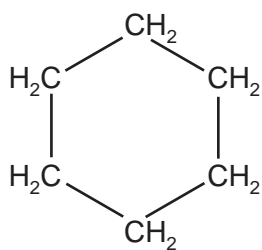


1 The structural formula of cyclohexane is drawn below.



(a) The name gives information about the structure of the compound.  
**Hex** because there are six carbon atoms and **cyclo** because they are joined in a ring.  
What information about the structure of this compound is given by the ending **ane**?

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

(b) What are the molecular and empirical formulae of cyclohexane?

molecular formula .....

empirical formula ..... [2]

(c) Draw the structural formula of cyclobutane.

[1]

(d) (i) Deduce the molecular formula of hexene.

..... [1]

(ii) Explain why cyclohexane and the alkene, hexene, are isomers.

.....

.....

..... [2]

(e) Describe a test which would distinguish between cyclohexane and the unsaturated hydrocarbon hexene.

test .....

result of test with cyclohexane .....

.....

result of test with hexene .....

..... [3]

[Total: 11]

2 Iron from the blast furnace is impure. It contains 5% of impurities, mainly carbon, sulfur, silicon and phosphorus. Almost all of this impure iron is converted into the alloy, mild steel.

(a) (i) State a use of mild steel.

..... [1]

(ii) Name and give a use of another iron-containing alloy.

name .....

use ..... [2]

(b) The oxides of carbon and sulfur are gases. The oxides of silicon and phosphorus are not. Explain how these impurities are removed from the impure iron when it is converted into mild steel.

.....  
.....  
.....  
.....  
..... [5]

[Total: 8]

3 The main uses of zinc are preventing steel from rusting and making alloys.

(a) The main ore of zinc is zinc blende. Zinc blende consists mainly of zinc sulfide, ZnS. There are two major methods of extracting zinc from its ore. They are the direct reduction of zinc oxide to zinc and by electrolysis. In both methods, zinc oxide is made from the zinc sulfide in the ore.

(i) How is zinc oxide made from zinc sulfide?

.....  
..... [1]

(ii) Write an equation for the reaction used to reduce zinc oxide to zinc.

..... [1]

(b) In the electrolytic method, zinc oxide reacts with sulfuric acid to form impure aqueous zinc sulfate. This solution contains Ni<sup>2+</sup>, Co<sup>2+</sup> and Cu<sup>2+</sup> ions as impurities.

(i) Write the equation for the reaction between zinc oxide and sulfuric acid.

..... [1]

(ii) Nickel, cobalt and copper are all less reactive than zinc. Explain why the addition of zinc powder removes these ions from the solution.

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

(c) The solution of zinc sulfate is electrolysed using inert electrodes. This electrolysis is similar to that of copper(II) sulfate with inert electrodes.

(i) Write the equation for the reaction at the negative electrode (cathode).

..... [1]

(ii) Complete the equation for the reaction at the positive electrode (anode).



(iii) The electrolyte changes from zinc sulfate to

..... [1]

**(d)** Brass is an alloy of copper and zinc. Suggest **two** reasons why brass is often used in preference to copper.

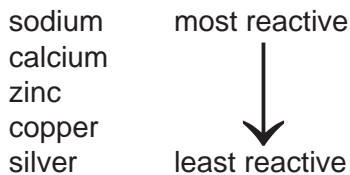
.....  
..... [2]

**(ii)** Sacrificial protection is a method of rust prevention. Explain in terms of electron transfer why steel, which is in electrical contact with zinc, does not rust.

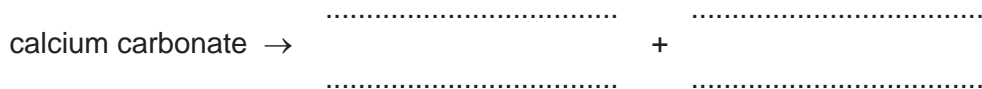
.....  
.....  
.....  
..... [4]

[Total: 15]

4 Reactive metals tend to have unreactive compounds. The following is part of the reactivity series.



(a) Sodium hydroxide and sodium carbonate do not decompose when heated. The corresponding calcium compounds do decompose when heated. Complete the following equations.



