



BENENDEN
CHEMISTRY

Sixth Form Entrance Examination 2021

Time: 1 hour 30 minutes

Full Name:.....

Current School:.....

Date:.....

Instructions to Candidates:

- Fill in the boxes above with your name, school and the date
- Use black ink or ball point pen. If you change your mind about an answer please put a line through it and then write your new answer (no Tipex or correction fluid please)
- Answer **all** questions
- Answer the questions in the space provided
- Show all of the steps in any calculations and remember to include units
- You may use a calculator
- Use the periodic table provided
- Marks available for each question are indicated in brackets
- Total marks for this paper 100

Questions

Q1.

- (a) Complete the sentence by putting a cross (☒) in the box next to your answer.
An acid reacts with a metal oxide to form.

(1)

- A** a salt and hydrogen only
 B a salt and oxygen only
 C a salt only
 D a salt and water only

- (b) Acids also react with metal carbonates.

The word equation for the reaction of copper carbonate with dilute nitric acid is



- (i) State **two** things you would **see** when solid copper carbonate reacts with dilute nitric acid.

(2)

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- (ii) Write the balanced equation for the reaction of copper carbonate with dilute nitric acid.

(3)

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- (c) Two gases can be produced by the electrolysis of water, under suitable conditions.

- (i) Explain what is meant by **electrolysis**.

(2)

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- (ii) One of the gases is hydrogen. Describe a test to show the gas is hydrogen.

(2)

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(Total for Question = 10 marks)

Q2.

The names and formulae of the first three alcohols in the homologous series of alcohols are given in the table.

name of alcohol	formula
methanol	CH ₃ OH
ethanol	C ₂ H ₅ OH
propanol	C ₃ H ₇ OH

(i) Pentanol is another member of the alcohol homologous series.

A molecule of pentanol contains five carbon atoms.
Predict the formula of a molecule of pentanol.

(1)

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(ii) Draw the structure of a molecule of ethanol, C₂H₅OH, showing all the bonds.

(1)

(Total for question = 2 marks)

Q3.

Lithium, sodium and potassium are metals in group 1 of the periodic table.

They are good conductors of heat and electricity.
The freshly-cut metals are shiny.

(a) (i) Give another physical property of all three of these metals. (1)

(ii) Explain, in terms of electrons in their atoms, why lithium, sodium and potassium are in group 1 of the periodic table. (2)

(b) A small piece of potassium is added to water.

(i) Describe what you would **see** in this reaction.

(2)

(ii) Which of these is the balanced equation for this reaction?

Put a cross () in the box next to your answer.

(1)

- A** $2\text{K} + 2\text{H}_2\text{O} \rightarrow \text{K}_2\text{O} + 2\text{H}_2$
- B** $2\text{K} + \text{H}_2\text{O} \rightarrow \text{K}_2\text{O} + \text{H}_2$
- C** $4\text{K} + 3\text{H}_2\text{O} \rightarrow 4\text{KOH} + \text{H}_2$
- D** $2\text{K} + 2\text{H}_2\text{O} \rightarrow 2\text{KOH} + \text{H}_2$

(c) There is an increase in reactivity of these group 1 metals from lithium to potassium.
Explain this increase in reactivity.

(2)

(Total for Question = 8 marks)

Q4.

(a) The table shows the number of electrons, neutrons and protons in particles P, Q, R, S, T and V.

particle	number of		
	electrons	neutrons	protons
P	1	0	1
Q	3	4	3
R	8	8	8
S	13	14	13
T	18	16	16
V	18	20	20

(i) Which particle is a negatively charged ion?

Put a cross (☒) in the box next to your answer.

(1)

- A P
- B S
- C T
- D V

(ii) Which particles are atoms of metals?

Put a cross (☒) in the box next to your answer.

(1)

- A P and R
- B Q and R
- C Q and S
- D Q, S and V

(b) Each element has an atomic number.

(i) State what is meant by **atomic number**.

(1)

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(ii) The atomic number of boron is 5.

Boron exists as two isotopes boron-10 and boron-11.

Use this information to explain why boron-10 and boron-11 are isotopes.

(2)

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(c) (i) Explain what is meant by the term relative atomic mass.

(2)

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(ii) A sample of boron contains

- 19.7% of boron-10.
- 80.3% of boron-11.

Use this information to calculate the relative atomic mass of boron.

