

Name: \_\_\_\_\_

## Using Resources part 2 AQA Triple Chemistry

Class: \_\_\_\_\_

Date: \_\_\_\_\_

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Time: **73 minutes**

Marks: **69 marks**

Comments:

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1.

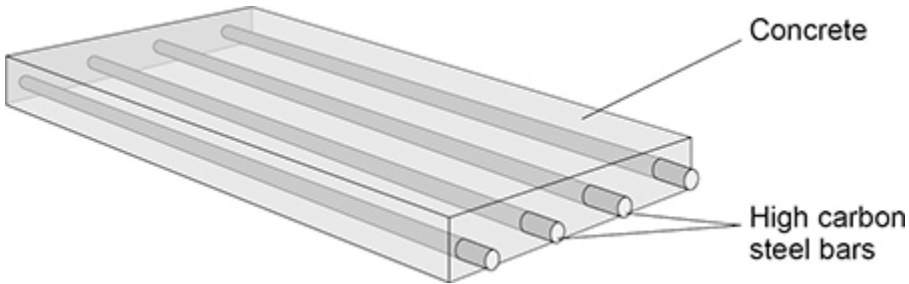
This question is about materials.

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.

- 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:



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.

<b>barium chloride</b>	<b>hydrochloric acid</b>	<b>limewater</b>
	<b>sodium hydroxide</b>	<b>universal indicator</b>

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.

	<b>Plain concrete</b>	<b>Pre-stressed concrete</b>
Cost in £ per m <sup>3</sup>	75	225
Density in kg per m <sup>3</sup>	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.

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(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.

1 \_\_\_\_\_

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2 \_\_\_\_\_

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(2)

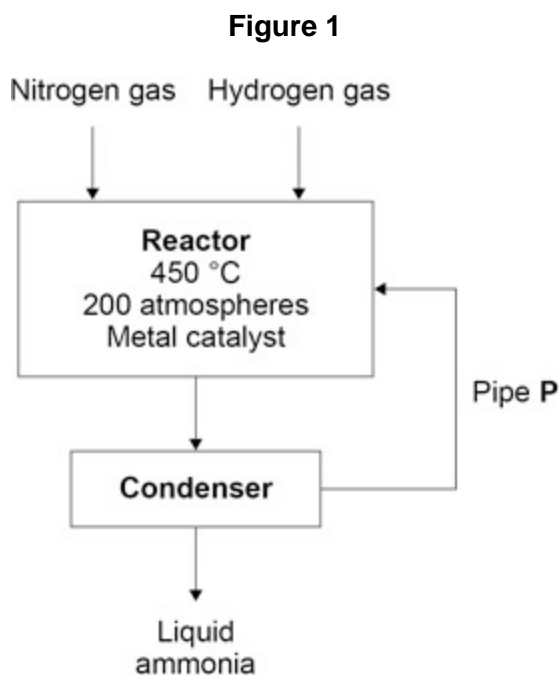
(Total 10 marks)

2.

This question is about ammonia and nitric acid.

In the Haber process ammonia is produced from nitrogen and hydrogen.

Figure 1 represents the Haber process.



(a) Pipe **P** links the condenser to the reactor.

Why is the condenser linked to the reactor?

Use **Figure 1**.

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(1)

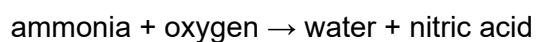
(b) Which metal is used as a catalyst in this reaction?

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(1)

Nitric acid is produced by reacting ammonia with oxygen.

The word equation for the production of nitric acid is:



Platinum is a catalyst in this reaction.

(c) Describe the test for oxygen gas.

Give the result if oxygen gas is present.

