

GCSE (9–1) Chemistry A (Gateway Science)

H

J248/03 Paper 3 (Higher Tier)

Sample Question Paper

Date – Morning/Afternoon

Version 2.1

Time allowed: 1 hour 45 minutes

You must have:

- the Data Sheet

You may use:

- a scientific or graphical calculator
- a ruler



First name

Last name

Centre number

Candidate number

INSTRUCTIONS

- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION

- The total mark for this paper is **90**.
- The marks for each question are shown in brackets [].
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document consists of **28** pages

SECTION A

Answer **all** the questions.

You should spend a maximum of 30 minutes on this section.

1 A student separates the colours in a sample of black ink using paper chromatography.

- He puts a spot of black ink onto a piece of filter paper.
- He dips the filter paper into ethanol in a beaker.

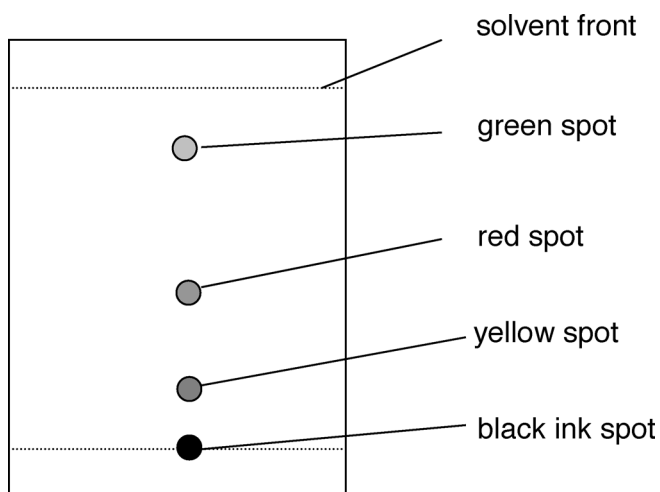
What phase describes **ethanol** in this experiment?

- A Gas phase
- B Mobile phase
- C Solid phase
- D Stationary phase

Your answer

[1]

2 Look at the chromatogram.



What is the R_f value of the **green** spot? Use a ruler to help you.

- A 0.17
- B 0.42
- C 0.83
- D 1.00

Your answer

[1]

3 What is the best description of the particles in a liquid?

	Distance between particles	Movement of particles
A	close together	in continuous random motion
B	close together	vibrating about a fixed point
C	far apart	in continuous random motion
D	far apart	vibrating about a fixed point

Your answer

[1]

4 The **molecular formula** of decene is $C_{10}H_{20}$.

What is the **empirical formula** of decene?

A CH_2

B C_2H_4

C C_5H_{10}

D $C_{20}H_{40}$

Your answer

[1]

5 A student measures the pH of an acid and an alkali.

He adds magnesium metal to the acid and to the alkali.

What results should he expect?

	Acid		Alkali	
	pH	Reaction with magnesium	pH	Reaction with magnesium
A	below 7	no reaction	above 7	magnesium fizzes
B	below 7	magnesium fizzes	above 7	no reaction
C	above 7	magnesium fizzes	above 7	no reaction
D	above 7	no reaction	below 7	magnesium fizzes

Your answer

[1]

6 A student tests the conductivity of an ionic compound.

Which row in the table shows the correct results?

	Solid ionic compound	Ionic compound dissolved in water	Molten ionic compound
A	conducts	conducts	does not conduct
B	conducts	conducts	conducts
C	does not conduct	does not conduct	conducts
D	does not conduct	conducts	conducts

Your answer

[1]

7 What is the approximate size of an atom?

- A 3×10^{-1} metres
- B 3×10^{-5} metres
- C 3×10^{-9} metres
- D 3×10^{-13} metres

Your answer

[1]

8 During the electrolysis of molten potassium chloride, what is made at the cathode?

- A Chlorine
- B Hydrogen
- C Potassium
- D Potassium hydroxide

Your answer

[1]

9 Crude oil can be separated in the laboratory into fractions which have different boiling points.

Look at the table. It shows possible relationships between:

- boiling point
- number of carbon atoms in the molecule
- size of intermolecular forces.

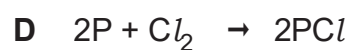
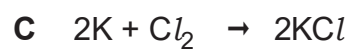
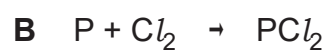
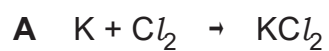
Which letter shows the correct relationship?

	Boiling point	Number of carbon atoms in the molecule	Size of intermolecular forces
A	high	less than 20	large
B	high	more than 50	small
C	low	less than 20	small
D	low	more than 50	large

Your answer

[1]

10 Which of these shows the balanced symbol equation for the reaction between potassium and chlorine to make potassium chloride?

