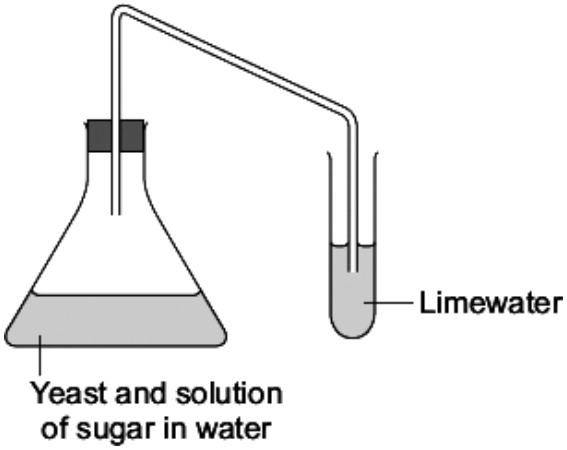
Q1. Two fuels that can be used for cars are:

- petrol from crude oil
- ethanol made from sugar in plants.

(a) A student used the apparatus shown to investigate the reaction to make ethanol from sugar.



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

This reaction to make ethanol from sugar is

combustion.
decomposition.
fermentation.

(1)

(ii) Complete the sentences.

The limewater turns ..... .

This happens because ..... .

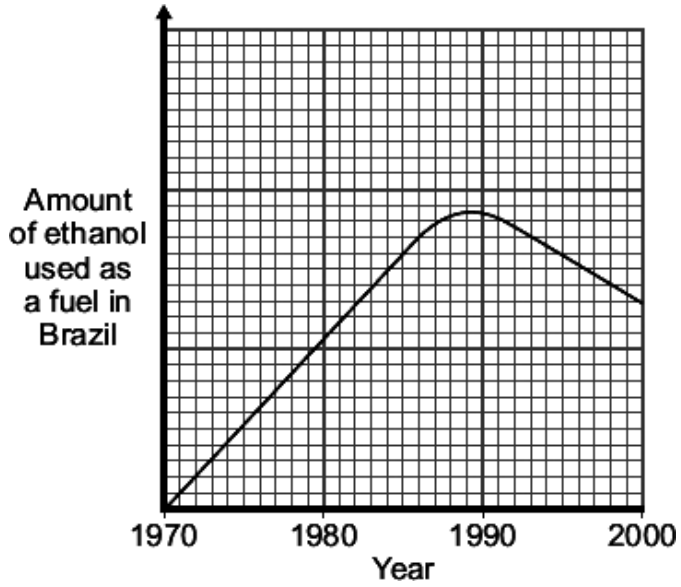
(2)

(b) In 1970, the Brazilian Government stated that all petrol must contain more than 25% ethanol.

The reasons for this statement in 1970 were:

- Brazil did not have many oilfields
- Brazil has a climate suitable for growing sugar cane.

The graph shows the amount of ethanol used as a fuel in Brazil from 1970 to 2000.



(i) Use the graph to describe the changes in the amount of ethanol used as a fuel in Brazil from 1970 to 2000.

.....

.....

.....

.....

(2)

(ii) In 2011, the Brazilian Government decided to reduce the amount of ethanol in petrol to 18%.

Suggest **one** reason for their decision.

.....

.....

(1)
(Total 6 marks)

Q2. Large amounts of cholesterol in the blood can cause heart disease.
Eating saturated fat increases the amount of cholesterol in blood.
Eating polyunsaturated fat decreases the amount of cholesterol in blood.

(a) The amounts of saturated fat and polyunsaturated fat in different types of margarine are shown in the table.

Type of margarine	Description	Saturated fat g per 100 g margarine	Polyunsaturated fat g per 100 g margarine
W	Hard margarine from animal and vegetable oils	30	14
X	Soft margarine from animal and vegetable oils	27	16
Y	Hard margarine from vegetable oils only	30	10
Z	Soft margarine from vegetable oils only	26	18

Which type of margarine would you consider best to use to lower blood cholesterol?

