Q1.

This question is about materials used to make plates.

Plates are made from ceramics, paper or poly(propene).

(a) Paper plates are biodegradable and recyclable.

Which stage of a life cycle assessment (LCA) would contain this information?

Tick (✓) **one** box.

Disposal at the end of useful life	☐
Extracting and processing raw materials	☐
Manufacturing and packaging	☐
Use and operation during lifetime	☐

(1)

(b) Which **two** processes are used to make ceramic plates?

Tick (✓) **two** boxes.

Forming a composite	☐
Galvanising with zinc	☐
Heating in a furnace	☐
Melting sand and boron trioxide	☐
Shaping wet clay	☐

(2)

Poly(propene) is produced from an alkene.

(c) Complete the sentences.

The name for very large molecules such as poly(propene) is

_____.

The name of the alkene used to produce poly(propene) is _____.

(2)

(d) The alkene needed to make poly(propene) is produced from crude oil.

Which **two** processes are used to produce this alkene from crude oil?

Tick (✓) **two** boxes.

Chromatography	☐
Cracking	☐
Fermentation	☐
Fractional distillation	☐
Quarrying	☐

(2)

(e) What type of bond joins the atoms in a molecule of poly(propene)?

Tick (✓) **one** box.

Covalent	☐
Ionic	☐
Metallic	☐

(1)

The table below shows information about two polymers used to make plates.

Polymer	Effect of heating the polymer
A	does not melt
B	melts at 50 °C

(f) What type of polymer is polymer **A**?

Use the table above.

_____

_____

(1)

(g) Why does polymer **A** behave differently to polymer **B** when heated?

You should refer to crosslinks in your answer.

_____

_____

(1)

(Total 10 marks)

Q2.

This question is about materials used to make food plates.

Food plates are made from paper, polymers or ceramics.

The table below shows information about plates of the same diameter made from each of these materials.

	Food plate material		
	Paper	**Polymers**	**Ceramics**
Raw material	Wood	Crude oil	Mined clay
Number packaged in 10 dm^3 cardboard box	500	100	50
Average number of times used	1	400	1000
Biodegradable?	Yes	No	No
Recyclable?	Yes	Yes	No

(a) The table above does **not** show information about energy usage.

Suggest **two** pieces of information about energy usage which would help to produce a complete life cycle assessment (LCA) for the three food plate materials.

1 _____

_____

2 _____

(2)

(b) Evaluate the use of these materials for making food plates.

You should use features of life cycle assessments (LCAs).

Use the table above.

(4)

(c) Describe how ceramic food plates are produced from clay.

(2)

(Total 8 marks)

Q3.

Figure 1 shows a surfer on a surfboard.

Figure 1

Some surfboards are made from addition polymers.

Addition polymers are made from small alkene molecules.

(a) Which type of bonding is present in small alkene molecules?

Tick (✓) **one** box.

Covalent ☐

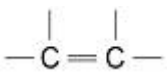
Ionic ☐

Metallic ☐

(1)

(b) What is the functional group in these small alkene molecules?

Tick (✓) **one** box.

 ☐

—COOH ☐

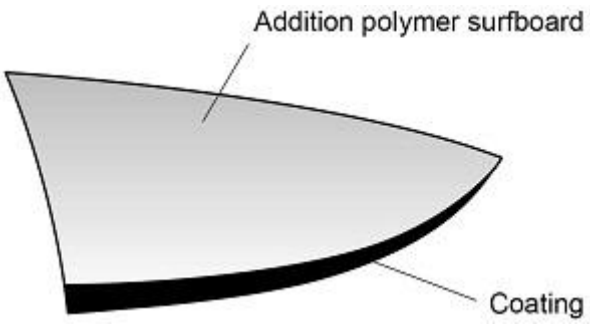
—OH ☐

(1)

Figure 2 shows the structure of part of an addition polymer surfboard.

The outer surface of the surfboard is coated.

Figure 2



The coating is made from soda-lime glass fibres surrounded by a plastic.

