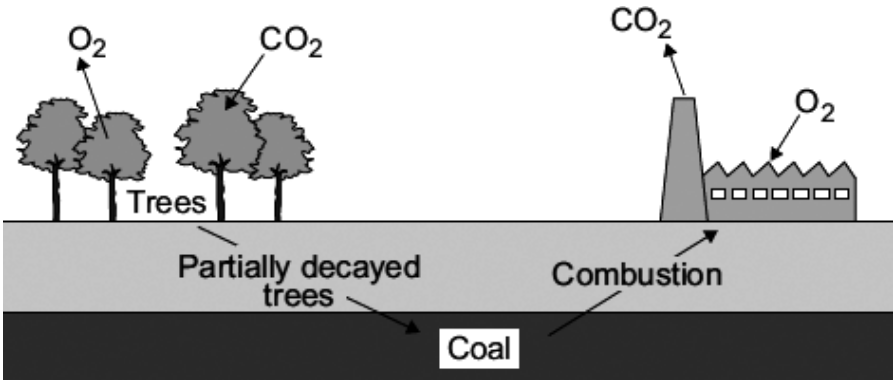
(2)

(Total 11 marks)

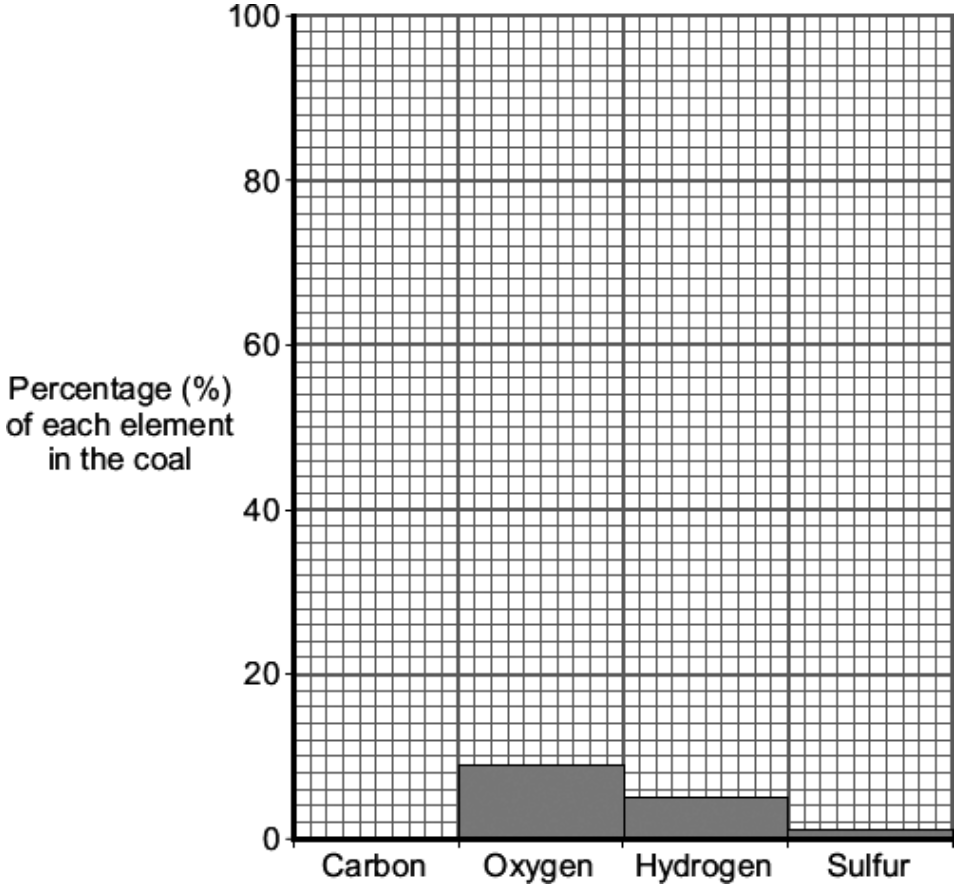
23 About 3000 million years ago carbon dioxide was one of the main gases in the Earth's early atmosphere.

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**
	Acid rain
Sulfur dioxide	
	Global dimming
Carbon particles	
	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.

_____

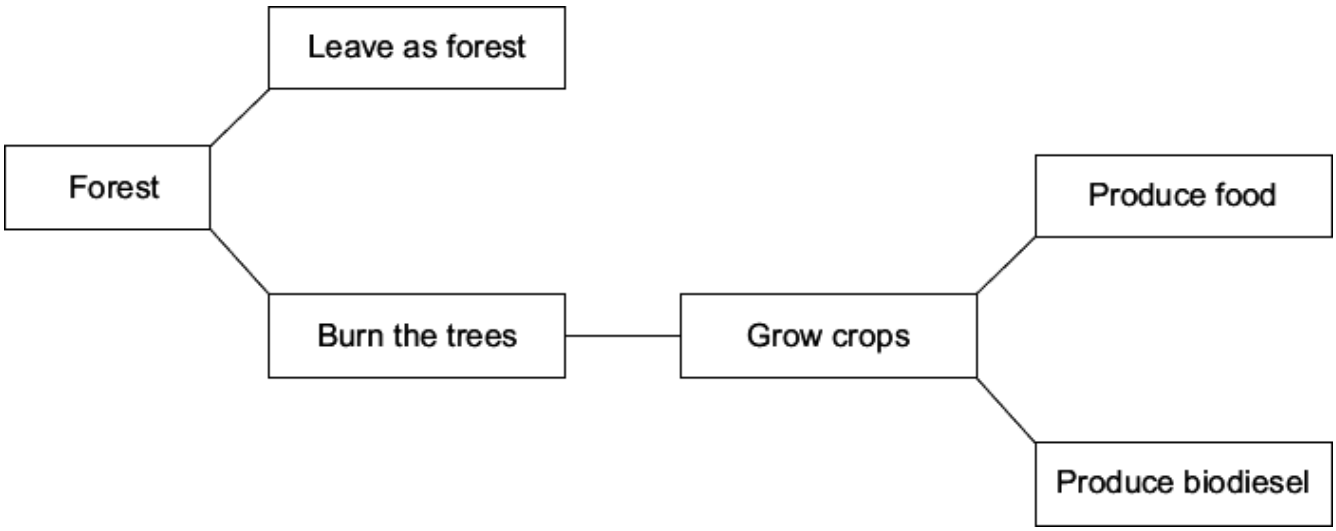
_____

_____

_____

(2)
(Total 6 marks)

24 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)

25 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.

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

(1)

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

increases atmospheric pollution

_____

_____

_____

_____

decreases atmospheric pollution.