Explain your answer.

Best type of margarine to use is ..... .

Explanation.....

.....

.....

.....

(2)

(b) Use the correct words from the box to complete the sentences.

higher	**hydrogen**	**lower**
oxygen	**saturated**	**unsaturated**

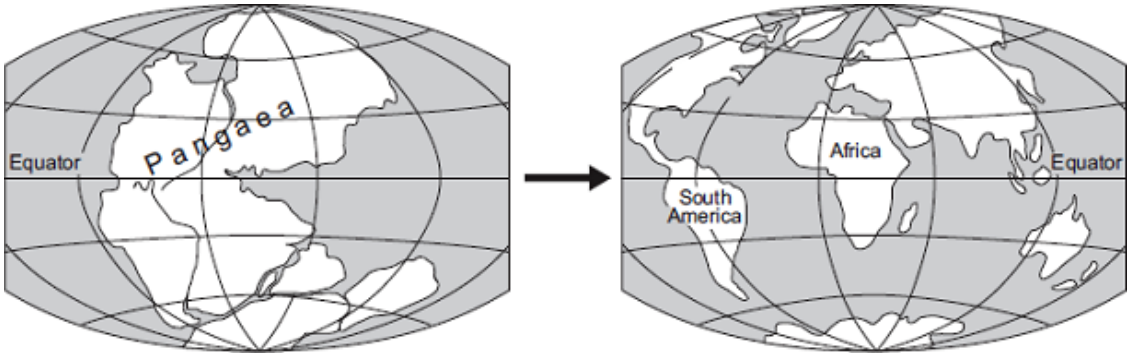
Animal and vegetable oils that contain ..... fats can be hardened.

Oils are hardened by a chemical reaction with ..... gas.

The product of the chemical reaction has a ..... melting point than the original oil.

(3)
(Total 5 marks)

Q3. In 1912 Wegener suggested his theory of continental drift.



In 1912, many scientists did not accept Wegener's theory because he could not explain:

- how Pangaea had split into continents
- how the continents had moved apart.

(a) Wegener used evidence to support his theory.

Give **two** pieces of evidence Wegener used.

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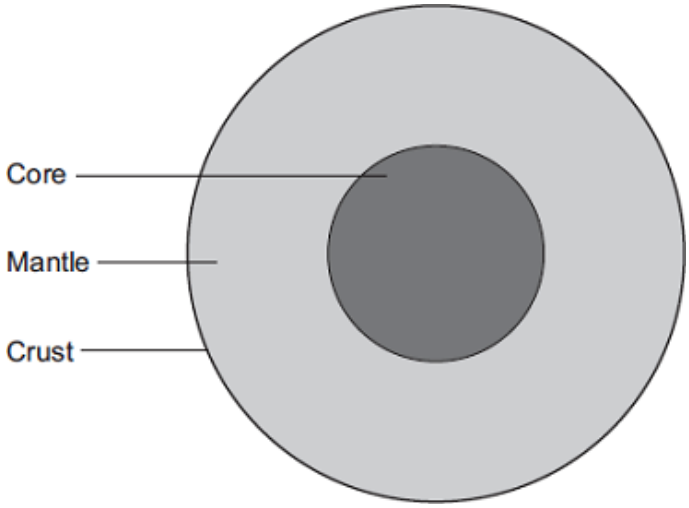
.....

.....

(2)

(b) Scientists have discovered that the Earth is made up of layers.



Complete the sentences by writing **one** word in each space.

Scientists now accept Wegener's theory because they know that

the Earth's ..... and upper part of the mantle are cracked into tectonic plates.

