Applied Science Chemistry Summer Work

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Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

Supplied materials:
Additional resources may be supplied with this paper.

Other materials required:
- Pencil
- Ruler (cm/mm)

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **60**.
- The total number of marks may take into account some 'either/or' question choices.

Answer **all** the questions.

1. 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 represents the correct relationship between the boiling point, number of carbon atoms and size of intermolecular forces?

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

Your answer ☐

[1]

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

A. $K + Cl_2 \rightarrow KCl_2$
B. $P + Cl_2 \rightarrow PCl_2$
C. $2K + Cl_2 \rightarrow 2KCl$
D. $2P + Cl_2 \rightarrow 2PCl$

Your answer ☐

[1]

3(a). Look at the table. It 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

Complete the table.

[4]

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

Explain why.

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[2]

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

What does this tell you about the position of particle **C** in the Periodic Table?

Explain your answer.

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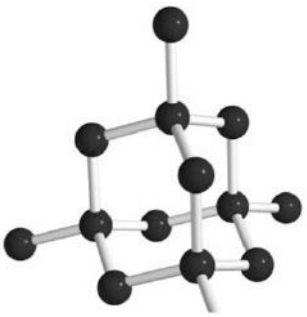
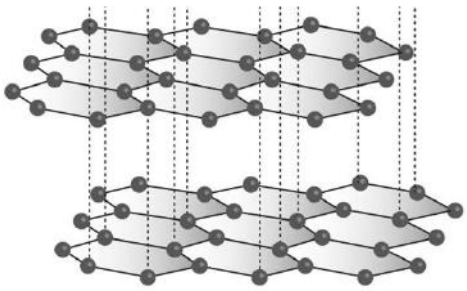
[4]

4. 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.

[3]

5(a). Irenka reacts an element, **X**, with oxygen, O_2.

There is one product. It is the oxide of **X** i.e. **X** oxide.

4.86 g of **X** reacts with 3.20 g of oxygen to make 8.06 g of **X** oxide.

i. Calculate the number of moles of **X**, oxygen and **X** oxide involved in the reaction.

(The relative atomic mass of **X** is 24.3 and the relative formula mass of oxygen, O_2, is 32.0 and of **X** oxide is 40.3.)

Number of moles of **X** = ...

Number of moles of O_2 = ...

Number of moles of **X** oxide = ...

ii. Use your answers to write the **balanced symbol** equation for the reaction between **X** and oxygen to make **X** oxide.

[2]

(b). Look at the equation.

It shows the reaction between sodium hydroxide and dilute sulfuric acid.

$$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$$

sodium hydroxide + sulfuric acid → sodium sulfate + water

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

Give your answer to three significant figures.

Mass of sodium hydroxide = ... g **[3]**

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

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

[2]

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7. Magnesium has an atomic number of 12.

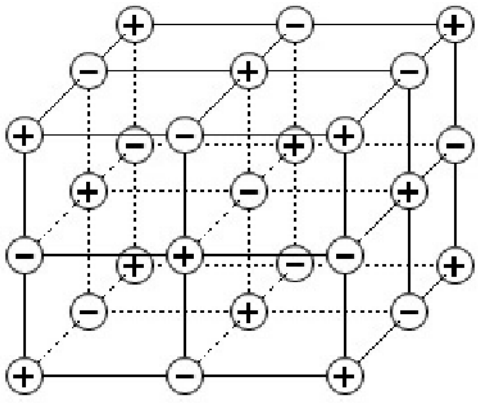
Calculate the mean mass of an atom of magnesium. Quote your answer to **three** significant figures.

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

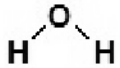
Mean mass ..... g **[2]**

8(a). Look at the diagrams.

They show the structures of two compounds.



sodium chloride



water

Sodium chloride has a melting point of 801°C.

Use the structure of sodium chloride to explain why.

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[2]

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

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

You should include the charges on the ions.

The electronic structure of magnesium is 2.8.2.

The electronic structure of oxygen is 2.6.

[3]

9(a). The Group 7 elements are known as the halogens.

The halogens have similar chemical properties.

Their physical properties vary with increasing atomic number.

Look at the table of information about the halogens.

Halogen	Atomic symbol	Atomic number	Molecular formula	Atomic radius in pm	Reaction of halogen with sodium iodide solution
fluorine	F	9	F_2	64	Makes iodine and sodium fluoride
chlorine	C*l*	17	Cl_2	99	Makes iodine and sodium chloride
bromine	Br	35	Br_2	114	....
iodine	I	53	I_2	133	No reaction
astatine	At	85	.....	.....	No reaction

i. Predict the molecular formula and atomic radius of astatine.

Put your answers in the table.

[2]

ii. Predict the reaction of bromine with sodium iodide solution.

Put your answer in the table.

[1]

iii. Explain your answer to **(ii)** in terms of the reactivity of the halogens.