Test \_\_\_\_\_

\_\_\_\_\_

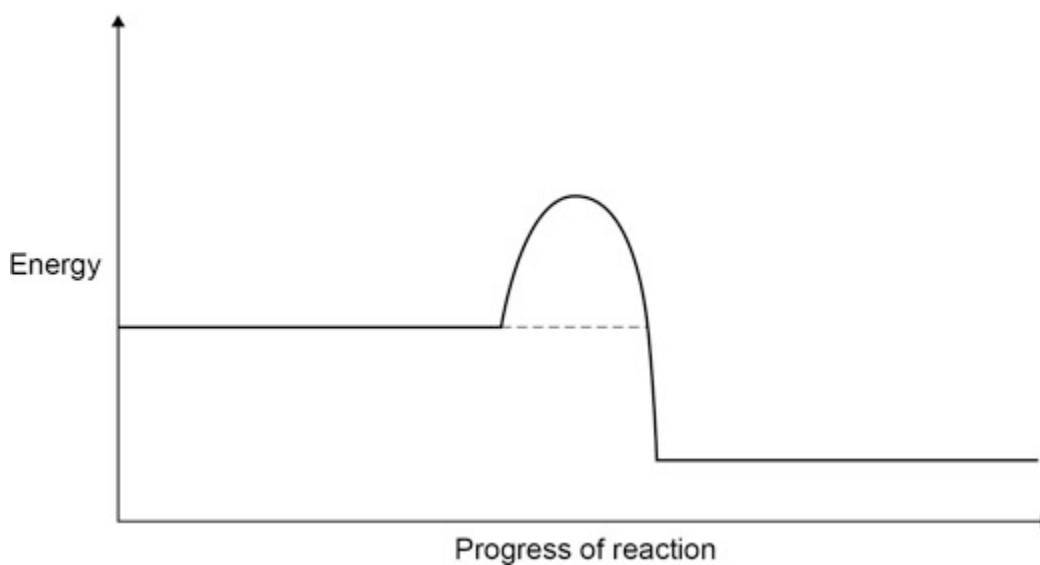
Result \_\_\_\_\_

\_\_\_\_\_

(2)

**Figure 2** represents the reaction profile of the catalysed reaction between ammonia and oxygen.

**Figure 2**



(d) Complete the reaction profile for the catalysed reaction in **Figure 2**.

You should:

- label the activation energy
- label the reactants and products, using the names of the reactants and products.

(2)

(e) How would **Figure 2** be different if **no** catalyst was used?

Tick (✓) **one** box.

The final energy level would be higher.

The final energy level would be lower.

The line would reach a higher peak.

The line would reach a lower peak.

(1)

(f) Ammonia and nitric acid react to produce the salt, ammonium nitrate.

Ammonium ions and nitrate ions both contain nitrogen.

Suggest **one** use of ammonium nitrate.

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(1)

(Total 8 marks)

**3.**

This question is about water.

(a) Hydrogen gas reacts with oxygen gas to produce water.

Water is decomposed into hydrogen gas and oxygen gas using electricity.

Which **two** words describe the reaction between hydrogen gas and oxygen gas?

Tick (✓) **two** boxes.

Alloying

Combustion

Corrosion

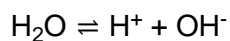
Endothermic

Reversible

**(2)**

(b) Water molecules break down into hydrogen ions and hydroxide ions.

The equation for the reaction is:



Which sentence describes this reaction at equilibrium?

Tick (✓) **one** box.

Water molecules break down at a higher rate than they reform.

Water molecules break down and reform at the same rate.

Water molecules break down at a lower rate than they reform.