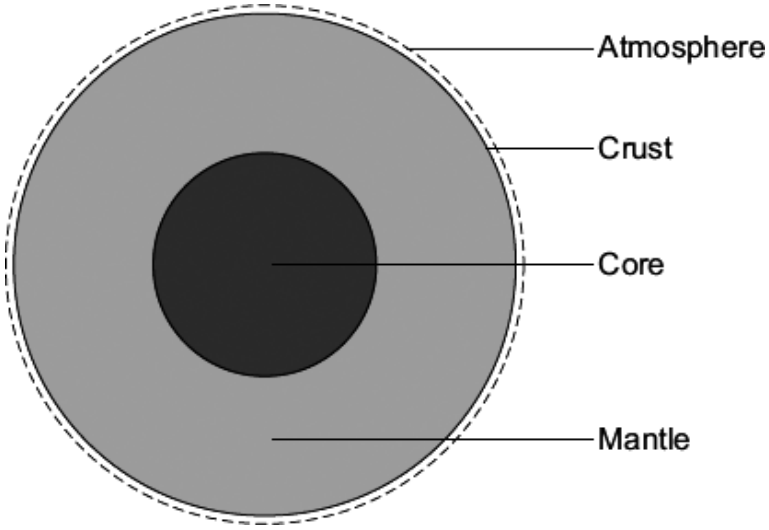
The tectonic plates move at relative speeds of a few centimetres per year because of convection currents in the Earth's ..... .

These convection currents are driven by ..... released from natural radioactivity.

A volcanic eruption or an ..... can happen at the boundaries between tectonic plates.

(4)
(Total 6 marks)

Q4. 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.

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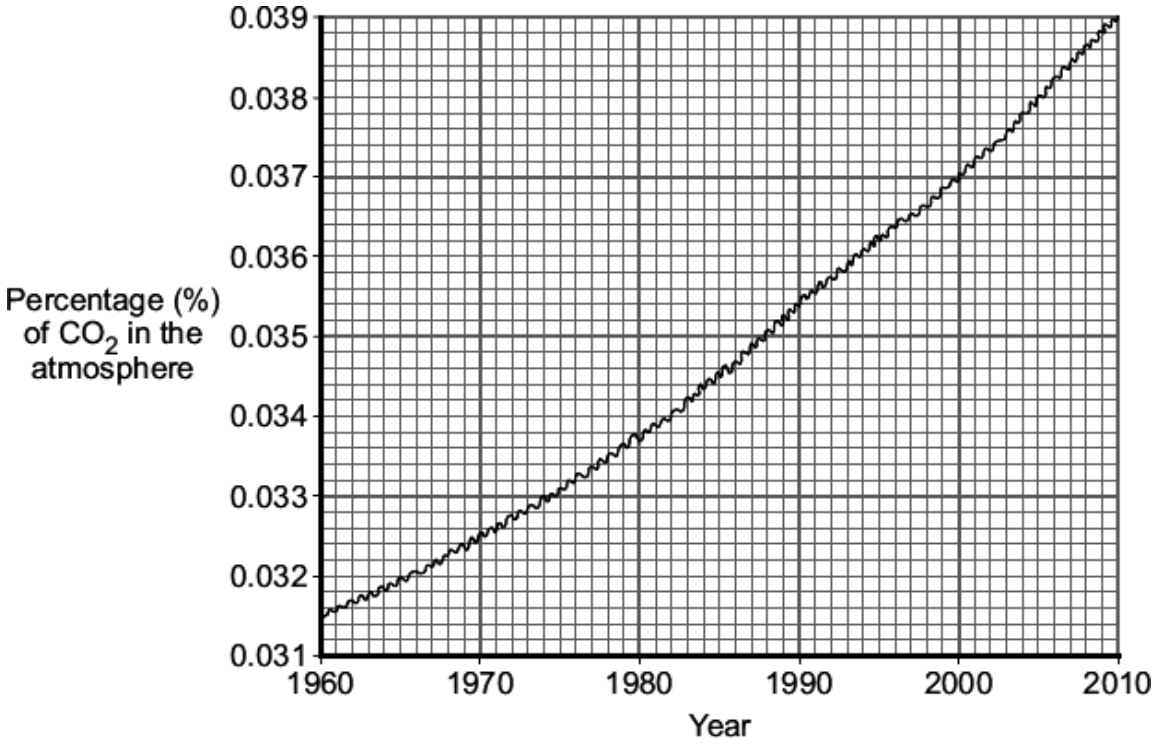
(2)

(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.