(3)

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(Total for Question = 10 marks)

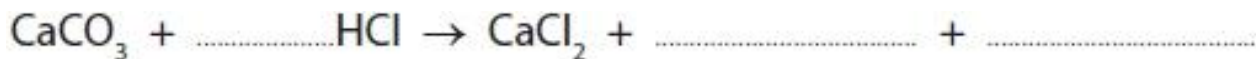
Q5.

Marble chips react with dilute hydrochloric acid.

Marble is a form of calcium carbonate.

(i) Complete the balanced equation for this reaction.

(2)



(ii) Explain how using smaller sized marble chips affects the rate of this reaction, when all the other conditions remain the same.

(2)

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(iii) Explain, in terms of collisions between particles, how increasing the concentration of the hydrochloric acid affects the rate of this reaction, when all the other conditions remain the same.

(2)

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(Total for question = 6 marks)

Q6.

Copper hydroxide, copper oxide and copper sulfide are three compounds of copper.

In an analysis of copper sulfide, 12.7 g of copper was found to be combined with 3.2 g of sulfur.

Calculate the empirical formula of the copper sulfide.

Show your working.

(relative atomic masses: Cu = 63.5, S = 32).

(3)

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empirical formula =

(Total for question = 3 marks)

Q7.

The table shows some properties of six compounds.

compound	melting point / °C	boiling point / °C	solubility in water	electrical conductivity of solution
copper sulfate	200	decomposes	soluble	high
hexane	-95	69	insoluble	does not dissolve
hydrogen chloride	-112	-85	soluble	high
octane	-57	126	insoluble	does not dissolve
silicon(IV) oxide	1610	2230	insoluble	does not dissolve
sodium chloride	801	1413	soluble	high

(a) Which of the following lists of compounds from the table contains only ionic compounds?
Put a cross () in the box next to your answer.

(1)

- A** copper sulfate, octane and sodium chloride
- B** silicon(IV) oxide and sodium chloride
- C** copper sulfate and sodium chloride
- D** copper sulfate and silicon (IV) oxide

(b) Two of the compounds in the table produce a colour in a flame test.
Give the name of **one** of these compounds and the colour it produces in the flame test.

(2)

compound

colour

(c) Hexane is a covalent compound containing simple molecules.
It has a low boiling point.

(i) Explain why it has a low boiling point.

(2)

(ii) Hexane and water are immiscible.

Describe how separate samples of hexane and water can be obtained from a mixture of Hexane and water.

(2)

(d) Draw a dot and cross diagram of a molecule of hydrogen chloride.
Show outer electrons only.

(2)

(Total for Question = 9 marks)

**Q8.
Structures**

The table shows some properties of diamond and graphite.

diamond	graphite
colourless crystals	black, shiny solid
very hard	flakes easily
does not conduct electricity	conducts electricity

(i) Suggest why diamond and graphite might be expected to have similar properties. (1)

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(ii) By referring to its structure, explain why diamond is very hard. (3)

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(iii) By referring to its structure, explain why graphite flakes easily. (2)

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(Total for Question = 6 marks)

Q9.

(a) An experiment is carried out to measure the temperature change when solid ammonium chloride is dissolved in water.

- initial temperature of water = 19°C
- final temperature of solution = 15°C

Explain what the temperature readings show about the type of heat change occurring when ammonium chloride dissolves in water.

(2)

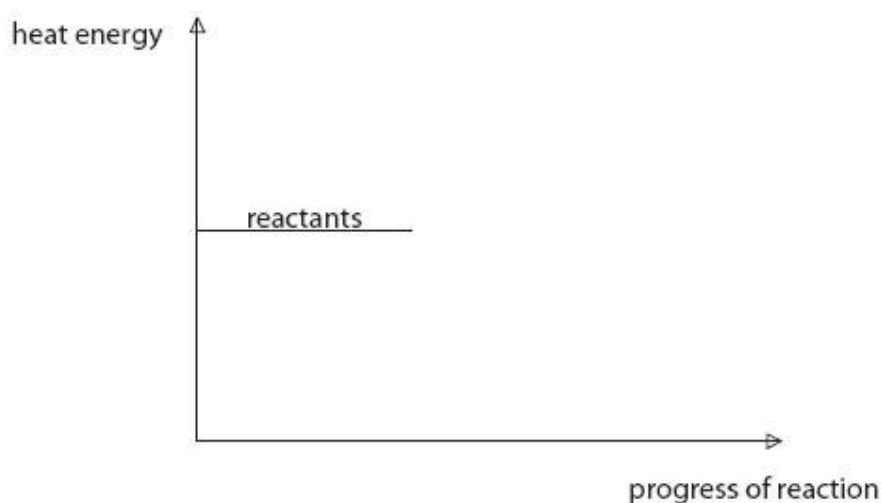
(b) When zinc reacts with copper sulfate solution, copper and zinc sulfate solution are formed.