_____

_____

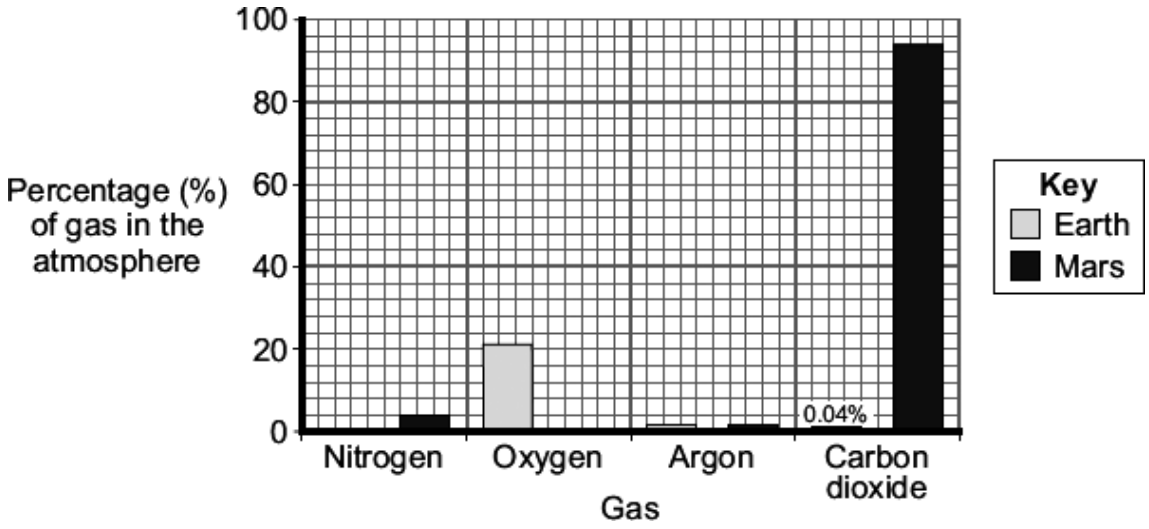
_____

_____

(4)

(Total 10 marks)

26 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

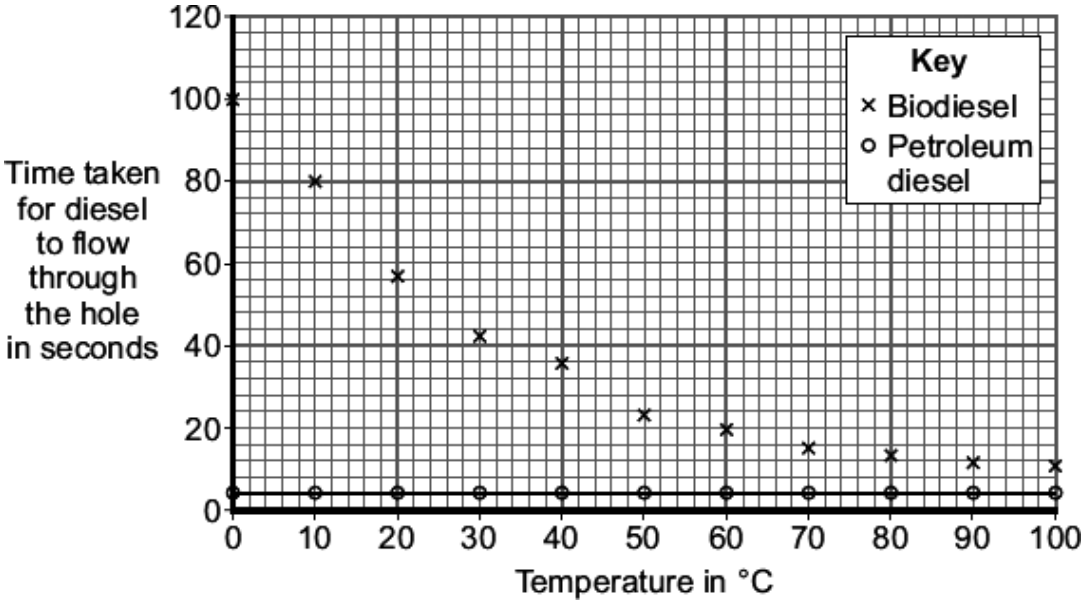
burning fossil fuels.
the formation of oceans.
the eruption of volcanoes.

(1)
(Total 5 marks)

27 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)

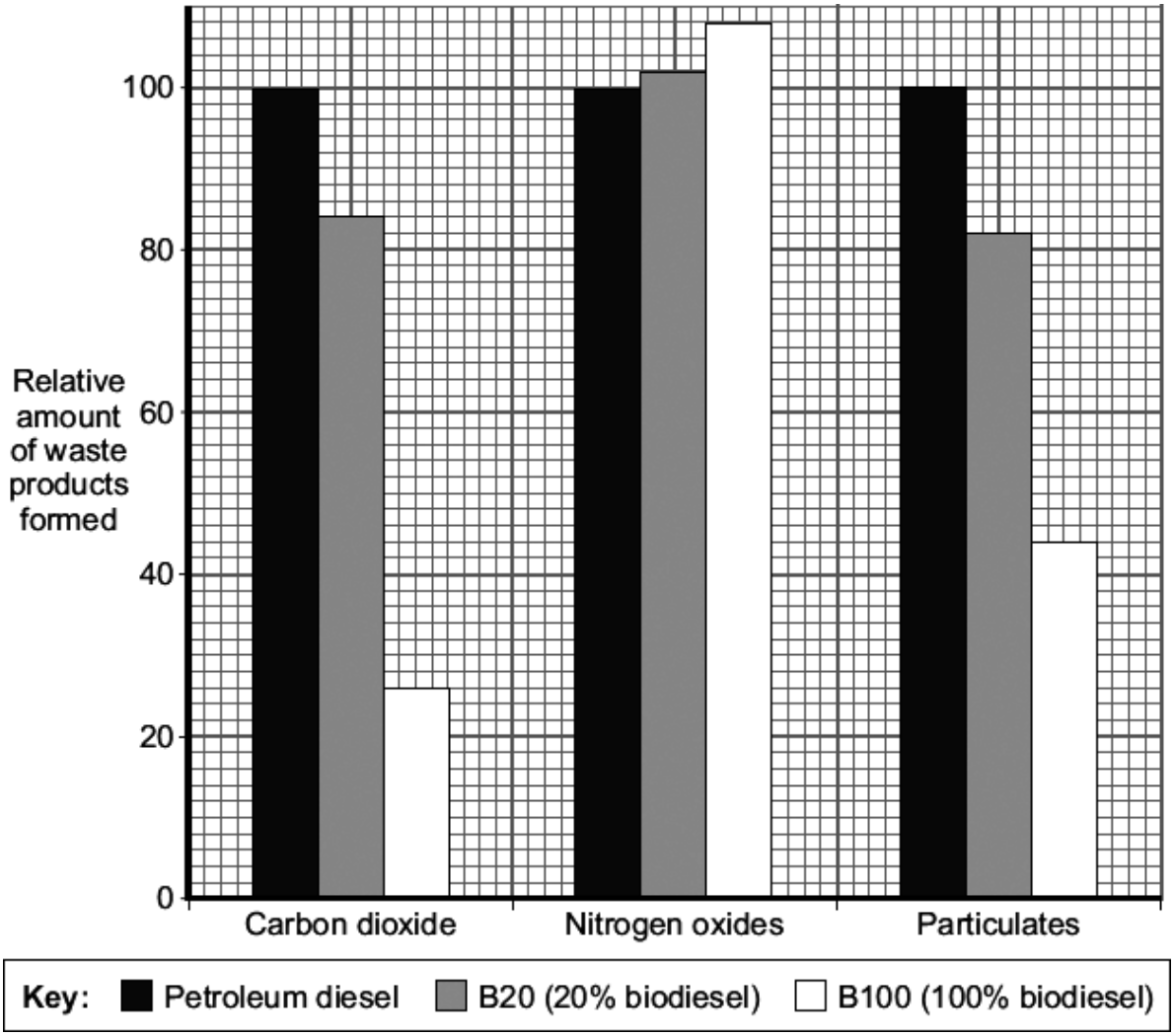
(iii) Biodiesel may be less suitable than petroleum diesel as a fuel for cars.
Use these results to suggest **one** reason why.

