

14–16 years

Exploding questions: structure and bonding



Education
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<https://rsc.li/2UfBa1B>

Learning objectives

1. Recall your prior learning on bonding, structure and the properties of matter and changes of state.
2. Develop a technique to tackle extended response exam questions and improve your answers.

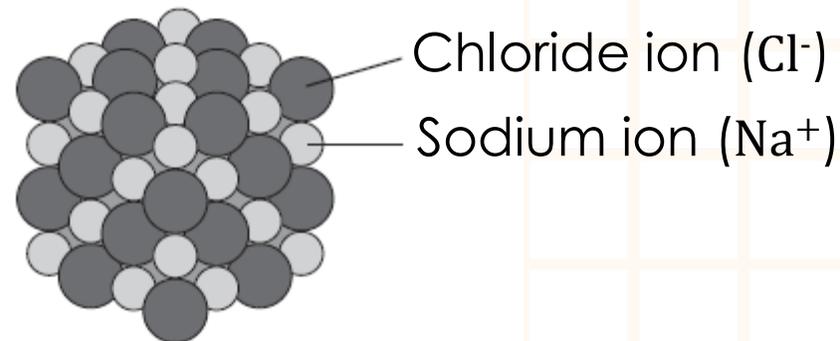
Example past-paper question

Explain why chlorine (Cl_2) is a gas at room temperature, but sodium chloride (NaCl) is a solid at room temperature.

Chlorine



Sodium chloride

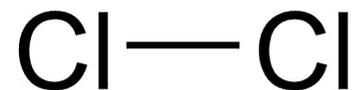


Include a description of the bonding and structure of chlorine and sodium chloride in your answer.

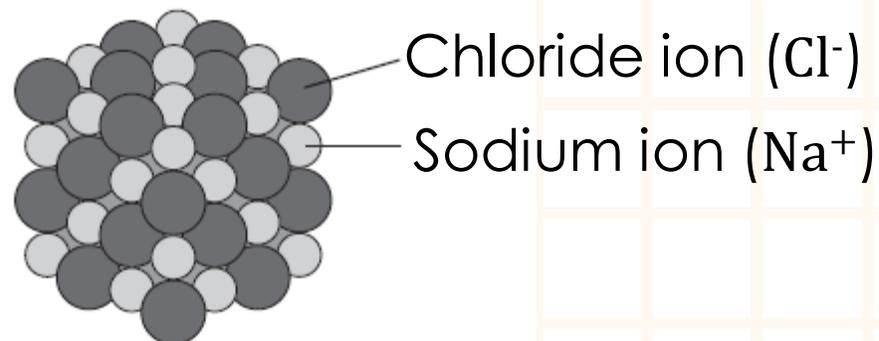
6 marks

Explain why chlorine (Cl_2) is a gas at room temperature, but sodium chloride (NaCl) is a solid at room temperature.

Chlorine



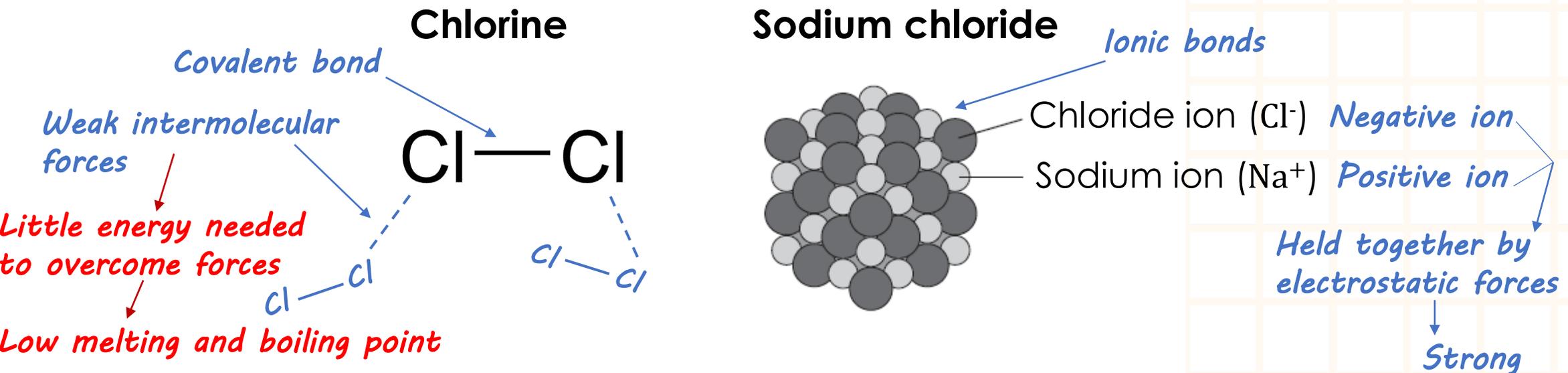
Sodium chloride



Include a **description** of the bonding and structure of chlorine and sodium chloride in your answer.