**(1)**

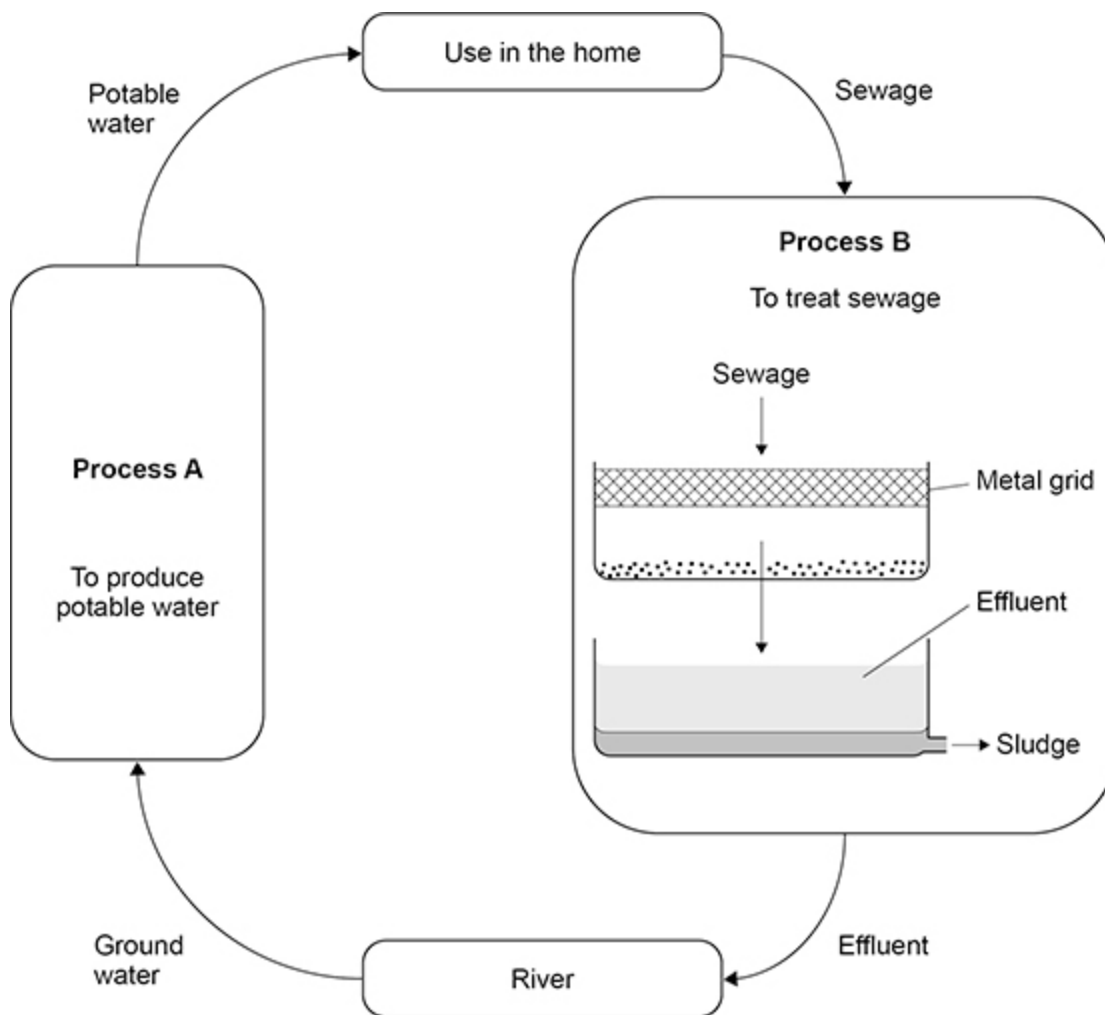
(c) Water collected from rivers is used in the home for drinking and flushing toilets.

Water used in the home must be potable.

Potable water is safe to drink.

Waste water produced after use in the home is called sewage.

The figure below shows how water is collected from rivers and returned to rivers after use.



Explain what happens to water in **Process A** and in **Process B** in above figure.

Do **not** refer to use of water in the home.

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(6)  
(Total 9 marks)

4. This question is about materials used to make bicycles.  
The figure below shows a bicycle.



The table below shows information about two materials used to make bicycle frames.

	<b>Material</b>	
	<b>Aluminium alloy</b>	<b>Bamboo</b>
Raw material	aluminium ore	bamboo plant
Cost of frame in £	250	1500
Strength in arbitrary units	290	193
Mass in kilograms	1.6	2.4
Lifespan in years	6–10	10–15
One method of disposal at end of life	recycled to make new products	burned to produce heat energy



(c) Bicycle chains are made from an alloy of iron.

Bicycle chains rust without protection.

Paint is **not** used to protect bicycle chains from rusting.