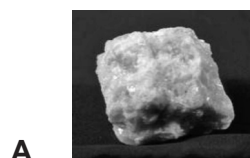


Your answer

[1]

11 Look at the diagrams.

Which diagram shows a solid with the **largest** surface area to volume ratio?

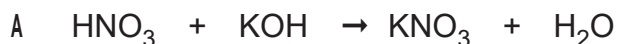


Your answer

[1]

12 A student neutralises nitric acid with potassium hydroxide solution.

Which equation shows the **ionic** equation for neutralisation?



Your answer

[1]

13 A student investigates some acids.

She has a solution of hydrochloric acid of concentration 0.01 mol/dm^3 .

This solution has a pH of 2.

She increases the concentration of hydrochloric acid from 0.01 mol/dm^3 to 0.1 mol/dm^3 .

What is the pH of this new solution?

A 0

B 1

C 3

D 12

Your answer

[1]

14 What is the **best** explanation of what is meant by a strong acid?

A There is a large amount of acid and a small amount of water.

B There is a small amount of acid and a large amount of water.

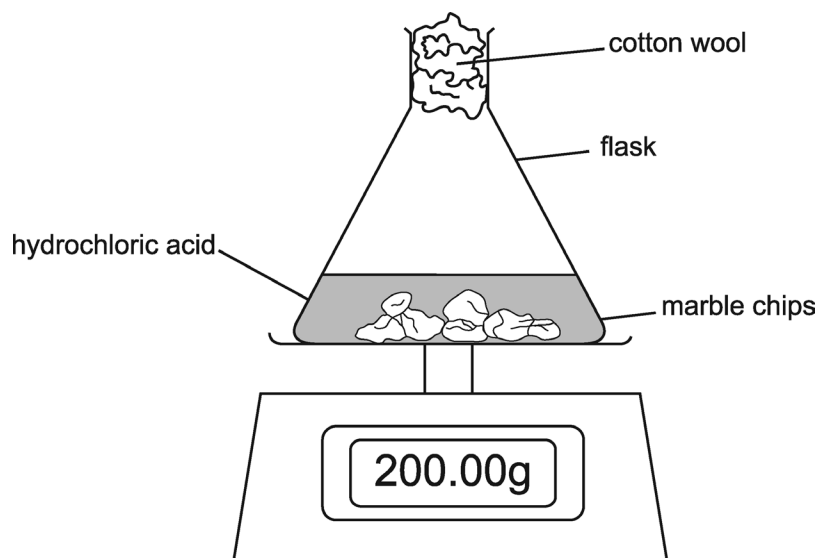
C The acid is completely ionised in solution in water.

D The acid is partially ionised in solution in water.

Your answer

[1]

15 Look at the diagram.



It shows how the reaction between hydrochloric acid and marble chips (calcium carbonate) can be monitored.

The reading on the balance **decreases** during the reaction.

Which statement is the **best** explanation?

- A Acid escapes from the flask.
- B Carbon dioxide gas is made which leaves the flask.
- C Hydrogen gas is made which leaves the flask.
- D The temperature in the laboratory changes.

Your answer

[1]

9
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TURN OVER FOR THE NEXT QUESTION

SECTION B

Answer **all** the questions.

- 16 The table shows information about some atoms and ions.

Particle	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Electronic structure
A	11	23	11	.....	11	2.8.1
B	9	19	9	10	9	.....
C	.....	37	17	.....	17	2.8.7
D	13	27	.....	.....	10	2.8

- (a) **Complete** the missing information in the **Table** above. [4]

- (b) Particle **A** is a metal **atom**, particle **D** is an **ion**.

Explain why.

.....

 [2]

- (c) Particle **C** has the electronic structure 2.8.7.

What does this electronic structure tell you about the position of particle **C** in the periodic table?

Explain your answer.

.....

 [4]

- (d) Complete the table below to give information about protons, neutrons and electrons.

	Charge	Mass in atomic mass units
proton	.....	1
neutron	.....	.....
electron	negative	.....

[2]

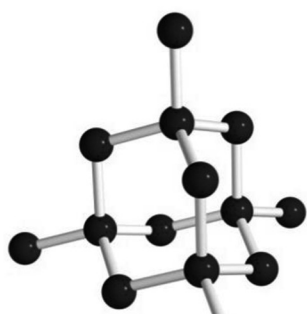
- (e) Rutherford was a scientist who helped to develop the atomic model.

State how Rutherford's work contributed to the development of the atomic model.

