AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.9.3 COMMON ATMOSPHERIC POLLUTANTS AND THEIR SOURCES (PACK 1)

SCORE	PERCENTAGE
/320	%

STEMUP

These questions belong to AQA, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by AQA. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with AQA and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. AQA has not endorsed, approved or been involved in the production of it. AQA and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

AQA publishes its past papers, mark schemes and examiner reports. Always check the current specification at aqa.org.uk before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Q1.

Older cars are tested each year to measure the amount of pollutants contained in exhaust fumes.

The table below shows the maximum allowed percentages of exhaust pollutants for petrol cars.

Age of car in years	Maximum allowed percentage (%) of exhaust pollutant	
	Carbon monoxide	Unburned hydrocarbons
16−24	0.30	0.02
3−16	0.20	0.02

(a) Explain how carbon monoxide is produced when petrol is burned in car engines.

_____

_____

_____

_____

(2)

(b) Suggest **two** reasons why the maximum allowed percentage of carbon monoxide has been decreased for newer cars.

1. _____

_____

2. _____

_____

(2)

(c) Give **one** reason for having a maximum allowed percentage of unburned hydrocarbons in exhaust fumes.

_____

_____

(1)

Oxides of nitrogen are also pollutants contained in exhaust fumes.

(d) Describe how oxides of nitrogen are produced when petrol is burned in car engines.

_____

_____

STEMUP.CO.UK

_____

_____

(2)

Catalytic converters are fitted to car exhausts to reduce the amount of pollutants released into the atmosphere.

(e) Nitrogen dioxide is an oxide of nitrogen.

Nitrogen dioxide reacts to produce nitrogen and oxygen in catalytic converters.

Complete the equation for this reaction.

The equation should be balanced.

$$___\ NO_2\,(g) \longrightarrow _____ + ___\ O_2\,(g)$$

(2)

(f) Give **two** effects of atmospheric pollution which are reduced by using catalytic converters.

1. _____

_____

2. _____

_____

(2)

(g) The catalyst in catalytic converters is a mixture of three elements.

Where in the periodic table are these elements most likely to be found?

Tick **one** box.

Alkali metals	☐
Halogens	☐
Noble gases	☐
Transition metals	☐

(1)

(Total 12 marks)

Q2.

This question is about fuels.

STEMUP.CO.UK

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

(a) Cracking breaks down large hydrocarbon molecules into smaller hydrocarbon molecules.

Which hydrocarbon molecule can be cracked to produce octane, C_8H_{18}?

Tick **one** box.

C_4H_8 ☐

C_4H_{10} ☐

C_8H_{16} ☐

$C_{12}H_{26}$ ☐

(1)

(b) What type of carbon compound is octane, C_8H_{18}?

Tick **one** box.

Alcohol ☐

Alkane ☐

Carboxylic acid ☐

Ester ☐

(1)

(c) Oxygen is needed to burn fuels.

Name the source of the oxygen needed to burn fuels.

_____

_____

(1)

(d) Particulates and sulfur dioxide are pollutants produced when some fuels burn.

Draw **one** line from each pollutant to the polluting effect.

Pollutant	**Polluting effect**

STEMUP.CO.UK

	Acid rain
Particulates	Global dimming
	Global warming
Sulfur dioxide	Landfill
	Sewage sludge

(2)

(e) Which **two** gases are produced when fuels burn in car engines?

Tick **two** boxes.

- Ammonia ☐
- Carbon dioxide ☐
- Carbon monoxide ☐
- Nitrogen ☐
- Oxygen ☐

(2)

(f) Vehicles produce most of the atmospheric pollution in cities.

How could the atmospheric pollution in cities be reduced?

Tick **two** boxes.

- Build more roads in cities ☐
- Build new car factories ☐
- Develop fuel efficient engines ☐
- Make car tax cheaper ☐

STEMUP.CO.UK

Use electric cars ☐

(2)

(Total 9 marks)

Q3.

Coal is used as a fuel in power stations.

The table shows the percentage of carbon and sulfur in four different coal samples.

Sample	Percentage (%) by mass in coal	
	Carbon	Sulfur
A	22.1	0.4
B	46.8	0.6
C	66.3	0.9
D	92.0	0.7

(a) Sulfur produces a gas that causes acid rain.

Name the gas.

_____

(1)

(b) Give **one** environmental effect caused by acid rain.

_____

(1)

(c) Which coal sample produces the most acid rain from 1 kg of coal?

Use the table above.

Give a reason for your answer.

Sample _____

Reason _____

_____

(2)

(d) Calculate the mass of coal sample **A** that would produce the same amount of carbon dioxide as 1 kg of coal sample **C**.

_____

_____

Mass of coal sample **A** = _____ kg

STEMUP.CO.UK

(2)

(e) Incomplete combustion of coal can produce carbon monoxide.

Carbon monoxide is a toxic gas.

Give **two** reasons why people may be unaware of the presence of carbon monoxide.

1. _____

_____

2. _____

_____

(2)

(Total 8 marks)

Q4.

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.

$C_3H_8 + 5O_2 \rightarrow 3$ _____ + 4 _____

(2)

STEMUP.CO.UK

(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

STEMUP.CO.UK

Particulate matter	Global warming
	Photosynthesis

(2)

(Total 11 marks)

Q5.

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 ☐

STEMUP.CO.UK

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 ☐

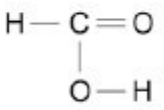
D ☐

(1)

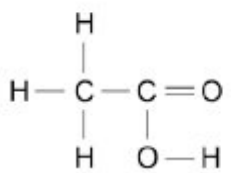
(d) Propanoic acid is a carboxylic acid.

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

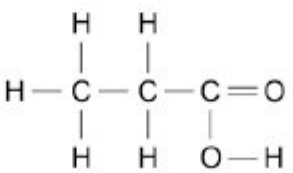
A



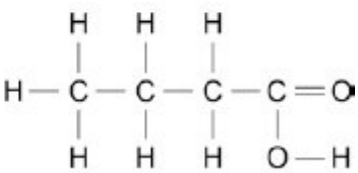
B



C



D



Tick **one** box.

A ☐

B ☐

C ☐

STEMUP.CO.UK

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)

Q6.

This question is about hydrocarbons.

(a) Most of the hydrocarbons in crude oil are alkanes.

(i) Large alkane molecules can be cracked to produce more useful molecules.

The equation shows the cracking of dodecane.

$$\underset{\text{dodecane}}{C_{12}H_{26}} \longrightarrow \underset{\text{butane}}{C_4H_{10}} + \underset{\text{hexene}}{C_6H_{12}} + \underset{\text{ethene}}{C_2H_4}$$

Give **two** conditions used to crack large alkane molecules.

1. _____

2. _____

(2)

(ii) The products hexene and ethene are alkenes.

Complete the sentence.

When alkenes react with bromine water the colour changes

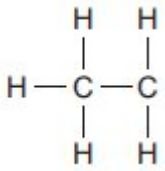
from orange to _____ .

(1)

(iii) Butane (C_4H_{10}) is an alkane.

Complete the displayed structure of butane.

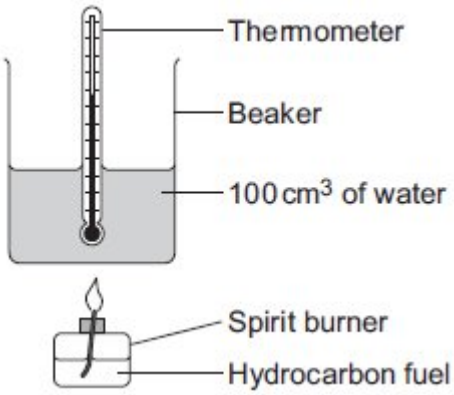
STEMUP.CO.UK



(1)

(b) A group of students investigated the energy released by the combustion of four hydrocarbon fuels.

The diagram below shows the apparatus used.



Each hydrocarbon fuel was burned for two minutes.

Table 1 shows the students' results.

Table 1

	After two minutes				
Name and formula of hydrocarbon fuel	**Mass of fuel used in g**	**Temperature increase of water in °C**	**Energy released by fuel in kJ**	**Energy released by 1.0 g of fuel in kJ**	**Relative amount of smoke in the flame**
Hexane, C_6H_{14}	0.81	40	16.80	20.74	very little smoke
Octane, C_8H_{18}	1.10	54	22.68	20.62	some smoke
Decane, $C_{10}H_{22}$	1.20	58	24.36		smoky
Dodecane, $C_{12}H_{26}$	1.41	67	28.14	19.96	very smoky

(i) Calculate the energy released by 1.0 g of decane in kJ.

_____

_____

Energy released = _____ kJ

(2)

STEMUP.CO.UK

(ii) Suggest **one** improvement to the apparatus, or the use of the apparatus, that would make the temperature increase of the water for each fuel more accurate.

Give a reason why this is an improvement.

_____

_____

_____

(2)

(iii) The students noticed that the bottom of the beaker became covered in a black substance when burning these fuels.

Name this black substance.

Suggest why it is produced.

_____

_____

_____

_____

(2)

(iv) A student concluded that hexane is the best of the four fuels.

Give **two** reasons why the results in **Table 2** support this conclusion.

1. _____

_____

2. _____

_____

(2)

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

Most car engines use petrol as a fuel.

- Petrol is produced from the fractional distillation of crude oil.
- Crude oil is a mixture of hydrocarbons.
- Sulfur is an impurity in crude oil.

Car engines could be developed to burn hydrogen as a fuel.

- Hydrogen is produced from natural gas.
- Natural gas is mainly methane.

STEMUP.CO.UK

Table 2 shows information about petrol and hydrogen.

