Name:

Date:

C2 - Test 3

BONDING, STRUCTURE AND PROPERTIES OF MATTER

Intermediate

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

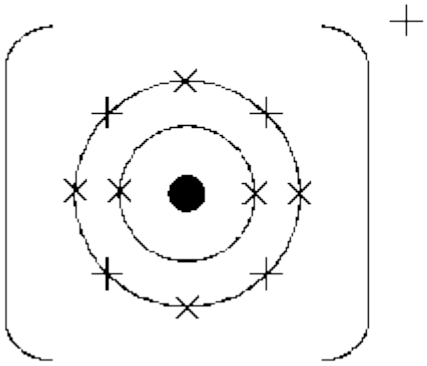
- Answer all questions
- Answer questions in the space provided
- All working must be shown

Information

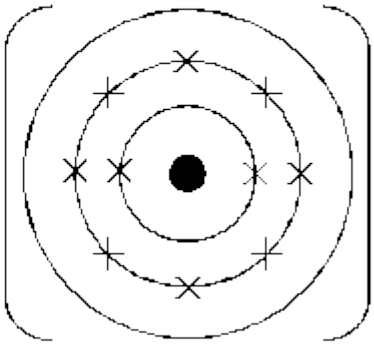
- The marks for the questions are shown in brackets

1. Sodium chloride is an ionic compound.

This is a diagram of a sodium ion.



Complete this diagram of a chloride ion.



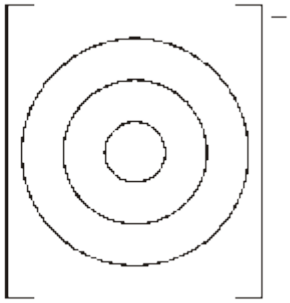
(Total 2 marks)

2. (a) A tin of red kidney beans contains calcium chloride as a firming agent.

Calcium chloride is an ionic compound which contains calcium ions (Ca^{2+}) and chloride ions (Cl^{-}).

(i) The diagram on the left represents the electronic structure of a chlorine atom.

Complete a similar diagram on the right to represent a chloride ion.



(2)

(ii) Explain how a calcium **atom** changes into a calcium **ion** which has a 2+ charge.

_____

_____

_____

_____

(2)

(b) Cola drinks contain phosphoric acid, H_3PO_4. The two equations show how phosphoric acid can be made from phosphorus.

Balance these two equations.

(i) P_4 + ____ $O_2 \rightarrow P_4O_{10}$

(1)

(ii) P_4O_{10} + _____ $H_2O \rightarrow 4H_3PO_4$

(1)

(Total 6 marks)

3. Calcium and magnesium are elements. They are found in the Earth's crust as compounds, often carbonates and sulphates. Magnesium is also found as its chloride.

(a) Calcium and magnesium are in the same Group in the Periodic Table.
State which Group this is.

_____

(1)

(b) Use the Data Sheet to help you to answer this question.

(i) Write the chemical formula of magnesium chloride.

_____

(1)

(ii) Name the type of bonding in magnesium chloride.

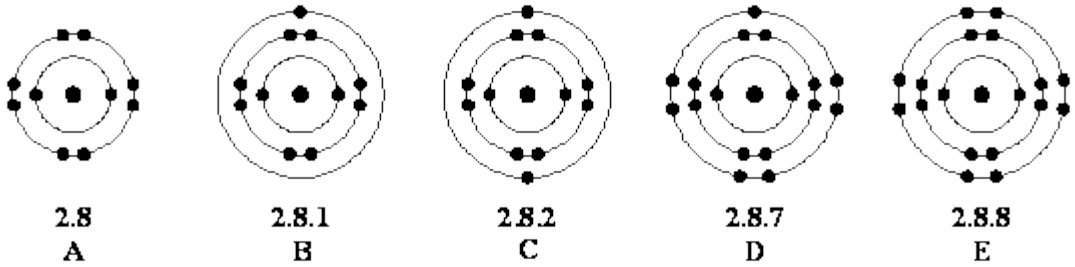
_____

(1)

(Total 3 marks)

4. Use the Data Sheet to help you answer this question.

When sodium reacts with water it forms sodium ions.
The diagrams below represent the electron arrangements of some atoms and ions.



Which of the diagrams, **A** to **E**, represents the electron arrangement of each of the following?

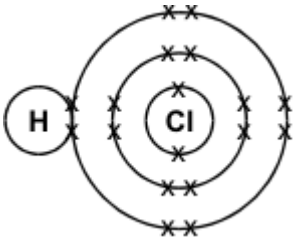
(i) A sodium atom, Na _____

(ii) A sodium ion, Na^+ _____

(Total 2 marks)

5. The hydrogen halides (hydrogen fluoride, hydrogen chloride, hydrogen bromide and hydrogen iodide) are important chemicals.