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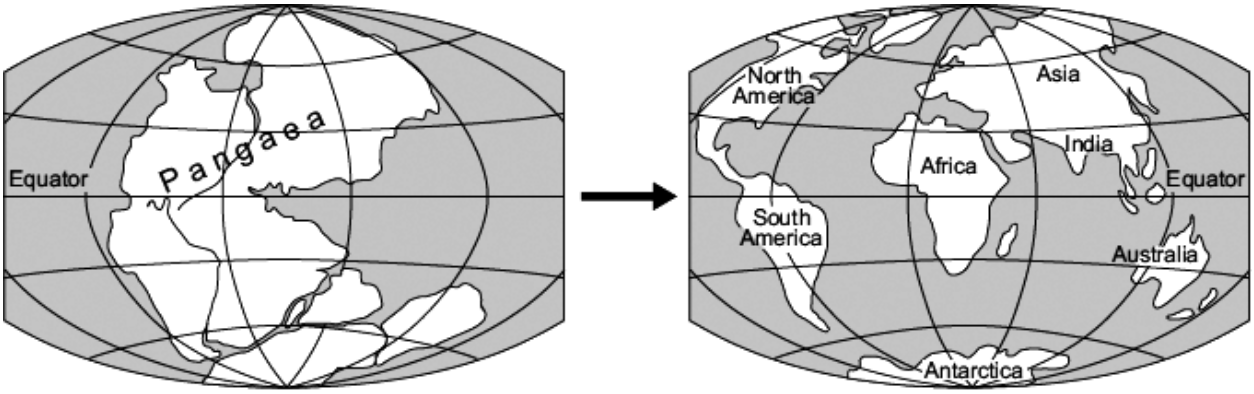
(3)

(c) Scientists believe that all the continents of the Earth were once joined together.
The huge 'supercontinent' was called Pangaea.



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.*

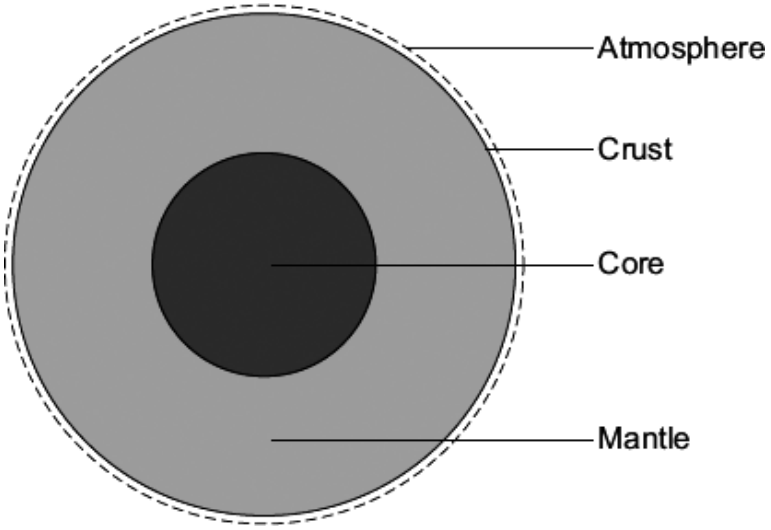
.....

.....

(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.

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.....

(3)

(Total 11 marks)

Q5. Scientists state that unsaturated fats are healthier to eat than saturated fats.

The table shows some information about four fats.

	Fat content as a percentage (%)		
Fat	**Unsaturated**	**Saturated**	**Melting point in °C**
A	80	20	–11
B	60	40	–5
C	30	70	+4
D	10	90	+63

(a) (i) Which fat, **A**, **B**, **C** or **D**, has the lowest melting point? ☐

(1)

(ii) Use the information in the table to describe the pattern between the percentage of unsaturated fat and the melting point.

.....

.....