_____

_____

(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.

_____

_____

_____

_____

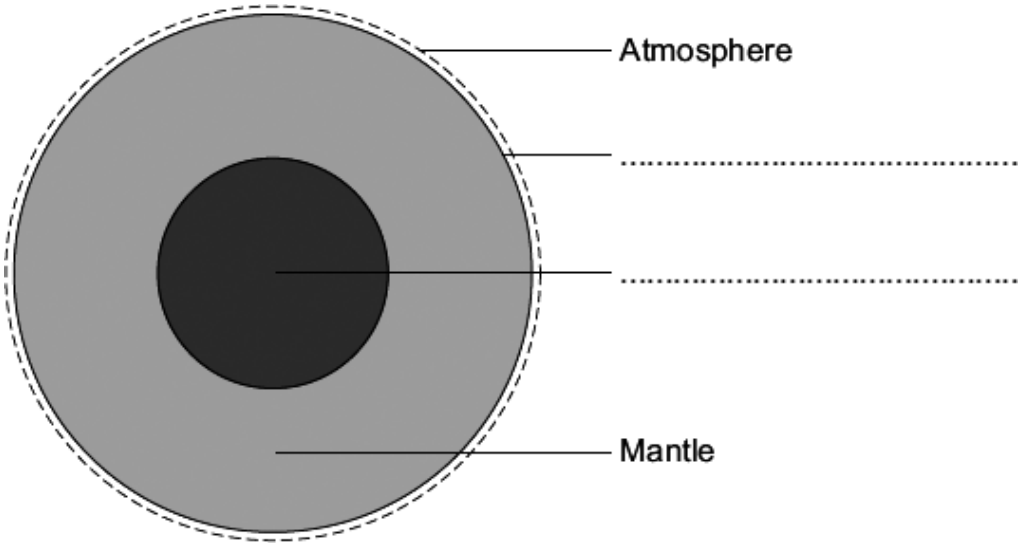
(2)

(Total 10 marks)

28 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.

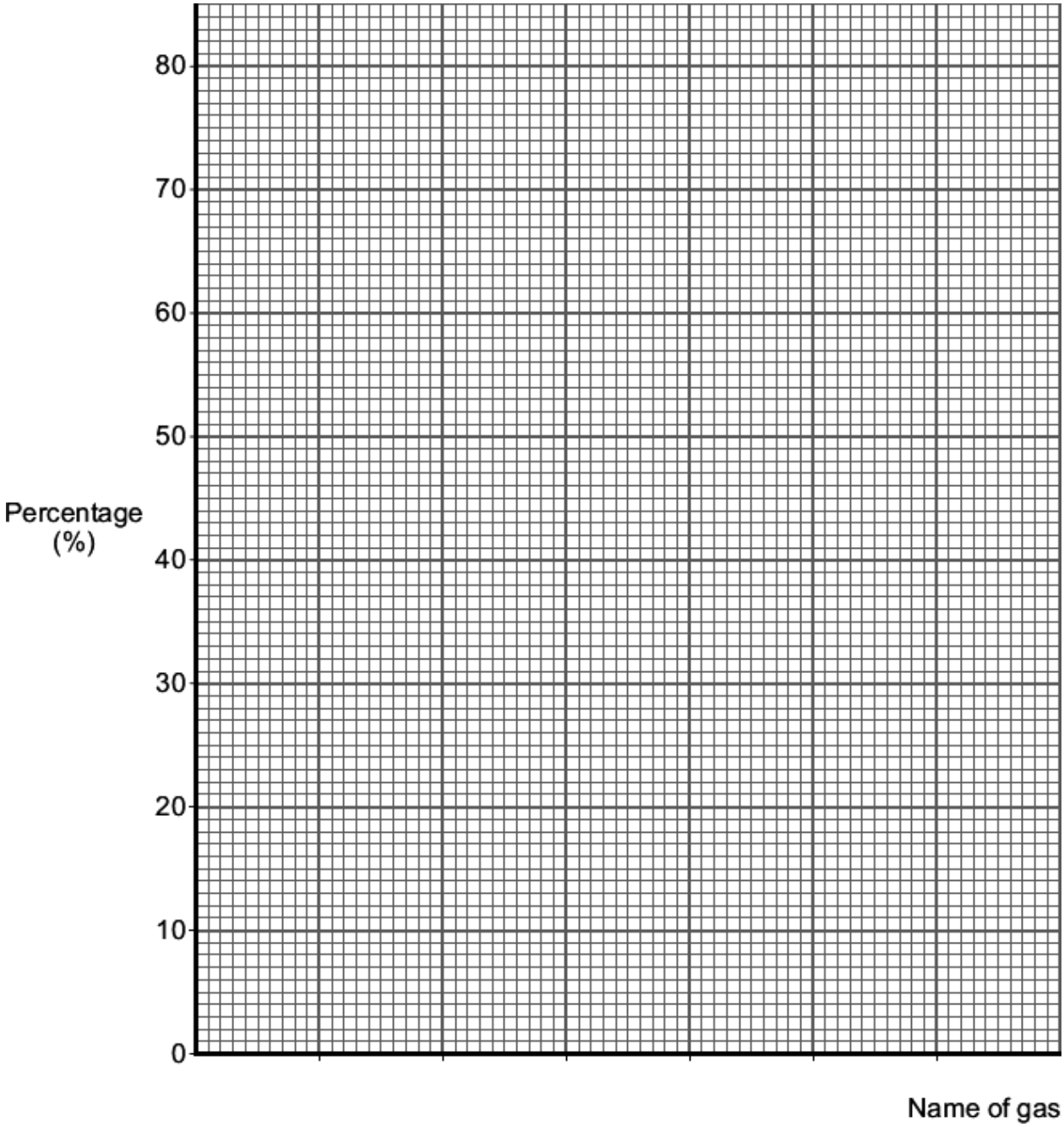


(2)

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

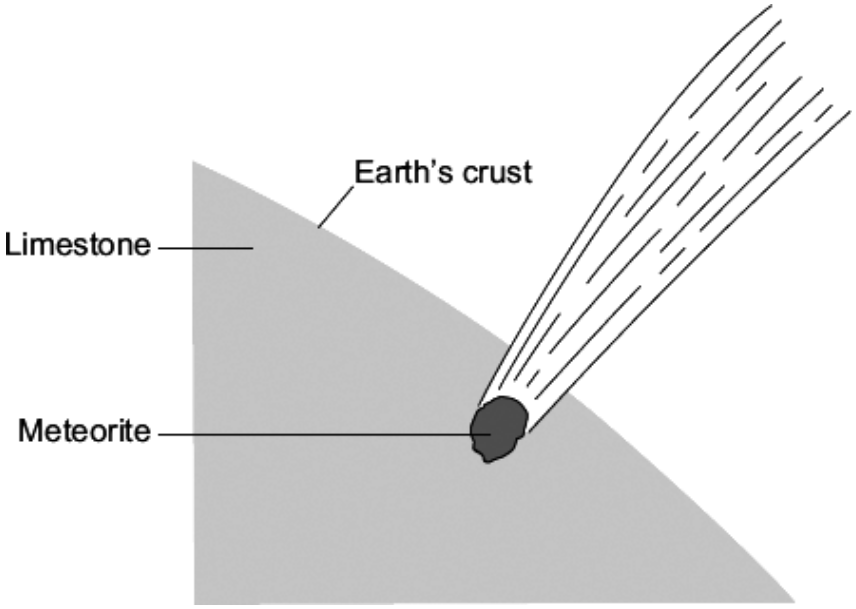
Name of gas	Percentage (%) of gas
Nitrogen	78
Oxygen	21
Other gases	1

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.

