**Q1.** This question is about organic compounds.

Hydrocarbons can be cracked to produce smaller molecules.

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

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

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

Tick **one** box.

$C_2H_4$ ☐

$C_3H_6$ ☐

$C_4H_8$ ☐

$C_6H_{14}$ ☐

**(1)**

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

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

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

Tick **one** box.

**A** ☐

**B** ☐

**C** ☐

**D** ☐

**(1)**

(c) The hydrocarbon $C_4H_8$ was burnt in air.

Incomplete combustion occurred.

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

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

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

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

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

Tick **one** box.

**A** ☐

**B** ☐

**C** ☐

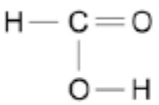
**D** ☐

**(1)**

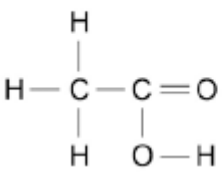
(d) Propanoic acid is a carboxylic acid.

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

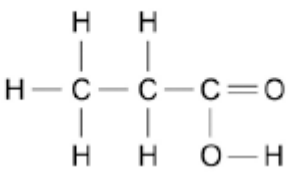
**A**



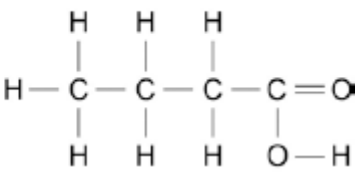
**B**



**C**



**D**



Tick **one** box.

**A** ☐

**B** ☐

**C** ☐

**D** ☐

**(1)**

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

Tick **one** box.

Propane ☐

Propene ☐

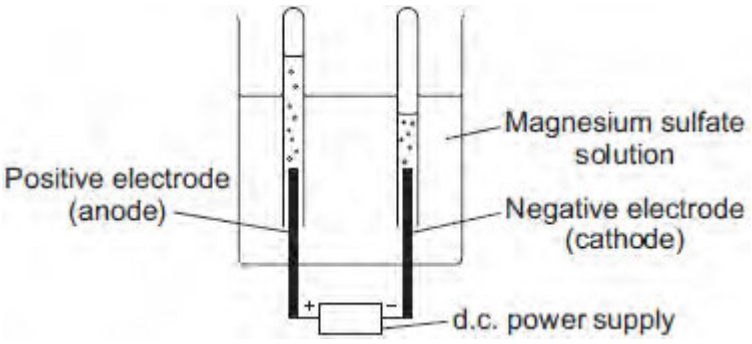
Propanol ☐

Polyester ☐

**(1)**
**(Total 5 marks)**

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

**Diagram 1**




Gases were given off at both electrodes.

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

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

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

**(1)**

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

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

Test .....

.....

Result .....

.....

**(2)**

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

.....

.....

**(1)**

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

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

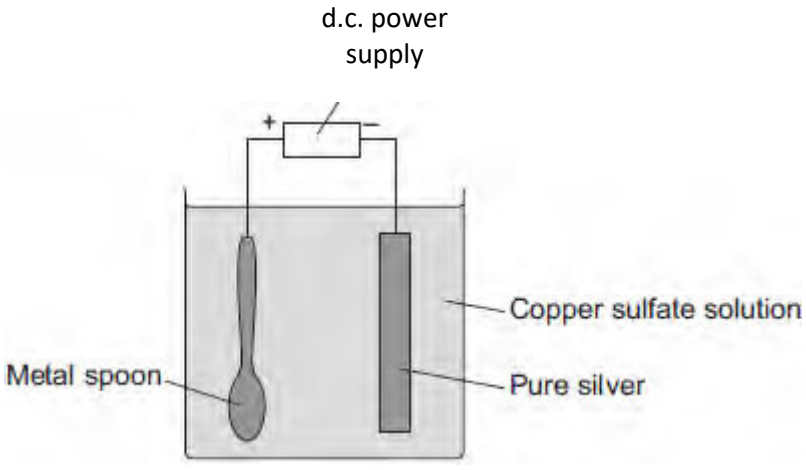
.....

.....

**(1)**

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

**Diagram 2**




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

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

.....

.....

.....

.....

.....

.....

.....

**(4)**

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

.....

.....

**(1)**
**(Total 10 marks)**

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

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

(i) Fuels react with oxygen to release energy.

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

.....

**(1)**

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

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

.....

