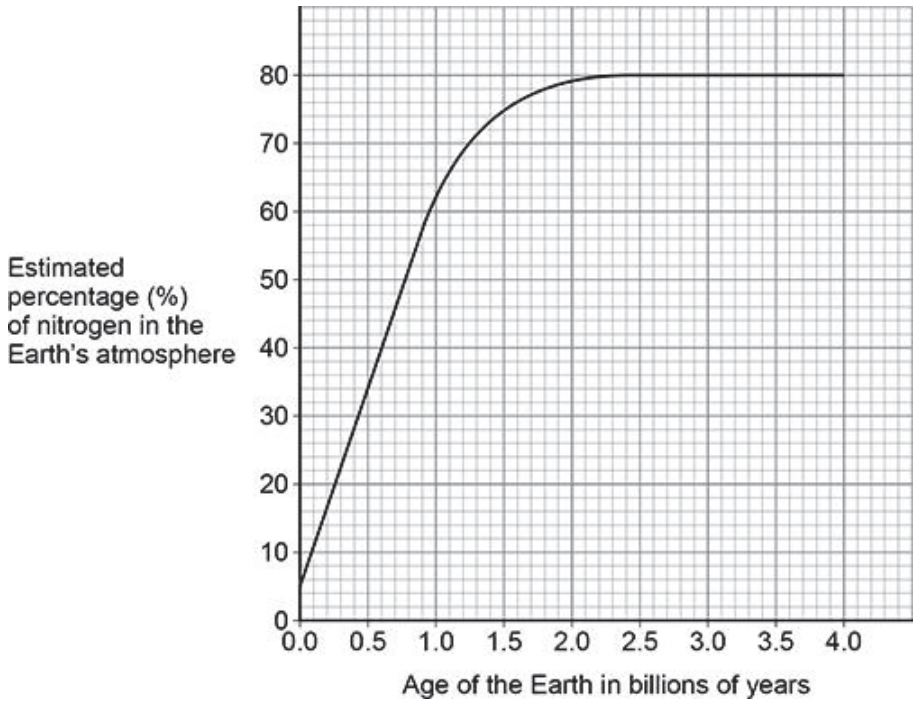
All questions are for separate science students only

Q1.

This question is about the Earth's atmosphere and naturally occurring polymers.

(a) The figure below shows how the estimated percentage of nitrogen in the Earth s atmosphere has changed since the Earth was formed.



Describe the trends shown by the graph.

Use data from the figure above.

_____

_____

_____

_____

_____

_____

(3)

The percentage of oxygen in the Earth s atmosphere has increased since the Earth was formed.

This is because of photosynthesis.

The word equation for the photosynthesis reaction is:

carbon dioxide + water → glucose + oxygen

(b) What happened to the percentage of carbon dioxide in the atmosphere when photosynthesis began?

Tick (✓) **one** box.

The percentage of carbon dioxide decreased. ☐

The percentage of carbon dioxide stayed the same. ☐

The percentage of carbon dioxide increased. ☐

(1)

(c) The photosynthesis reaction takes in energy from the surroundings.

Complete the sentence.

Choose the answer from the box.

carbon dioxide	**light**	**water**

The source of the energy used in photosynthesis is _____.

(1)

(d) Which **two** produce oxygen by photosynthesis?

Tick (✓) **two** boxes.

- Algae ☐
- Animals ☐
- Plants ☐
- Viruses ☐
- Yeast ☐

(2)

(e) The glucose produced during photosynthesis can form naturally occurring polymers.

Which **two** are naturally occurring polymers that can be produced from glucose?

(chemistry only)

Tick (✓) **two** boxes.

- Cellulose ☐
- DNA ☐
- Poly(propene) ☐
- Protein ☐
- Starch ☐

(2)

DNA molecules contain two polymer chains.

A DNA molecule has a relative formula mass (M_r) of approximately 140 000 000 000

(f) What is the approximate relative formula mass (M_r) of the DNA molecule in standard form? **(chemistry only)**

Tick (✓) **one** box.

1.4×10^9 ☐

1.4×10^{10} ☐

1.4×10^{11} ☐

1.4×10^{12} ☐

(1)

(g) What is the approximate relative formula mass (M_r) of each polymer chain in the DNA molecule? **(chemistry only)**

Tick (✓) **one** box.

70 000 000 000 ☐

140 000 000 000 ☐

280 000 000 000 ☐

560 000 000 000 ☐

(1)

(h) Complete the sentence. **(chemistry only)**

The shape of a DNA molecule is a double _____ .

(1)

(i) How many different nucleotides are present in a molecule of DNA? **(chemistry only)**

Tick (✓) **one** box.

1 ☐

2 ☐

3 ☐

4 ☐

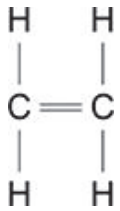
(1)

(Total 13 marks)

Q2.

This question is about addition reactions.

The figure below shows the displayed structural formula of ethene.



(a) Complete the sentence.

When bromine water is added to ethene, the bromine water changes from orange to

_____.

(1)

Chlorine reacts with ethene.

(b) What is used to identify chlorine?

Tick (✓) **one** box.

A lighted splint ☐

Damp litmus paper ☐

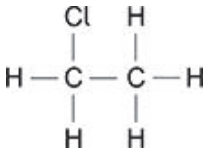
Limewater ☐

(1)

(c) Which of the following shows the displayed structural formula of the compound produced when chlorine reacts with ethene? **(chemistry only)**

Use the figure above.