Table 2

	Petrol	**Hydrogen**
State of fuel at room temperature	Liquid	Gas
Word equation for combustion of the fuel	petrol + oxygen ⟶ carbon dioxide + water	hydrogen + oxygen ⟶ water
Energy released from combustion of 1 g of the fuel	47 kJ	142 kJ

Describe the **advantages** and **disadvantages** of using hydrogen instead of petrol in car engines.

Use the information given and your knowledge and understanding to answer this question.

(6)

(Total 18 marks)

Q7.

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.

_____

_____

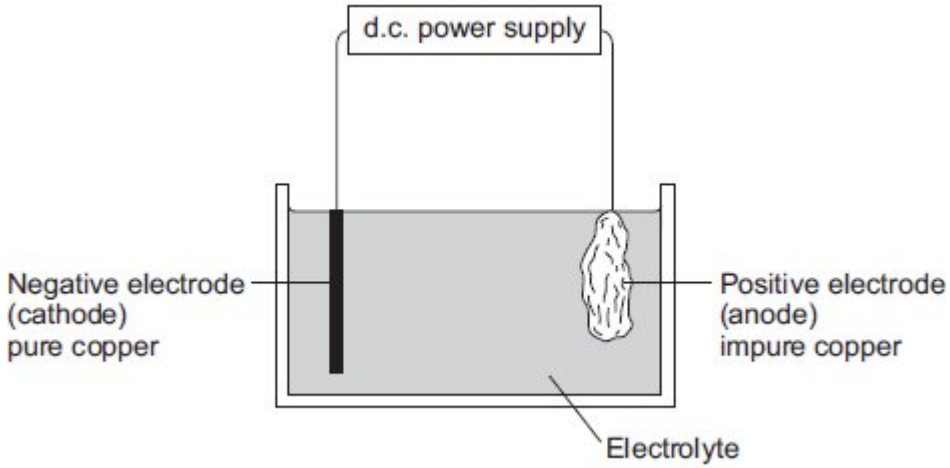
_____

_____

(2)

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

STEMUP.CO.UK



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.

_____

_____

_____

_____

_____

_____

_____

STEMUP.CO.UK

_____

_____

(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)

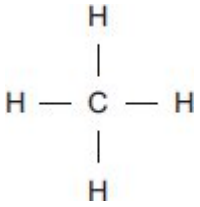
(Total 16 marks)

Q8.

STEMUP.CO.UK

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. ☐

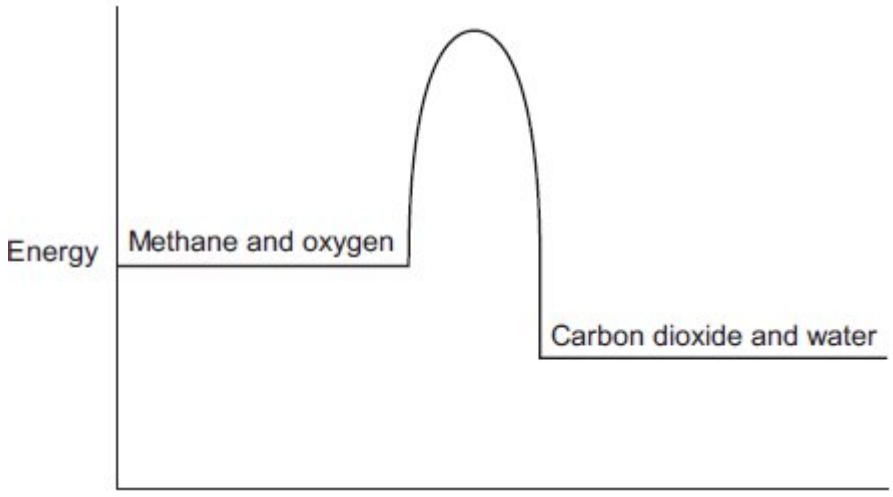
(1)

(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)

STEMUP.CO.UK

(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

STEMUP.CO.UK

(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)

Q9.

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.

STEMUP.CO.UK

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)

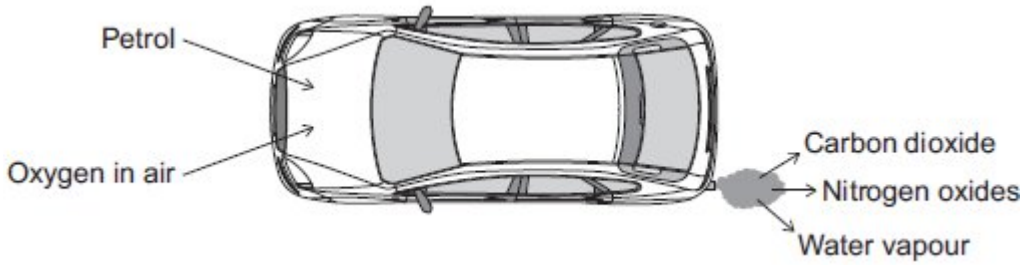
(iii) Crude oil is separated by fractional _____ .

(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)

STEMUP.CO.UK

(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:

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

(i) Why is propane useful?

Tick (✓) **one** box.

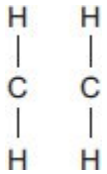
Propane is a polymer. ☐

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 ☐

STEMUP.CO.UK

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)

Q10.

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.

_____

STEMUP.CO.UK

_____

_____

_____

_____

_____

_____

(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.

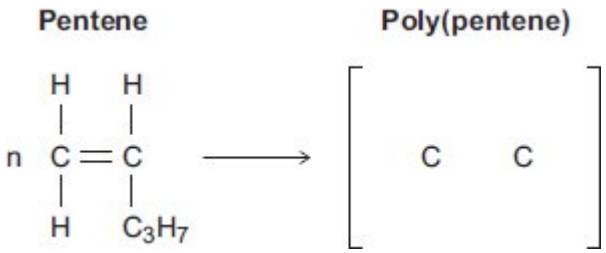
$C_{10}H_{22} \longrightarrow C_5H_{10} + C_3H_8 +$ _____

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)

Q11.

Sulfur is a non-metal.

Sulfur burns in the air to produce sulfur dioxide, SO_2

STEMUP.CO.UK

(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.

STEMUP.CO.UK

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**.

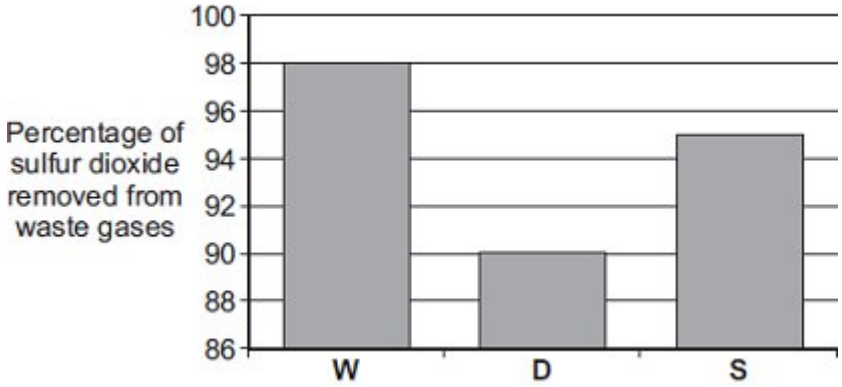


Table 1

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

_____

_____

STEMUP.CO.UK

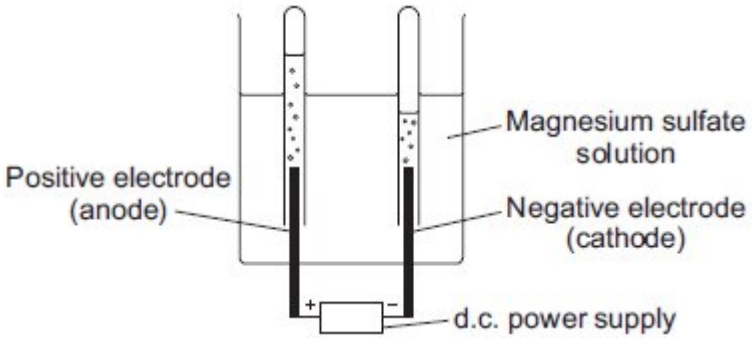
(6)

(Total 12 marks)

Q12.

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.

STEMUP.CO.UK

Test	Result
Place a glowing splint in the tube of the gas	The splint relights
	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.

_____

_____

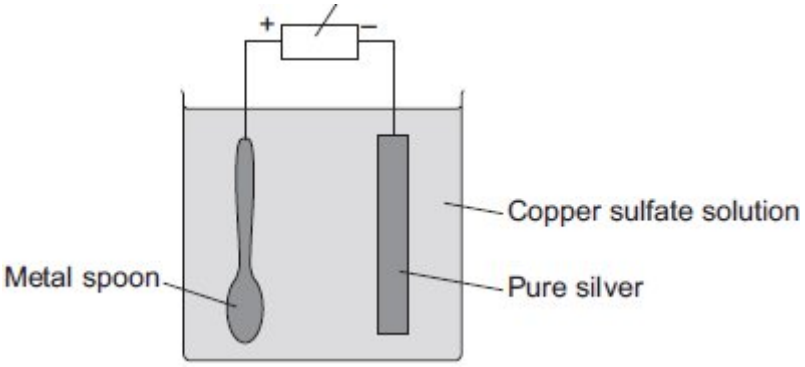
(1)

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

Diagram 2

d.c. power supply

STEMUP.CO.UK



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?

_____

_____

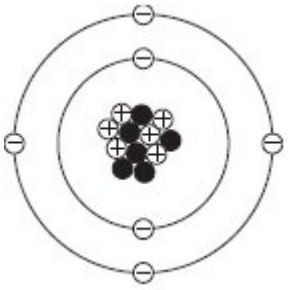
(1)

(Total 10 marks)

Q13.