Suggest how bicycle chains can be protected from rusting.

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(1)

(d) Bicycle frames can also be made from a composite of carbon fibres embedded in a polymer resin.

What description is given in this composite to:

- the carbon fibre component
- the polymer resin component?

Carbon fibre \_\_\_\_\_

Polymer resin \_\_\_\_\_

(2)

(Total 11 marks)

5.

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 cm <sup>3</sup> 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.

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.

Use **Table 1**.

\_\_\_\_\_

\_\_\_\_\_

**(1)**

- (c) Which is a raw material used to make borosilicate glass?

Tick (✓) **one** box.

Boron trioxide

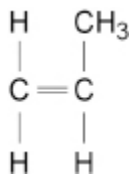
Clay

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**

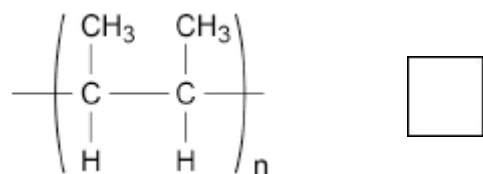
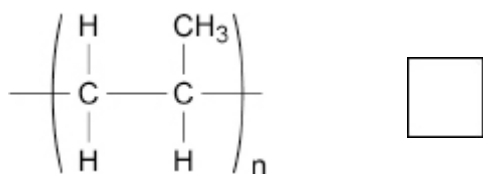
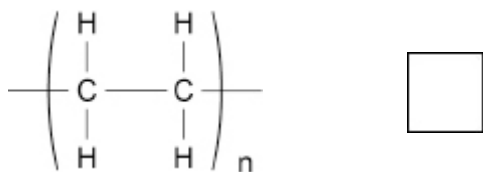
Symbol for element	Name of element	Number of atoms of element in one molecule of propene
C		
H		

Complete **Table 2**.

(2)

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

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**.

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?

Tick (✓) **two** boxes.

Alkene	<input type="checkbox"/>
Catalyst	<input type="checkbox"/>
Composite	<input type="checkbox"/>
Element	<input type="checkbox"/>
Monomer	<input type="checkbox"/>

(2)

(Total 12 marks)

**6.** This question is about alloys.

Steels are alloys of iron.

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

Tick (✓) **one** box.

Carbon

Iodine

Sulfur

**(1)**

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

Tick (✓) **two** boxes.

Chromium

Gold

Magnesium

Nickel

Zinc

**(2)**

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

Choose answers from the box.

<b>brittle</b>	<b>hard</b>	<b>low density</b>
<b>resistant to corrosion</b>	<b>soluble in water</b>	

Property 1 \_\_\_\_\_

Property 2 \_\_\_\_\_

(2)

Titanium is used in alloys.

The table below shows information about some alloys of titanium.

<b>Titanium alloy</b>	<b>Other metals in alloy</b>	<b>Strength</b>	<b>Used in</b>
<b>A</b>	6.0% aluminium 4.0% vanadium	high	aircraft parts hip joint replacements
<b>B</b>	5.0% aluminium 2.5% tin	high	aircraft parts
<b>C</b>	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**.

Use the table above.

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Mass = \_\_\_\_\_ kg

(3)

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

Use the table above.

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(1)

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

Suggest why alloy **B** is **not** used for medical purposes.

Use the table above.

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(1)

(Total 10 marks)

7.

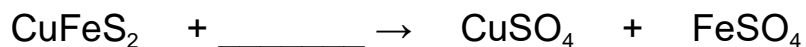
Copper is extracted from metal ores.

Chalcopyrite is a metal ore containing a compound with the formula  $\text{CuFeS}_2$

- (a)  $\text{CuFeS}_2$  reacts with oxygen to produce copper(II) sulfate and iron(II) sulfate.

Complete the equation for this reaction.

You should balance the equation.



(2)

- (b) Calculate the percentage by mass of copper in  $\text{CuFeS}_2$

Relative atomic masses ( $A_r$ ): S = 32 Fe = 56 Cu = 63.5

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Percentage by mass = \_\_\_\_\_ %

(3)

(c) Describe a test to show the presence of copper(II) ions in a solution of copper(II) sulfate.