(c) What type of material is the coating of the surfboard?

Tick (✓) **one** box.

Alloy ☐

Ceramic ☐

Composite ☐

Nanotube ☐

(1)

(d) Complete the sentence.

Choose answers from the box.

air	**ammonia**	**copper**
	limestone	**sand**

The materials used to make the soda-lime glass fibres are sodium carbonate,

_____ and _____

(2)

(e) Suggest **two** reasons why surfboards are coated.

1 _____

_____

2 _____

_____

(2)

Some surfboards are made from wood.

The following table contains information about the materials in an addition polymer surfboard and a wooden surfboard.

	Addition polymer surfboard	**Wooden surfboard**
Relative strength	14	38
Cost (£ per m³)	140	390
Density (kg/m³)	50	150
Disposal at end of life	Difficult to recycle	Can be used as fuel

(f) Suggest **two** advantages and **two** disadvantages of using addition polymers rather than wood to make surfboards.

Use the table.

Advantages of addition polymers _____

_____

_____

_____

Disadvantages of addition polymers _____

_____

_____

_____

(4)

(g) Calculate the volume of wood in a wooden surfboard of mass 5.25 kg

Use the table above and the equation:

$$\text{Density in kg/m}^3 = \frac{\text{Mass in kg}}{\text{Volume in m}^3}$$

_____

_____

_____

_____

Volume = _____ m^3

(3)

(Total 14 marks)

Q4.

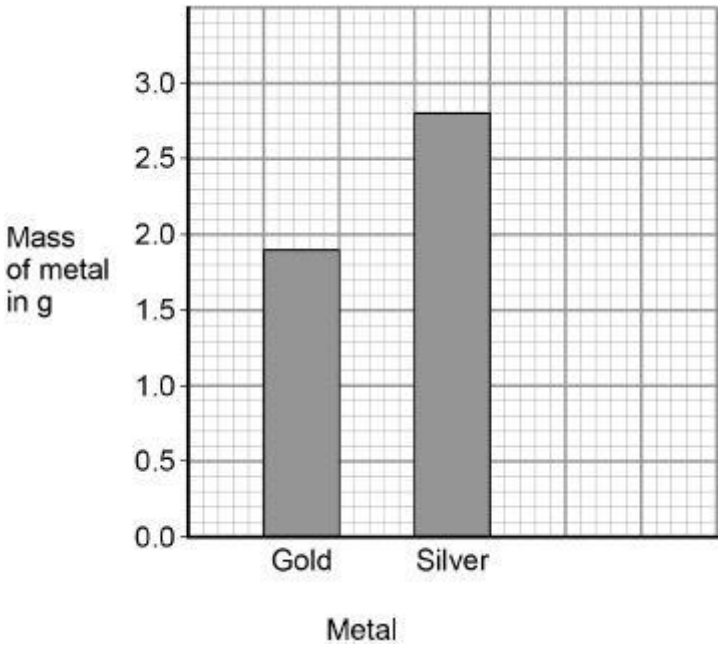
A 9 carat gold ring is made from a mixture of metals.

The table below shows the mass of different metals in the ring.

The mass of the ring is 5.0 g

Metal	Mass of metal in g
Gold	1.9
Silver	2.8
Copper	0.3

(a) Plot the data for copper from the table above on the graph below.



(2)

(b) The cost of gold is £30 per gram.

Calculate the cost of the gold used in the 9 carat gold ring.

Use the table above.

_____

_____

Cost of gold = £_____

(1)

(c) Rings can be made from 22 carat gold.

The ratio of the mass of gold in 22 carat gold compared to 9 carat gold is 22 :9

Calculate the mass of gold in a 22 carat gold ring of mass 5.0 g

Use the table above.

_____

_____

_____

Mass of gold = _____ g

(2)

(d) Pure gold is 24 carats.

Suggest **two** reasons why silver and copper are mixed with gold to make 9 carat gold rings.

