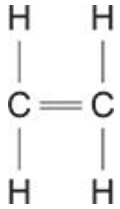
All questions are for separate science students only

Q1.

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 ☐

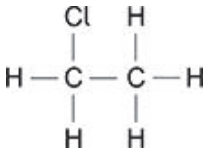
Limewater ☐

(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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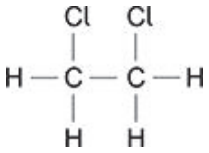

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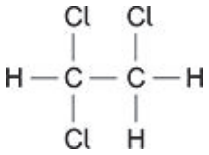
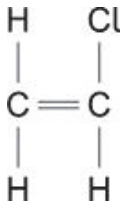


☐

(1)

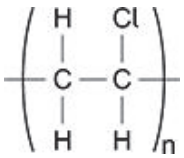
(d) Chloroethene can be used to produce a polymer called poly(chloroethene).

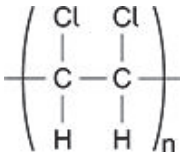
The displayed structural formula of chloroethene is

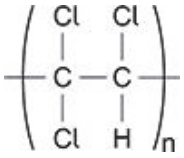


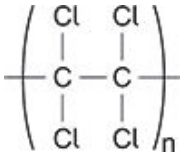
Which represents the structure of poly(chloroethene)? **(chemistry only)**

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). **(chemistry only)**

_____

_____

_____

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. **(chemistry only)**

_____

_____

(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)

Q2.

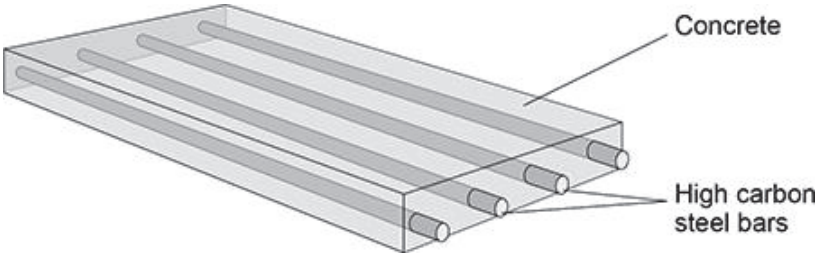
This question is about materials.

Pre-stressed concrete is a composite material.

The concrete is strengthened using high carbon steel bars.

Figure 1 shows the structure of a piece of pre-stressed concrete.

Figure 1



(a) Which **two** words describe the high carbon steel bars?

Tick (✓) **two** boxes. **(chemistry only)**

- Alloy ☐
- Binder ☐
- Matrix ☐
- Ore ☐
- Reinforcement ☐

(2)

Limestone is mainly calcium carbonate.

Limestone is a raw material used in the production of concrete.

(b) In the first part of the production of concrete:

- air is heated by burning methane
- the hot air is used to heat limestone
- the limestone decomposes.

The equation for the decomposition of limestone is:

calcium carbonate → calcium oxide + carbon dioxide

Give **two** ways in which a greenhouse gas is released in this process.

1 _____

_____

2 _____

_____

(2)

(c) How could a sample of limestone be tested to show the presence of carbonate ions?

Complete the sentences.

Choose answers from the box. **(chemistry only)**

barium chloride	**hydrochloric acid**	**limewater**
sodium hydroxide	**universal indicator**	

The substance added to the limestone is _____.

The gas produced is identified using _____.

(2)

The table below gives some information about plain concrete and pre-stressed concrete.

	Plain concrete	Pre-stressed concrete
Cost in £ per m^3	75	225
Density in kg per m^3	2300	2500
Strength in arbitrary units	600	3000

(d) Explain why pre-stressed concrete rather than plain concrete is used to make bridges that carry heavy lorries.

Use the table above. **(chemistry only)**

_____

_____

_____

_____

(2)

(e) **Figure 2** shows a garden path made of plain concrete slabs.

Figure 2

Suggest **two** reasons why plain concrete rather than pre-stressed concrete is used to make slabs for garden paths.

Use the table above. **(chemistry only)**

1 _____

_____

2 _____

_____

(2)

(Total 10 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 ☐

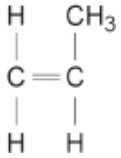
Clay ☐

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

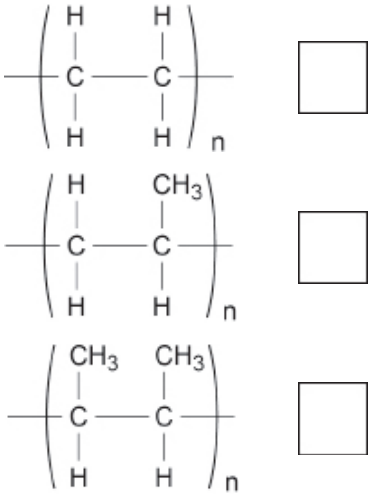
Symbol for element	Name of element	Number of atoms of element in one molecule of propene
C		
H		

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)

Q4.

This question is about alloys.

Steels are alloys of iron.

(a) Which non-metal element is in all steels? **(chemistry only)**

Tick (✓) **one** box.

Carbon ☐

Iodine ☐

Sulfur ☐

(1)

(b) Which **two** elements other than iron are in stainless steels? **(chemistry only)**

Tick (✓) **two** boxes.

Chromium ☐

Gold ☐

Magnesium ☐

Nickel ☐

Zinc ☐

(2)

(c) Give **two** properties of stainless steels. **(chemistry only)**

Choose answers from the box.

brittle	**hard**	**low density**
resistant to corrosion	**soluble in water**	

Property 1 _____

Property 2 _____

(2)

Titanium is used in alloys.

The table below shows information about some alloys of titanium.

Titanium alloy	Other metals in alloy	Strength	Used in
A	6.0% aluminium 4.0% vanadium	high	aircraft parts hip joint replacements
B	5.0% aluminium 2.5% tin	high	aircraft parts
C	3.0% aluminium 2.5% vanadium	medium	tennis rackets heart pacemakers

(d) Calculate the mass of titanium in 5.0 kg of titanium alloy **C**. **(chemistry only)**

Use the table above.

_____

_____

_____

_____

_____

Mass = _____ kg

(3)

(e) Suggest why alloy **A** and alloy **B** are used to make aircraft parts. **(chemistry only)**

Use the table above.

_____

_____

(1)

(f) Titanium alloys used for medical purposes must **not** be toxic.

Suggest why alloy **B** is **not** used for medical purposes. **(chemistry only)**

Use the table above.

_____

_____

(1)

(Total 10 marks)