(1)

(iii) Which fat, **A**, **B**, **C** or **D**, contains the smallest number of carbon carbon double bonds

per gram? ☐

(1)

(b) Fat **A** is reacted with hydrogen (hydrogenated).

State **one** way in which the physical properties of Fat **A** are changed by this reaction.

.....

.....

(1)

(c) Tick (✓) **one** thing that scientists are **not** able to do.

One thing that scientists are not able to do	Tick (✓)
find out if a fat is unsaturated	
show that an unsaturated fat is healthier to eat than a saturated fat	
stop people eating unhealthy fat	
change unsaturated fat to saturated fat	

(1)
(Total 5 marks)

Q6. Venus is often compared to the Earth. The Earth's early atmosphere was mainly carbon dioxide like the atmosphere of Venus today.

Atmosphere of Earth today		**Atmosphere of Venus today**	
Gas	**Percentage (%)**	**Gas**	**Percentage (%)**
Nitrogen	78	Nitrogen	3.5
Oxygen	21	Oxygen	A trace
Carbon dioxide	0.04	Carbon dioxide	96

(a) Give **two** reasons why the percentage of carbon dioxide decreased in the Earth's early atmosphere.

.....

.....

.....

.....

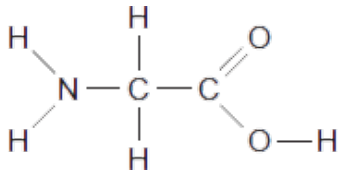
(2)

(b) In the 1950s two scientists, Miller and Urey, investigated the origin of life on Earth.
Miller and Urey used the gases that they believed were in the Earth's early atmosphere and used water to represent the oceans.
The gases they used were methane (CH_4), ammonia (NH_3) and hydrogen (H_2).

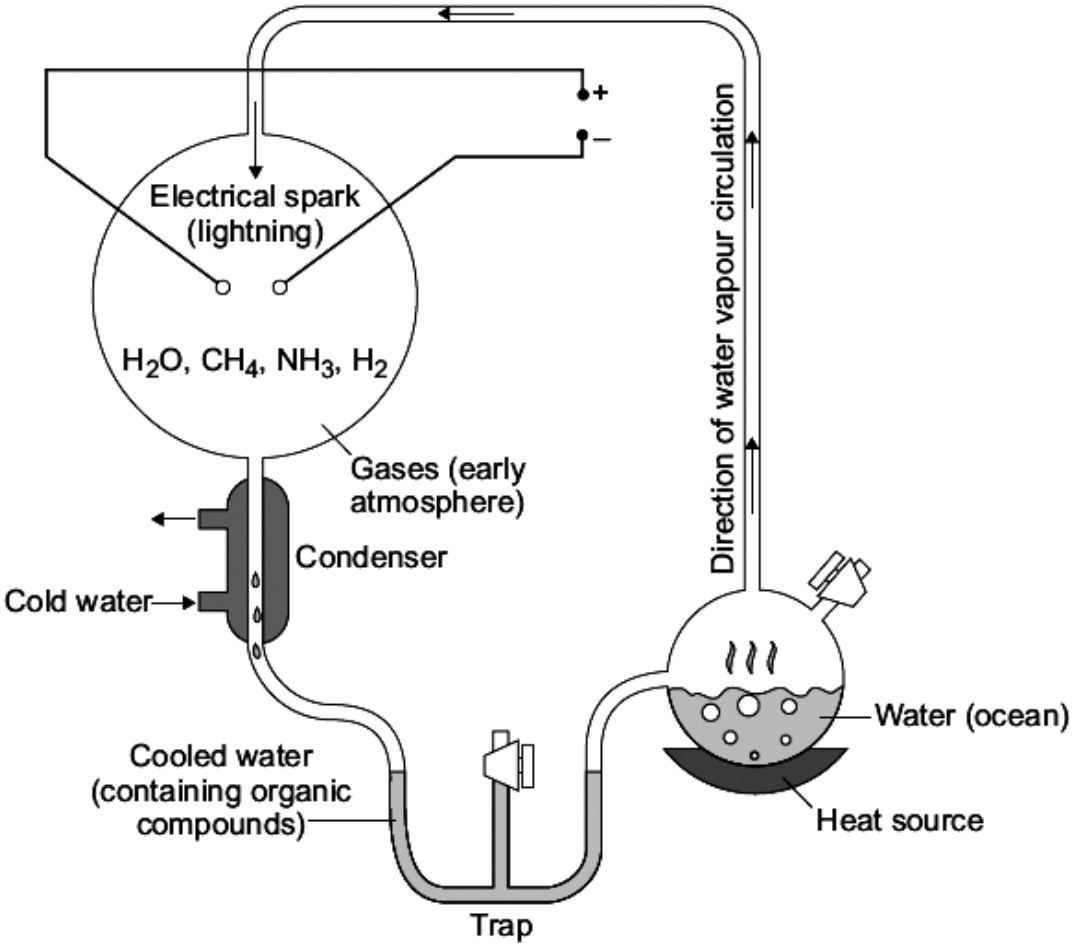
A continuous electrical spark was used to simulate lightning storms.

