

Name:

Date:

C2 - Test 5

BONDING, STRUCTURE AND PROPERTIES OF

MATTER

Advanced

GCSE

CHEMISTRY

AQA - Combined Science

Mark

Grade

Materials

For this paper you must have:

- Ruler
- Pencil and Rubber
- Scientific calculator, which you are expected to use when appropriate

Instructions

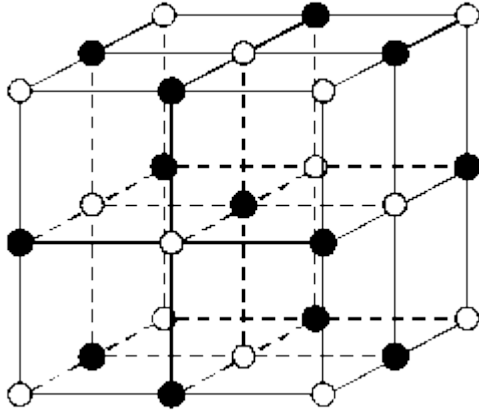
- Answer all questions
- Answer questions in the space provided
- All working must be shown

Information

- The marks for the questions are shown in brackets

1.

(a) The diagram shows part of the ionic lattice of a sodium chloride crystal.



(i) Complete the spaces in the table to give information about **both** of the ions in this lattice.

Name of ion	Charge
_____	_____
_____	_____

(2)

(ii) When it is solid, sodium chloride will not conduct electricity. However, molten sodium chloride will conduct electricity. Explain this difference.

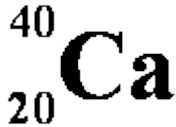
(2)

(iii) Complete the sentence.

Sodium chloride conducts electricity when it is molten and when it is

(1)

(b) The symbol for a calcium atom can be shown like this:



(i) What is the mass number of this atom?

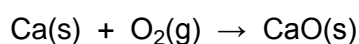
(1)

(ii) What information is given by the mass number?

(1)

(c) Calcium burns in oxygen with a brick-red flame. The product is a white solid. It is calcium oxide and its formula is CaO.

(i) Balance the chemical equation for the reaction.



(1)

(ii) Describe, in terms of electrons, what happens to a calcium atom when it becomes a calcium ion.

(2)

(Total 10 marks)

2.

X is an element with the following properties:

- melts at -220°C and boils at -188°C ;
- does not conduct electricity at room temperature;
- forms molecular compounds with non-metals;
- forms ionic salts with metals in which its ion has a 1-charge.

(a) Would you expect X to be a solid, a liquid or a gas at 20°C ?

(1)

- (b) Predict the formula of the product formed when X reacts with aluminium.
(The aluminium ion is Al^{3+} and the X ion is X^- .)
Select your answer from the list below.

AlX **AlX_2** **AlX_3** **Al_3X** **Al_2X_3**

Predicted formula _____

(1)

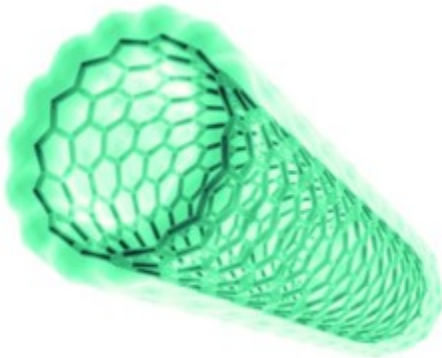
- (c) To which Group of the Periodic Table does the element X belong?

(1)

(Total 3 marks)

3.

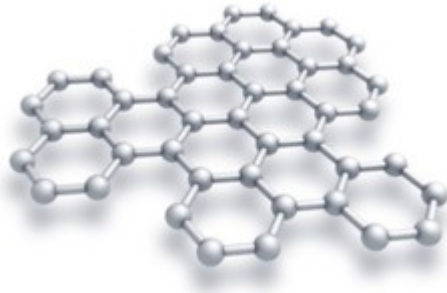
Carbon atoms are used to make nanotubes.



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Carbon atoms in a nanotube are bonded like a single layer of graphite.

The figure below shows the structure of a single layer of graphite.



© Evgeny Sergeev/iStock/Thinkstock

(a) Suggest why carbon nanotubes are used as lubricants.

(2)

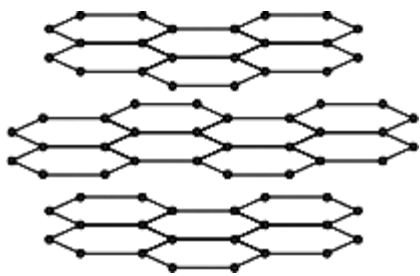
(b) Explain why graphite can conduct electricity.