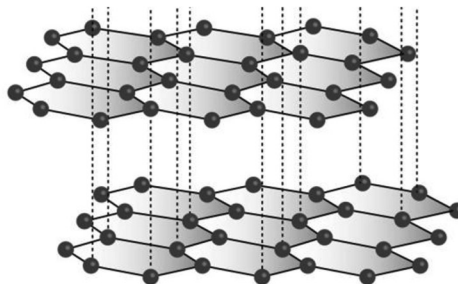
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..... [1]

17 (a) The diagrams show the structures of two forms of carbon.



diamond



graphite

- Graphite is a good conductor of electricity.
- Diamond does **not** conduct electricity.

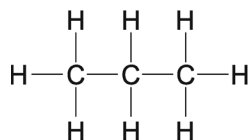
Use ideas about structure and bonding in diamond and graphite to explain these observations.

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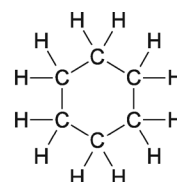
 [3]

(b) Carbon can form many thousands of different compounds.

Two examples are shown below.



propane



cyclohexane

Why can carbon form many thousands of different compounds?

.....
 [1]

(c) Ethanol contains carbon.

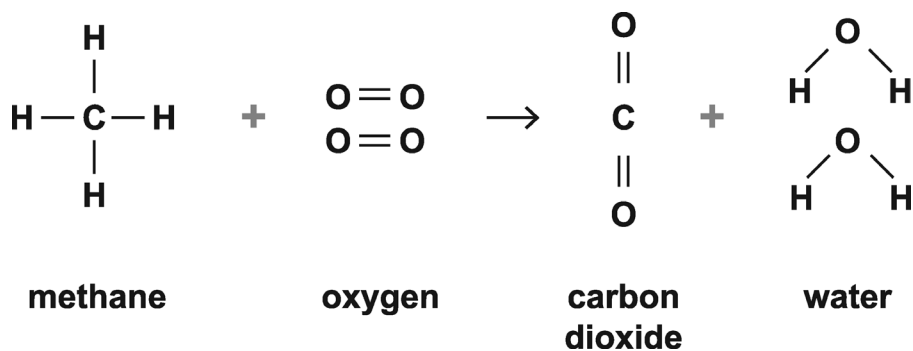
Look at some information about ethanol.

- Melting point = -114°C
- Boiling point = 78°C

Predict the state of ethanol at 25°C . How can you tell?

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

(b) Look at the equation.



The table shows the bond energies of the bonds involved.

Bond	Bond energy (kJ/mol)
C–H	435
O=O	498
C=O	805
O–H	464

(i) What type of energy change happens when bonds are broken and when bonds are made?

Bonds broken

Bonds made.....[2]

(ii) Calculate the energy change for this reaction.

Answer = kJ/mol [3]

(c) When propane reacts with oxygen, energy is given out.

- Propane gives out 50 kJ/g.
- A propane burner is used to boil 200 g of water to make a cup of tea.
- The initial temperature of the water is 15 °C.

What mass of propane (in g) is needed to heat this water?

Use the following equation:

Energy transferred in J = 4.2 J/g°C × mass of water in g × temperature change in °C.

Answer = g [5]

19 An element, **X**, is reacted with oxygen, O_2 .

- There is one product. It is the oxide of **X**, **X** oxide.
- 4.86 g of **X** reacts with 3.20 g of oxygen to make 8.06 g of **X** oxide.

(a) (i) Calculate the number of moles of **X**, oxygen and **X** oxide in the reaction.

- Relative atomic mass of **X** = 24.3
- Relative formula masses: $O_2 = 32.0$; **X** oxide = 40.3.

Number of moles of **X** =

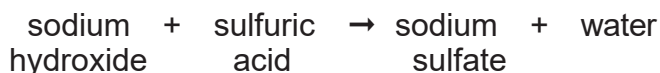
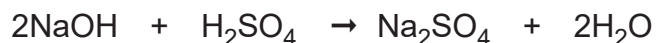
Number of moles of O_2 =

Number of moles of **X** oxide = [3]

(ii) Use your answer to (i) to write the **balanced symbol** equation for the reaction between **X** and oxygen to make **X** oxide.

..... [2]

(b) The equation shows the reaction between sodium hydroxide and dilute sulfuric acid.



Calculate the mass of sodium hydroxide needed to make 30.0 g of sodium sulfate.

Give your answer to **3** significant figures.

Answer = g [3]

(b) The student has separated a **pure** sample of substance **B** from the mixture.

Suggest how the student can check that the sample of substance **B** is pure.

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

21 Zinc nitrate can be made by reacting zinc oxide with nitric acid, HNO_3 .

(a) Write a **balanced symbol** equation for this reaction.

..... [2]

(b) A student suggests this method for preparing zinc nitrate.

1. Measure 50 cm^3 of dilute nitric acid into a beaker.
2. Add one spatula measure of zinc oxide.
3. Heat the mixture until crystals of zinc nitrate are made.

