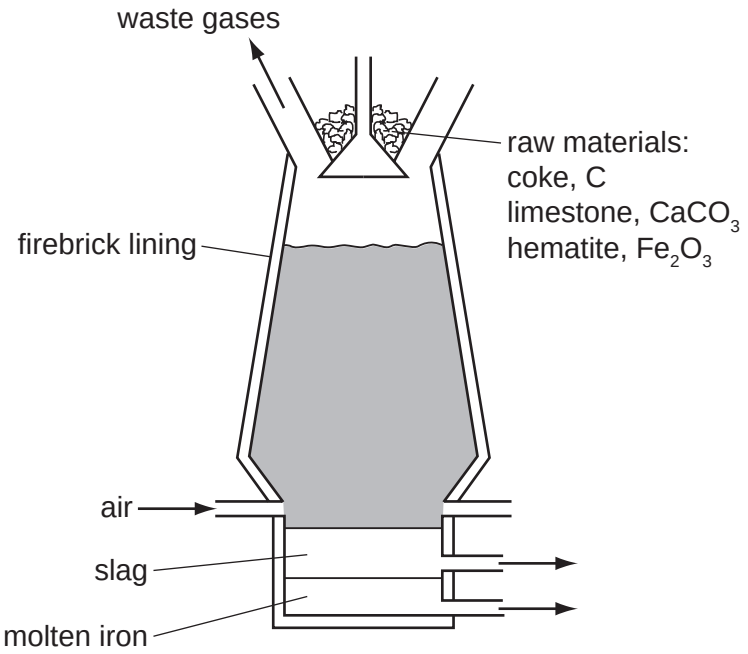
1 Iron is extracted from its ore, hematite, in the blast furnace.



(a) The temperature inside the blast furnace can rise to 2000 °C.
Write an equation for the exothermic reaction which causes this high temperature.

..... [1]

(b) Carbon monoxide is formed in the blast furnace. This reduces the ore hematite, Fe_2O_3, to iron.

(i) Explain how carbon monoxide is formed in the blast furnace.

.....

..... [2]

(ii) Write an equation for the reduction of hematite by carbon monoxide.

..... [2]

(c) Explain why it is necessary to add limestone, calcium carbonate, to the blast furnace. Include an equation in your explanation.

.....

.....

..... [3]

(d) Most of the iron from the blast furnace is converted into mild steel. A method of preventing the steel from rusting is coating it with zinc.

(i) What is the name of this method of rust prevention?

..... [1]

(ii) Explain, using the idea of electron transfer, why zinc-coated steel does not rust even when the coating is scratched and the steel is in contact with oxygen and water.

.....

.....

.....

..... [3]

[Total: 12]

2 Iron from the blast furnace is impure. It contains about 4 % carbon and 0.5 % silicon. Most of this impure iron is used to make mild steel, an alloy of iron containing less then 0.25 % carbon.

(a) A jet of oxygen is blown through the molten iron in the presence of a base, usually calcium oxide. Explain how the percentage of carbon is reduced and how the silicon is removed.

.....

.....

.....

..... [4]

(b) Why are steel alloys used in preference to iron?

..... [1]

(ii) State a use of the following alloys.

mild steel .....

stainless steel ..... [2]

(c) Both iron and steel have typical metallic structures - a lattice of positive ions and a sea of electrons.

(i) Suggest an explanation for why they have high melting points.

.....

.....

..... [2]

(ii) Explain why, when a force is applied to a piece of steel, it does not break but just changes its shape.

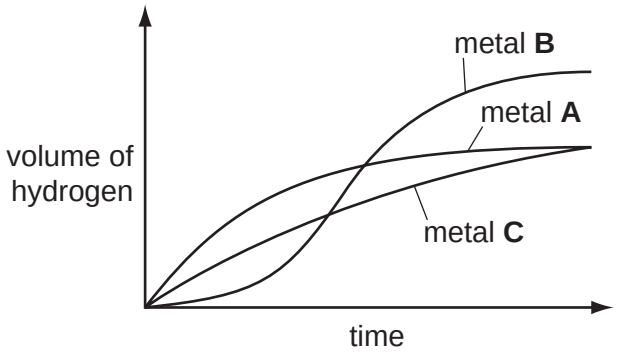
.....

..... [2]

[Total: 11]

3 Excess hydrochloric acid was added to powdered zinc. The hydrogen evolved was collected and its volume measured every 20 seconds.

The experiments were repeated at the same temperature using the same number of moles of powdered magnesium and aluminium.