The diagram below represents a molecule of hydrogen chloride.



(i) What type of particles are represented by the crosses (X)?

_____

(1)

(ii) What type of chemical bond holds the atoms in this molecule together?

_____

(1)

(iii) Would you expect hydrogen chloride to be a gas, a liquid or a solid, at room temperature and pressure? Explain your answer.

_____

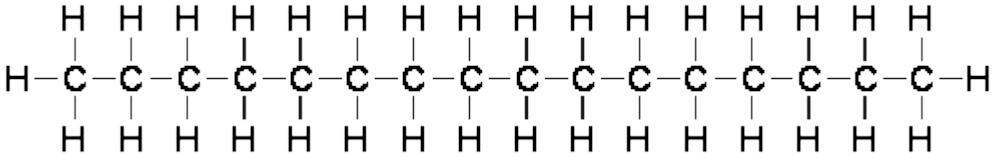
_____

_____

(3)

(Total 5 marks)

6. Diesel oil is obtained from crude oil. It can be used as a fuel for car engines. The diagram below represents a compound found in diesel oil.



(a) What is the formula of this compound?

_____

(1)

(b) Each of the lines on the diagram above represents a covalent bond.

What is a covalent bond?

_____

_____

(2)

(Total 3 marks)

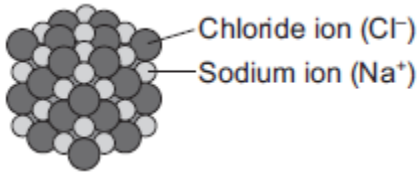
7. **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

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

Chlorine

Cl — Cl

Sodium chloride



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

Extra space

(Total 6 marks)

8. (a) Magnesium burns in oxygen, forming magnesium oxide.

This equation represents the reaction.

$Mg\ (s) + O_2\ (g) \rightarrow MgO\ (s)$

(i) Balance the equation.

(1)

(ii) Give the meaning of the state symbols (s) and (g).

(s) _____

(g) _____

(2)

(b) Use the Formulae of Some Common Ions table on the Data Sheet to help you to answer this question.

Magnesium also reacts with chlorine to form magnesium chloride.

Give the formula of magnesium chloride _____

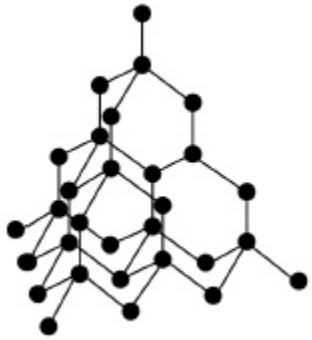
(1)

(Total 4 marks)

9. This question is about diamond and graphite.

Figure 1 shows part of the structure of diamond.

Figure 1



(a) Complete the sentence.

Choose the answer from the box.

calcium	**carbon**	**chromium**	**cobalt**

Diamond is a form of _____ .

(1)

(b) Which **two** statements about diamond are correct?

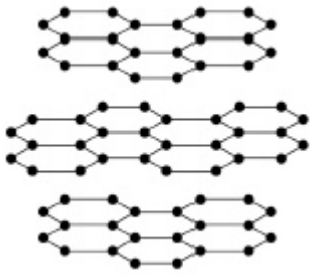
Tick **two** boxes.

Diamond has a giant structure.	☐
Diamond has ionic bonds.	☐
Diamond is made of layers.	☐
Diamond has weak bonds.	☐
Each atom is joined to four other atoms.	☐

(2)

Figure 2 shows part of the structure of graphite.

Figure 2



(c) Explain why graphite is soft and slippery.

Use **Figure 2** and your own knowledge.

_____

_____

_____

_____

_____

_____

(3)

(d) Graphite has covalent bonds between the atoms.

How many covalent bonds does each atom form?

Tick **one** box.

1 ☐ 2 ☐ 3 ☐ 4 ☐

(1)

(e) Explain why graphite can conduct electricity.

You should include a reference to electrons in your answer.