Fossil fuels contain carbon.

(a) The figure below represents a carbon atom.



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

STEMUP.CO.UK

(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**

STEMUP.CO.UK

Carbon dioxide	Acid rain
Sulfur dioxide	Global dimming
Water	Global warming
	No pollution

(3)

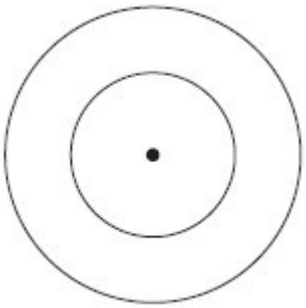
(Total 8 marks)

Q14.

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?

_____

_____

_____

_____

STEMUP.CO.UK

_____

_____

_____

_____

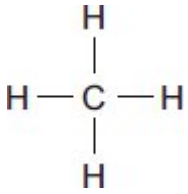
(4)

(Total 6 marks)

Q15.

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. _____

STEMUP.CO.UK

(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.

_____

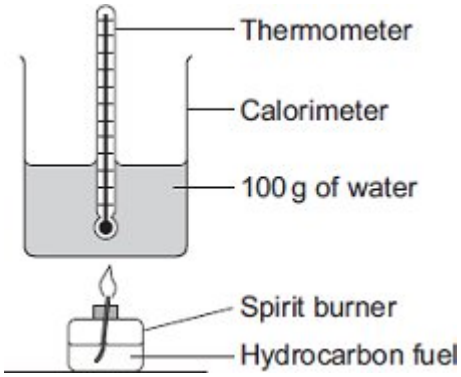
(1)

(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.

STEMUP.CO.UK

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.

STEMUP.CO.UK

(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)

Q16.

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.

STEMUP.CO.UK

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

_____

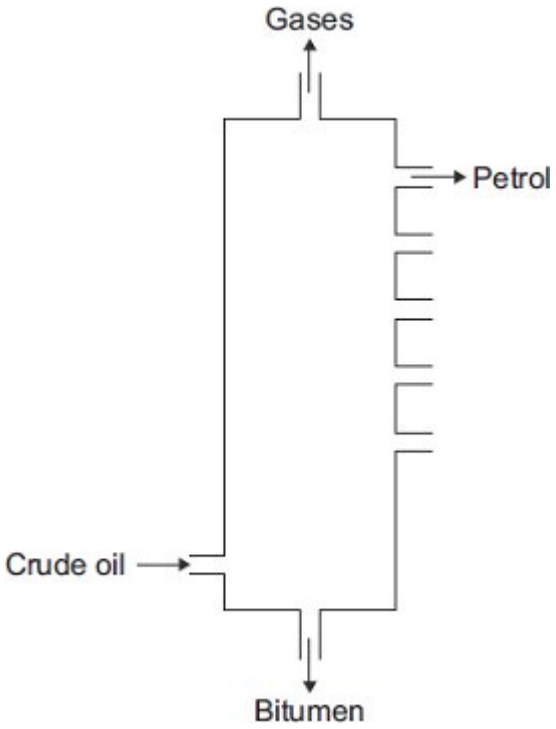
_____

_____

_____

(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.

_____

_____

_____

_____

_____

_____

_____

STEMUP.CO.UK

_____

_____

_____

_____

(6)

(Total 9 marks)

Q17.

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

$$\mathbf{C_nH}$$

(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)

STEMUP.CO.UK

(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)

STEMUP.CO.UK

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

Explain why.

_____

_____

_____

_____

(2)

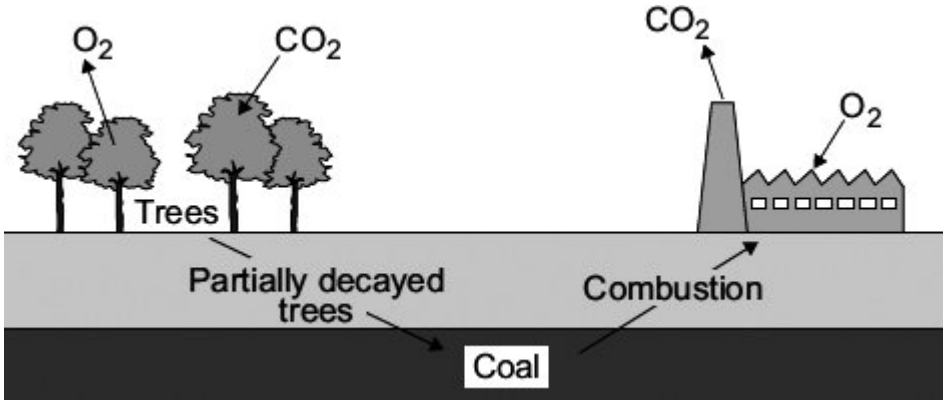
(Total 11 marks)

Q18.

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

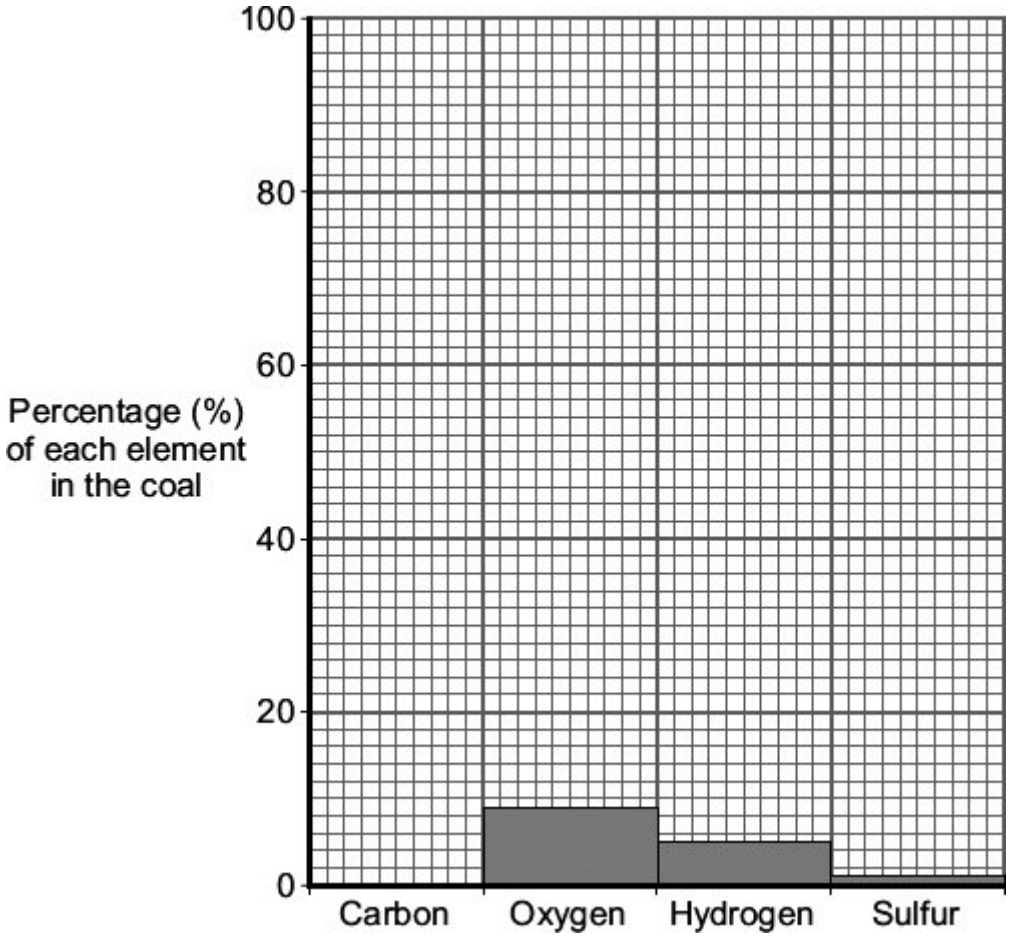
About 400 million years ago plants and trees grew on most of the land. When the plants and trees died they were covered by sand and slowly decayed to form coal.

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.

STEMUP.CO.UK



(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?

STEMUP.CO.UK

_____

_____

(1)

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

_____

_____

_____

_____

(2)

(Total 6 marks)

Q19.

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.

_____

_____

_____

STEMUP.CO.UK

(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.

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

(1)

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

increases atmospheric pollution

_____

_____

_____

_____

decreases atmospheric pollution.

_____

_____

_____

_____

(4)

(Total 10 marks)

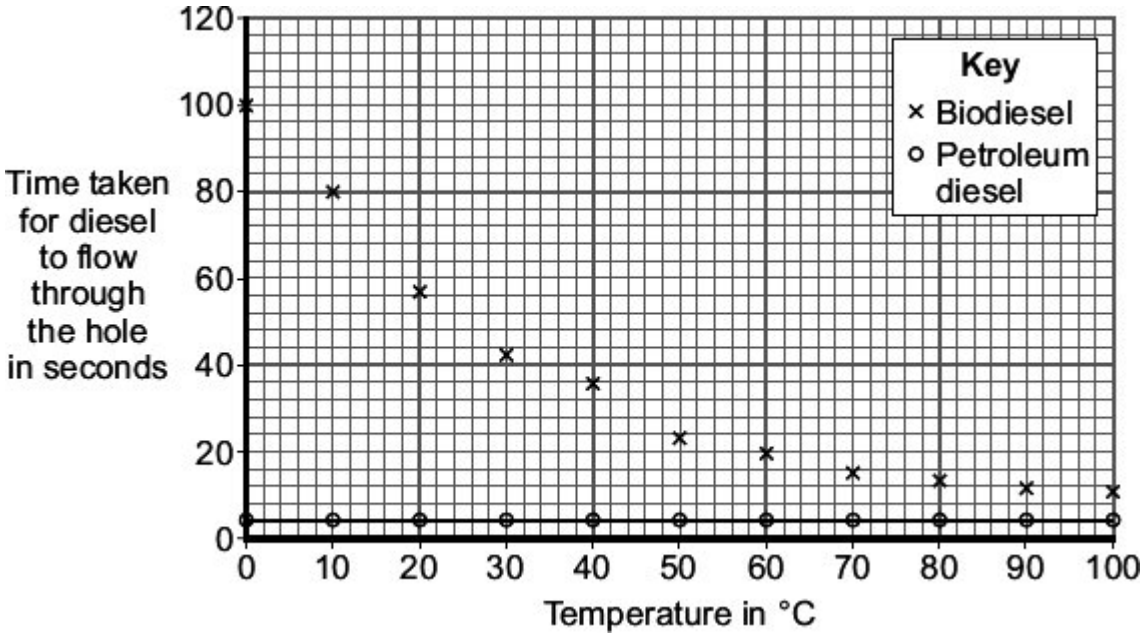
Q20.