---

[1]

(b). All halogens react with alkali metals to make a salt.

i. All halogens have similar chemical reactions.

Explain why in terms of electronic structure.

---

[1]

ii. Sodium reacts with bromine to make sodium bromide, NaBr.

Construct the **balanced symbol** equation for this reaction.

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[2]

iii. What is the formula of the product of the reaction between astatine and potassium?

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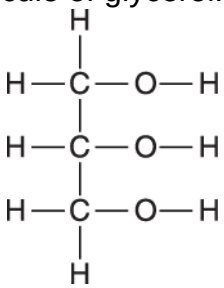
[1]

10. Look at the displayed formula of a molecule of glycerol.



What is the **molecular formula** of glycerol?

[1]

11. Fluorine reacts with chlorine to make a compound called chlorine fluoride, C*l*F.

C*l*F is a **covalent** compound.

The electronic structure of chlorine is 2.8.7.

The electronic structure of fluorine is 2.7.

Draw a 'dot and cross' diagram to show the covalent bonding in chlorine fluoride.

[2]

12. Jed is testing iron(III) chloride and some unknown compounds.

He does some tests.

These are the tests that Jed does on solutions of the compounds:

- adding sodium hydroxide solution
- adding silver nitrate solution.

Look at his results.

Compound	Adding sodium hydroxide solution	Adding silver nitrate solution
iron(III) chloride	brown solid made	white solid made
A	blue solid made	white solid made
B	green solid made	cream solid made

Iron(III) chloride, $FeC?_3$, reacts with silver nitrate, $AgNO_3$, to make silver chloride, AgC*?*, and iron(III) nitrate, $Fe(NO_3)_3$.

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

Identify the unknown compounds **A** and **B** and explain your answers.

The quality of written communication will be assessed in your answer to this question.

[6]

13. One scientist who helped to develop the Periodic Table was called Mendeleev.

Write about how Mendeleev helped in the development of the Periodic Table.

[2]

14(a). Zinc, Zn, reacts with hydrochloric acid, HC*l* .

Hydrogen gas, H_2, and zinc chloride, $ZnCl_2$, are made.

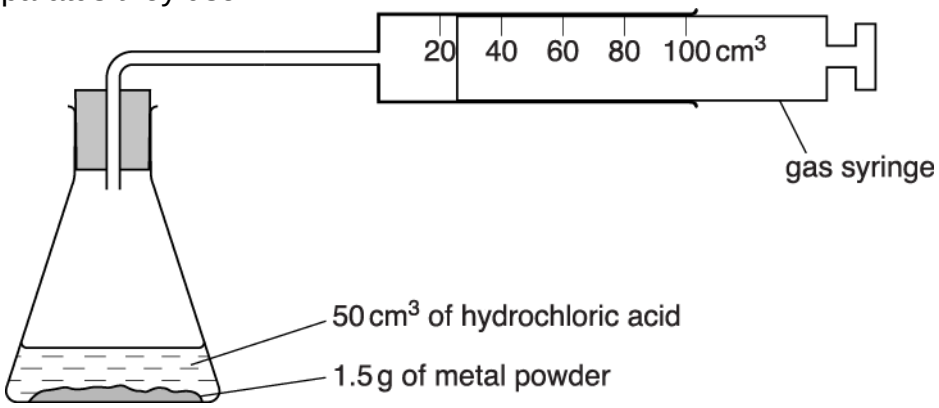
Construct the **balanced symbol** equation for this reaction.

[1]

(b). Fatimah and Sam investigate the reaction between acid and metals.

They react dilute hydrochloric acid with zinc powder and with iron powder.

Look at the apparatus they use.

