

Combined Science

Paper 2

Foundation Tier

Total Marks

Thursday 14 May 2020 – Morning

Time: 1 hour 10 minutes plus your additional time allowance

In the boxes below, write your name, centre number and candidate number.

Surname					
Other names					
Centre Number					
Candidate Number					

YOU MUST HAVE

Calculator, ruler.

YOU WILL BE GIVEN

Diagram Booklet.

Periodic Table.

INSTRUCTIONS

Answer ALL questions.

**Answer the questions in the spaces provided
– there may be more space than you need.**

Calculators may be used.

**Any diagrams may NOT be accurately drawn, unless
otherwise indicated.**

**You must SHOW ALL YOUR WORKING OUT with YOUR
ANSWER CLEARLY IDENTIFIED at the END OF YOUR
SOLUTION.**

INFORMATION

The total mark for this paper is 60.

The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.

In questions marked with an **ASTERISK (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.**

A periodic table is provided.

ADVICE

Read each question carefully before you start to answer it.

Try to answer every question.

Check your answers if you have time at the end.

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

- 1 (a) When solid sodium chloride is mixed with water, sodium chloride solution forms.**

What name is given to the process of mixing a solid with water to form a solution? (1 mark)

☐ **A crystallising**

☐ **B diluting**

☐ **C dissolving**

☐ **D melting**

(continued on the next page)

1 continued.

(b) Sodium reacts with hydrochloric acid to form sodium chloride and hydrogen.

**(i) Write the word equation for this reaction.
(2 marks)**

_____ →

(continued on the next page)

1 continued.

- (ii) The hazard symbol shown in Figure 1 is used on containers of sodium.

FIGURE 1



What is the meaning of this hazard symbol?
(1 mark)

- ☐ A corrosive
- ☐ B flammable
- ☐ C oxidising
- ☐ D toxic

(continued on the next page)

1 continued.

(iii) Hydrogen has one electron in its electron shell.

In the Diagram Booklet Figure 2 shows the incomplete dot and cross diagram of a hydrogen molecule.

Complete Figure 2 to show the electrons in the covalent bond between the two atoms of hydrogen. (1 mark)

(continued on the next page)

1 continued.

(c) The pH of a sodium chloride solution was measured.

(i) State what could be used to measure the pH of a solution. (1 mark)

(ii) Sodium chloride solution is neutral.

Give the pH of this solution. (1 mark)

(TOTAL FOR QUESTION 1 = 7 MARKS)

2 Chlorine has an atomic number of 17.

(a) In the Diagram Booklet Figure 3 shows the arrangement of electrons in an atom of chlorine.

(i) What is the electronic configuration of this atom? (1 mark)

☐ **A 10.7**

☐ **B 17**

☐ **C 2.8.7**

☐ **D 7.8.2**

(continued on the next page)

2 continued.

(ii) Explain, using Figure 3, why chlorine belongs to group 7 of the periodic table. (2 marks)

(continued on the next page)

2 continued.

- (b) The nucleus of an atom is made up of protons and neutrons.**

Atoms of chlorine contain 17 protons.

In the Diagram Booklet Figure 4 shows some information about a proton, a neutron and an electron.

- (i) Explain, using the information in Figure 3 and Figure 4, why atoms of chlorine have no overall charge. (2 marks)**

(continued on the next page)

2 continued.

- (ii) Atoms of chlorine-37 have a mass number of 37.**

Calculate the number of neutrons in atoms of chlorine-37. (1 mark)

number of neutrons = _____

(continued on the next page)

2 continued.

(iii) There are two isotopes of chlorine, chlorine-35 and chlorine-37.

**Explain the meaning of the term ISOTOPES.
(2 marks)**

(TOTAL FOR QUESTION 2 = 8 MARKS)

- 3 (a) In the 19th century, Mendeleev arranged the elements known at the time to form his periodic table.

Mendeleev's periodic table is different from the modern periodic table.

State ONE difference between Mendeleev's periodic table and the modern periodic table.
(1 mark)

(continued on the next page)

3 continued.

(b) Aluminium oxide reacts with hydrochloric acid to form a salt and water.

(i) State the name of the salt formed. (1 mark)

(ii) In this reaction aluminium oxide is a base.

State the type of reaction that takes place when an acid reacts with a base. (1 mark)

(continued on the next page)

3 continued.

- (c) Gallium, Ga, is in the same group of the modern periodic table as aluminium.**

The formula of aluminium oxide is Al_2O_3 .

- (i) Predict the formula of gallium oxide. (1 mark)**
-

- (ii) Gallium oxide has a very high melting point.**

Gallium oxide does not conduct electricity when solid but does conduct electricity when molten.

**What type of substance is gallium oxide?
(1 mark)**

- ☐ **A giant covalent**
- ☐ **B ionic**
- ☐ **C metallic**
- ☐ **D simple molecular**

(continued on the next page)

3 continued.

(d) In the Diagram Booklet Figure 5 shows the changes of state for gallium and the arrangement of particles in liquid gallium.

- (i) Complete the boxes for solid gallium and gaseous gallium by drawing the arrangement of the particles in each of these physical states. (2 marks)**
 - (ii) Give the name of the change of state labelled Y in Figure 5. (1 mark)**
-

(continued on the next page)

3 continued.

