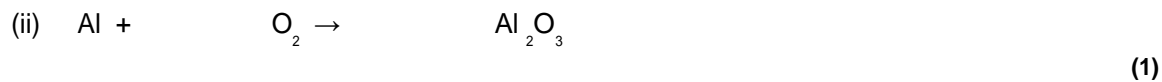
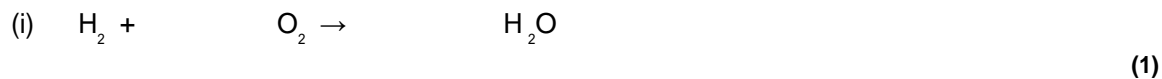


Q1. (a) Balance these chemical equations.



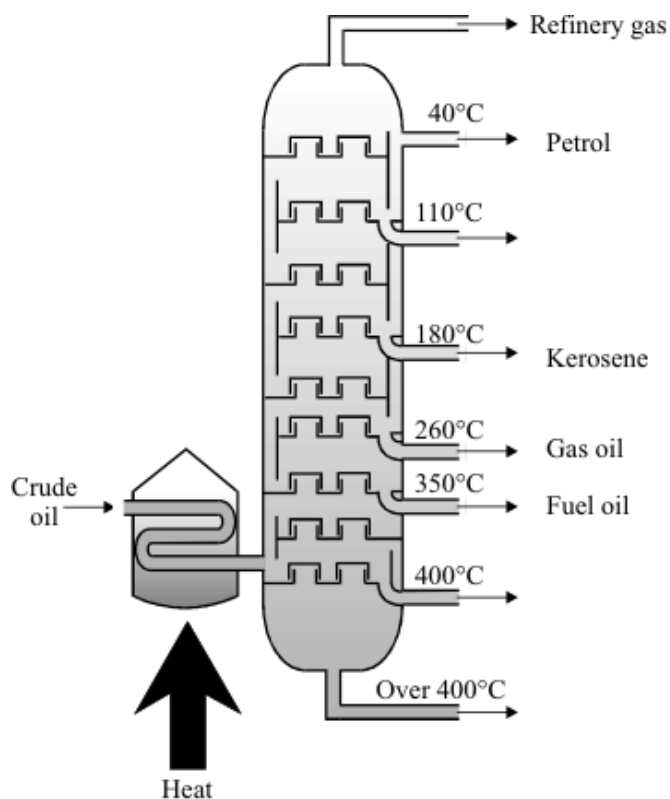
(b) Briefly explain why an unbalanced chemical equation cannot fully describe a reaction.

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(2)

(Total 4 marks)

Q2. To make crude oil more useful it is separated into different fractions.



(a) Complete the gaps in the following sentences.

Crude oil is separated into different fractions by a process called
..... Each fraction has a different

(2)

- (b) Each fraction is a mixture of compounds. Most of these compounds are hydrocarbons, made up of the elements hydrogen and carbon.

- (i) Explain the difference between a mixture and a compound.

.....

.....

.....

(2)

- (ii) Explain the difference between a compound and an element.

.....

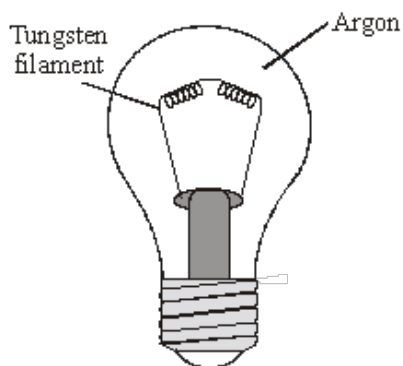
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(2)

(Total 6 marks)

- Q3.** The diagram shows an electric light bulb.



When electricity is passed through the tungsten filament it gets very hot and gives out light.

- (a) What reaction would take place if the hot tungsten was surrounded by air?

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(1)

- (b) State why argon is used in the light bulb. Explain your answer in terms of the electronic structure of an argon atom.