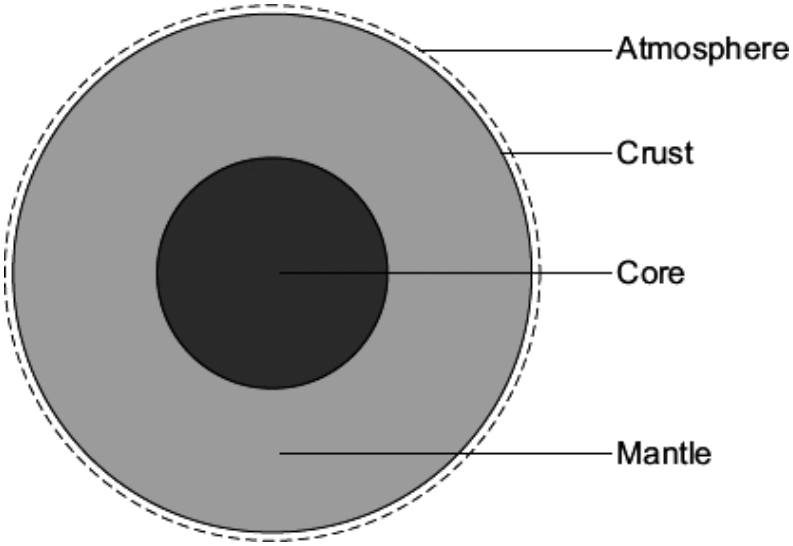
(1)

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

acid rain.
global dimming.
global warming.

(1)
(Total 7 marks)

29 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.

_____

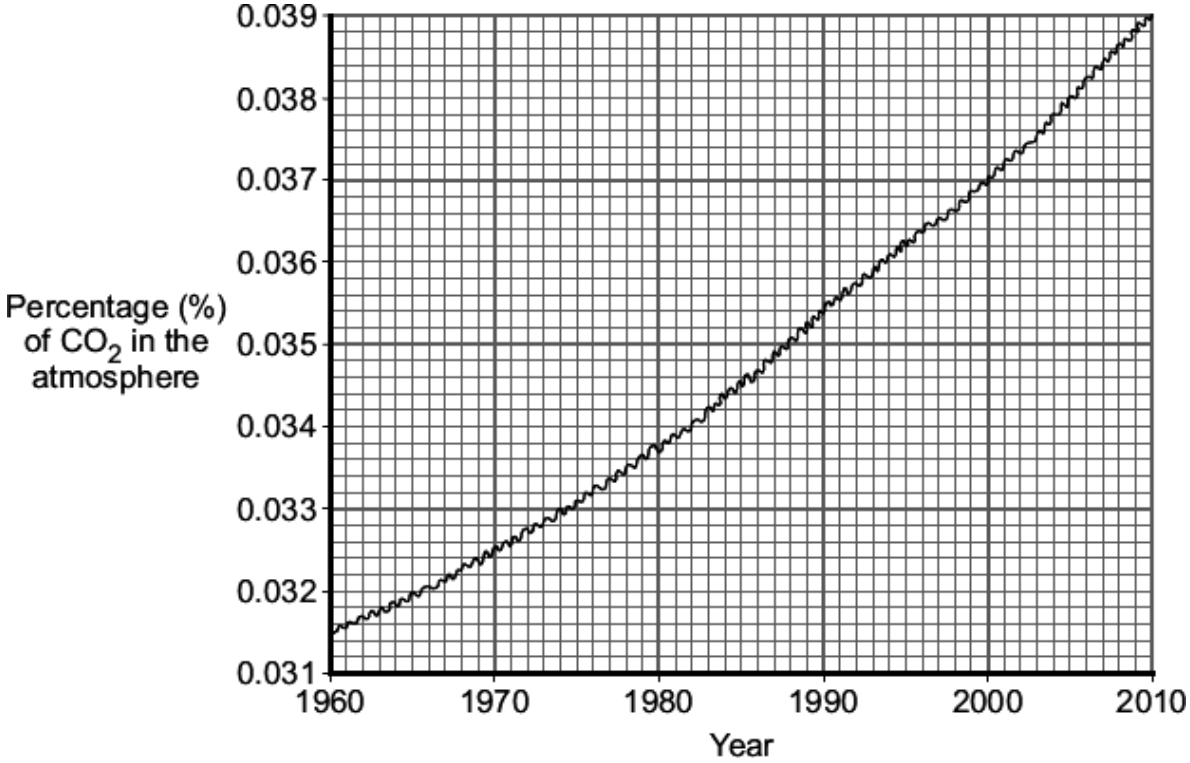
_____

_____

_____

(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.

