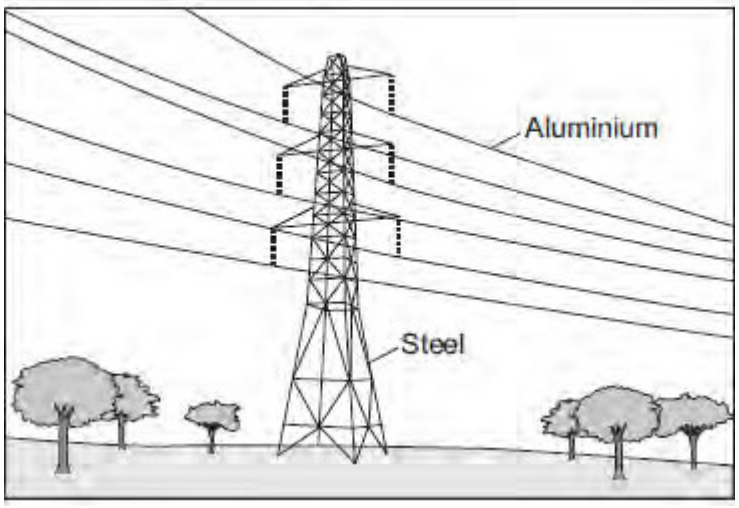
Q1. This question is about metals.

Figure 1 shows the metals used to make pylons and the wires of overhead cables.

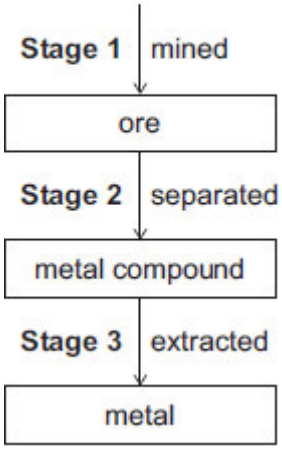
Figure 1



(a) An ore contains a metal compound.

A metal is extracted from its ore in three main stages, as shown in **Figure 2**.

Figure 2



Explain why **Stage 2** needs to be done.

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(2)

(b) Cast iron from a blast furnace contains 96% iron and 4% carbon.

(i) Cast iron is not suitable for the manufacture of pylons.

Give **one** reason why.

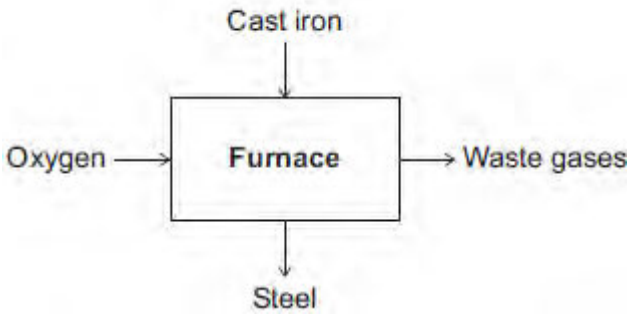
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(1)

(ii) Most cast iron is converted into steel, as shown in **Figure 3**.

Figure 3



Describe how cast iron is converted into steel.

Use **Figure 3** to help you to answer this question.

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(2)

(c) Aluminium and copper are good conductors of electricity.

(i) State **one** property that makes aluminium more suitable than copper for overhead cables.

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(1)

(ii) How can you tell that copper is a transition metal and aluminium is **not** a transition metal from the position of each metal in the periodic table?

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(2)

(iii) Copper can be extracted from solutions of copper salts by adding iron.

Explain why.

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(2)
(Total 10 marks)

Q2. Oil rigs are used to drill for crude oil.



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(a) Drill heads are made from steel. Steel is an alloy.

Explain why alloys are harder than pure metals.

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(3)

(b) Drill heads also contain diamonds.

Describe, as fully as you can, the structure and bonding in diamond.

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(4)

(c) Polymers are produced from crude oil.

Describe the structure and bonding in a thermosoftening polymer and explain why thermosoftening polymers melt when heated.

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(4)
(Total 11 marks)

Q3. (a) PEX is a material that is used as an alternative to copper for hot water pipes. PEX is made from poly(ethene).

(i) Describe how ethene forms poly(ethene).

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(2)

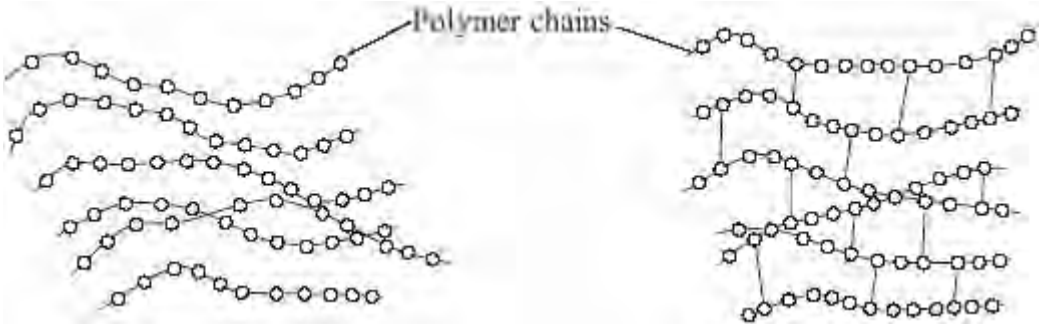
(ii) PEX is a shape memory polymer. What property does a shape memory polymer have?

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(1)

(iii) The simplified structures of poly(ethene) and PEX are shown.



Poly(ethene) **PEX**

Poly(ethene) is a thermoplastic that softens easily when heated.

Suggest and explain how the structure of PEX changes this property.

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(3)

(b) Copper was considered to be the most suitable material to use for hot water pipes. PEX is now used as an alternative material for hot water pipes.

Copper is extracted from its ore by a series of processes.

1 The low-grade ore is powdered and concentrated.
2 Smelting is carried out in an oxygen flash furnace. This furnace is heated to 1100 °C using a hydrocarbon fuel. The copper ore is blown into the furnace with air, producing impure, molten copper.
3 Oxygen is blown into the impure, molten copper to remove any sulfur. The copper is cast into rectangular slabs.
4 The final purification of copper is done by electrolysis.

PEX is made from crude oil by a series of processes.

1 Fractional distillation
2 Cracking
3 Polymerisation
4 Conversion of poly(ethene) into PEX

Suggest the possible environmental advantages of using PEX instead of copper for hot water pipes.

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(4)
(Total 10 marks)