This reaction is exothermic.

Use this information to complete the diagram.

(2)



(c) Reactions are accompanied by heat changes.

The heat changes are the results of bonds being broken and bonds being formed.

Which row of the table shows the heat energy changes that occur when bonds are broken and when bonds are formed?

Put a cross (☒) in the box next to your answer.

(1)

	bonds broken	bonds formed
<input type="checkbox"/> A	heat energy is released	heat energy is released
<input type="checkbox"/> B	heat energy is required	heat energy is required
<input type="checkbox"/> C	heat energy is released	heat energy is required
<input type="checkbox"/> D	heat energy is required	heat energy is released

(d) Reactions can occur when particles collide.

Rates of reactions can be altered by changing conditions.

Explain how the rate of reaction between a solid and a liquid is altered by changing the size of the pieces of solid and by changing the temperature of the liquid.

(6)

(Total for Question = 11 marks)

Q10.

(a) Complete the sentence by putting a cross (☒) in the box next to your answer.

(i) The percentage of carbon dioxide in the Earth's atmosphere today is

(1)

- A** greater than 5%
- B** 4%
- C** 3%
- D** less than 0.5%

(ii) The percentage of carbon dioxide in the Earth's atmosphere today is less than that in the Earth's earliest atmosphere.

Explain what has caused the percentage of carbon dioxide to decrease.

(2)

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(iii) Carbon dioxide and other gases in the atmosphere help to keep the Earth warm.
State how these gases keep the Earth warm.

(1)

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(b) Describe the test to show that a gas is oxygen.

(2)

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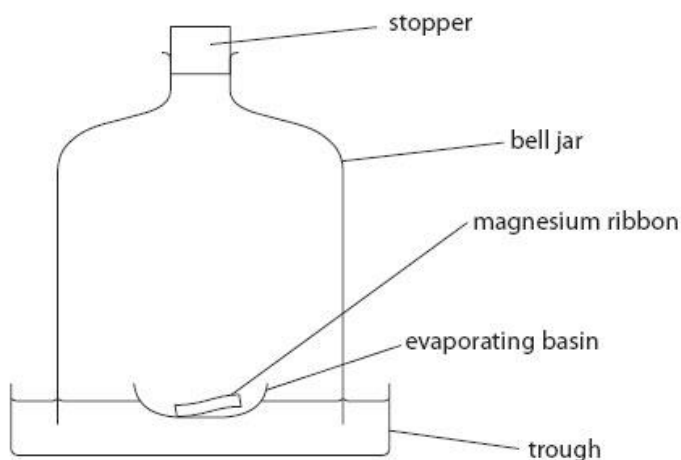
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(c) Magnesium reacts with oxygen to form magnesium oxide.

An excess of magnesium ribbon was placed in an evaporating basin that was floated on water in a trough.

The magnesium ribbon was lit.

A bell jar was placed over the evaporating basin and the stopper inserted to seal the experiment.



When the magnesium flame went out, there was some magnesium left in the basin.

When the apparatus had cooled, the water in the bell jar had risen.

(i) Explain why the water level had risen.

(2)

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(ii) At the start of the experiment, the volume of the air in the bell jar was 1000 cm^3 .

Assume that 21% of the air by volume is oxygen.

Calculate the volume of gas that was present in the bell jar at the end of the experiment.

(2)

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volume of gas = cm^3

(d) Metal oxides react with acids to produce salts and water.

Dilute sulfuric acid was added to magnesium oxide.

State the name of the salt formed.

(1)

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(Total for Question = 11 marks)

Q11.

In industry sodium carbonate is made from sodium chloride solution and calcium carbonate in the Solvay Process.

(a) Describe the test to show that calcium carbonate contains carbonate ions.