After one week the Miller-Urey experiment had produced amino acids.
Amino acids are essential to life.

The simplest amino acid is glycine (aminoethanoic acid).



The apparatus used in the Miller-Urey experiment is shown in the diagram.



Use the information above and in the diagram to answer these questions.

(i) Miller and Urey used methane, ammonia and hydrogen for the Earth's early atmosphere.

Suggest why.

.....

.....

(1)

(ii) The experiment provides only weak evidence of how amino acids formed on Earth.

Suggest **two** reasons why.

.....

.....

.....

.....

(2)

(Total 5 marks)

Q7. Medical evidence suggests that eating saturated fats, compared with unsaturated fats, is associated with a higher risk of circulatory and heart problems.

Each of the oils listed in the table contains a mixture of saturated and unsaturated fats.

Oil	Melting point in °C	Iodine number
palm	24	54
olive	-6	85
rapeseed	-10	98
sunflower	-17	127

The iodine number is the mass of iodine in grams that reacts with 100 cm^3 of the oil.
The iodine number shows the amount of unsaturated fat in each oil.

(a) (i) What would be seen if a solution containing 1 g of iodine was added to 100 cm^3 of any of these oils?

.....

.....

(1)

(ii) What does the word *unsaturated* mean?

.....

.....

(1)

(iii) Which oil in the table would **probably** cause the highest risk of circulatory and heart problems?

Use the information in the table to give a reason for your answer.

Oil .....

Reason .....

.....

.....

.....

(2)

(b) Sunflower oil can be hardened so that it can be used to make margarine.

Explain how sunflower oil can be hardened.

.....

.....

.....

.....

.....

.....

(3)
(Total 7 marks)

Q8. Water sold in plastic bottles has a high 'carbon cost'.

The 'carbon cost' depends on the amount of carbon dioxide emitted in making and transporting the product.

The more carbon dioxide emitted, the higher the 'carbon cost'.

(a) Plastic water bottles are made from a polymer.
The polymer is made from ethene.
Ethene is made by cracking hydrocarbons.

(i) Name the polymer made from ethene.

.....

(1)

(ii) Ethene can be made by cracking the hydrocarbon pentane, C_5H_{12}.

$$C_5H_{12} \rightarrow C_2H_4 + C_3H_8$$

Explain why there is a 'carbon cost' for the process of cracking a hydrocarbon.

.....