1. _____

_____

2. _____

_____

(2)

(e) Copper is obtained from copper ores or by recycling copper.

- Copper ores are non-renewable.
- Copper ores can be obtained by mining.
- Some scrap copper goes to landfill sites.

Give **three** reasons why we should use recycled copper instead of copper from copper ores.

1. _____

_____

2. _____

_____

3. _____

_____

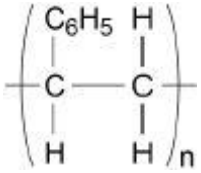
(3)

(Total 10 marks)

Q5.

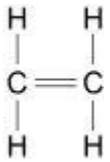
Disposable cups are made from coated paper or poly(styrene).

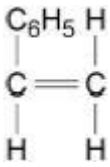
The diagram below represents the structure of poly(styrene).

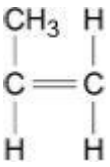


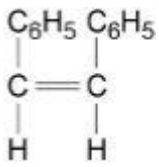
(a) Which small molecule is used to produce poly(styrene)?

Tick **one** box.

 ☐

 ☐

 ☐

 ☐

(1)

(b) Which process is used to make poly(styrene) from small molecules?

Tick **one** box.

Cracking ☐

Distillation ☐

Fermentation ☐

Polymerisation ☐

(1)

(c) Complete the sentences.

Choose answers from the box.

ceramics	**composites**	**four**	**many**
monomers	**polymers**	**two**	

Poly(styrene) is produced from small molecules called

_____

When poly(styrene) is made, _____styrene molecules join to form

large molecules.

These large molecules are called _____ .

(3)

(d) The table below gives some information about disposable cups.

	Coated paper cups	**Polystyrene cups**
Source of raw materials	Wood	Crude oil
Energy to make 1 cup in arbitrary units	550	200
Biodegradable	Yes	No
Recyclable	No	Yes

Compare the advantages and disadvantages of using coated paper and poly(styrene) to make disposable cups.

Use the table above and your knowledge and understanding of life cycle assessments (LCAs).

_____

_____

_____

_____

(4)

(Total 9 marks)

Q6.

Disposable cups are made from coated paper or poly(styrene).

The table below shows information on the life cycle assessments (LCAs) of disposable cups.

	Coated paper cups	**Poly(styrene) cups**
Raw materials	Wood	Crude oil
Mass of 1 cup in g	8.3	1.9
Energy to produce 1 cup in kJ	550	200
Energy released when 1 cup is burned in kJ	166	76
Biodegradable	Yes	No
Recyclable	No	Yes

(a) Evaluate the use of coated paper compared with poly(styrene) to make disposable cups.

Use the table above and your knowledge and understanding of LCAs.

(6)

(b) Calculate the energy needed to produce 1.00 kg of coated paper cups.

Use the table above.

Give your answer in standard form.

Energy = _____ kJ

(2)

(c) Melamine is a polymer used to make non-disposable cups.

Melamine does **not** melt when it is heated.

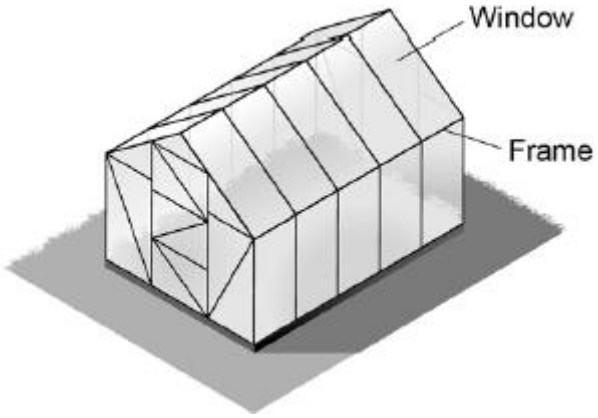
Explain why.

_____

(2)
(Total 10 marks)

Q7.

The diagram shows a greenhouse.



A greenhouse frame can be made from wood or aluminium.

Table 1 gives some information about wood and aluminium.