(2)

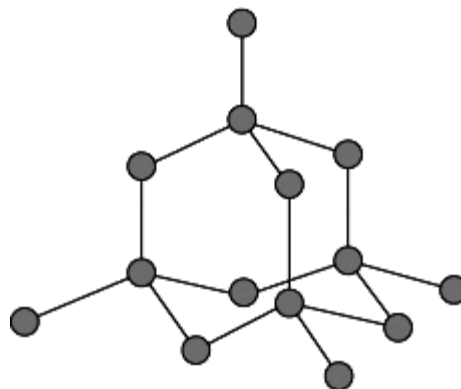
(Total 4 marks)

4. Graphite and diamond are different forms of the element carbon.
Graphite and diamond have different properties.

The structures of graphite and diamond are shown below.



Graphite



Diamond

- (a) Graphite is softer than diamond.

Explain why.

(4)

(b) Graphite conducts electricity, but diamond does not.

Explain why.

(3)

(Total 7 marks)

5.

(a) By reference to their structure, explain how the particles in a piece of metal are held together and how the shape of the metal can be changed without it breaking.

(You may use a diagram in your answer.)

(5)

- (b) Explain why metals are good conductors of electricity and suggest why this conductivity increases across the periodic table from sodium to magnesium to aluminium.

(4)

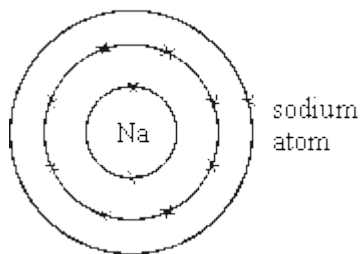
(Total 9 marks)

6.

- (a) The electronic structure of a sodium atom can be written 2,8,1.
Write the electronic structure of a potassium atom in the same way.

(1)

- (b) The electronic structure of a sodium atom can also be represented as in the diagram below.



- (i) Draw a similar diagram for a fluorine atom.

- (ii) Draw similar diagrams to show the electronic structure of the particles in sodium fluoride.

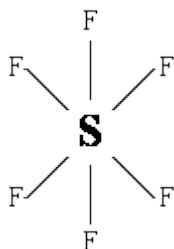
(4)

(Total 5 marks)

7.

Sulphur hexafluoride is a colourless, odourless, non-flammable gas, which is insoluble in water and extremely unreactive. It is used as an insulator in high voltage transformers and switchgear.

The diagram below represents a molecule of sulphur hexafluoride.



- (a) What type of chemical bond holds the sulphur and fluorine atoms together in sulphur hexafluoride molecules?

(1)

- (b) Explain why sulphur hexafluoride has a low boiling point.

(2)

(c) Explain how **three** of the properties of sulphur hexafluoride make it suitable for use as an insulator inside electrical transformers.

Property 1: _____

Explanation: _____

Property 2: _____

Explanation: _____

Property 3: _____

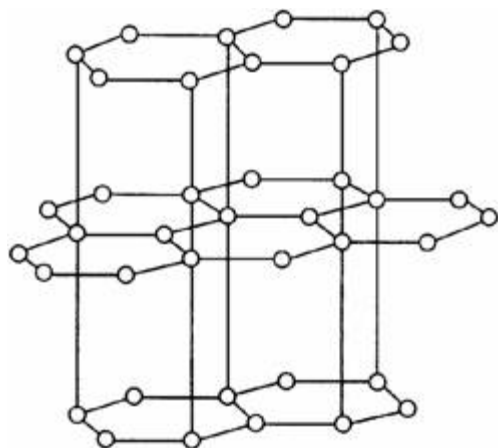
Explanation: _____

(3)

(Total 6 marks)

8.

The diagram represents the structure of graphite.



Use your knowledge and understanding of the structure of graphite to explain why graphite can be used:

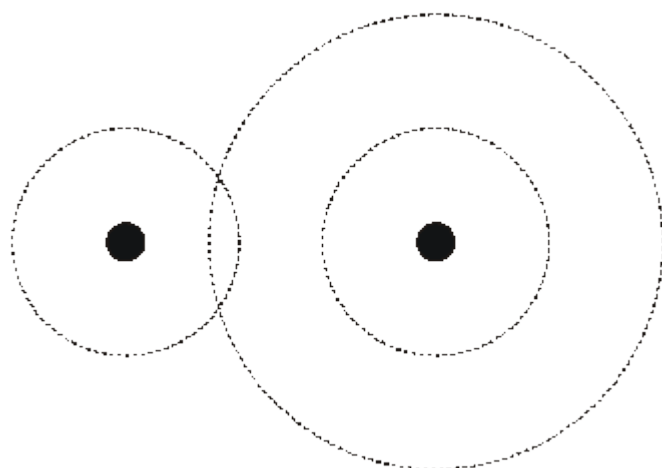
(a) in the 'leads' of pencils;

(b) as an electrical conductor.

(Total 5 marks)

9.

(i) Complete the drawing to show the electron structure of a hydrogen fluoride molecule. Draw electrons as dots or crosses.



(1)

(ii) Explain why hydrogen fluoride is a gas at room temperature.

(2)
(Total 3 marks)

10.

Carbon nanotubes are cylindrical fullerenes.