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.

STEMUP.CO.UK



(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.

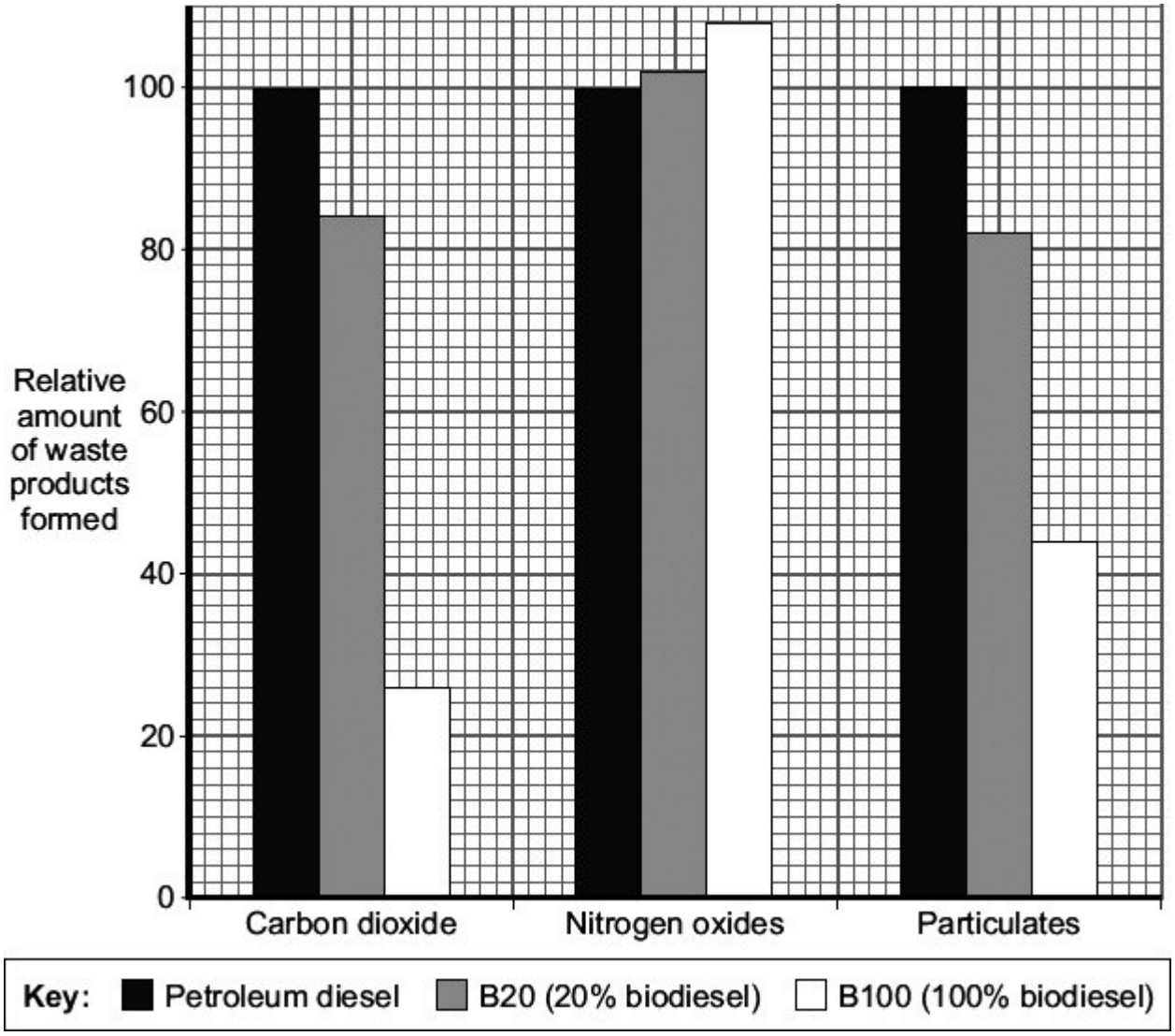
_____

_____

(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.

STEMUP.CO.UK



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.

_____

_____

_____

STEMUP.CO.UK

_____

(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)

Q21.

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.

_____

_____

_____

_____

STEMUP.CO.UK

_____

_____

_____

_____

_____

_____

_____

_____

_____

(5)

(Total 7 marks)

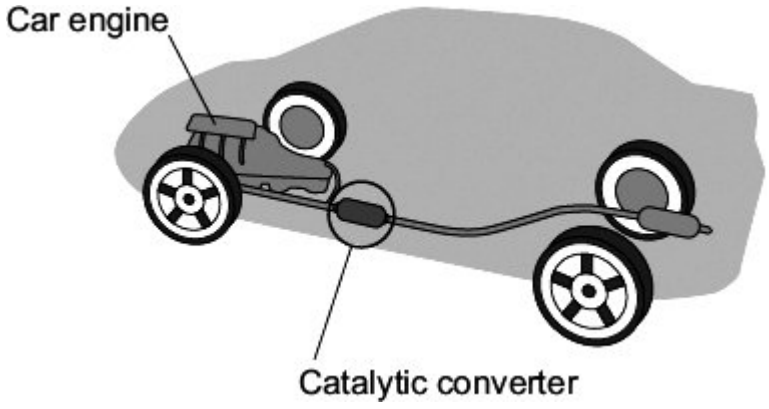
Q22.

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)

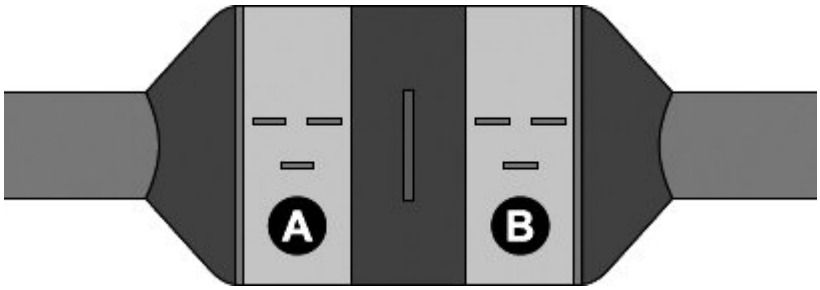
STEMUP.CO.UK

(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.	

STEMUP.CO.UK

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)

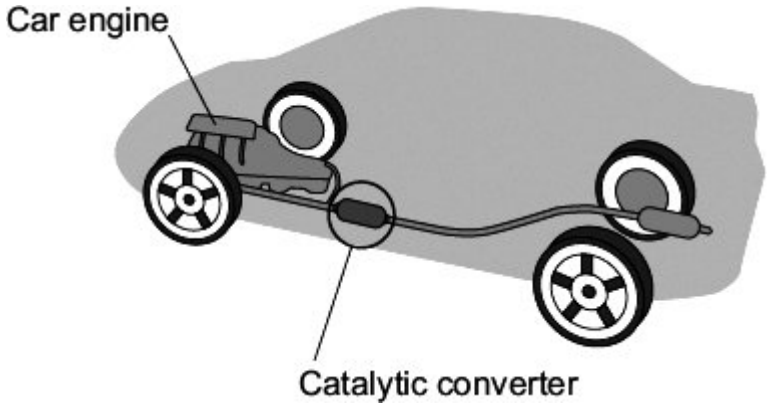
Q23.

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) The reaction is *exothermic*. What is the meaning of *exothermic*?

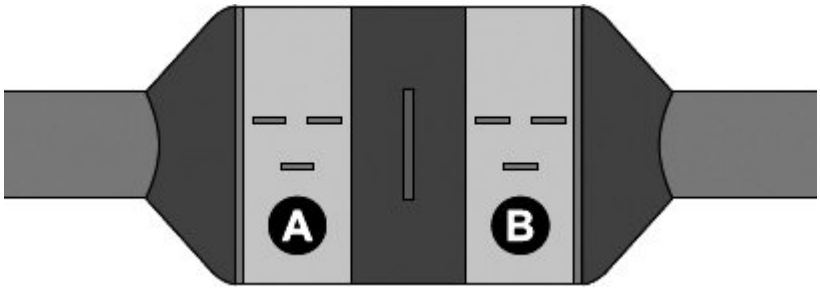
STEMUP.CO.UK

_____

_____

(1)

(b) The catalytic converter has two parts shown as **A** and **B** in the diagram.



Part **A** contains a catalyst made from platinum and rhodium.

Part **B** contains a catalyst made from platinum and palladium.

(i) Why are catalysts used in chemical reactions?