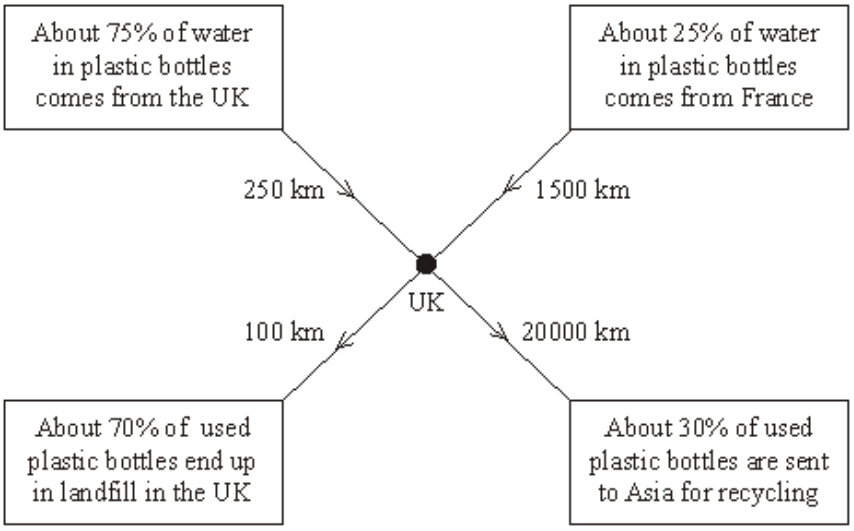
.....

.....

.....

(2)

(b) The diagram shows information about water sold in plastic bottles in the UK.
The diagram also shows the average distances that water and plastic bottles are transported.



Suggest how the high 'carbon cost' of water sold in plastic bottles could be reduced.

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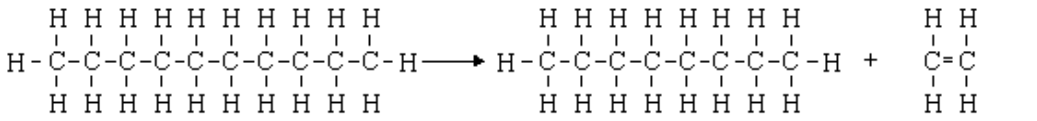
.....

.....

(3)
(Total 6 marks)

Q9. The high demand for petrol (octane) can be met by breaking down longer hydrocarbons, such as decane, by a process known as cracking.



Decane Octane Hydrocarbon **X**

(a) Apart from heat, what is used to make the rate of this reaction faster?

.....

(1)

(b) Octane is a *hydrocarbon.*

(i) What does *hydrocarbon* mean?

.....

.....

(1)

(ii) Give the molecular formula of octane.

.....

(1)

(c) The hydrocarbon **X** is used to make poly(ethene).

(i) What is the name of **X**?

.....

(1)

(ii) What is the name of the process in which **X** is changed into poly(ethene)?

.....

(1)

(Total 5 marks)

M1. (a) (i) fermentation

1

(ii) cloudy

accept milky / white

1

there is carbon dioxide / CO_2

accept calcium carbonate forms

1

allow a (white) solid / precipitate forms

(b) (i) (the amount of ethanol used) increases (from 1970) to 1989

*if no year(s) or incorrect year(s) indicated then max **1***
correct year(s) only needs to be indicated once to gain full marks
accept values in range 1987-1992

1

then it decreases from 1989 (to 2000)

1

(ii) any **one** from:

- Brazil had more oilfields
- cost of crude oil had decreased
- cost of ethanol / sugar (cane) had increased
- demand for ethanol / sugar (cane) had increased
- availability of ethanol / sugar (cane) had decreased

  accept availability of land to grow sugar (cane) had decreased
- climate change affects growing sugar (cane)

1

[6]

M2. (a) **Z**

accept soft (margarine) vegetable oils only

1

contains the high(est) amount of polyunsaturated fat **or** the low(est) amount of saturated fat

ignore any values / percentages

1

(b) unsaturated

must be in the order given

1

hydrogen

1

higher

1

[5]

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

- similar fossils in Africa and South America
  ignore same plants / animals
- similar rocks in Africa and South America
- 'jigsaw fit'
  allow rocks / fossils match in Africa and South America

2

(b) crust

1

mantle

1

heat / energy

1

earthquake

1

[6]

M4. (a) (i) any **two** from:

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

2

(ii) calcium carbonate / $CaCO_3$

1

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

1

(b) increasing (CO_2 or global warming)