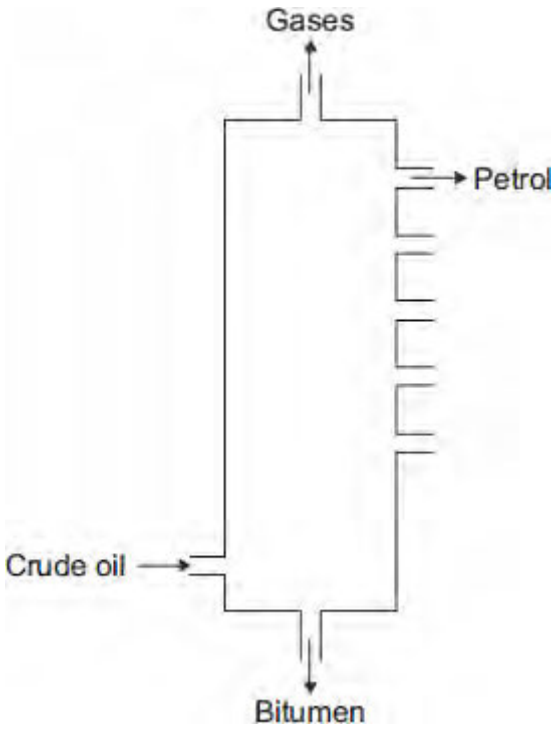
.....

.....

.....

**(2)**

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




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

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

Use the diagram and your knowledge to answer this question.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

**(6)**
**(Total 9 marks)**

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

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

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

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

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

(i) Give the formula for heptane

.....

**(1)**

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

**$C_nH$**

**(1)**

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

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

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

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

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

.....

**(1)**

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

.....

.....

**(1)**

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

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

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

.....

**(1)**

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

.....

**(1)**

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

.....

.....

**(1)**

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

.....

.....

.....

.....

**(2)**

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

Explain why.

.....

.....

.....

.....

**(2)**
**(Total 11 marks)**

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

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

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

.....

.....

.....

.....

.....

.....

.....

.....

**(3)**

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

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

.....

.....

.....

**(2)**

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

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

Balance the chemical equation.

$2CaCO_3(s)$ + $2SO_2(g)$ + $O_2(g)$ → ……$CaSO_4(s)$ + ……$CO_2(g)$

**(1)**

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

increases atmospheric pollution

.....

.....

.....

.....

decreases atmospheric pollution.

.....

.....

.....

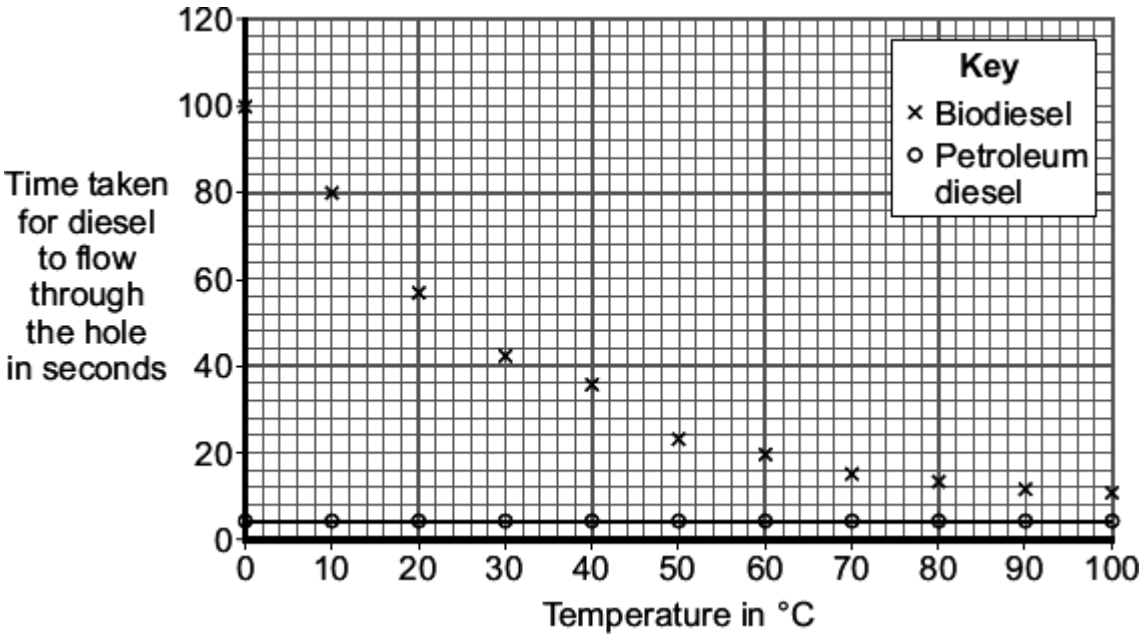
.....