.....

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(3)
(Total 4 marks)

- Q4.** Titanium is used for replacement hip joints because it has a low density, is strong and does not corrode.
Titanium is extracted from titanium dioxide (TiO_2) in three stages.

(a) **Stage 1**

Titanium dioxide is converted into titanium chloride (TiCl_4) because the metal cannot be extracted from its oxide by *reduction* with carbon.

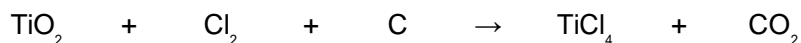
- (i) What does *reduction* mean?

.....

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(1)

- (ii) Balance the chemical equation for the conversion of titanium dioxide to titanium chloride.



(1)

- (iii) Chemical equations are always balanced. Explain why.

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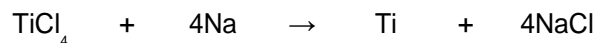
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(1)

(b) **Stage 2**

Titanium is extracted from the titanium chloride by reacting it with sodium at 1000 °C in a reactor.

The only other substance in the reactor is argon gas.



- (i) What does this tell you about the reactivity of sodium compared with titanium?

.....
.....

(1)

- (ii) Suggest why the reactor contains argon and **not** air.

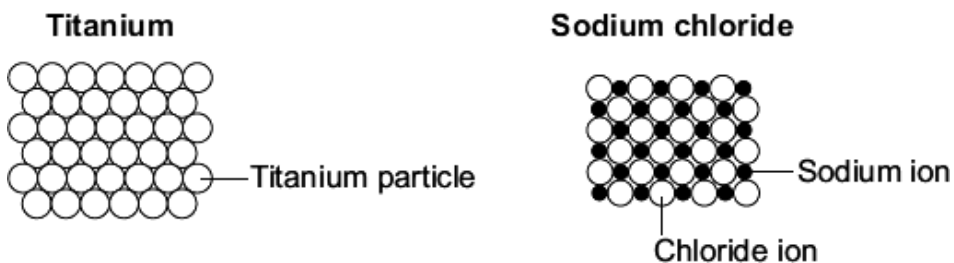
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(1)

(c) **Stage 3**

After **Stage 2** the titanium is separated from the products by washing out the sodium chloride with water.

The diagrams show sections through the lattice of titanium metal and the lattice of sodium chloride.



How do the diagrams show that:

- (i) titanium is an element

.....
.....

(1)

(ii) sodium chloride is a compound?

.....

.....

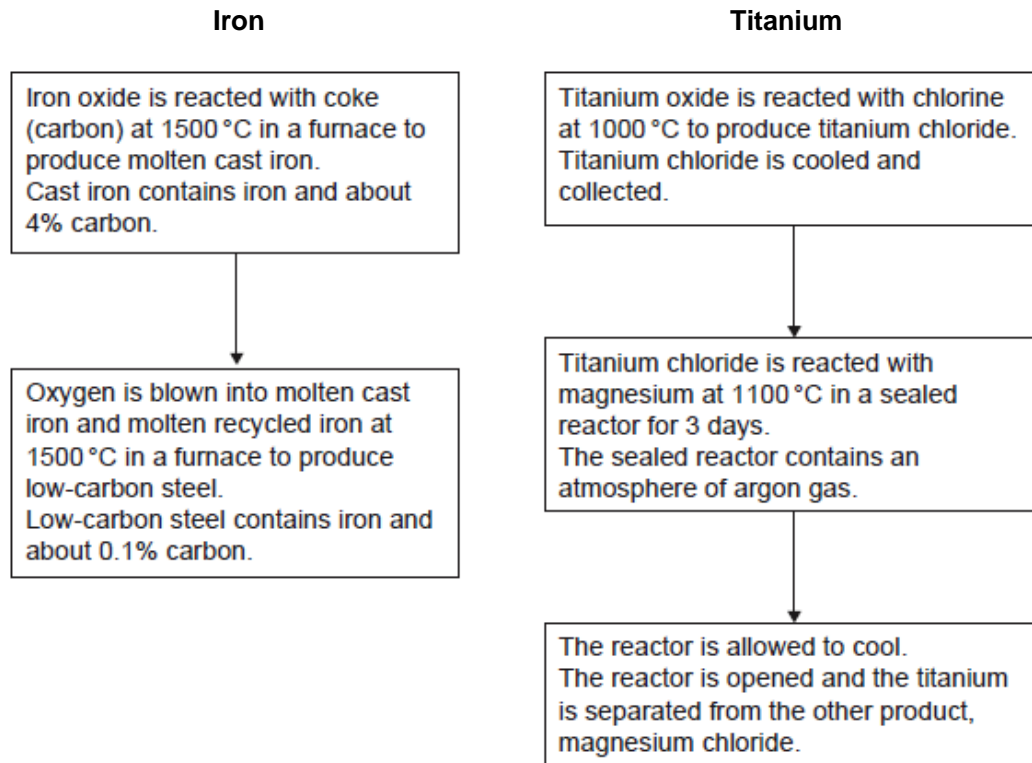
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(2)
(Total 8 marks)