(a) Identify metals **A**, **B** and **C** by choosing from zinc, magnesium and aluminium. Give a reason for each choice.

metal **A** .....

.....

metal **B** .....

.....

metal **C** .....

..... [5]

(b) Using 'moles', explain why two of the metals form the same volume of hydrogen but the third metal forms a larger volume.

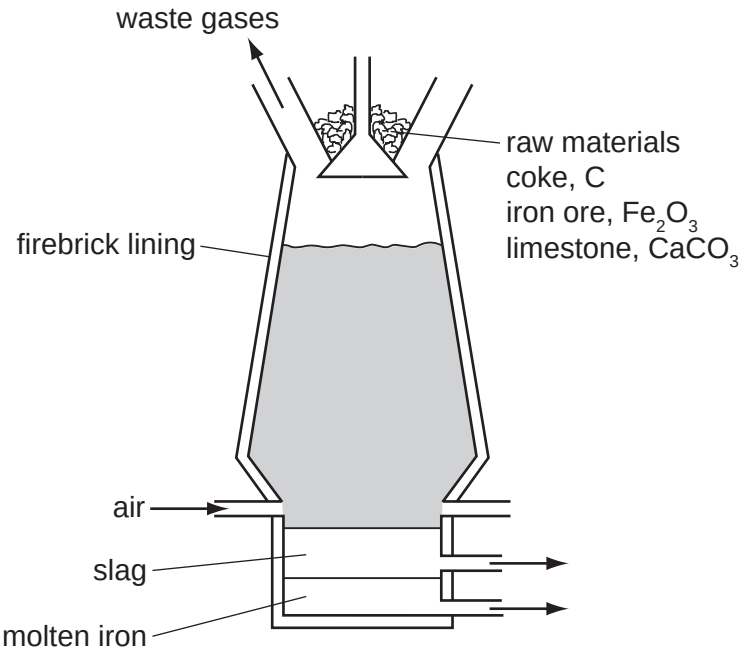
.....

.....

..... [3]

[Total: 8]

4 Iron is extracted from its ore, hematite, in the blast furnace.



Describe the reactions involved in this extraction. Include in your description an equation for a redox reaction and one for an acid / base reaction.

.....

.....

.....

.....

..... [5]

[Total: 5]

5 **(a)** Steel rusting is an example of an oxidation reaction.

(i) Define the term *steel*.

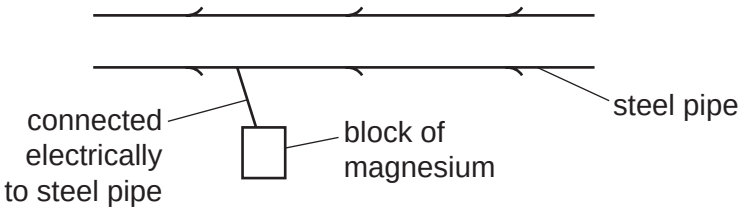
.....

..... [2]

(ii) Define oxidation in terms of electron transfer.

..... [1]

(b) A method of preventing steel rusting is sacrificial protection.

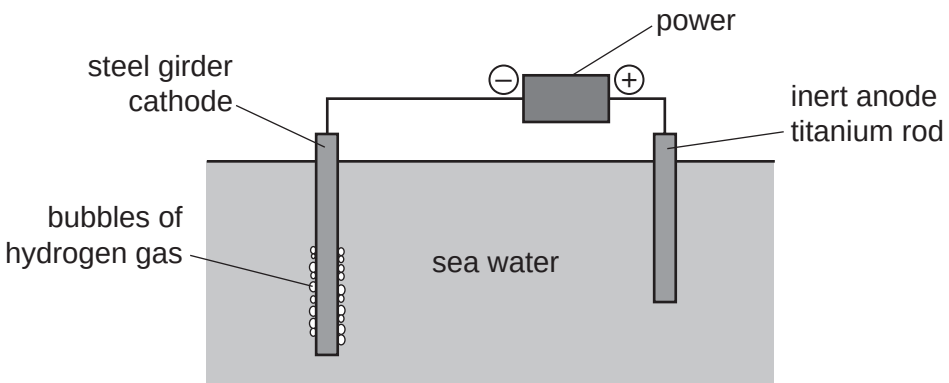


Give an explanation, in terms of electron transfer, why the steel does not rust.

.....

..... [2]

(c) Another method of preventing steel rusting is cathodic protection.



(i) Write an equation for the formation of the gas given off at the steel cathode during cathodic protection.