_____

_____

_____

_____

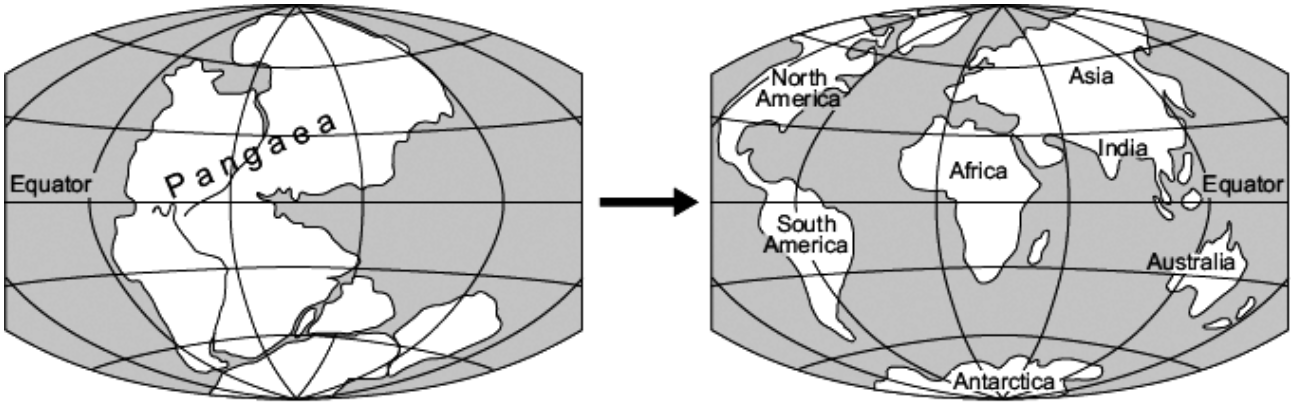
_____

_____

_____

(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.*

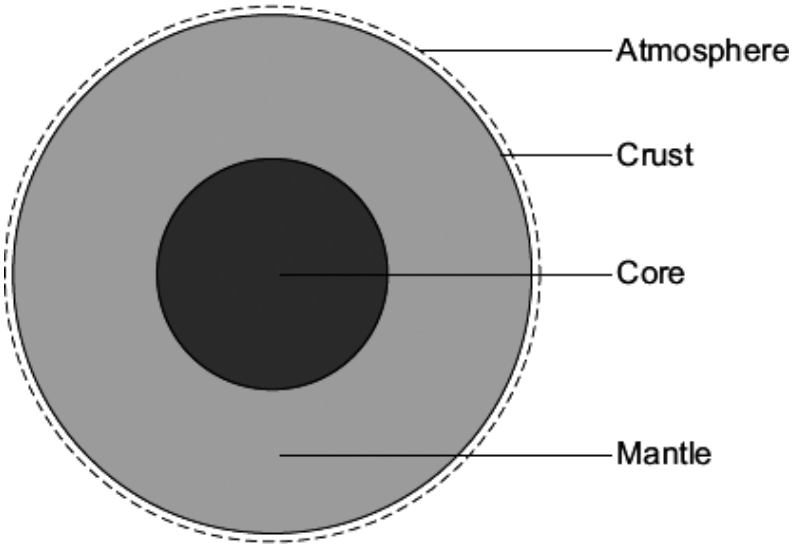
_____

_____

(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)

30 This information about diesel was printed in a magazine.

Almost all of the crops that we eat can be converted into fuel for cars.
Vegetable oils can be used as biodiesel. Diesel from crude oil is called fossil diesel.
When either biodiesel or fossil diesel burn they both produce similar amounts of carbon dioxide.
Both types of diesel produce carbon monoxide. However, biodiesel produces fewer carbon particles and less sulfur dioxide.

(a) Carbon monoxide can be produced when diesel burns in a car engine. Explain how.

_____

_____

_____

_____

(2)

(b) Use the information at the start of this question and your knowledge and understanding to evaluate the use of biodiesel compared with fossil diesel as a fuel for cars.

Remember to give a conclusion to your evaluation.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

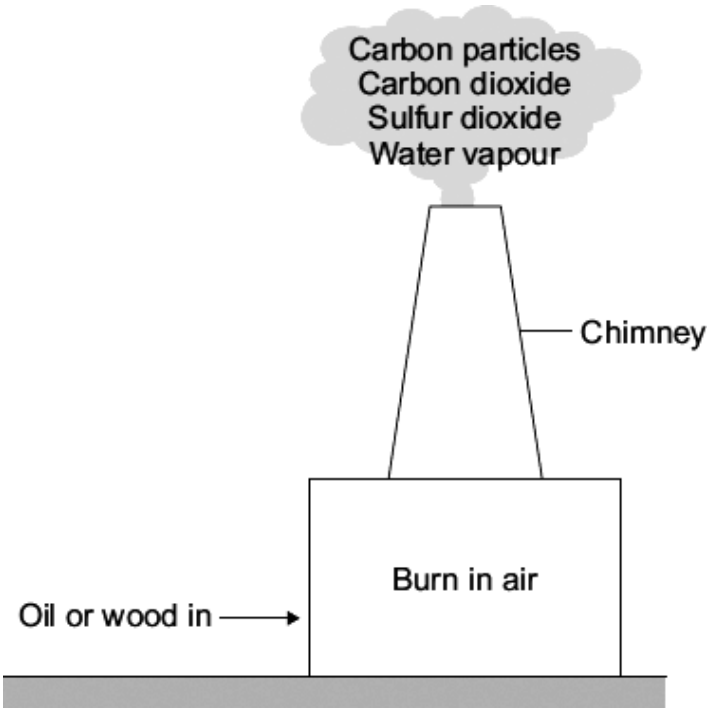
_____

(5)

(Total 7 marks)

31 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’.

_____

_____

_____

_____

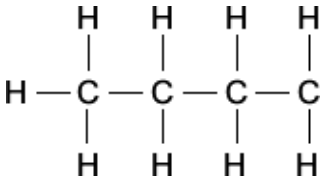
(2)

(Total 6 marks)

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

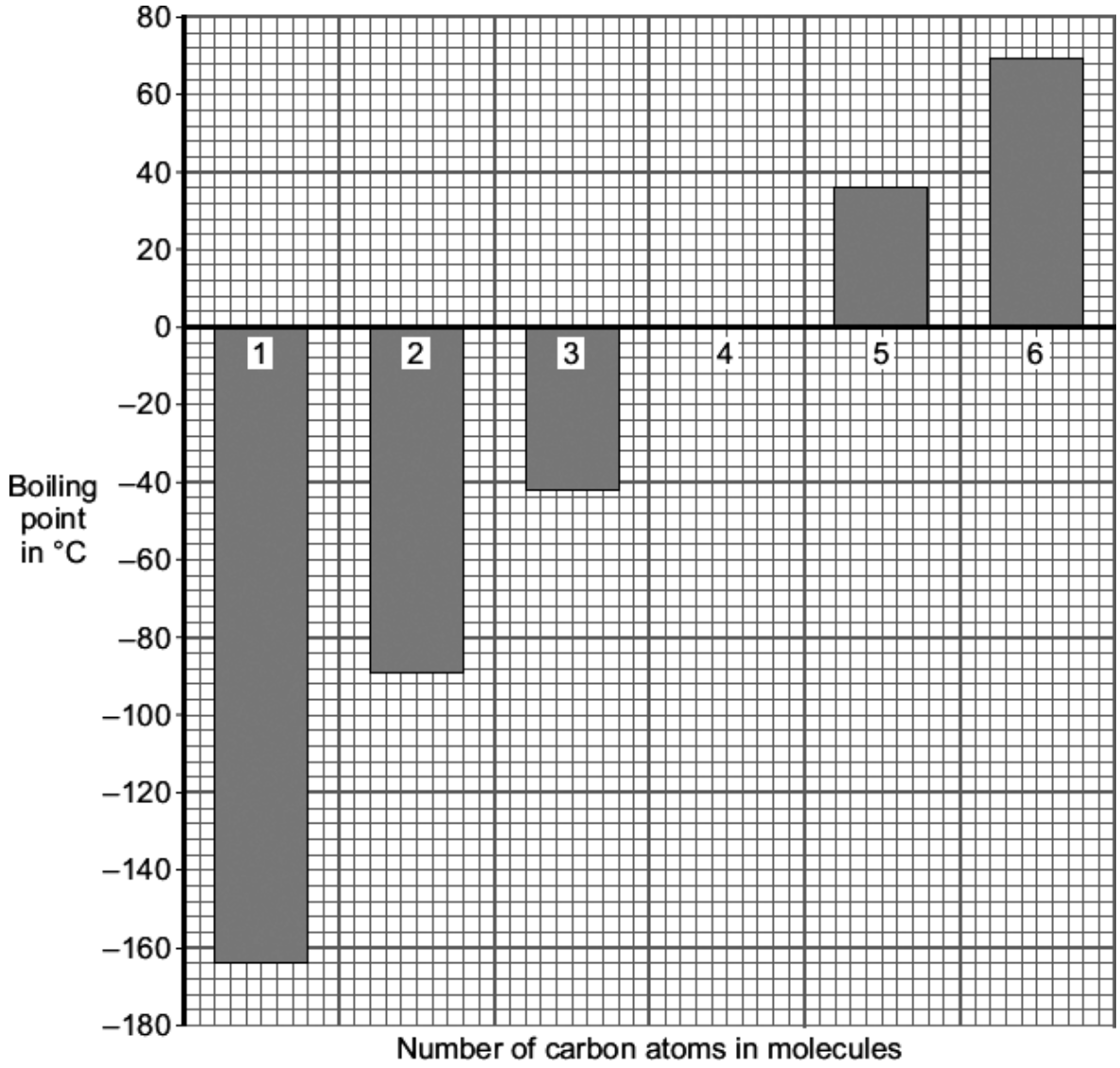
(a) The general formula of an alkane is C_nH_{2n+2}

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.