Tick (✓) **one** box.



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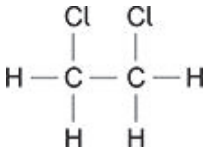

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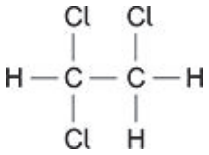
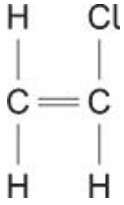


☐

(1)

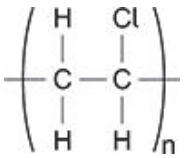
(d) Chloroethene can be used to produce a polymer called poly(chloroethene).

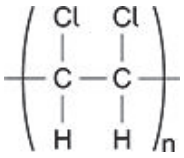
The displayed structural formula of chloroethene is

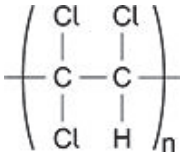


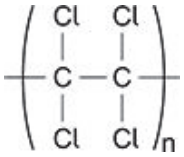
Which represents the structure of poly(chloroethene)? **(chemistry only)**

Tick (✓) **one** box.

 ☐

 ☐

 ☐

 ☐

(1)

Ethene can be used to produce another polymer called poly(ethene).

The table below shows information about poly(chloroethene) and poly(ethene).

	Poly(chloroethene)	**Poly(ethene)**
Density in g/cm^3	1.5	0.9
Temperature at which polymer completely melts in °C	260	120

(e) Determine the simplest whole number ratio of the density of poly(chloroethene) : density of poly(ethene).

_____

_____

_____

Simplest whole number ratio = _____ : _____

(3)

(f) Poly(ethene) **and** poly(chloroethene) can both be used to make pipes.

Suggest why neither polymer is suitable for pipes carrying steam at a temperature of 300 °C.

Use the table above.

_____

_____

(1)

(g) Poly(ethene) and paper can both be used to make shopping bags.

Poly(ethene) is produced from crude oil. Paper is produced from trees.

Suggest **one** reason why paper is more sustainable than poly(ethene) for making shopping bags.

_____

_____

(1)

(Total 9 marks)

Q3.

This question is about glass and polymers.

Beakers can be made from borosilicate glass or poly(propene).

Table 1 shows information about materials used to make beakers.

Table 1

	Material used to make beakers	
	borosilicate glass	**poly(propene)**
Temperature at which melting begins in °C	850	160
Flammability	does not burn	burns
Resistance to impact	shatters	tough
Cost of 100 cm³ beaker in £	1.50	2.00

(a) Suggest **two** reasons why a Bunsen burner should **not** be used to heat a liquid in a poly(propene) beaker. **(chemistry only)**

Use **Table 1**.

1 _____

_____

2 _____

_____

(2)

(b) Poly(propene) beakers are more expensive than borosilicate glass beakers.

Suggest **one** reason why using poly(propene) beakers instead of borosilicate glass beakers could save money. **(chemistry only)**

Use **Table 1**.

_____

_____

(1)

(c) Which is a raw material used to make borosilicate glass? **(chemistry only)**

Tick (✓) **one** box.

Boron trioxide ☐

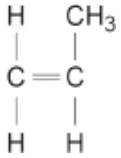
Clay ☐

Limestone ☐

(1)

Poly(propene) is produced from propene.

The displayed structural formula of propene is:



(d) **Table 2** shows some information about the elements in one molecule of propene.

Table 2

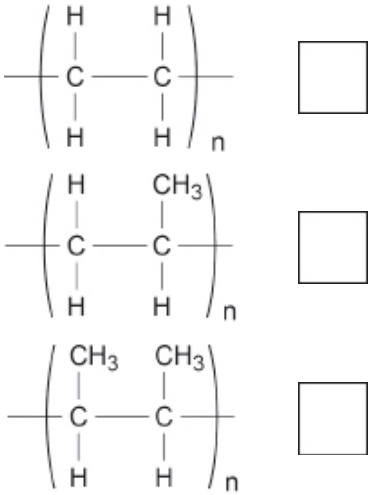
Symbol for element	Name of element	Number of atoms of element in one molecule of propene
C		
H		

Complete **Table 2**.

(2)

(e) Which structure is the repeating unit of poly(propene)? **(chemistry only)**

Tick (✓) **one** box.



(1)

(f) Poly(propene) is produced in three stages:

- **Stage 1:** separating large alkane molecules from crude oil
- **Stage 2:** producing propene molecules from large alkane molecules
- **Stage 3:** joining many propene molecules together.

Name **Stage 1**, **Stage 2** and **Stage 3**. **(chemistry only)**

Choose answers from the box.

cracking	**fermentation**	**fractional distillation**
polymerisation	**reverse osmosis**	

Stage 1 is _____.

Stage 2 is _____.

Stage 3 is _____.

(3)

(g) A molecule of hexene contains a double carbon–carbon bond.

Many hexene molecules join together to form poly(hexene).

Which **two** words describe a hexene molecule in this process? **(chemistry only)**

Tick (✓) **two** boxes.

Alkene ☐

Catalyst ☐

Composite ☐

Element ☐

Monomer ☐

(2)

(Total 12 marks)