6 marks

Explain why chlorine (Cl_2) is a gas at room temperature, but sodium chloride (NaCl) is a solid at room temperature.



Little energy needed to overcome forces

Low melting and boiling point

Lots of energy needed to break bonds

High melting and boiling point

6 marks

Include a **description** of the bonding and structure of chlorine and sodium chloride in your answer.

Description

Explanation

Task

- Use your exploded exam question to write an answer to the question. You must use all annotations.
- Tick each point as you include it in your answer.

Marking guidance

Level	Criteria
0 marks	No relevant content
Level 1 (1–2 marks)	Up to two marks can be given for any of the description statements given below.
Level 3 (3–4 marks)	There must be either a description statement and an explanation about one substance or description statements about both substances.
Level 3 (5–6 marks)	Descriptions and explanations of both substances must be included. Please note that not all points must be included to be awarded full marks. Key points can be found in bold.

Examples of chemistry points made in response

Chlorine:

- **Structure: simple** molecules are formed.
- Bonding: covalent bonds between atoms.

Explanation of why it is a gas

- Weak attraction between molecules
- **Weak** intermolecular **forces take little energy to overcome.**
- Chlorine has a low boiling point.

Sodium chloride:

- Structure: giant - strong bonds in all directions forming a giant lattice.
- **Bonding: ionic** bonds or electrostatic attraction between oppositely charged ions.

Explanation of why it is a solid

- **Strong ionic bonds** between the atoms.
- **Lots of energy needed to break** the bonds.
- Sodium chloride has a high melting point.

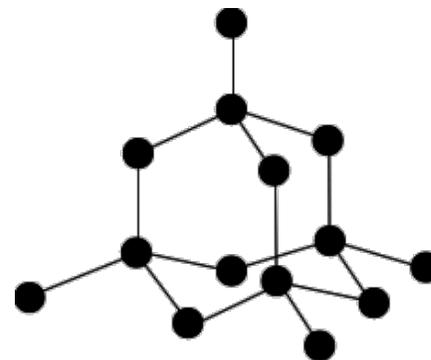
Exam-style question

Explain why carbon dioxide (CO₂) is a gas at room temperature, but diamond is a solid at room temperature.

Carbon dioxide



Diamond



Include a description of the bonding and structure of carbon dioxide and diamond in your answer.

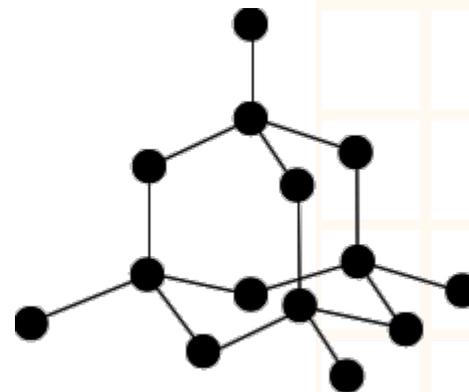
6 marks

1. You have three minutes to work on your own in silence to explore the exam question.
2. You then have two minutes to discuss in pairs before answering the question.

Supporting questions



1. Is carbon a metal or a non-metal?
2. Is oxygen a metal or a non-metal?
3. What type of bonding does carbon dioxide have?
4. Is the structure simple (molecular) or giant?
5. Are the forces between the molecules strong or weak?
6. Does this mean a little or a lot of energy is needed to overcome the forces?
7. So, does carbon dioxide have a low or high melting point and boiling point?



1. Which element does diamond consist of?
2. Is this element a metal or a non-metal?
3. What type of bonding does diamond have?
4. Is the structure simple (molecular) or giant?
5. Are the bonds between the atoms strong or weak?
6. Does this mean a little or a lot of energy is needed to overcome them?
7. So, does diamond have a low or high melting point and boiling point?

Marking guidance

Level	Criteria
0 marks	No relevant content
Level 1 (1–2 marks)	Up to two marks can be given for any of the description statements given below.
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Examples of chemistry points made in response

Carbon dioxide:

- **Structure: simple** molecules are formed.
- Bonding: covalent bonds between atoms.

Explanation of why it is a gas

- Weak attraction between molecules.
- **Weak** intermolecular **forces take little energy to overcome.**
- Carbon dioxide has a low boiling point.

Diamond:

- **Structure:** diamond is a **giant** covalent molecule.
- Bonding: **covalent bonds** between carbon atoms.

Explanation of why it is a solid

- The **bonds are strong.**
- Each carbon atom forms four bonds with other carbon atoms.
- **Lots of energy needed to break** bonds.
- Diamond has a high melting point.