Table 1

	Wood	**Aluminium**
Raw material	Renewable	Non-renewable
Mass of greenhouse frame in kg	80	20
Useful lifetime in years	20	50
End of useful life	Can be chopped up and used as fuel	Can be recycled into new aluminium products

(a) Evaluate the use of each material for making greenhouse frames.

Use **Table 1**.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(b) Greenhouse frames are transported by lorry.

The lorry used can carry a maximum load of 12 tonnes.

Calculate the largest number of wooden greenhouse frames which could be transported by the lorry.

Use **Table 1**.

100 kg = 1 tonne

_____

_____

_____

Number of wooden greenhouse frames = _____

(2)

(c) It is more sustainable to make greenhouse frames from recycled aluminium than from aluminium from aluminium ore.

Give **two** reasons why.

1. _____

_____

2. _____

_____

(2)

(d) Greenhouse windows can be made from glass or from polymers.

Table 2 gives information about glass and a polymer.

Table 2

	Glass	**Polymer**
Density in g / cm^3	2.8	1.2
Cost in £ per m^2	20	28
Effect of sunlight	No effect	Discolours over time

Suggest **one** advantage of making greenhouse windows from the polymer rather than from glass.

Use **Table 2**.

_____

_____

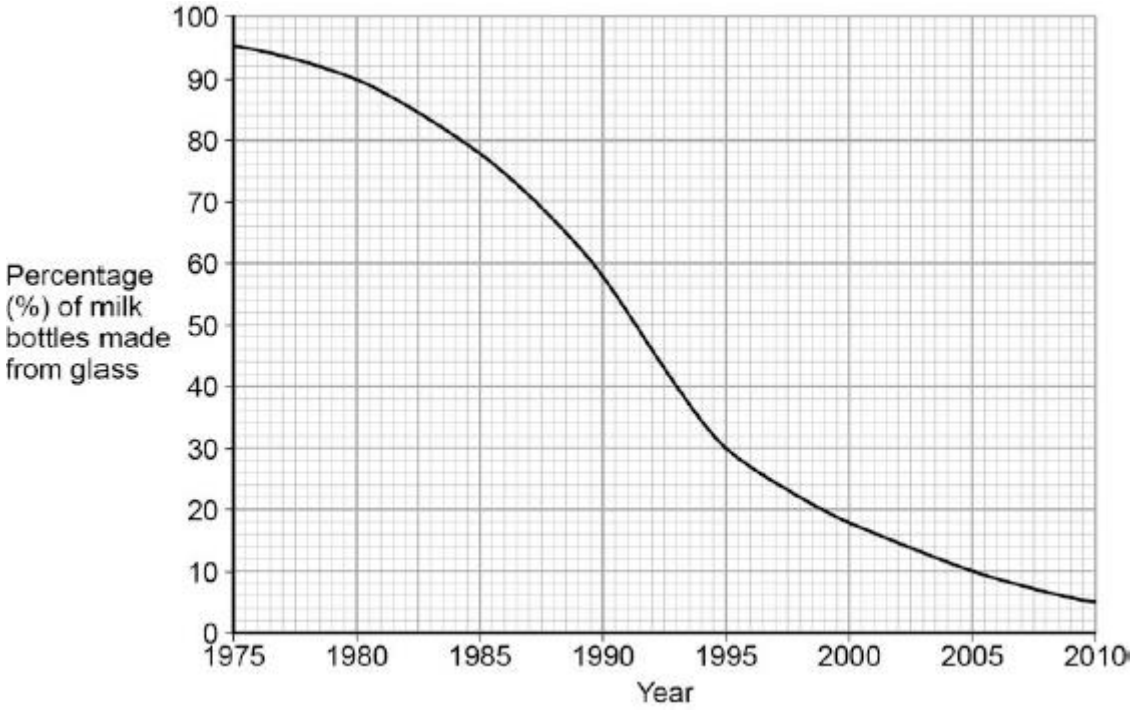
(1)

(Total 9 marks)

Q8.