Q5. Iron is produced from the ore haematite (iron oxide).

Titanium is produced from the ore rutile (titanium oxide).



(a) The production of low-carbon steel uses oxygen but the production of titanium uses argon.

Explain why.

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(3)

- (b) There is less titanium than iron in the Earth's crust.

Apart from titanium's scarcity, explain why titanium costs much more than iron.

Use the two flow diagrams above to help you to answer this question.

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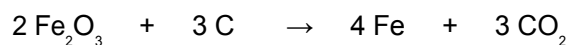
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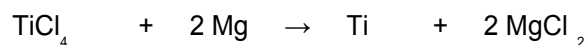
(3)

- (c) Many chemical reactions take place in the production of both metals.

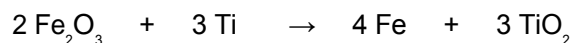
A chemical reaction in the production of iron is:



A chemical reaction in the production of titanium is:



Titanium can be used to produce iron from iron oxide. The chemical reaction is:



Use these three reactions and the Chemistry Data Sheet to answer this question.

Suggest the position of titanium in the Reactivity Series of Metals.

Explain your answer.

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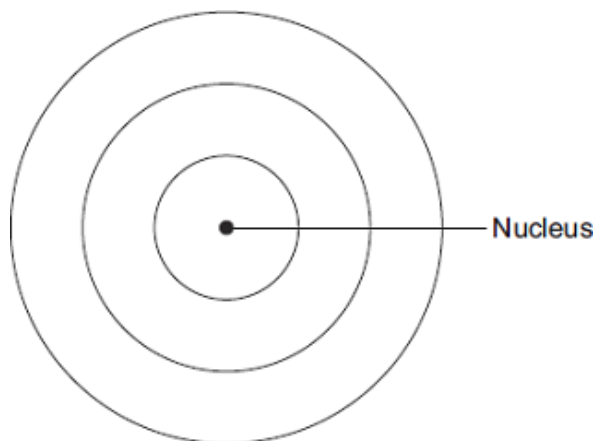
(2)

(Total 8 marks)

Q6. Aluminium has many uses.

(a) An aluminium atom has 13 electrons.

(i) Draw the electronic structure of an aluminium atom.



(1)

(ii) Name the **two** sub-atomic particles in the nucleus of an aluminium atom.

..... and

(1)

(iii) Why is there no overall electrical charge on an aluminium atom?

.....

.....

(1)

(b) Rail tracks are made from steel.

Molten iron is used to weld rail tracks.

The reaction of aluminium with iron oxide is used to produce molten iron.

(i) Balance the chemical equation for the reaction.



(1)

(ii) Why does aluminium react with iron oxide?

.....

.....

(1)

(Total 5 marks)

