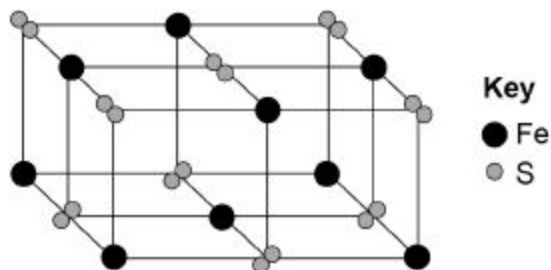


1

This question is about metals and metal compounds.

(a) Iron pyrites is an ionic compound.

The diagram below shows a structure for iron pyrites.



Determine the formula of iron pyrites.

Use the diagram above.

(1)

(b) An atom of iron is represented as ${}^{56}_{26}\text{Fe}$

Give the number of protons, neutrons and electrons in this atom of iron.

Number of protons _____

Number of neutrons _____

Number of electrons _____

(3)

(c) Iron is a transition metal.

Sodium is a Group 1 metal.

Give **two** differences between the properties of iron and sodium.

1. _____

2. _____

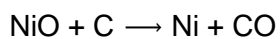
(2)

Nickel is extracted from nickel oxide by reduction with carbon.

(d) Explain why carbon can be used to extract nickel from nickel oxide.

(2)

(e) An equation for the reaction is:



Calculate the percentage atom economy for the reaction to produce nickel.

Relative atomic masses (A_r): C = 12 Ni = 59

Relative formula mass (M_r): NiO = 75

Give your answer to 3 significant figures.

Percentage atom economy = _____ %

(3)

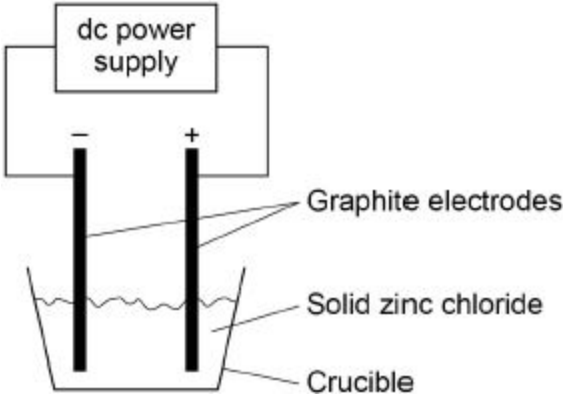
(Total 11 marks)

2

A student investigated the electrolysis of different substances.

Figure 1 shows the apparatus.

Figure 1



(a) Explain why electrolysis would not take place in the apparatus shown in Figure 1.

(2)

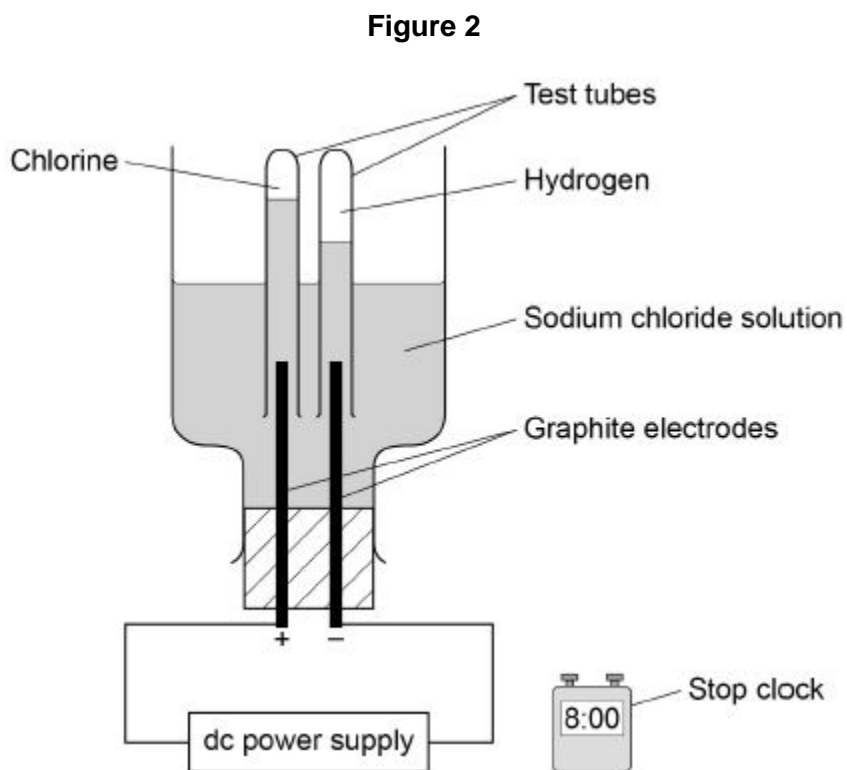
(b) Explain why graphite conducts electricity.