..... [2]

(ii) Give **one** difference between the two methods.

.....

..... [2]

[Total: 9]

6 About 4000 years ago the Bronze Age started in Britain. Bronze is an alloy of copper and tin.

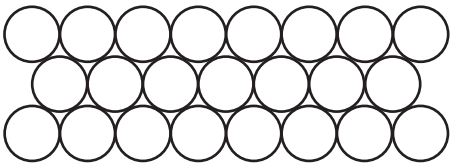
(a) Suggest a reason why a bronze axe was better than a copper axe.

..... [1]

(ii) Brass is another copper alloy. Name the other metal in brass.

..... [1]

(b) The diagram below shows the arrangement of particles in a pure metal.



(i) What is the name given to a regular arrangement of particles in a crystalline solid?

..... [1]

(ii) Draw a diagram which shows the arrangement of particles in an alloy.

[2]

(iii) Explain the term *malleable*.

..... [1]

(iv) Why are metals malleable?

.....

..... [2]

(c) The common ore of tin is tin(IV) oxide and an ore of copper is malachite, $CuCO_3.Cu(OH)_2$.

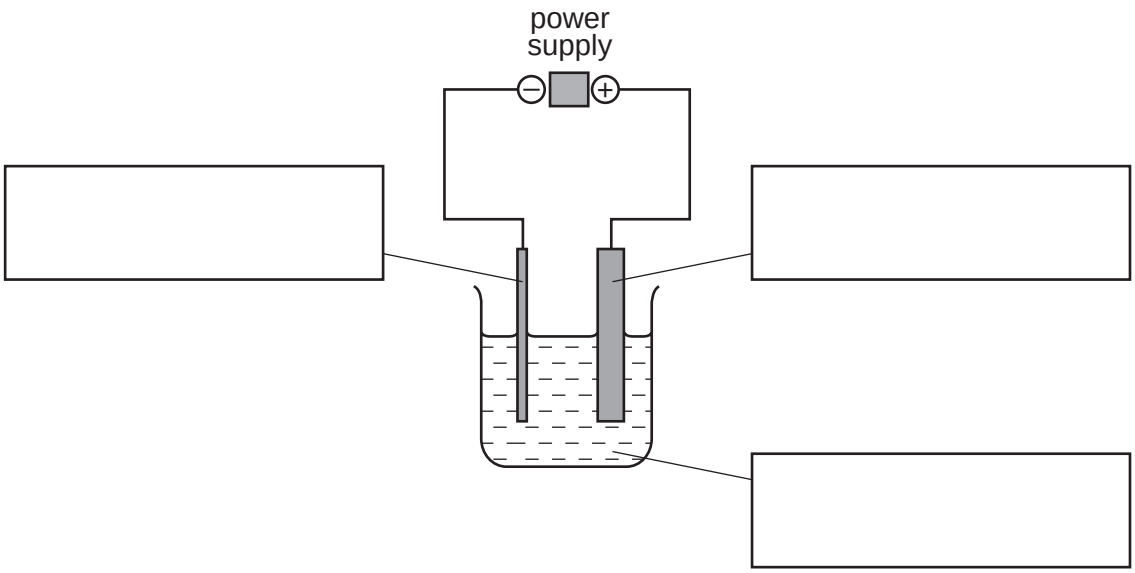
(i) Write a word equation for the reduction of tin(IV) oxide by carbon.

..... [1]

(ii) Malachite is heated to form copper oxide and two other chemicals.
Name these chemicals.

..... and ..... [2]

(iii) Copper oxide is reduced to copper which is then refined by electrolysis.
Label the diagram of the apparatus which could be used to refine copper.



[3]

(iv) Give **one** use of copper, other than making alloys.

..... [1]

[Total: 15]

7 An ore of the important metal zinc is zinc blende, ZnS. This is changed into zinc oxide which is reduced to the impure metal by carbon reduction.

(a) **(i)** How is zinc oxide obtained from zinc sulfide?

.....

..... [2]

(ii) Write a balanced equation for the reduction of zinc oxide by carbon.

..... [1]

(iii) The major impurity in the zinc is cadmium. The boiling point of zinc is 907 °C and that of cadmium is 767 °C.
Name a technique which could be used to separate these two metals.

..... [2]

(b) In common with most metals, zinc is a good conductor of electricity. It is used as an electrode in cells.

(i) Give **two** other uses of zinc.

.....

..... [2]

(ii) Describe the metallic bonding in zinc and then explain why it is a good conductor of electricity.

.....

.....

.....

..... [4]

[Total: 11]