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

(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.

_____

_____

_____

_____

_____

_____

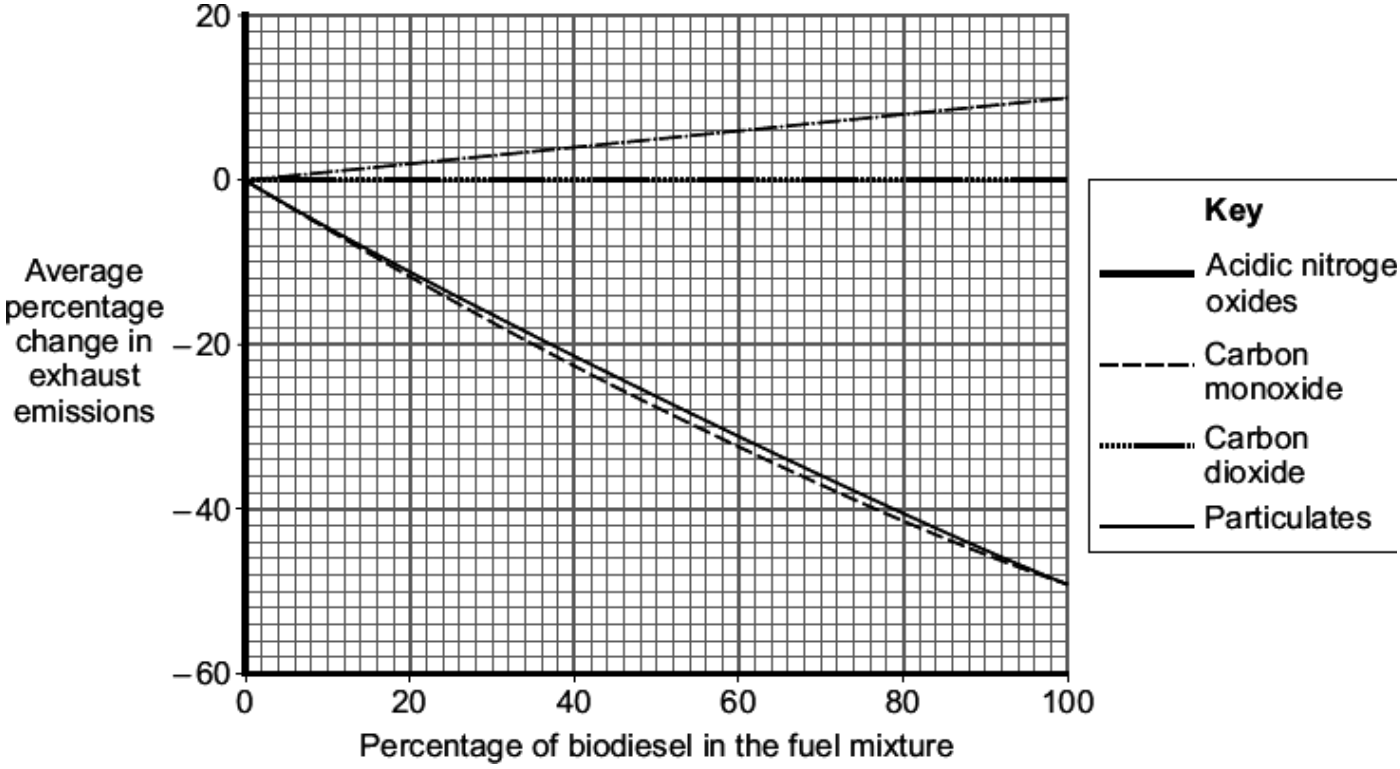
(2)
(Total 8 marks)

33 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)

34 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?

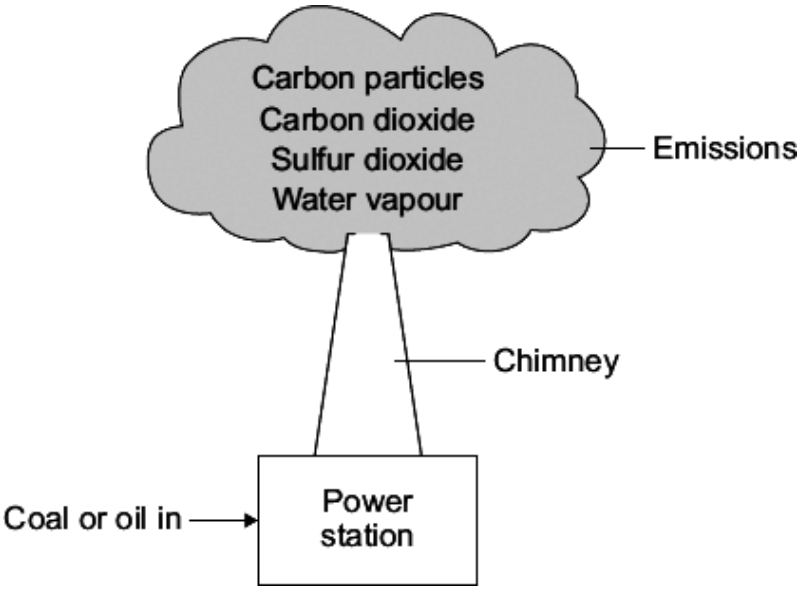
(1)

(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)

35 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**
	carbon particles
acid rain	
	carbon dioxide
global warming	
	sulfur dioxide
global dimming	
	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)

Mark schemes

1 (a) dissolved

in this order

1

carbonates

1

(b) Photosynthesis

1

(c) water

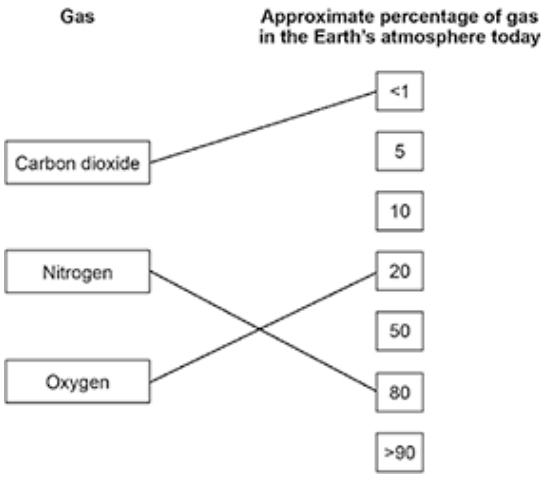
In this order

oxygen

both needed for the mark

1

(d)