Plastic and glass can be used to make milk bottles.

The figure below shows the percentage of milk bottles made from glass between 1975 and 2010.



(a) Plot the points and draw a line on the figure above to show the percentage of milk bottles made from materials **other** than glass between 1975 and 2010.

(3)

(b) The table below gives information about milk bottles.

	Glass milk bottle	**Plastic milk bottle**
Raw materials	Sand, limestone, salt	Crude oil
Bottle material	Soda-lime glass	HD poly(ethene)
Initial stage in production of bottle material	Limestone and salt used to produce sodium carbonate.	Production of naphtha fraction.

Maximum temperature in production process	1600 °C	850 °C
Number of times bottle can be used for milk	25	1
Size(s) of bottle	0.5 dm^3	0.5 dm^3, 1 dm^3, 2 dm^3, 3 dm^3
Percentage (%) of recycled material used in new bottles	50 %	10 %

Evaluate the production and use of bottles made from soda-lime glass and those made from HD poly(ethene).

Use the information given and your knowledge and understanding to justify your choice of material for milk bottles.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(Total 9 marks)

Q9.

Metals are extracted from ores in the Earth's crust.

(a) Why is copper used in the manufacture of computers?

Tick (✓) **one** box.

Because it has a high density. ☐

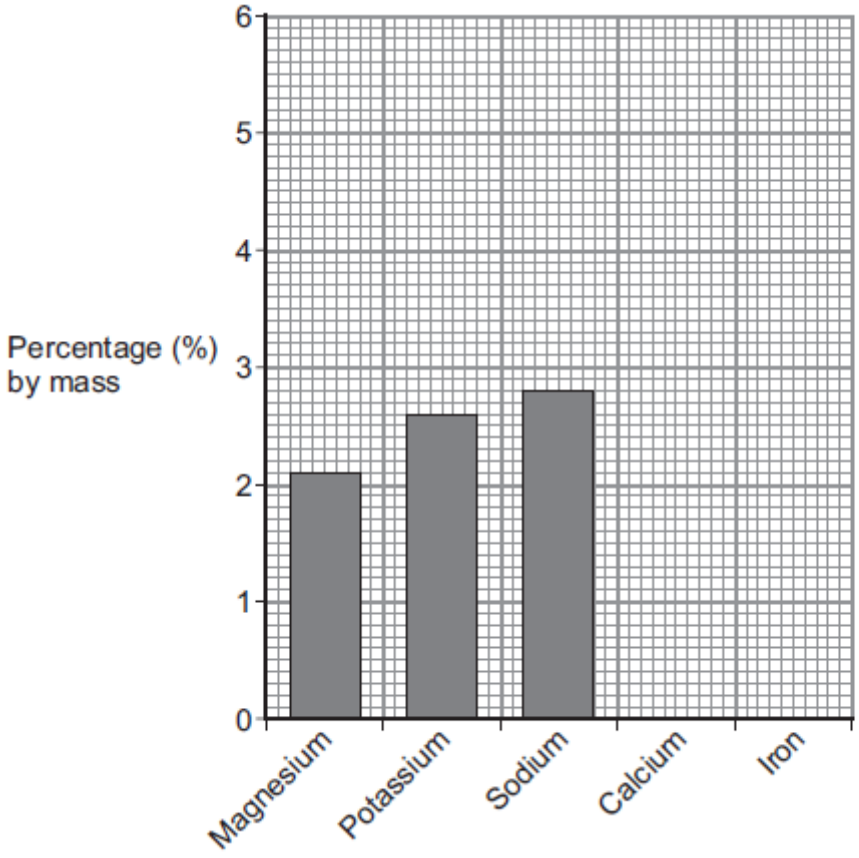
Because it does not react with water. ☐

Because it is a good conductor of electricity. ☐

(1)

(b) **Figure 1** shows the percentage (%) by mass of some metals in the Earth's crust.