(3)

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(b) Another product of the Solvay Process is calcium chloride.
Calculate the relative formula mass of calcium chloride, CaCl_2 .
(Relative atomic masses: Ca = 40; Cl = 35.5).

(1)

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(c) The overall equation for the Solvay Process is:
 $2\text{NaCl} + \text{CaCO}_3 \rightarrow \text{Na}_2\text{CO}_3 + \text{CaC}_2$
Calculate the maximum mass of sodium carbonate that could be formed by reacting 40 kg of calcium carbonate with an excess of sodium chloride solution.
(Relative formula masses: $\text{CaCO}_3 = 100$; $\text{Na}_2\text{CO}_3 = 106$).

(2)

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(d) Sodium carbonate was made in a laboratory experiment.
The theoretical yield of the experiment was 15.0 g.
The actual yield of the experiment was 10.4 g.
(i) Calculate the percentage yield of sodium carbonate in this experiment.

(2)

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(ii) Suggest **two** reasons why the actual yield was less than the theoretical yield.

(2)

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(Total for Question = 10 marks)

Q12.

(a) Two pieces of metal can be joined by welding them together.



(i) Complete the sentence by putting a cross (☒) in the box next to your answer.
The structure of a metal is a lattice of

(1)

- A** anions
- B** anions and cations
- C** cations in a sea of electrons
- D** molecules in a sea of electrons

(ii) To join two pieces of metal by welding, they must be melted together.
State why a high temperature has to be used.

(1)

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(iii) The pieces of metal are welded together in an atmosphere of argon.
Explain why an atmosphere of argon is used.

(2)

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(b) Some metals react with halogens.
Iron reacts with bromine, Br₂, to form iron(III) bromide, FeBr₃.
Write the balanced equation for this reaction.

(2)

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(c) Complete the sentence by putting a cross (☒) in the box next to your answer.
At room temperature, iodine is a

(1)

- A** brown gas

- B brown liquid
- C grey solid
- D purple gas

(d) When a halogen is added to a solution containing halide ions a displacement reaction may occur.

In the table

- ✓ shows a displacement reaction occurs
- × shows a displacement reaction does not occur

halogen added	halide ion in solution		
	chloride ion	bromide ion	iodide ion
chlorine		✓	✓
bromine	×		✓
iodine	×	×	

Use the information in the table to explain the order of reactivity of the three halogens.

(2)

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(Total for Question = 9 marks)

Q13.

Complete the sentence by putting a cross (☒) in the box next to your answer.
The number of oxygen atoms in the formula $\text{Ca}_3(\text{PO}_4)_2$ is

(1)

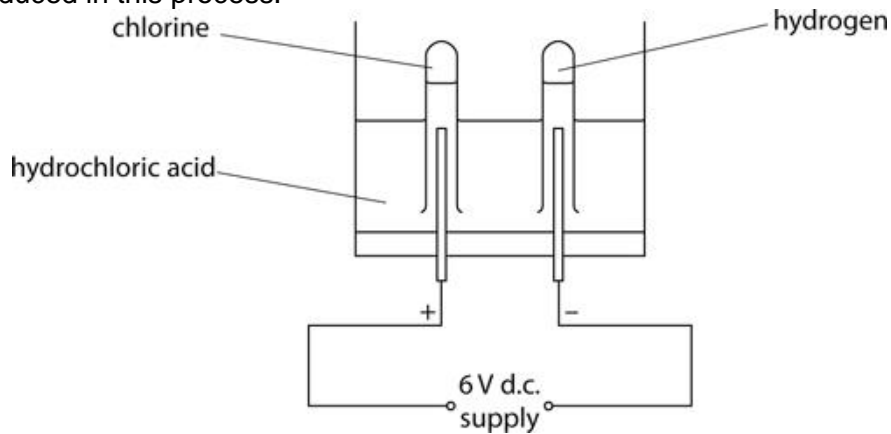
- A 2
- B 4
- C 8
- D 12

(Total for Question = 1 mark)

Q14.

The diagram shows the electrolysis of hydrochloric acid.

Chlorine is produced in this process.



- (i) Chlorine is given off in this experiment.
Describe the test to show the gas is chlorine.

(2)

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- (ii) Explain **one** precaution that should be taken if hydrochloric acid is electrolysed on a large scale.

(2)

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(Total for Question = 4 marks)

END OF QUESTION PAPER