_____

_____

(1)

(ii) One reaction in part **A** is shown by this equation.

$$2NO \rightarrow N_2 + O_2$$

Suggest why this reaction helps the environment.

_____

_____

(1)

(iii) The equation for one of the reactions in part **B** is shown below.

Balance this equation.

$$____\ CO + O_2 \rightarrow ____\ CO_2$$

(1)

(iv) The catalytic converter works for many years without replacing the catalyst.

Explain why the catalyst does not need to be replaced.

_____

_____

(1)

(v) Suggest why different catalysts are used in parts **A** and **B**.

STEMUP.CO.UK

_____

_____

(1)

(c) Modern catalytic converters contain nanosized particles of catalyst. Using nanosized particles reduces the cost of the catalytic converter.

Suggest and explain why the use of nanosized catalyst particles reduces the cost of the catalytic converter.

Your answer should include information about the size and surface area of the particles.

_____

_____

_____

_____

_____

_____

_____

(3)

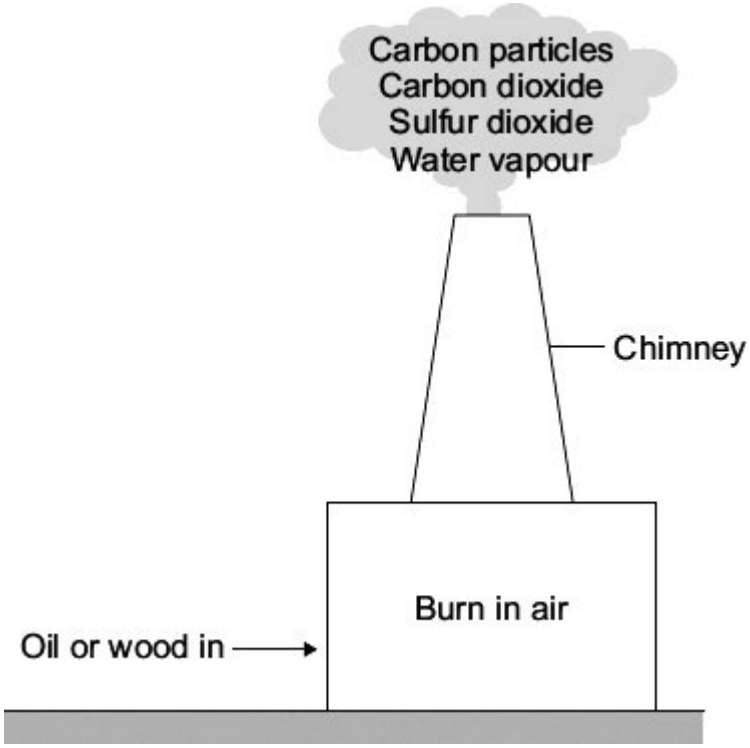
(Total 9 marks)

Q24.

In the future:

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

STEMUP.CO.UK



(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'.

_____

STEMUP.CO.UK

_____

_____

_____

(2)

(Total 6 marks)

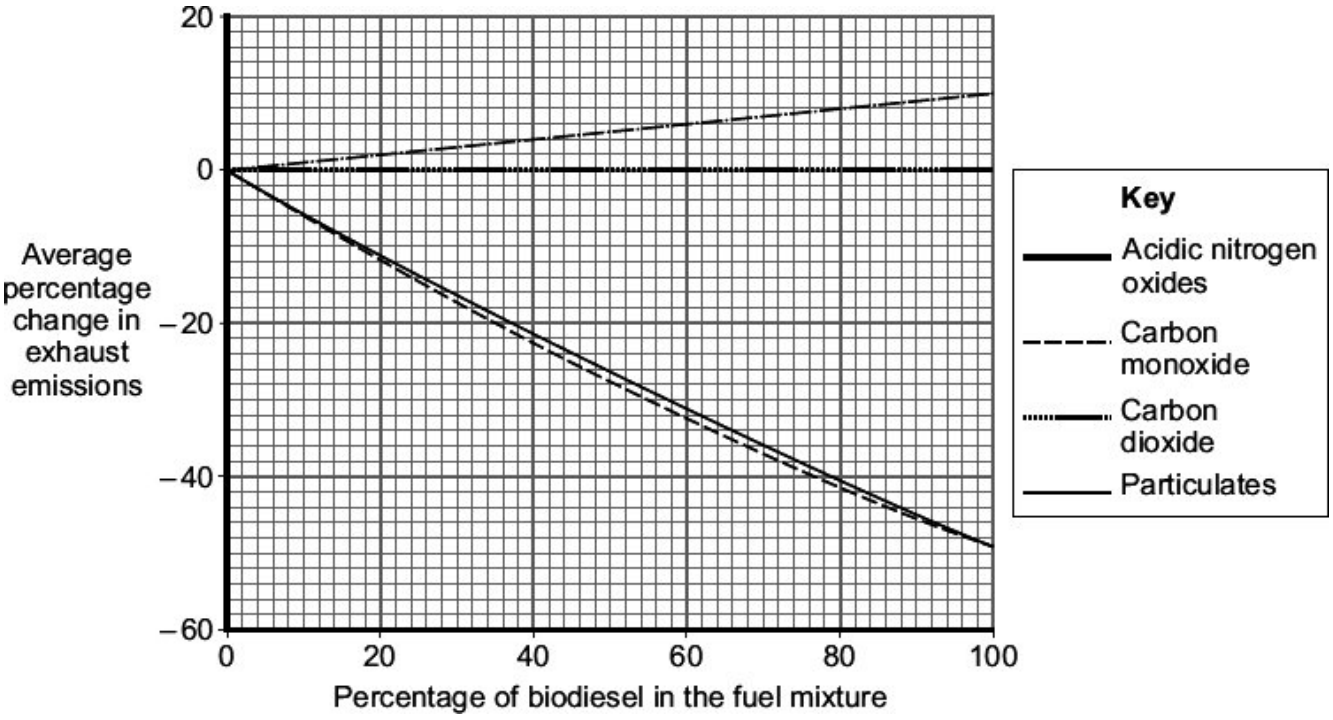
Q25.

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.

_____

STEMUP.CO.UK

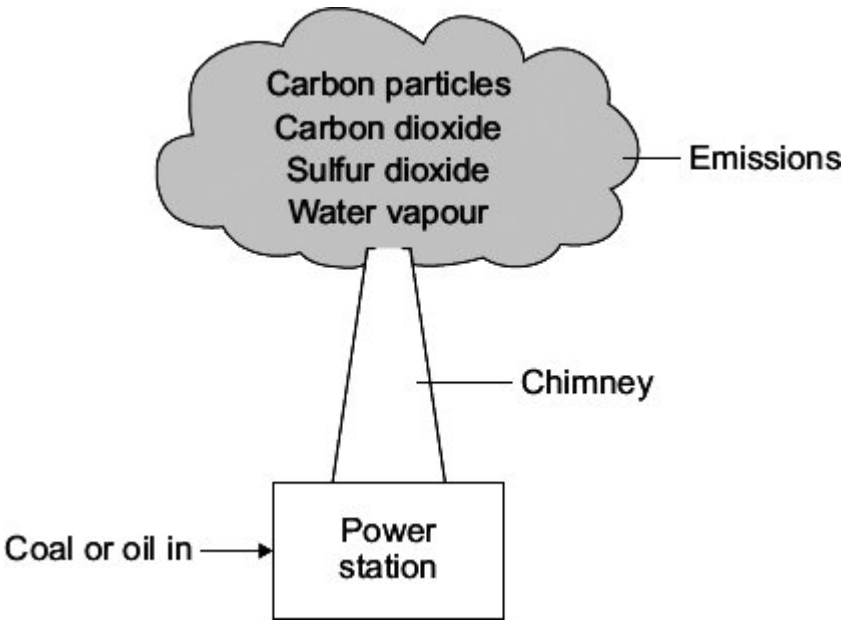
(5)

(Total 5 marks)

Q26.

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.



STEMUP.CO.UK

(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

STEMUP.CO.UK

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. _____

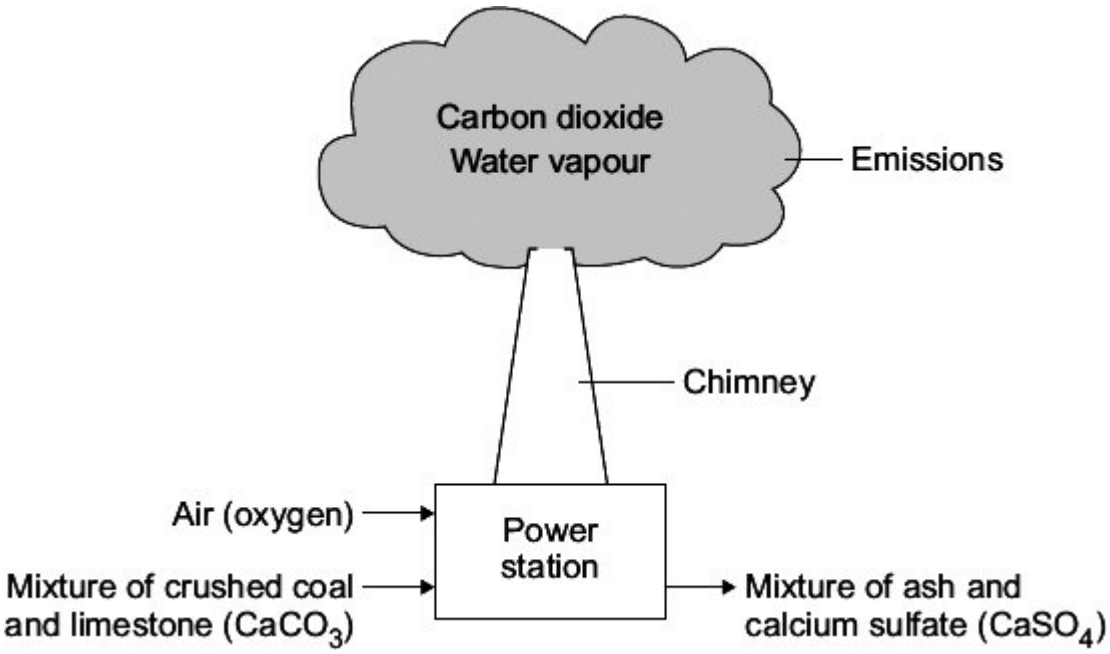
_____

(2)

(Total 8 marks)

Q27.