Her method will **not** make a pure dry sample of zinc nitrate.

What improvements should she make to the method to make sure that:

- the reaction is complete
- the zinc nitrate can be separated from the nitric acid and the zinc oxide?

Explain your answer.

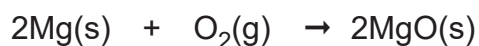
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..... [4]

(c) Describe why this reaction is a neutralisation reaction.

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

22 Magnesium burns in oxygen to make magnesium oxide.

The reaction involves both oxidation and reduction.



magnesium + oxygen → magnesium oxide

(a) **Complete** the sentences.

During this reaction, the oxidising agent is

The reducing agent is[1]

(b) Magnesium has an atomic number of 12.

Calculate the mean mass of an atom of magnesium.

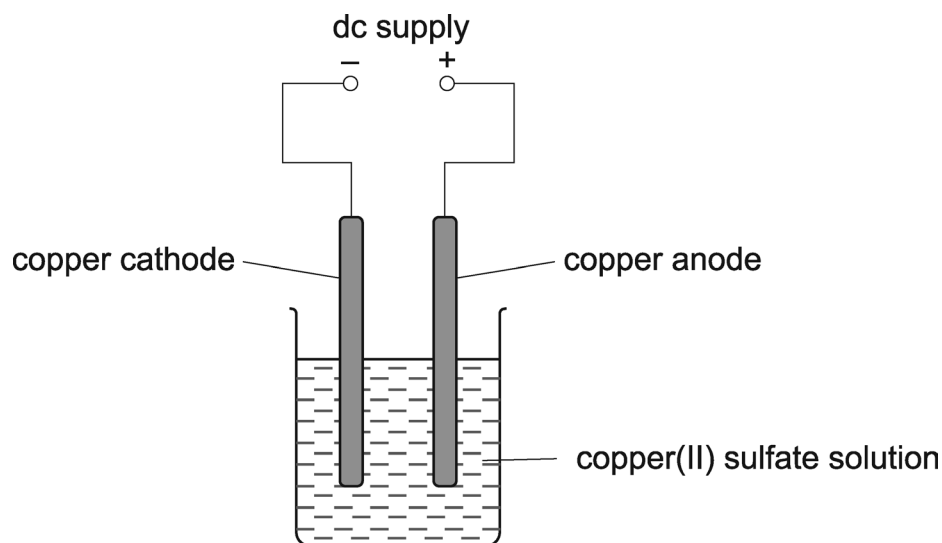
Quote your answer to 3 significant figures.

- Avogadro constant = 6.022×10^{23} atoms per mole

Answer = g [2]

23 A student electrolyses copper sulfate using copper electrodes.

Look at the diagram. It shows the apparatus she uses.



She investigates the change in mass at each electrode before and after the electrolysis.

Look at her method.

1. Using a balance, measure the mass of the copper cathode and copper anode.
2. Set up the apparatus and run the electrolysis for 30 seconds.
3. Remove the copper cathode and the copper anode and immediately place them on the balance and measure their masses again.

(a) What improvements could you make to the student's experiment?

Explain your answers.

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[4]

(b) The student finds that:

- the cathode gains mass
- the anode loses mass.

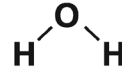
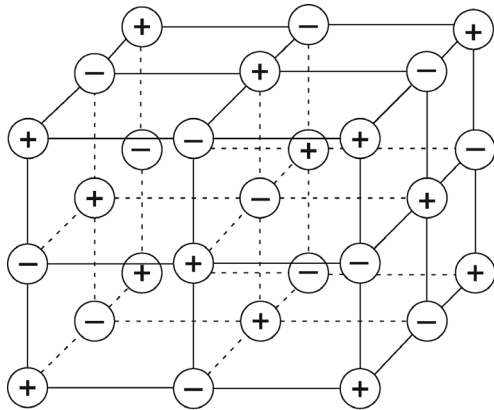
Explain these observations in terms of the reactions at each electrode.

.....

.....

..... [2]

24 Look at the diagrams of sodium chloride and water.



sodium chloride

water

(a) Sodium chloride has a melting point of 801°C .

Use the diagram of sodium chloride to explain why.

.....

 [2]

(b) Water has a low melting point and boiling point.

Explain why.

.....

 [2]

(c) Magnesium oxide has a similar structure to sodium chloride.

Draw 'dot and cross' diagrams to show the ionic bonding in magnesium oxide.

- Include the charges on the ions.
- The electronic structure of magnesium is 2.8.2.
- The electronic structure of oxygen is 2.6.

[3]

- 25** A student adds calcium to dilute hydrochloric acid. The mixture begins to fizz.

Write a balanced symbol equation for this reaction.

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

END OF QUESTION PAPER

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