Answer in terms of the structure and bonding in graphite.

(3)

The student investigated how the volume of gases produced changes with time in the electrolysis of sodium chloride solution.

Figure 2 shows the apparatus.



(c) The student made an error in selecting the apparatus for this investigation.

How should the apparatus be changed?

Give **one** reason for your answer.

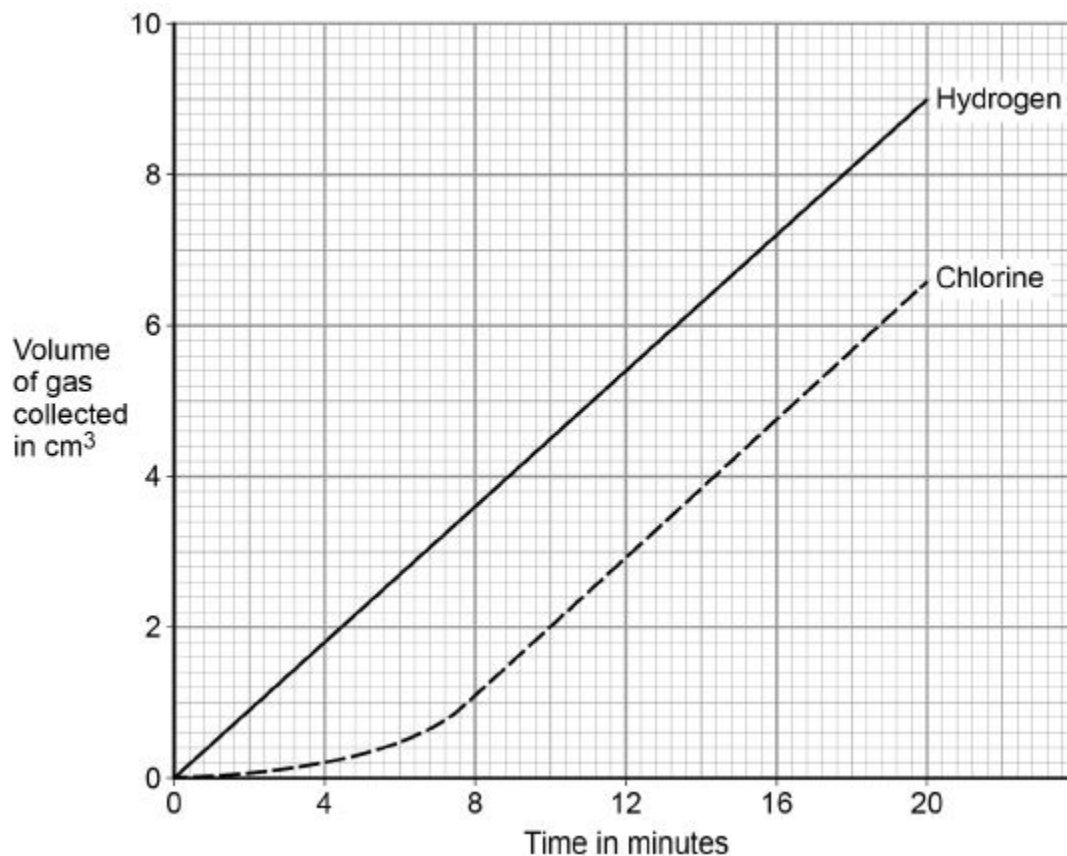
(2)

Another student used the correct apparatus.

This student measured the volumes of gases collected every minute for 20 minutes.

Figure 3 shows the student's results.

Figure 3



(d) Describe the trends shown in the results.

Use values from **Figure 3**.

(3)

(e) The number of moles of each gas produced at the electrodes is the same.

No gas escapes from the apparatus.

Suggest **one** reason for the difference in volume of each gas collected.

(1)

(f) Calculate the amount in moles of chlorine collected after 20 minutes.

Use **Figure 3**.

The volume of one mole of any gas at room temperature and pressure is 24.0 dm³

Give your answer in standard form.

Moles of chlorine = _____ mol

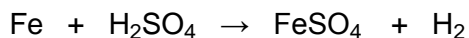
(3)

(Total 14 marks)

3

'Iron tablets' usually contain iron sulphate (FeSO₄).

(a) This salt can be made by reacting iron with sulphuric acid.



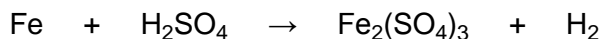
Calculate the mass of iron sulphate that could be obtained from 4 g of iron.