Figure 1



(i) What is the percentage by mass of magnesium in the Earth's crust?

_____ %

(1)

(ii) On **Figure 1** draw the bars for:

- calcium at 3.6% by mass
- iron at 5.0% by mass.

(2)

(c) An ore of zinc contains zinc carbonate.

The equation for the reaction when zinc carbonate is heated is:

$$\underset{\text{zinc carbonate}}{ZnCO_3} \longrightarrow \underset{\text{zinc oxide}}{ZnO} + \underset{\text{carbon dioxide}}{CO_2}$$

(i) What is the name of this type of reaction?

Tick (✓) **one** box.

corrosion ☐

decomposition ☐

electrolysis ☐

(1)

(ii) Which substance in the equation is a gas at room temperature (20 °C)?

Tick (✓) **one** box.

zinc carbonate ☐

zinc oxide ☐

carbon dioxide ☐

(1)

(iii) Complete the table below to show the number of atoms of carbon and oxygen in the formula of zinc carbonate.

Element	**Number of atoms in the formula $ZnCO_3$**
zinc, Zn	1
carbon, C	
oxygen, O	

(2)

(iv) When 125 g zinc carbonate is heated, 81 g zinc oxide is produced.

Calculate the mass of carbon dioxide produced.

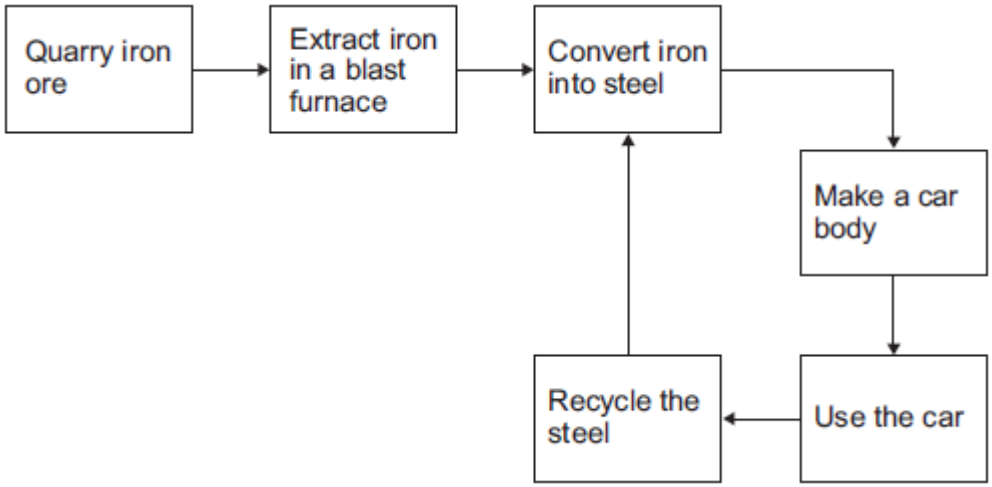
_____

Mass of carbon dioxide = _____g

(1)

(d) **Figure 2** shows a simple life cycle of a car body.

Figure 2



(i) What is **one** reason why iron from the blast furnace is converted into steel?

Tick (✓) **one** box.

To make the iron pure. ☐

To make the iron more brittle. ☐

To make alloys for specific uses. ☐

(1)

(ii) Apart from cost, give **three different** reasons why steel should be recycled.

1. _____

_____

2. _____

_____

3. _____

_____

(3)

(Total 13 marks)

Q10.

Metals are extracted from ores in the Earth's crust.

Some ores contain metal carbonates and some ores contain metal oxides.

(a) (i) Name the type of reaction that happens when a metal carbonate is heated.

_____

(1)

(ii) Which solid product is formed when copper carbonate is heated?