_____

_____

_____

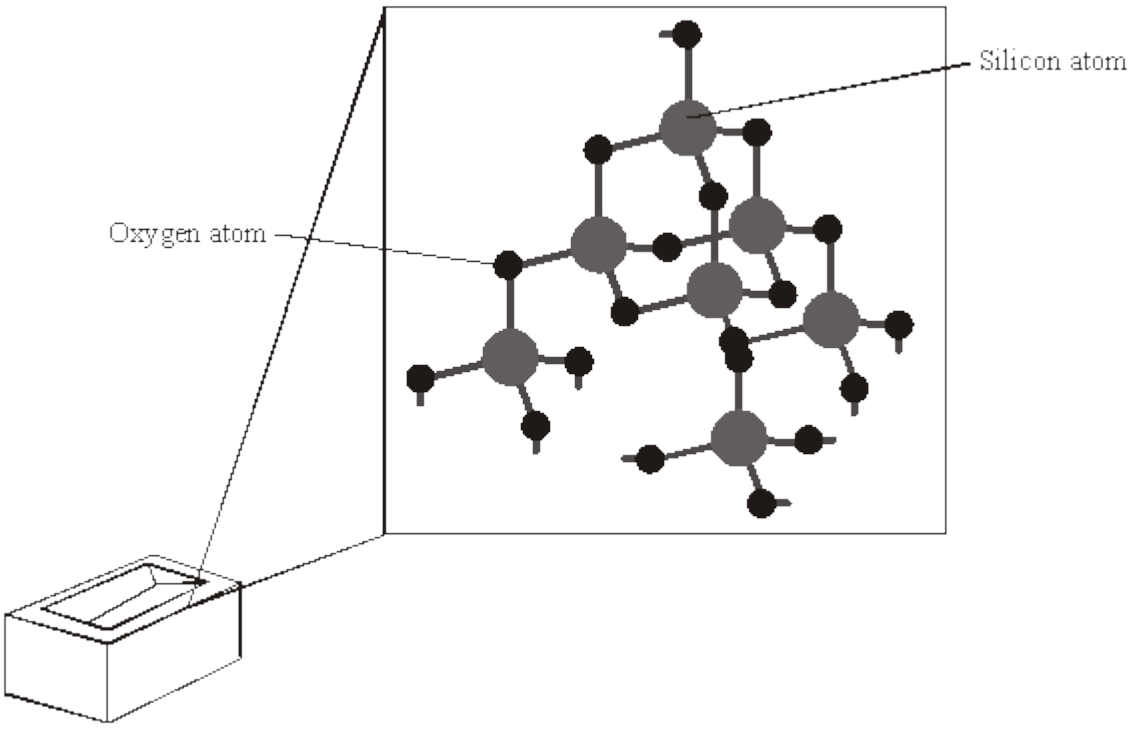
_____

(2)

(Total 9 marks)

10. Bricks made from silica (silicon dioxide) are used to line furnaces that operate at high temperatures.

Part of the structure of silica is shown in the diagram.



Suggest and explain why silica is used to make bricks for high-temperature furnaces. In your answer, you should refer to the structure of, and bonding in, silica.

(Total 4 marks)

11. Hydrogen chloride (HCl) can be made by the reaction of hydrogen (H_2) with chlorine (Cl_2).

(a) The diagrams represent molecules of hydrogen and chlorine.

Draw a similar diagram to represent a molecule of hydrogen chloride (HCl).
You need show only the outer energy level (shell) electrons.

(1)

(b) The word equation for the reaction of hydrogen with chlorine is shown below.

hydrogen + chlorine → hydrogen chloride

Write a balanced symbol equation for this reaction.

(2)

(c) Hydrogen chloride gas reacts with magnesium to form the ionic compound called magnesium chloride. Use the table of ions on the Data Sheet to help you to write the formula of magnesium chloride.

_____

(1)

(d) Why does magnesium chloride have a much higher melting point than hydrogen chloride?

_____

_____

_____

_____

(2)

(Total 6 marks)

12. Transition metals are useful as catalysts. Iron is used as a catalyst in the manufacture of ammonia.

$N_2(g) + 3\ H_2(g) \rightleftharpoons 2\ NH_3(g)$

(i) What is meant by $\rightleftharpoons$ in the chemical equation?

_____

_____

(1)

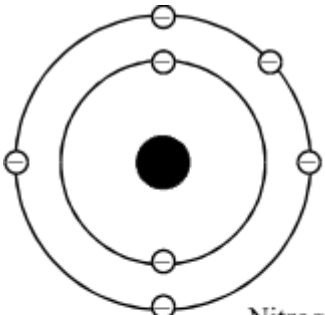
(ii) What would be the effect on the yield of ammonia if the pressure was increased?

_____

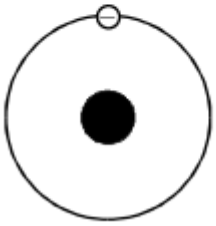
_____

(1)

(iii) Draw a diagram to show the arrangement of the electrons in a molecule of ammonia. The electron arrangement of each atom is shown.