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

STEMUP.CO.UK

_____

_____

(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)

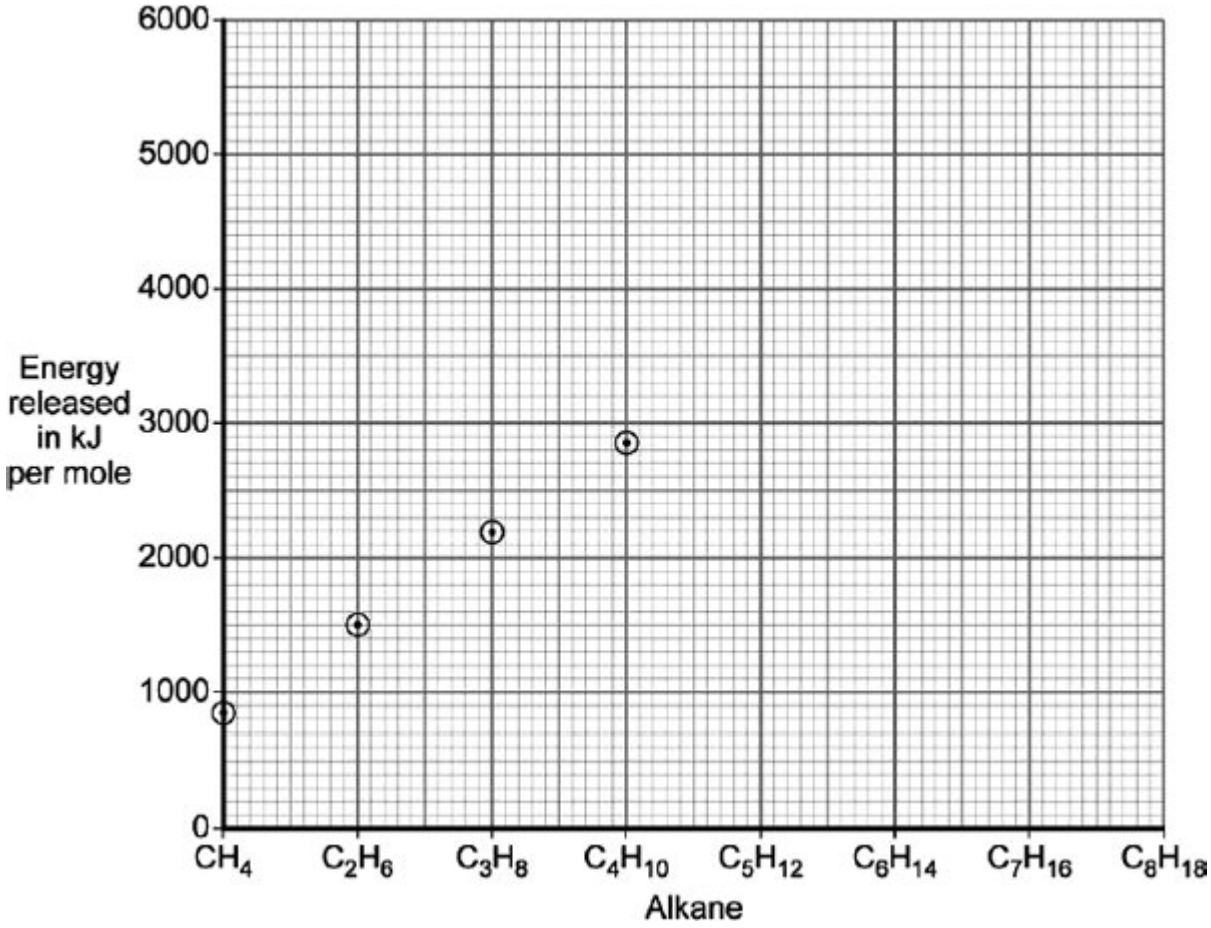
(Total 7 marks)

Q28.

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

STEMUP.CO.UK

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."

STEMUP.CO.UK

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."

_____

_____

_____

_____

_____

STEMUP.CO.UK

_____

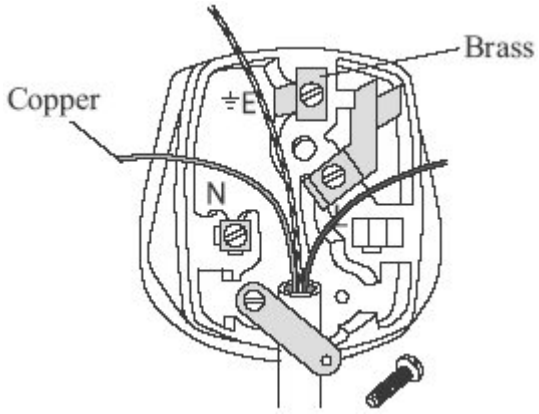
_____

(2)

(Total 9 marks)

Q29.

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.

STEMUP.CO.UK



(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.

STEMUP.CO.UK

1. _____

_____

2. _____

_____

(2)

(Total 7 marks)

Q30.

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).

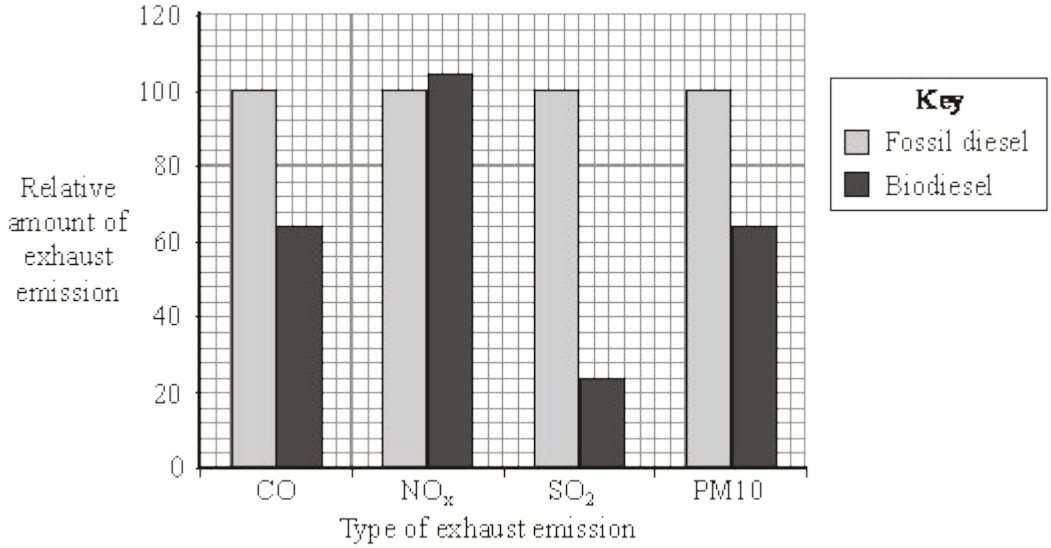
_____

(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.

STEMUP.CO.UK



(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)

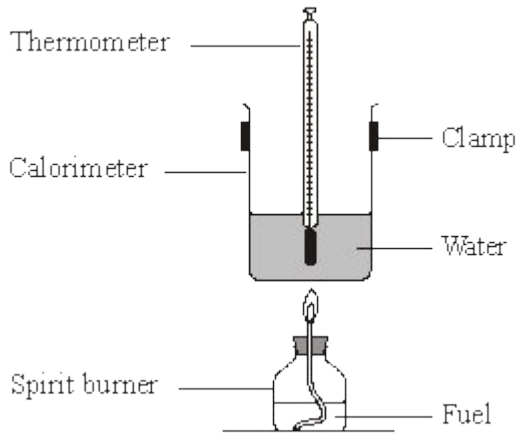
(Total 8 marks)

STEMUP.CO.UK

Q31.

A student burned four fuels and compared the amounts of energy they produced.

The student set up the apparatus as shown in the diagram.



The heat produced when each fuel was burned was used to raise the temperature of 100 g of water. The student noted the mass of fuel burned, the increase in temperature and whether the flame was smoky.

The results are shown in the table.

Fuel	Mass of fuel burned (g)	Temperature increase (°C)	Type of flame
Ethanol	4	24	Not smoky
Methanol	3	9	Not smoky
Peanut oil	2	20	Smoky
Vegetable oil	1	15	Smoky

(a) The student suggested that the vegetable oil was the best fuel for producing heat.

Explain why.

_____

_____

_____

_____

(2)

(b) Suggest an environmental problem that could be caused when large amounts of vegetable oil are burned. Suggest how the problem could be overcome.