Extra lines from Gas negate the mark

3

(e) increases global temperatures

1

(f) use renewable energy supplies

1

(g) correct reason, eg:

- renewable technology underdeveloped
- disagreement between countries

1

[10]

2 (a) Colourless liquid / condensation / water

1

(b) incomplete combustion of the fuel

1

because not enough oxygen

1

(c) Sulfur dioxide

1

[4]

3 (a) sediment / limestone formation from carbonates

1

(b) short wavelength radiation

1

passes through atmosphere to Earth's surface

1

Earth's surface radiates different wavelengths

1

which are absorbed by greenhouse gases to produce temperature increase

allow CH_4 H_2O or CO_2

1

(c) 13.8 %

allow values in the range 13.0 to 15.0

1

(d) 15.08 (°C)

allow values in the range 15.05 – 15.10

1

(e) correlation between CO_2 levels and temperature

1

despite short-term variations of temperature

1

supported by values from graph which show correlation

1

cannot determine causality from this data or possible causality as increasing use of fossil fuels since 1900 has caused accelerated temperature increase

1

[11]

4 (a) carbon dioxide (decreased) **one** from:

***1** mark for one reason for each gas*

- photosynthesis
- formation of (sedimentary) rocks
- formation of fossil fuels
- dissolved in oceans

ignore respiration

1

nitrogen (increased) **one** from:

- volcanoes / volcanic activity
- ammonia reacted with oxygen

1

oxygen (increase):

- photosynthesis

1

(b) 1960

1

because the rise became much steeper

1

(c) 362 − 320 = 42 (ppm)

both readings from graph

1

42 ÷ 320 × 100

1

= 13(%)

1

(d) **Level 2 (3–4 marks):**
A detailed and coherent explanation of how the rise in carbon dioxide levels affect the environment.

Level 1 (1–2 marks):
Simple relevant statements are made about the effects of rise in carbon dioxide levels on the environment. The account is incomplete or inaccurate and lacks coherence.

0 marks:
No relevant content.

Indicative content

consequences of rise in carbon dioxide levels

- carbon dioxide is a greenhouse gas
- it stops infrared radiation escaping from the Earth
- warming up the atmosphere
- rise in level warms atmosphere up more
- so leads to global warming
- leading to climate change

effects on environment:

- extreme weather fluctuations
- rise in sea levels
- effects on human habitats
- effects on animal habitats
- decrease in biodiversity
- effects on food producing capacity.

4

[12]

5 (a) $N_2 + 2O_2 \longrightarrow 2NO_2$

correct formulae for reactants **1**

correct balancing **1**

(b) 2.96 − 0.98

correct values read from graph **1**

1.98 ÷ 2.96 (×100)

allow ecf from readings from graph **1**

= 66.9(%)

*allow 66.9 shown without working for the **3** calculation marks* **1**

*incorrect number of sig. figs max **2** marks*

(c) less acid rain **or** fewer respiratory problems in humans

allow improved air quality **1**

[6]

6 **Level 3 (5–6 marks):**
A full explanation is given that is coherent and logically structured, linking effect of increase in carbon dioxide to climate change and effects on biodiversity.

Level 2 (3–4 marks):
An attempt is made to link the effects of rising carbon dioxide levels to climate change and biodiversity. The logic may be inconsistent at times but builds towards a coherent explanation.

Level 1 (1–2 marks):
Discrete relevant points made. The logic may be unclear and attempts at reasoning may not be consistent.

0 marks:
No relevant content.

Indicative content

- rise in carbon dioxide increases atmospheric temperature / causes global warming
- global warming causes extreme weather patterns
- such as rise in sea levels
- increased or decreased rainfall
- frequency of storms / droughts
- rise in sea levels means habitats will change due to flooding
- rise in sea levels could increase salt in soil
- increased rainfall will increase water levels
- severity of storms / droughts could affect photosynthesis
- consequences of changes are loss of or damage to habitats
- which will affect animal and plant distributions
- by increasing migration or species dying off
- which decreases biodiversity

[6]

7 (a) gravity (of moon and sun)

1

(b) any **two** from:

*1 mark for statement, **1** mark for correctly linked reason*

- tidal energy is renewable (1)
- so won't run out like fossil fuels (1)

or

- doesn't emit carbon dioxide
- so won't contribute to global warming / climate change

or

- doesn't emit oxides of sulfur or nitrogen
- so doesn't cause acid rain

or

- doesn't use fossil fuels
- so less impact on environment of extraction / transport

or

- doesn't produce particulates
- so less effect on health / environment

Max. 4

(c) coal consumption per year = 29.25 × 1000 × 6 million = 175 500 000 000 MJ

1

1 hectare of willow will produce 9 × 13 × 1000 = 117 000 MJ per year

1

so need 175 500 000 000 ÷ 117 000 = 1 500 000 (hectares)

1

*allow 1 500 000 with no working shown for **3** marks*

(d) although has higher direct emissions than other fuels

1

it has much lower lifetime emissions

1

[10]

8 (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]

9 (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

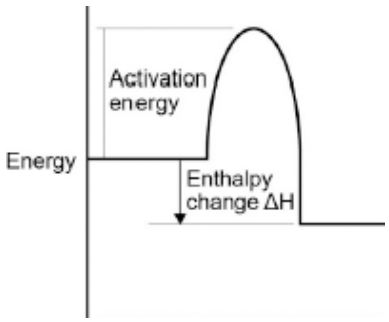
1

(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 bon

1

[15]

10 (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 / $S0_2$

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]

11 (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]

12 (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

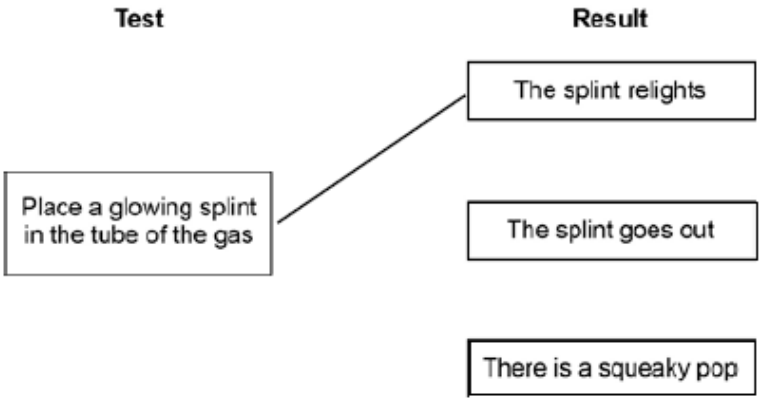
waste materials

- 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]

13 (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]

14 (a) (i) a proton

1

(ii) nucleus

1

(iii) 12

order must be correct

1

4

1

(b) (i) 5 / five (%)

1

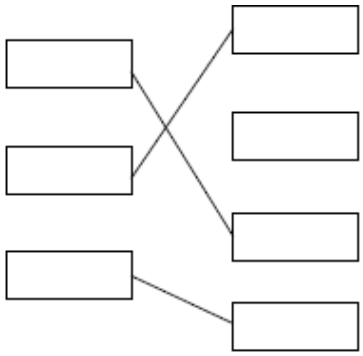
(ii) Carbon dioxide > global warming

1

Sulfur dioxide > acid rain

1

Water > no pollution



1

[8]