**(4)**
**(Total 10 marks)**

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

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

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




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

**(1)**

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

.....

.....

.....

.....

**(2)**

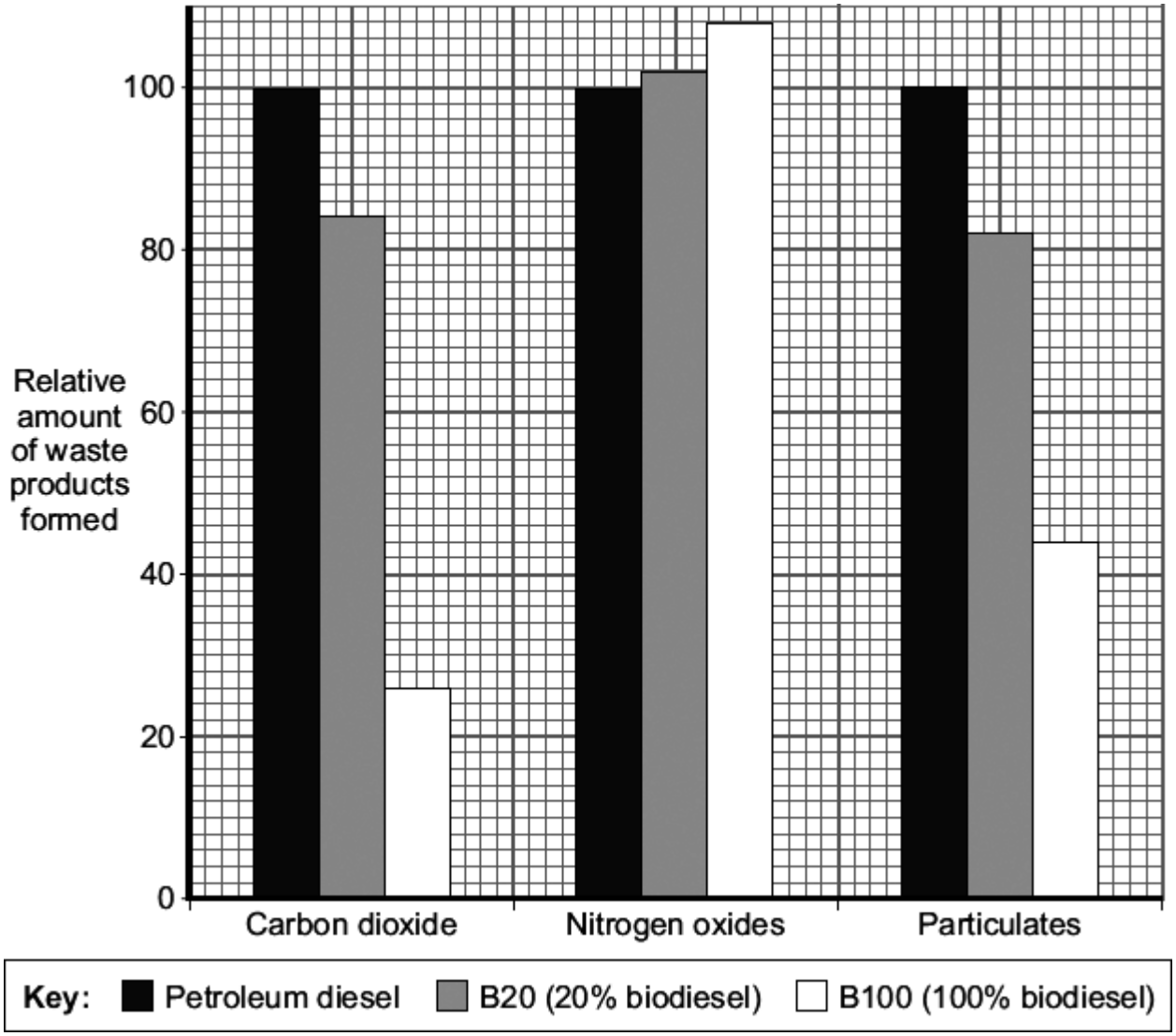
(iii) Biodiesel may be less suitable than petroleum diesel as a fuel for cars.
Use these results to suggest **one** reason why.

.....

.....

**(1)**

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




Nitrogen oxides and sulfur dioxide cause a similar environmental impact.

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

.....

**(1)**

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

..... %

**(1)**

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

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

.....

.....

.....

.....

**(2)**

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

Is biodiesel a carbon neutral fuel?

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

.....

.....

.....

.....

**(2)**
**(Total 10 marks)**