_____

_____

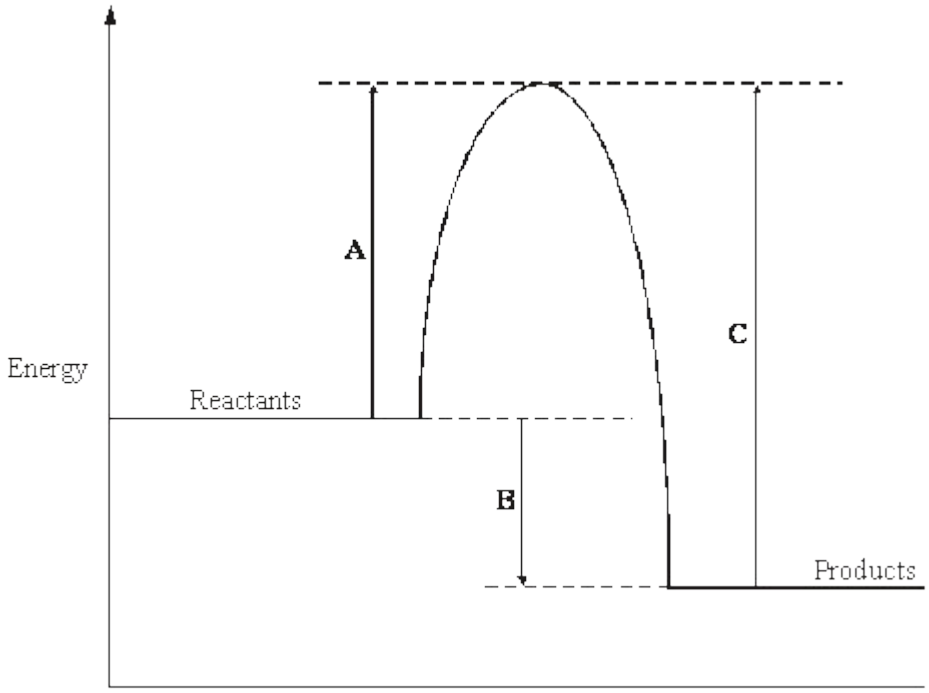
STEMUP.CO.UK

_____

_____

(2)

(c) An energy level diagram for the burning of vegetable oil is shown below.



Which of the energy changes **A**, **B** or **C:**

(i) represents the activation energy

_____

(1)

(ii) shows the amount of energy given out during the reaction?

_____

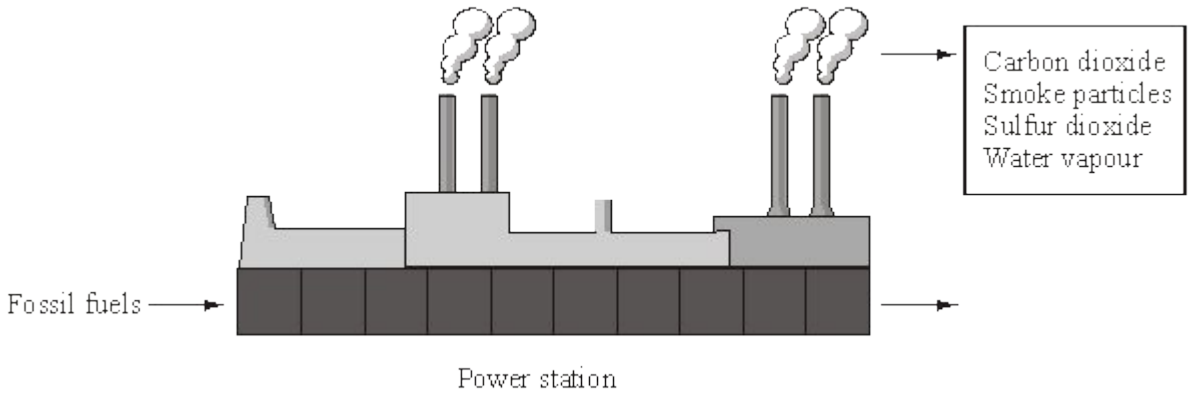
(1)

(Total 6 marks)

Q32.

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.

STEMUP.CO.UK



(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.

_____

_____

_____

_____

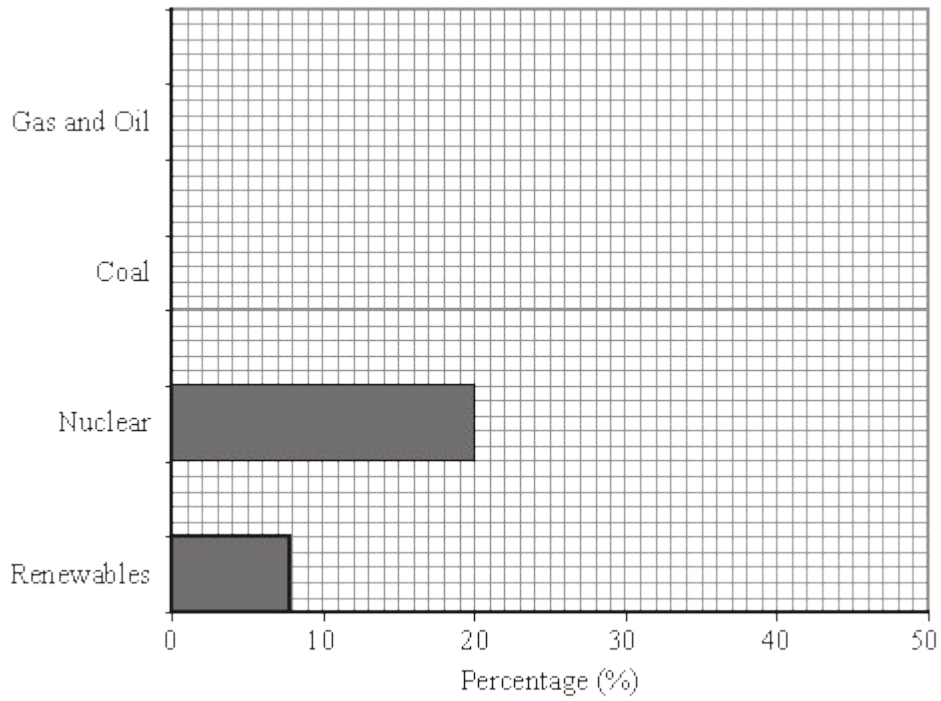
(2)

(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.

STEMUP.CO.UK

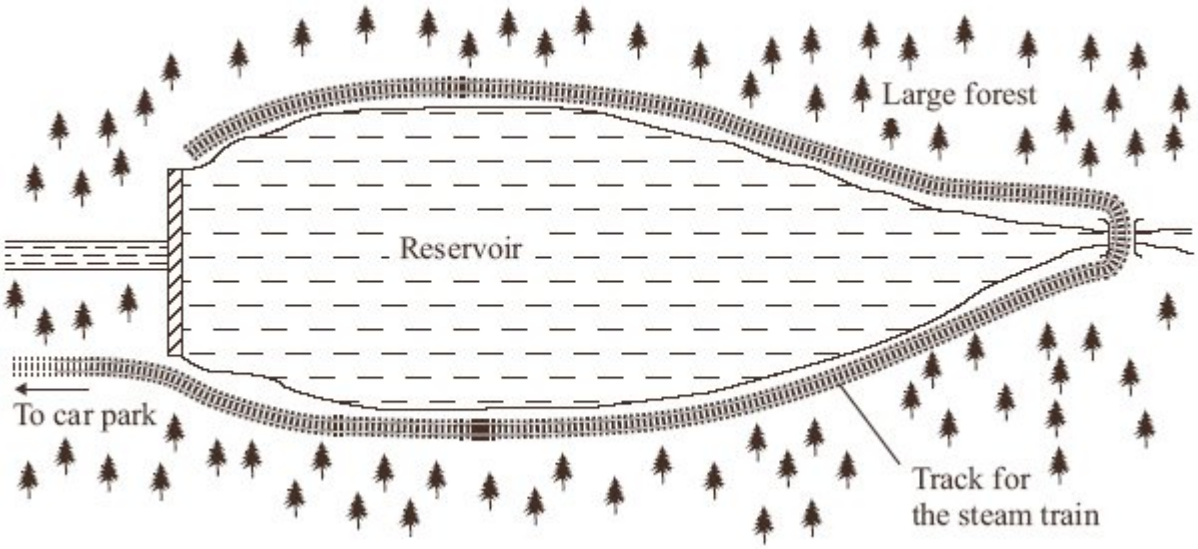


(2)

(Total 6 marks)

Q33.

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.

_____

_____

STEMUP.CO.UK

_____

_____

_____

_____

_____

_____

(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.

_____

_____

_____

_____

_____

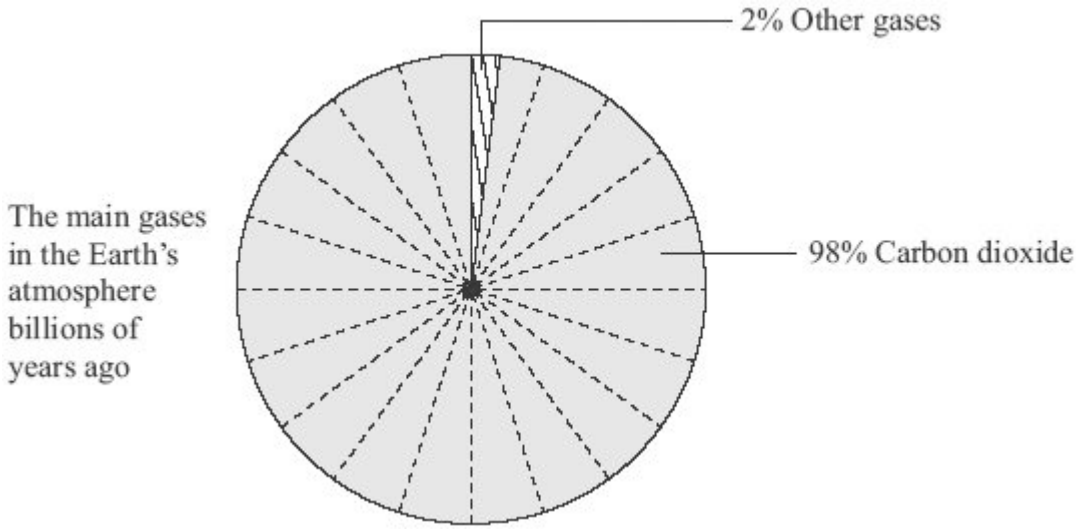
_____

(3)

(Total 7 marks)

Q34.