(e) Gallium metal is a conductor of electricity.

Explain how metals conduct electricity. (2 marks)

(TOTAL FOR QUESTION 3 = 10 MARKS)

- 4 Some metals are found in the Earth's crust as uncombined elements.**

Reactive metals are found in ores.

In ores, metals are combined with other elements.

- (a) Which of these metals is found as the uncombined element in the Earth's crust? (1 mark)**

☐ **A aluminium**

☐ **B gold**

☐ **C potassium**

☐ **D zinc**

(continued on the next page)

4 continued.

(b) Give TWO advantages of recycling metals rather than extracting metals from their ores. (2 marks)

1 _____

2 _____

(c) An ore of iron is mostly iron oxide, Fe_2O_3 .

Iron can be extracted from this iron oxide by heating it with carbon.

Balance this equation for the reaction that takes place. (1 mark)



(continued on the next page)

4 continued.

(d) Most copper ores are described as low grade.

This means that the percentage of copper in the ore is very small.

5000 kg of one copper ore was found to contain 42.5 kg of copper.

**Calculate the percentage of copper in this ore.
(2 marks)**

percentage of copper in ore = _____

(continued on the next page)

4 continued.

- (e) In one stage of the extraction of lead from its ore, lead oxide is heated strongly with carbon.**

The equation for the reaction is



Explain, using this equation, which substance has been oxidised in this reaction. (2 marks)

(continued on the next page)

4 continued.

- (f) A titanium ore was analysed and found to contain 12g of titanium atoms combined with 8.0g of oxygen atoms.**

Calculate the empirical formula of this titanium compound.

(relative atomic masses: Ti = 48, O = 16)

You must show your working. (3 marks)

empirical formula = _____

(TOTAL FOR QUESTION 4 = 11 MARKS)

Turn over

5 In the Diagram Booklet Figure 6 shows the apparatus that can be used to electrolyse sodium sulfate solution using inert electrodes.

(a) Hydrogen is produced at the negative electrode during electrolysis.

**(i) Describe the test to show the gas is hydrogen.
(2 marks)**

(continued on the next page)

5 continued.

(ii) What is the name of gas X that forms at the positive electrode? (1 mark)

- ☐ **A ammonia**
- ☐ **B oxygen**
- ☐ **C nitrogen**
- ☐ **D sulfur dioxide**

**(iii) State what is meant by the term
ELECTROLYSIS. (2 marks)**

(continued on the next page)

5 continued.

- (b) The sodium sulfate solution was made by dissolving 28.4 g of sodium sulfate in water to make 250 cm³ of solution.

Calculate the concentration of this solution in g dm⁻³.

Give your answer to three significant figures.
(3 marks)

concentration = _____ g dm⁻³

(continued on the next page)

5 continued.

(c) The ions present in sodium sulfate are

sodium Na^+

sulfate SO_4^{2-}

Write the formula of sodium sulfate using this information. (1 mark)

(d) (i) In Figure 6, in the Diagram Booklet, the gases given off at the electrodes are collected in test-tubes. However, the actual volume of gases cannot be measured using these test-tubes.

Suggest what apparatus could be used in place of the test-tubes in Figure 6 to measure the volume of gases given off. (1 mark)

(continued on the next page)

5 continued.

- (ii) State what could be added into the circuit to show a current is flowing during electrolysis.
(1 mark)**

(TOTAL FOR QUESTION 5 = 11 MARKS)

- 6 The word equation for the reaction between copper carbonate and dilute sulfuric acid is



- (a) (i) Complete the balanced equation for this reaction. (2 marks)



- (ii) Calculate the relative formula mass of copper carbonate, CuCO_3 . (2 marks)

(relative atomic masses: C = 12.0, O = 16.0, Cu = 63.5)

relative formula mass of $\text{CuCO}_3 = \underline{\hspace{2cm}}$

(continued on the next page)

Turn over

6 continued.

(iii) What is the chemical test to show that a gas is carbon dioxide? (1 mark)

- ☐ **A bubble the gas through limewater, limewater turns cloudy**
- ☐ **B put damp blue litmus paper in the gas, litmus paper turns red**
- ☐ **C put a lighted splint into the gas, splint is extinguished**
- ☐ **D measure the pH of the gas, pH = 4**

(continued on the next page)

6 continued.

(b) In the Diagram Booklet Figure 7 shows a conical flask containing dilute sulfuric acid.

Copper carbonate is added to the acid in the flask.

The copper carbonate is added one spatula measure at a time until the reaction has finished.

(i) State TWO observations that would show the reaction has finished. (2marks)

1 _____

2 _____

(continued on the next page)

6 continued.

- *(ii) Describe how you would obtain a solution of copper sulfate from the mixture and how you would obtain pure, dry copper sulfate crystals from this solution.**

Your description should include the apparatus you would use.

**You may wish to use diagrams in your answer.
(6 marks)**

(continued on the next page)

Turn over

6 continued.

[illegible]

(continued on the next page)

Turn over

6 continued.

[illegible]

(continued on the next page)

Turn over

6 continued.

[illegible]

(continued on the next page)

Turn over

6 continued.

[illegible]

(continued on the next page)

Turn over

6 continued.

[illegible]

(TOTAL FOR QUESTION 6 = 13 MARKS)

TOTAL FOR PAPER = 60 MARKS
END