Nitrogen atom



Hydrogen atom

(1)

(Total 3 marks)

13. Read the following information about an element X.

The element X melts above 600°C. It conducts electricity at room temperature. It burns in oxygen to form an oxide. When the oxide is mixed with water it turns Universal Indicator blue.

The oxide of X is a white solid at room temperature. It has the formula XO and contains the ion X^{2+}.

The element X reacts with chlorine to form a chloride with a high melting point. The chloride conducts electricity when molten and it is soluble in water.

(a) From the information give **three** pieces of evidence which suggest that X is a metal.

1. _____

_____

2. _____

_____

3. _____

_____

(3)

(b) In which Group of the Periodic Table should X be placed? Give a reason for your answer.

Group _____

Reason _____

_____

(2)

(c) Predict the formula for the chloride of X. _____

(1)

(Total 6 marks)

14. (a) The list below gives six substances.

- aluminium
- beer
- copper
- milk
- pure water
- sodium chloride

Put each substance in the correct column of the table.

ELEMENTS	COMPOUNDS	MIXTURES

(3)

(b) Elements can be divided into two groups, metals and non-metals.

The list below gives some properties of elements.

- brittle
- can be hammered into shape
- dull
- good conductors of electricity
- poor conductors of electricity
- shiny

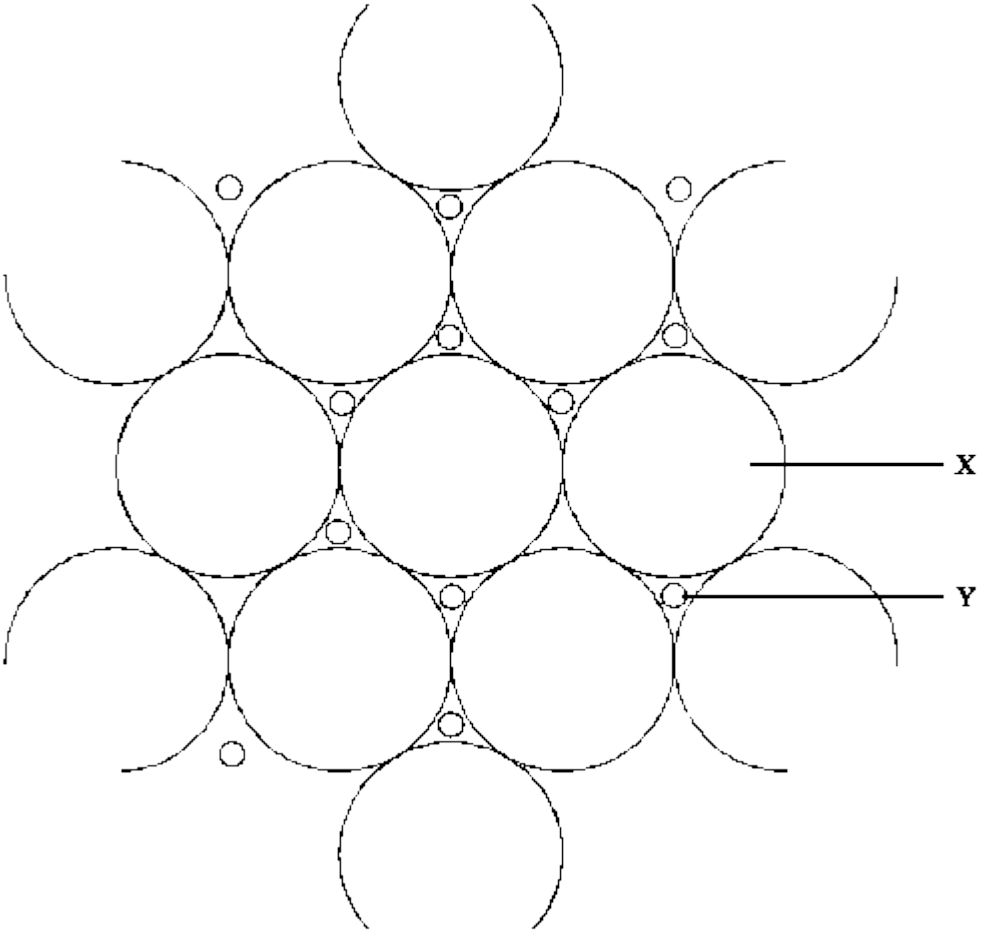
Put each property into the correct column.

PROPERTIES OF METALS	PROPERTIES OF NON-METALS

(3)

(Total 6 marks)

15. The diagram shows a model of part of the giant lattice of a metal.



(a) Name particles **X** and **Y**.

X _____

Y _____

(2)

(b) Explain, in terms of the giant structure above, why is it possible to bend a piece of metal.

_____

_____

_____

_____

(2)

(Total 4 marks)