15 (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*
- <u>locked</u> up in (sedimentary) rocks
- <u>locked</u> up in fossil fuels

2

[6]

16 (a) (i) 2,4 drawn (as dots / crosses / e^-)

1

(ii) Water (vapour) / steam

allow hydrogen oxide / H_2O

*do **not** accept hydroxide*

1

(b) any **two** pairs from:

carbon dioxide (1)

causes global warming (1)

allow greenhouse effect / climate change / sea level rise / melting of polar ice caps

or

carbon (particles) / soot (1)

allow particulates

causes global dimming (1)

allow blocks out sunlight / smog / prevents plant growth / causes breathing difficulties

or

carbon monoxide (1)

is toxic (1)

or

sulfur dioxide (1)

causes acid rain (1)

allow kills plants / erosion / acidifies water

4

[6]

17 (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]

18 (a) (i) CH_4

allow H_4C

*do **not** allow lower-case h*

*do **not** allow superscript*

1

(ii) single

1

(iii) alkanes

1

(b) (i) carbon / C

any order

1

hydrogen / H

allow phonetic spelling

1

sulfur / sulphur / S

1

(ii) air / atmosphere

1

(iii) acid rain

1

damages trees / plants **or** kills aquatic organisms **or** damages buildings / statues **or** causes respiratory problems

allow harmful to living things

1

(c) carbon / C

accept soot / particulates / charcoal

1

(d) any **four** from:

- (supports hypothesis) because when the fuel contained more carbon the temperature of the water went up more / faster (in 2 minutes)
- (does not support hypothesis as) temperature change per gram decreases as the number of carbons increases
- (does not support hypothesis) because the more carbon in the fuel the more smoke **or** the dirtier / sootier it is
- only tested hydrocarbons / alkanes / fuels with between 5 and 12 carbon atoms
- valid, justified, conclusion

accept converse statements

4

(e) (i) 0.15

*correct answer with or without working gains **2** marks*

*if answer incorrect, M_r carbon dioxide = 44 gains **1** mark*

*allow 0.236 / 0.24 / 0.2357142 (ecf from M_r of 28) for **1** mark*

2

(ii) 0.4(0)

1

(iii) C_3H_8

*correct formula with or without working scores **2** marks*

0.15 / 0.05 = 3

*allow ecf from **(e)(i)***

and

0.4 / 0.05 = 8 (1)

*allow ecf from **(e)(ii)***

*allow **1** mark for correct empirical formula from their values*

If use 'fall-back-values:

0.50 / 0.05 = 10

and

0.20 / 0.05 = 4

1 mark

C_4H_{10}

1 mark

*if just find ratio of C to H using fall-back values, get C_2H_5 allow **1** mark*

2

[19]

19 (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]

20 (a) (i) H_2O

must be formula

1

CaO

must be formula

1

(ii) carbon dioxide from the air / (Earth's early) atmosphere

it = carbon (dioxide)

accept carbon dioxide from millions of years ago

1

formed (sedimentary) rocks **or** fossil fuels

ignore trapped / stored

1

(b) (i) decreases rapidly at first

it = carbon (dioxide)

1

then slowly **or** levels off

allow both marks if the description is correct using either 'rapidly' ***or*** *'slowly'*

allow correct use of figures for either marking point

*if no other mark awarded, allow CO_2 decreased for **1** mark*

1

(ii) any **two** from:

it = carbon (dioxide)

accept photosynthesis

- used by plants
- dissolved in oceans
- 'locked up' in fossil fuels **or** formed fossil fuels
- 'locked up' in rocks **or** formed rocks

2

(c) (yes)

it = percentage of carbon (dioxide)

ignore yes or no

because the percentage of carbon dioxide is increasing

1

which causes global warming (to increase)

allow (carbon dioxide) causes greenhouse effect/climate change

1

or

(no)

because the percentage of carbon dioxide is low (1)

compared to millions of years ago (1)

allow global warming can be caused by other factors (e.g. Sun / water vapour / methane)

[10]

21 (a) (i) 42 000

*correct answer gains **2** marks with or without working*
allow 42 kJ
*if answer incorrect : correct substitution 500 x 4.2 x 20 gains **1** mark*

2

(ii) any **two** from:

- eye protection
- lab coat
- heat-proof mat
- (heat-proof) gloves
- (long) hair tied back
- stand up
- secure the beaker

2

(iii) Stir the water before measuring the temperature.

1

Place a lid on the beaker.

1

(b) the products → S

1

the activation energy → Q

1

the energy released by the reaction → P

1

(c) carbon dioxide produced

it = propane
allow converse arguments
allow greenhouse gas / global warming / atmospheric pollution

(crude oil / propane) non-renewable

1

allow crude oil running out

1

[11]

22 (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 'locked up' (in fossil fuels) **or**

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

1

[11]

23 (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 absorb (carbon dioxide)
- coal 'locks up' (carbon dioxide)

1

(ii) it increases the amount (of CO_2)

1

because carbon in coal (forms carbon dioxide)

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

1

[6]

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

burning biodiesel releases CO_2

ignore burning trees

1

CO_2 is absorbed / used by the crops/plants (used to produce the biodiesel)

allow CO_2 absorbed / used by trees

1

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

increases CO_2 / greenhouse effect

accept causes global warming

OR

allow causes climate change

less CO_2 is absorbed (from atmosphere)

ignore other correct effects

1

because burning trees releases CO_2

accept fewer trees to absorb CO_2

***or** crops / plants do not absorb as much CO_2 as trees*

OR

because there is less 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]

25 (a) carbon dioxide decreased (by plants / trees)

allow plants / trees absorbed carbon dioxide

1

oxygen increased (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]

26 (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]

27 (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 viscous than petroleum diesel at all / lower temperatures
- biodiesel – as the temperature increases the viscosity decreases or vice versa
- petroleum diesel – the viscosity 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 more 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 not 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]

28 (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]

29 (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

<u>more rapid</u> 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]

30 (a) carbon / diesel / it reacts / burns in oxygen / air

1

limited supply (of oxygen / air)

accept incomplete combustion

$2C + O_2 \rightarrow 2CO$ ***or***

*$C + CO_2 \rightarrow 2CO$ gains **2** marks*

1

(b) any **four** from:

accept converse statements for fossil diesel.

ignore cost / ease of manufacture / usage issues

for biodiesel:

- less global dimming (because fewer carbon particles)
- less acid rain (because less sulfur dioxide)
  *if neither point awarded, fewer carbon particles and less sulfur dioxide = **1** mark*
- renewable resource / sustainable
  accept fossil fuel / diesel supplies are limited
- use <u>waste</u> vegetable oils / fats
- vegetables / plants absorbed carbon dioxide / carbon neutral
  accept fossil fuel / diesel releases locked up carbon / is not carbon neutral
- uses land which could be used to produce food
- third world countries can produce bio diesel
- biodegrades easily
- more NOx released

4

justified conclusion

1

[7]

31 (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]

32 (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 dead plants / animals*
allow dead sea creatures
ignore shells

1

(iii) increase 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]

33

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]

34 (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]

35 (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]