Give the result of the test.

Test \_\_\_\_\_

\_\_\_\_\_

Result \_\_\_\_\_

\_\_\_\_\_

**(2)**

(d) Copper can be extracted from low-grade ores by bioleaching.

Describe what is meant by bioleaching.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**(2)**

**(Total 9 marks)**

## Mark schemes

- 1.** (a) alloy 1
- reinforcement 1
- (b) burning (of methane) releases carbon dioxide  
*allow burning methane*  
*ignore methane is a greenhouse gas* 1
- decomposition (of limestone) releases carbon dioxide  
*allow decomposition of limestone* 1
- (c) hydrochloric acid 1
- limewater 1
- (d) (pre-stressed concrete) can bear the weight of (heavy) traffic  
*allow converse for plain concrete*  
*allow (pre-stressed concrete) bridge is less likely to collapse* 1
- (because pre-stressed concrete is) stronger  
*do **not** accept (because prestressed concrete is) more dense* 1
- (e) any **two** from:  
(plain concrete slabs)  
  - are cheaper
  - will be lighter (to transport / lay)
  - do not need to carry vehicles*allow converse for pre-stressed concrete* 2
- [10]**
- 2.** (a) to recycle (remaining) nitrogen and hydrogen  
*allow to recycle unreacted gases*  
*allow to return nitrogen and hydrogen to the reactor* 1
- (b) iron  
*allow Fe* 1

(c) (test)  
glowing splint

1

(result)  
(splint) relights

*MP2 is dependent upon MP1 being awarded*

1

(d) labelled vertical arrow from dotted line to peak

*ignore arrow heads*

1

ammonia **and** oxygen on left

**and**

nitric acid **and** water on right

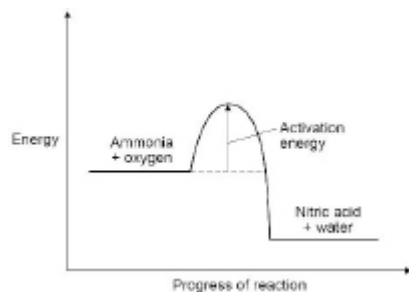
*allow NH<sub>3</sub> for ammonia*

*allow O<sub>2</sub> for oxygen*

*allow HNO<sub>3</sub> for nitric acid*

*allow H<sub>2</sub>O for water*

*an answer of*



*scores 2 marks*

1

(e) the line would reach a higher peak

1

(f) fertilisers

*allow explosives*

*allow sports injury packs*

1

[8]

3.

(a) combustion

1

reversible

1

(b) water molecules break down  
and reform at the same rate

1

(c) <b>Level 3:</b> Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6
<b>Level 2:</b> Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4
<b>Level 1:</b> Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2
<b>No relevant content</b>	0

**Indicative content**

**Potable water production**

- pass water through filter beds
- to remove solids
  
- use chlorine / ozone / UV light
- to sterilise water
- to destroy microbes

**Waste water treatment**

- screening
- using a metal grid
- to remove solids
- to remove grit
  
- sedimentation
- to produce sewage sludge and effluent
- anaerobic digestion of sewage sludge
- aerobic biological treatment of effluent

access to **Level 3** requires reference to **both** potable water production **and** waste water treatment.

**[9]**

<b>4.</b> (a) <b>Level 3:</b> A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	5–6
<b>Level 2:</b> Some logically linked reasons are given. There may also be a simple judgement.	3–4
<b>Level 1:</b> Relevant points are made. They are not logically linked.	1–2
<b>No relevant content</b>	0

## Indicative content

- bamboo is renewable
- aluminium is a finite resource
  
- growing bamboo uses up agricultural land
- mining aluminium ore is a polluting activity
  
- cost of aluminium alloy is lower
- (so) can be replaced more frequently
  
- aluminium alloy is stronger
- (so) can withstand larger forces
  
- aluminium alloy has lower mass
- (so) bicycle is faster
- (so) is easier to carry / transport
  