(b) All nitrates decompose when heated.

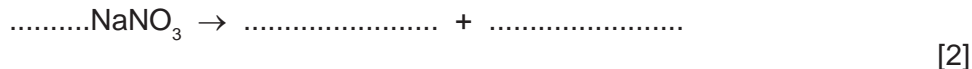
(i) The equation for the thermal decomposition of silver(I) nitrate is given below.



What are the products formed when copper(II) nitrate is heated?

..... [1]

(ii) Complete the equation for the action of heat on sodium nitrate.



(c) Which of the metals in the list on page 5 have oxides which are not reduced by carbon?

..... [1]

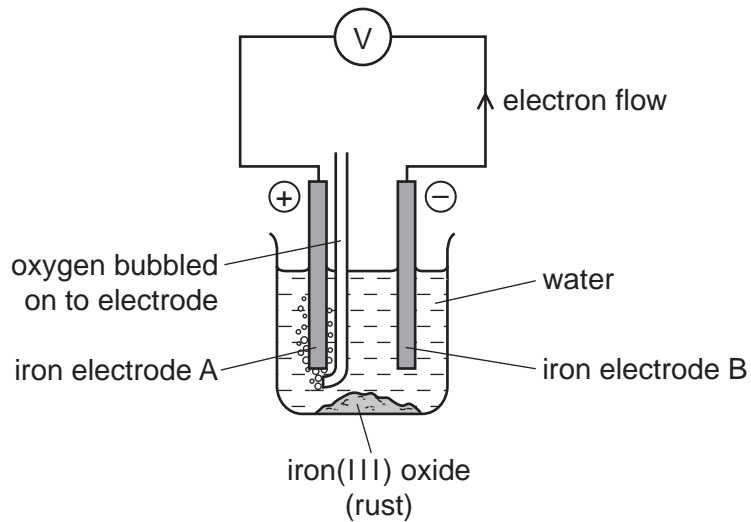
(d) Choose from the list on page 5, metals whose ions would react with zinc.

..... [2]

[Total: 8]

5 Iron and steel rust when exposed to water and oxygen. Rust is hydrated iron(III) oxide.

(a) The following cell can be used to investigate rusting.



(i) What is a cell?

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

(ii) Which electrode will be oxidised and become smaller? Explain your choice.

.....  
.....  
..... [3]

(iii) What measurements would you need make to find the rate of rusting of the electrode you have chosen in (ii)?

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

(iv) Suggest an explanation why the addition of salt to the water increases the rate of rusting.

..... [1]

**(b)** A sample of rust had the following composition:

51.85 g of iron            22.22 g of oxygen            16.67 g of water.

Calculate the following and then write the formula for this sample of rust.

number of moles of iron atoms, Fe = ..... [1]

number of moles of oxygen atoms, O = ..... [1]

number of moles of water molecules, H<sub>2</sub>O = ..... [1]

simplest mole ratio Fe : O : H<sub>2</sub>O is ..... : ..... : .....

formula for this sample of rust is ..... [1]

[Total: 12]



6 The uses of a substance are determined by its properties.

(a) Plastics are poor conductors of electricity. They are used as insulation for electric cables. Which other **two** properties of plastics make them suitable for this purpose?

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

(b) Chromium is a hard, shiny metal. Suggest **two** reasons why chromium is used to electroplate steel.

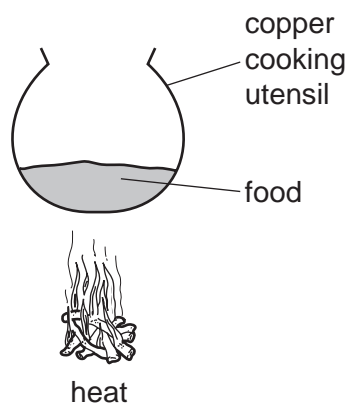
.....  
..... [2]

(c) Why is aluminium used extensively in the manufacture of aeroplanes?



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

(d) Why is copper a suitable material from which to make cooking utensils?



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

(e) Describe the bonding in a typical metal.

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

[Total: 10]