(Relative atomic masses: Fe = 56, H = 1, O = 16, S = 32)

Mass of iron sulphate = _____ g

(3)

- (b) Under different conditions, another type of iron sulphate may form.
Balance the symbol equation for this reaction.

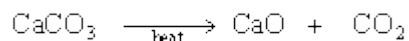


(1)

(Total 4 marks)

4

Limestone (CaCO_3) is a raw material. On strong heating it is converted to calcium oxide which is a very useful substance.



- (a) Calculate the formula mass (M_r) of calcium carbonate.

M_r of calcium carbonate = _____

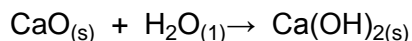
(2)

- (b) About 60 million tonnes of calcium oxide is made in Britain each year.
Calculate the mass of calcium carbonate needed to make this amount of calcium oxide.

Mass of calcium carbonate needed = _____ million tonnes

(4)

- (c) Water is added to some of the calcium oxide produced in a process known as 'slaking'. The product of this reaction is used to make plaster.



- (i) Give the chemical name of Ca(OH)_2 .

(1)

- (ii) What is the physical state of the Ca(OH)_2 formed in the reaction?

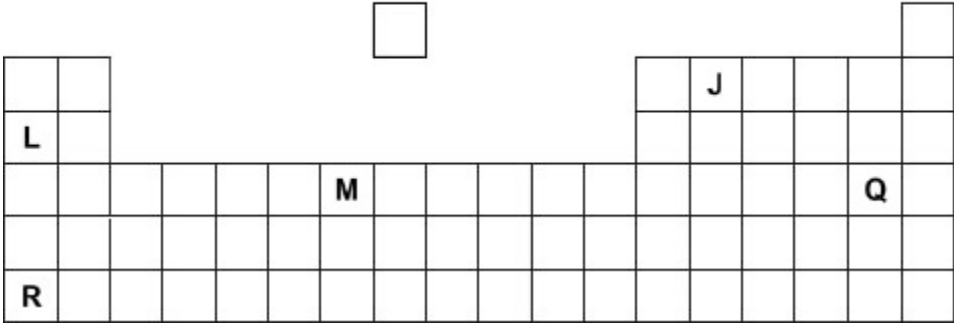
(1)

(Total 8 marks)

5

Figure 1 shows an outline of the modern periodic table.

Figure 1



J, L, M, Q and R represent elements in the periodic table.

(a) Which element has four electrons in its outer shell?

Tick (✓) **one** box.

J L M Q R

(1)

(b) Which **two** elements in **Figure 1** are in the same period?

_____ and _____

(1)

(c) Which element reacts with potassium to form an ionic compound?

Tick (✓) **one** box.

J L M Q R

(1)

(d) Which element forms ions with different charges?

Tick (✓) **one** box.

J L M Q R

(1)

(e) Which element has three electron shells?

Tick (✓) **one** box.

J

L

M

Q

R

(1)

(f) In the 1860s scientists were trying to organise elements.

Figure 2 shows the table published by John Newlands in 1865.

The elements are arranged in order of their atomic weights.

Figure 2

| | | | | | | |
|-------|----|----|-------|----|-------|-------|
| H | Li | Be | B | C | N | O |
| F | Na | Mg | Al | Si | P | S |
| Cl | K | Ca | Cr | Ti | Mn | Fe |
| Co,Ni | Cu | Zn | Y | In | As | Se |
| Br | Rb | Sr | Ce,La | Zr | Di,Mo | Ro,Ru |
| Pd | Ag | Cd | U | Sn | Sb | Te |

Figure 3 shows the periodic table published by Dmitri Mendeleev in 1869.

Figure 3

| | | | | | | | | | | | | | | | | |
|----|----|----|----|-----|------|----|----|----|----|----|----|----|----|----|----|----|
| H | | | | | | | | | | | | | | | | |
| Li | Be | B | C | N | O | F | | | | | | | | | | |
| Na | Mg | Al | Si | P | S | Cl | | | | | | | | | | |
| K | Cu | Ca | Zn | ? ? | Ti ? | V | As | Cr | Se | Mn | Br | Fe | Co | Ni | | |
| Rb | Ag | Sr | Cd | Y | In | Zr | Sn | Nb | Sb | Mo | Te | ? | I | Ru | Rh | Pd |

Mendeleev's table became accepted by other scientists whereas Newlands' table was not.

Evaluate Newlands' and Mendeleev's tables.

You should include:

- a comparison of the tables
- reasons why Mendeleev's table was more acceptable.

Use **Figure 2** and **Figure 3** and your own knowledge.

(6)
(Total 11 marks)