- the aluminium alloy frame lasts less long
- (so) bicycle must be replaced more frequently
  
- aluminium alloy is recyclable (so) aluminium ores are conserved
  
- bamboo can provide renewable heat energy
- (so) less overall contribution to global warming
- (and) is carbon neutral
  
- neither material may reach landfill
- both materials have a sustainable disposal method

## Reasoned judgment

(b) aluminium (alloy) has an oxide coating

1

(so) contact between aluminium (alloy) and water / air / oxygen is prevented

*do **not** accept sacrificial protection*

1

(c) (coating with) grease

*allow (coating with) oil*

*allow galvanise*

*allow use stainless steel as the alloy*

1

- (d) (carbon fibre) reinforcement  
*allow reinforces the polymer / resin*  
*ignore (carbon) fibres*

1

- (polymer resin) matrix / binder  
*allow binds the fibres / fragments*  
*ignore (polymer) resin*

1

[11]

5.

- (a) (the poly(propene) beaker will begin to) melt  
*allow poly(propene) has a low melting point*

1

- (the poly(propene) beaker will) burn / ignite  
*allow poly(propene) is flammable*

1

- (b) (poly(propene) beakers are) less easily broken  
*allow (poly(propene) beakers are) less likely to shatter*

*allow (poly(propene) beakers are) tougher*

*allow (poly(propene) beakers have a) higher resistance to impact*

1

- (c) boron trioxide

1

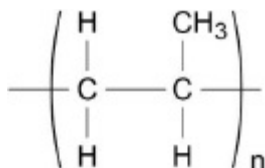
- (d)

Symbol for element	Name of element	Number of atoms of element in one molecule of propene
C	carbon	3
H	hydrogen	6

*if no other mark awarded allow 1 mark for a correct column*

2

- (e)



1

- (f) (Stage 1 is) fractional distillation 1
- (Stage 2 is) cracking 1
- (Stage 3 is) polymerisation 1
- (g) alkene 1
- monomer 1
- [12]**

- 6.** (a) carbon 1
- (b) chromium 1
- nickel 1
- (c) hard 1
- resistant to corrosion 1
- in either order*
- (d) (percentage of titanium = 100 - 3.0 - 2.5) = 94.5 (%) 1

$$(\text{mass} =) \frac{94.5}{100} \times 5.0$$

*allow correct use of incorrectly determined percentage of titanium*

1

$$= 4.725 \text{ (kg)}$$

*allow 4.7 / 4.73 (kg)*

1

**alternative approach:**

$$(\text{mass of Al} + \text{V} = \frac{5.5}{100} \times 5.0 =)$$

(mass of titanium =) 5 - 0.275 (1)

*allow correct use of incorrectly determined mass of Al and V*

$$= 4.725 \text{ (kg) (1)}$$

*allow 4.7 / 4.73 (kg)*

- (e) (both are) strong  
*allow (both contain) more aluminium* 1
- (f) tin is toxic  
*allow tin reacts in the body* 1

[10]

7.

- (a)  $\text{CuFeS}_2 + 4\text{O}_2 \rightarrow \text{CuSO}_4 + \text{FeSO}_4$   
*allow multiples*  
*allow O<sub>2</sub> for 1 mark* 2

- (b) ( $M_r = 63.5 + 56 + (2 \times 32) =$ ) 183.5 1

$$(\% \text{ of copper} =) \frac{63.5}{183.5} \times 100$$

*allow correct use of incorrectly determined M<sub>r</sub>* 1

$$= 34.6 (\%)$$

*allow 34.60490 correctly rounded to at least 2 significant figures*

1

- (c) (test) (add) sodium hydroxide (solution) 1

(result) blue precipitate

**OR**

(test) flame test (1)

(result) green (flame) (1)

*allow blue-green (flame)*

1

*MP2 is dependent upon MP1 being awarded*

- (d) (the use of) bacteria 1

to produce leachate solutions (that contain metal / copper compounds)

1

[9]