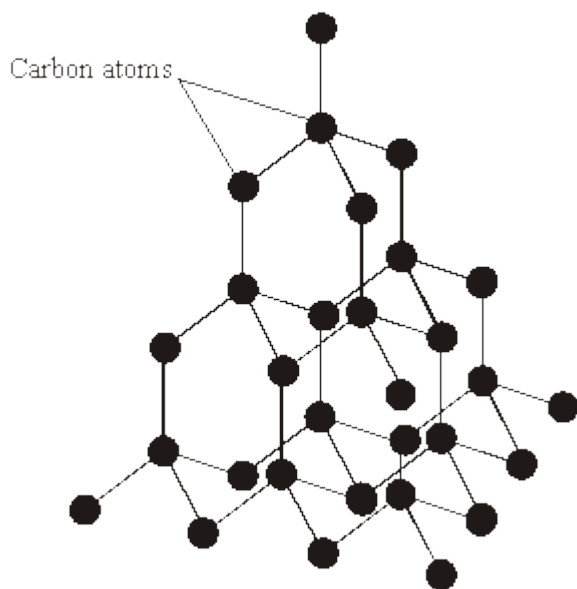
Explain the properties of carbon nanotubes.

Answer in terms of structure and bonding.

(Total 6 marks)

11.

The diagram shows the structure of diamond.



- (a) *To gain full marks for this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

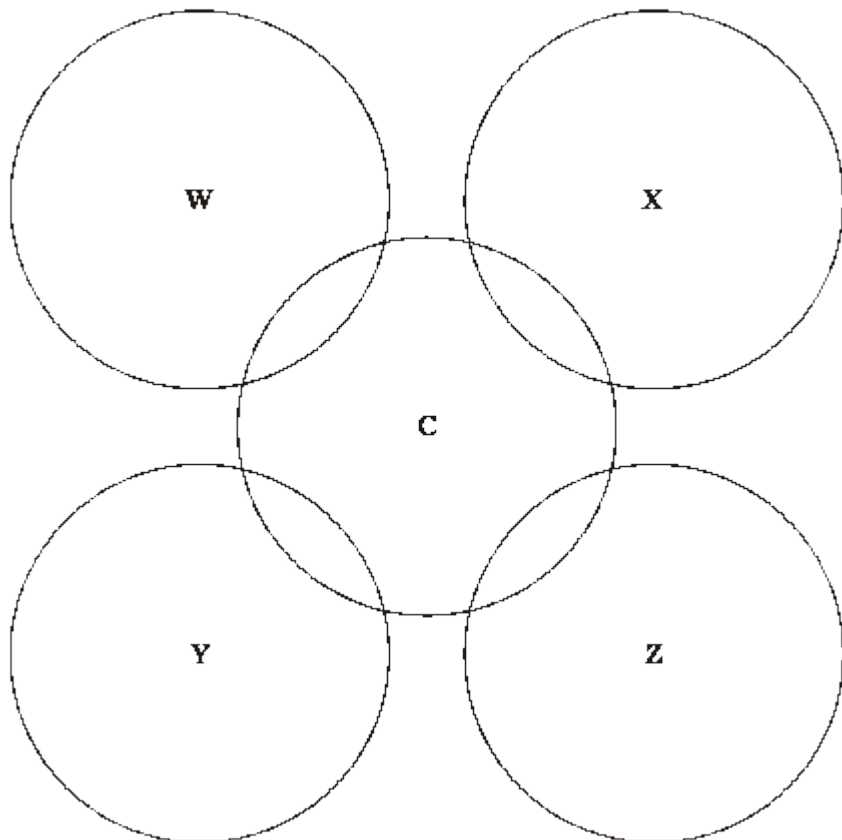
Explain, as fully as you can, why diamond has a high melting point.

(3)

- (b) The diagram below shows the outer electron shells of five carbon atoms in the giant lattice of diamond.

Carbon atom **C** forms bonds with each of the carbon atoms **W**, **X**, **Y** and **Z**.

Draw the positions of all the electrons in the outer shells of each of carbon atoms **C**, **W**, **X**, **Y** and **Z**.



(3)

(Total 6 marks)

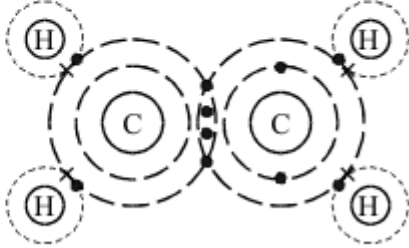
12.

The questions which follow refer to the element hydrogen.

- (a) Draw a diagram to show the bonding in one molecule of hydrogen.

(2)

(b) The table gives information about two compounds which contain hydrogen.

NAME	FORMULA	STRUCTURE
dilute sulphuric acid	H_2SO_4	$[H]^+[SO_4]^{2-}[H]^+$
ethene	C_2H_4	

Use the information in the table to explain why it is difficult to classify hydrogen as a metal or a non metal.

(4)
(Total 6 marks)