1

more rapid increase recently

1

carbon dioxide causes global warming

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

1

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

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

1

(ii) any **three** from:

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

3

[11]

M5. (a) (i) A

allow -11

1

(ii) as the percentage of unsaturated fat decreases the melting point increases **or** vice versa

ignore boiling point / temperature
ignore pattern linked to the percentage of saturated fat
ignore numerical values

1

(iii) D

allow 10

1

(b) any **one** from:

*do **not** accept to make it less healthy **or** more healthy*

- increase the melting point
  ignore boiling point
- make it ‘spreadable’
- make it solid (at room temperature)
  allow make it hard(er)
  ignore density / mass / viscous / thicker
- increase the % of saturated fat
  allow make it saturated

  or decrease the % of unsaturated fat
  ignore references to double / single bonds

1

(c) stop people eating unhealthy fat

1

[5]

M6. (a) any **two** from:

- carbon dioxide dissolves in water/oceans
- marine organisms use (dissolved) carbon dioxide to form their shells/ skeletons
  or
  limestone was formed from the shells/skeleton of marine organisms
  accept carbon dioxide became locked up in sedimentary rocks/carbonates/limestone
  or
  precipitation or formation of insoluble carbonates
- plants / algae photosynthesise/ absorb/use carbon dioxide
  accept remains of plants/algae/ marine organisms contain locked up carbon dioxide/carbon in the form of fossil fuels
  *do **not** accept plants use carbon dioxide for respiration*

2

(b) (i) because these gases/molecules contain the elements / atoms in amino acids
or the gases / they contain carbon, hydrogen and nitrogen
ignore oxygen

1

(ii) *ignore small-scale / timescale*

ignore references to water/oceans or other theories

any **two** from:

- nobody knows what was in the Earth's early atmosphere
  accept these gases / hydrogen / methane / ammonia may not have been in the Earth's early atmosphere
  accept carbon dioxide / nitrogen may have been in the Earth's early atmosphere
  accept reference to Venus' present atmosphere
  ignore concentration of gases
- there may not have been (continuous) lightning
- Miller and Urey selected only the gases needed to produce amino acids

2

[5]

M7. (a) (i) (iodine is) decolourised

accept colourless

allow oil decolourised

ignore initial colour of iodine / nothing / clear

1

(ii) (molecule / compound) has a double (carbon carbon) bond

allow C = C

1

(iii) palm

1

any **one** from:

*only allow this mark if correct **or** no answer in first part*

ignore references to iodine number / melting point

- contains less / low amount of unsaturated fat(s)
- contains more / high amount of saturated fat(s)

1

(b) any **three** from:

*cracking / emulsification = max **2***

- (react with) hydrogen
  accept by hydrogenation
  *do **not** accept cracking / emulsify*
- with a (nickel) catalyst
- at about 60°C
  *allow hot **or** range 50°C to 120°C*
- increase *the* melting point

3

[7]

M8. (a) (i) polyethene / poly(ethene)

accept polythene / polyethylene

1

(ii) needs heat / energy / high temperature / fuel (for cracking)

ignore other processes

1

produces carbon dioxide / CO_2

*ignore use of CO_2 **or** 'produces carbon'*

1

(b) any **three** from:

- use water from local sources **or** water from close to home
- recycle bottles in the UK / close to home
  accept do not recycle in other countries / Asia
- (reduction in distance travelled) would reduce CO_2 emitted by transport
  accept use of transport with low / no carbon dioxide emissions
- use tap water
- use glass bottles / waxed cartons / metal bottles
  *do **not** accept 'do not use plastic bottles' without an alternative material*
- do not put in landfill **or** recycle more
- reuse / refill plastic bottles
- tax imported water / plastic bottles (to offset carbon cost)
- make more / all plastic bottles in UK
  answers must be about the reduction of carbon cost

3

[6]

M9. (a) catalyst

1

(b) (i) made up of **only** carbon and hydrogen

1

(ii) C_8H_{18}

1

(c) (i) ethene

1

(ii) polymerisation

1

[5]