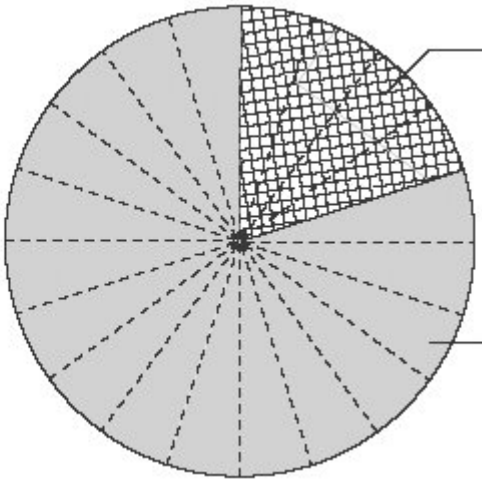
Life on Earth would not exist without the atmosphere. Billions of years ago the composition of the Earth's atmosphere was very different from the composition today.



(a) Label the pie chart below to show the percentages and names of the two main gases in the Earth's atmosphere today.

STEMUP.CO.UK

The main gases in the Earth's atmosphere today



.....% .....

.....% .....

(2)

(b) There is evidence that the composition of the Earth's atmosphere is still changing. One possible reason is that many power stations generate electricity by burning fossil fuels such as coal, oil or natural gas. Sulfur dioxide, SO_2, is produced when coal burns in air.

(i) What environmental problem does sulfur dioxide cause?

_____

_____

(1)

(ii) How could this environmental problem be reduced in coal-fired power stations?

_____

_____

(1)

(iii) Gas-fired power stations burn methane, CH_4, in air.

Complete the word equation for this reaction.

methane + _____ → carbon dioxide + _____

(2)

(c) Excess carbon dioxide should be prevented from entering the atmosphere.

Explain why.

_____

_____

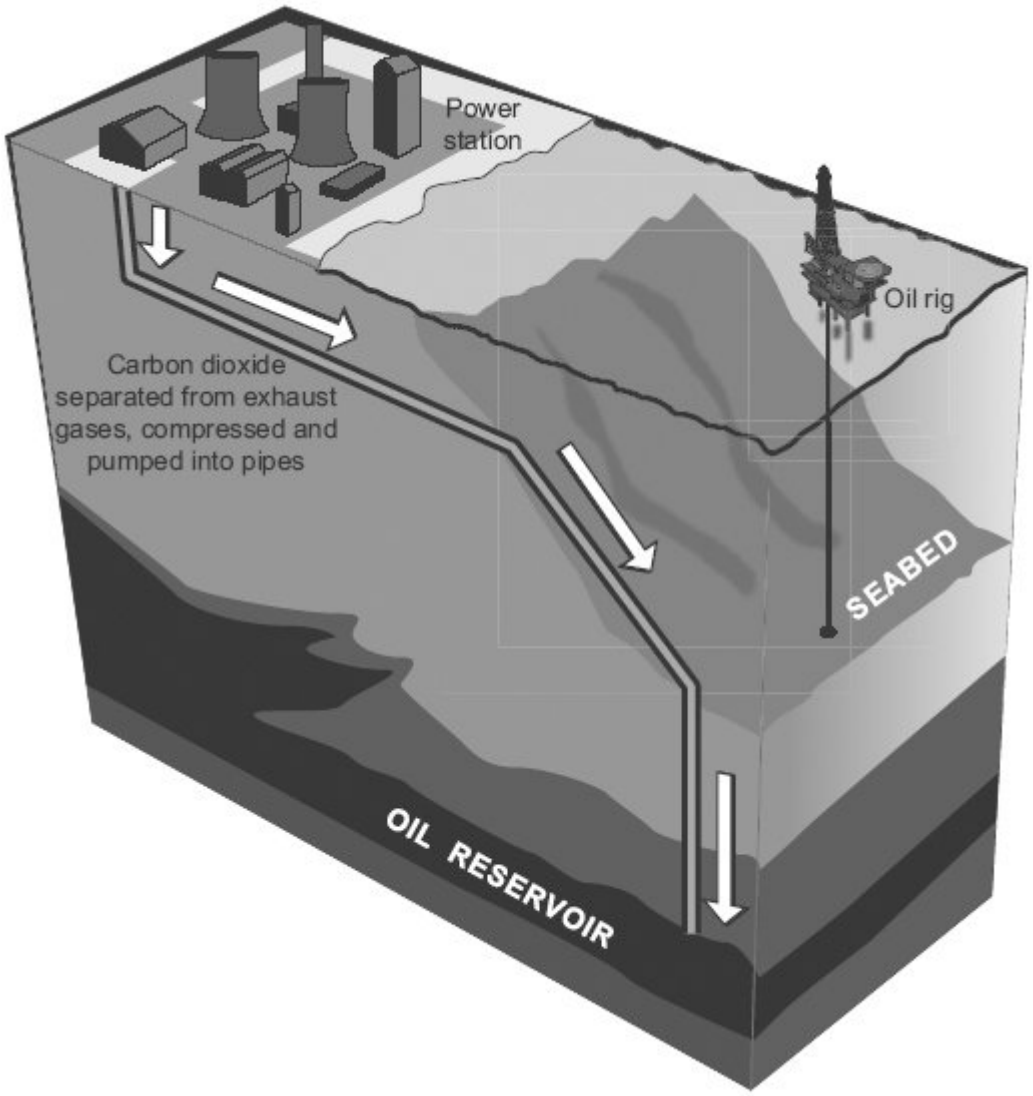
_____

_____

(2)

STEMUP.CO.UK

(d) Carbon dioxide is produced when fossil fuels burn in power stations. The diagram represents one idea to prevent excess carbon dioxide from entering the atmosphere.



Use the diagram to explain how carbon dioxide can be prevented from entering the atmosphere.

_____

_____

_____

_____

(2)

(Total 10 marks)

Q35.

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

(a) Crude oil is a mixture of hydrocarbons.

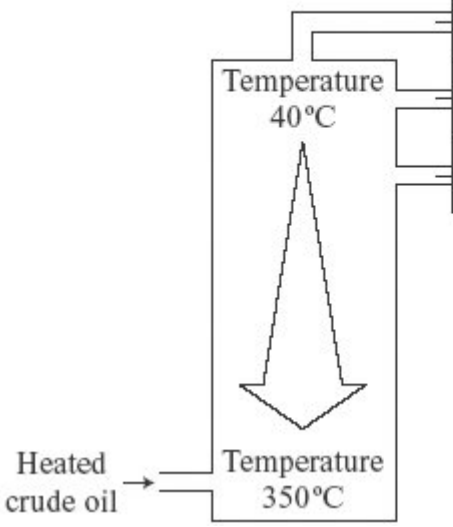
STEMUP.CO.UK

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)

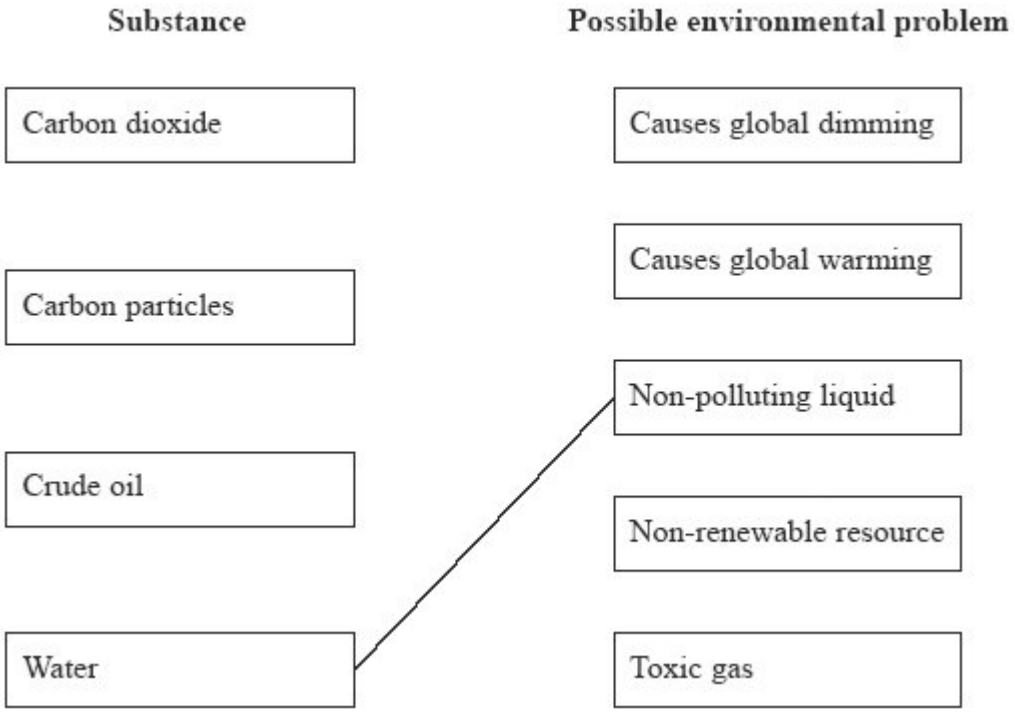
(c) Fuels from crude oil burn to provide heat energy.

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.

STEMUP.CO.UK



(3)

(Total 6 marks)

STEMUP.CO.UK