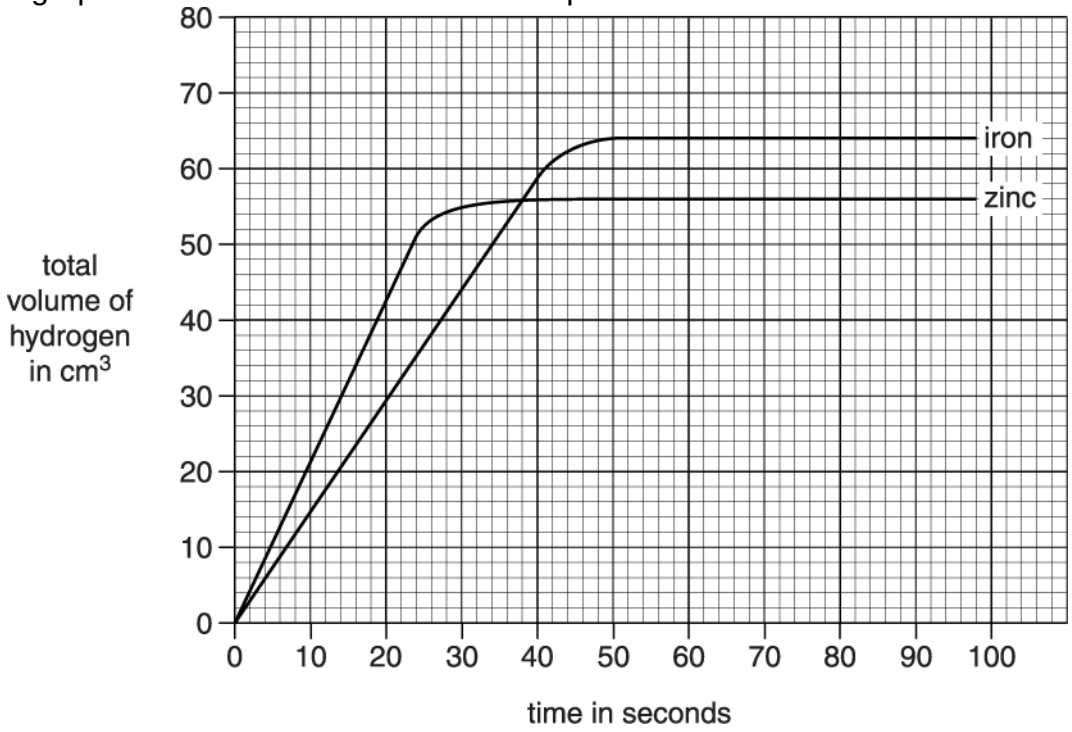


Every 10 seconds they measure the volume of gas in the gas syringe.

Fatimah and Sam do three different experiments.

- 50 cm^3 hydrochloric acid and 0.15 g of zinc
- 50 cm^3 hydrochloric acid and 0.15 g of iron
- 50 cm^3 hydrochloric acid and 0.075 g of iron mixed with 0.075 g of zinc.

Look at the graph of the results for the first two experiments.



i. Calculate the rate of reaction of **iron** during the **first 30 seconds**.

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rate of reaction = ... cm^3 / s

[1]

ii. Predict the total volume of hydrogen formed when the **mixture** of zinc and iron powder is used.

..... cm^3

[1]

(c). Increasing the concentration of a reactant in solution will increase the rate of reaction.

Use the reacting particle model to explain why.

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[2]

15. Sodium hydrogencarbonate decomposes when it is heated.

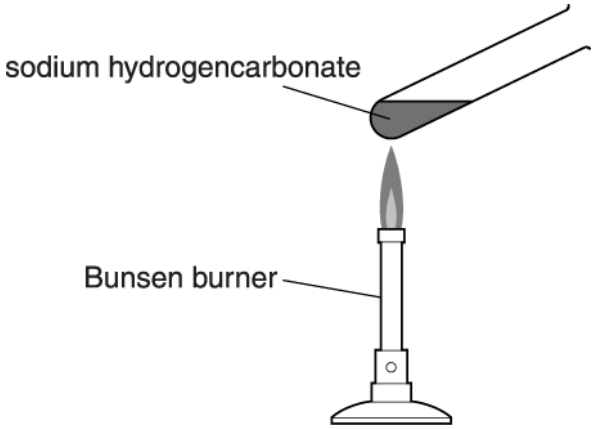
sodium hydrogencarbonate	→	sodium carbonate	+	carbon dioxide	+	water
$2NaHCO_3$	→	Na_2CO_3	+	CO_2	+	H_2O

The table shows the relative formula masses, M_r, of the substances in the equation.

Substance	Relative formula mass
$NaHCO_3$	84
Na_2CO_3	106
CO_2	44
H_2O	18

Zakia heats some sodium hydrogencarbonate.

Look at the apparatus she uses.



Zakia heats 1.000 g of solid sodium hydrogencarbonate.

After heating for ten minutes the test tube contains 0.631 g of solid sodium carbonate.

Zakia does the experiment again.

This time she uses 2.500 g of solid sodium hydrogencarbonate.

i. Show that the predicted mass of solid sodium carbonate that she should make is 1.578 g.

---

[1]

ii. Zakia actually makes 1.124 g of solid sodium carbonate.

Calculate the percentage yield.

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

percentage yield = ... %

[2]

16(a). i. Iron rusts in damp air.

Rust is hydrated iron(III) oxide.

Write the **word** equation for the rusting of iron.

[1]

ii. The rusting of iron is an **oxidation** reaction.

Explain why.

[1]

(b). This question is about the corrosion of metals.

Look at the table. It shows how four metals corrode in different conditions.

Metal	Does the metal corrode in		
	damp air?	**damp acidic air?**	**dry air?**
A	no	quickly	no
B	slowly	quickly	no
C	very slowly	very slowly	no
D	very quickly	very quickly	quickly

Metal **A** is aluminium.

Explain how you can tell from the information in the table.

[1]

END OF QUESTION paper