2021 ASSESSMENT MATERIALS

GCSE
CHEMISTRY

Chemistry Test 1: Atomic structure and the periodic table and Bonding, structure and the properties of matter (Higher)

Total number of marks: 34

0 3 This question is about silver iodide.

Silver iodide is produced in the reaction between silver nitrate solution and sodium iodide solution.

The equation for the reaction is:

$$AgNO_3(aq) + NaI(aq) \rightarrow AgI(s) + NaNO_3(aq)$$

0 3 . 1 A student investigated the law of conservation of mass.

This is the method used.

1. Pour silver nitrate solution into a beaker labelled **A**.
2. Pour sodium iodide solution into a beaker labelled **B**.
3. Measure the masses of both beakers and their contents.
4. Pour the solution from beaker **B** into beaker **A**.
5. Measure the masses of both beakers and their contents again.

Table 3 shows the student's results.

Table 3

	Mass before mixing in g	**Mass after mixing in g**
Beaker **A** and contents	78.26	108.22
Beaker **B** and contents	78.50	48.54

Explain how the results demonstrate the law of conservation of mass.

You should use data from **Table 3** in your answer.

[2 marks]

total mass of reactants = 78.26 + 78.50
= 156.76

total mass of products = 108.22 + 48.54
= 156.76

the mass of the reactants equals the mass of the products, therefore no atoms have been created or destroyed in the reaction (law of conservation of mass).

0 3 . 2 Suggest how the student could separate the insoluble silver iodide from the mixture at the end of the reaction.

[1 mark]

filtration using filter paper and a funnel

The student purified the separated silver iodide.

This is the method used.

1. Rinse the silver iodide with distilled water.

2. Warm the silver iodide.

0 3 . 3 Suggest **one** impurity that was removed by rinsing with water.

[1 mark]

sodium nitrate

0 3 . 4 Suggest why the student warmed the silver iodide.

[1 mark]

to evaporate any water on silver iodide

0 3 . 5 Calculate the percentage atom economy for the production of silver iodide in this reaction.

The equation for the reaction is:

$$AgNO_3(aq) + NaI(aq) \rightarrow AgI(s) + NaNO_3(aq)$$

Give your answer to 3 significant figures.

Relative formula masses (M_r): $AgNO_3 = 170$ $NaI = 150$ $AgI = 235$ $NaNO_3 = 85$

[4 marks]

$$\left(\frac{235}{170 + 150}\right) \times 100 = 73.4375\ \%$$

Percentage atom economy (3 significant figures) = 73 4 %

0 3 . 6 Give **one** reason why reactions with a high atom economy are used in industry.

[1 mark]

more economically beneficial

0 4 This question is about atomic structure.

0 4 . 1 Atoms contain subatomic particles.

Table 2 shows properties of two subatomic particles.

Complete **Table 2**.

[2 marks]

Table 2

Name of particle	Relative mass	Relative charge
neutron	1	0
proton	1	+1

An element **X** has two isotopes.

The isotopes have different mass numbers.

0 4 . 2 Define mass number.

[1 mark]

number of protons plus the number of neutrons

0 4 . 3 Why is the mass number different in the two isotopes?

[1 mark]

they have different numbers of neutrons

0 4 . 4 The model of the atom changed as new evidence was discovered.

The plum pudding model suggested that the atom was a ball of positive charge with electrons embedded in it.

Evidence from the alpha particle scattering experiment led to a change in the model of the atom from the plum pudding model.

Explain how.

[4 marks]

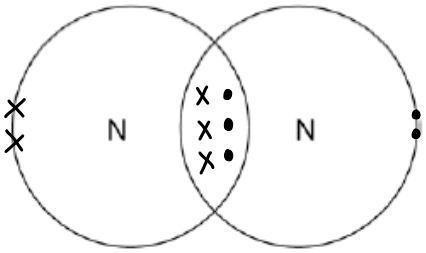
In the alpha particle scattering experiment, positively charged alpha particles were fired at a thin sheet of gold foil. Some of the alpha particles bounced back from the sheet, reinforcing the idea that an atom contained positive charges. Some of the particles were deflected as they moved through the foil, reinforcing the negative charges (electrons).
But most of the particles went straight through the foil, suggesting that the atom was mostly empty space, hence the changing of the plum pudding model to Rutherford's model of the atom which had a positive nucleus and shells of electrons orbiting the nucleus.

0 6 This question is about structure and bonding.

0 6 . 1 Complete the dot and cross diagram to show the covalent bonding in a nitrogen molecule, N_2

Show only the electrons in the outer shell.

[2 marks]



0 6 . 2 Explain why nitrogen is a gas at room temperature.

Answer in terms of nitrogen's structure.

[3 marks]

nitrogen is a very small diatomic molecule therefore it has weak intermolecular forces which requires little energy to break so has a very low boiling point (below room temperature).

Graphite and fullerenes are forms of carbon.

0 6 . 3 Graphite is soft and is a good conductor of electricity.

Explain why graphite has these properties.

Answer in terms of structure and bonding.

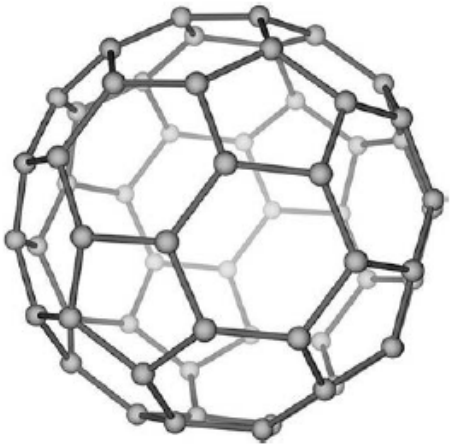
[4 marks]

Graphite has the structure of each carbon atom being covalently bonded to 3 other carbon atoms, with the fourth electron being delocalised.

Graphite forms hexagonal sheets of carbon atoms with weak intermolecular forces between the sheets, meaning the layers can slide over each other, making graphite slippery. Graphite can conduct electricity because of the delocalised electrons which are free to move throughout the structure and carry the electric current.

0 6 . 4 **Figure 5** shows a model of a Buckminsterfullerene molecule.

Figure 5



A lubricant is a substance that allows materials to move over each other easily.

Suggest why Buckminsterfullerene is a good lubricant.

Use **Figure 5**.

[2 marks]

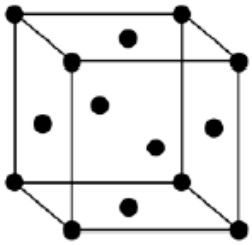
Buckminsterfullerene has a very regular structure, meaning each ball / sphere can slide over each other easily and make the substance slippery.

There are very strong covalent bonds between the carbon atoms but weak forces between the molecules.

Silver can form cubic nanocrystals.

Figure 6 represents a silver nanocrystal.

Figure 6



0 6 . 5 A silver nanocrystal is a cube of side 20 nm

Calculate the surface area to volume ratio of the nanocrystal.

[3 marks]

area of 1 face = 20 x 20 = 400

400 x 6 = 2400 (surface area)

volume = 20 x 20 x 20

= 8000

8000 ÷ 2400 = 3.33

Surface area to volume ratio = 1 : 3.33

0 6 . 6 Silver nanoparticles are sometimes used in socks to prevent foot odour.

Suggest why it is cheaper to use nanoparticles of silver rather than coarse particles of silver.

[2 marks]

nanoparticles are much smaller than coarse particles but they have a greater surface area to volume ratio, so less of them is needed to have the same effect.