Tick (✓) **one** box.

copper ☐

copper nitrate ☐

copper oxide ☐

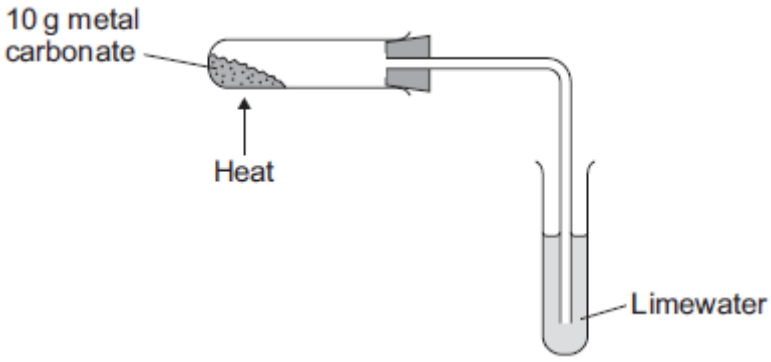
copper sulfide ☐

(1)

(b) A student investigated heating four metal carbonates.

Figure 1 shows the apparatus used.

Figure 1



The student heated each metal carbonate for five minutes.

The table below shows the results.

Metal carbonate	Mass of metal carbonate at start in g	Mass of solid after heating for 5 minutes in g	Observations
Copper carbonate	10.0	6.9	Limewater turns cloudy
Magnesium carbonate	10.0	9.1	Limewater turns cloudy

Potassium carbonate	10.0	10.0	Limewater does not turn cloudy
Zinc carbonate	10.0	8.3	Limewater turns cloudy

(i) Explain the results for potassium carbonate.

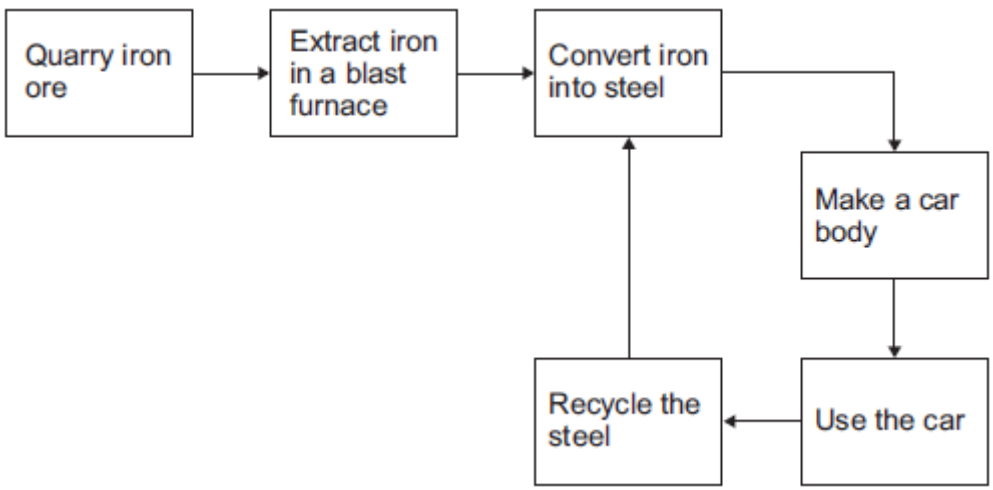
(3)

(ii) Suggest how the reactivity series can be used to predict which metal carbonate reacts most easily when heated.

(2)

(c) **Figure 2** shows a simple life cycle of a car body.

Figure 2



(i) Complete the sentence.

Iron ores must contain enough iron to _____

_____

(1)

(ii) Some iron ores contain iron oxide (Fe_2O_3).

Complete and balance the equation for a reaction to produce iron from iron oxide.

_____ Fe_2O_3 + _____ C $\longrightarrow$ _____ + _____ CO_2

(2)

(iii) Give **two** reasons why iron produced in a blast furnace is converted into steel.

_____

_____

_____

_____

(2)

(iv) When a car reaches the end of its useful life, the car body can be:

- recycled
- reused
- sent to landfill.

Give **three** reasons why a steel car body should be recycled and **not** reused or sent to landfill.

_____

_____

_____

_____

_____

_____

(3)

(Total 15 marks)