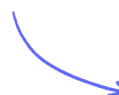


Bonding & Substance Properties

States of Matter / Particle Theory & its Limitations / State Symbols / Properties of Ionic Compounds / Properties of Small Molecules / Polymers / Giant Covalent Structures / Properties of Metals & Alloys / Metals as Conductors

Easy (5 questions)	/38
Medium (10 questions)	/51
Hard (5 questions)	/49
Total Marks	/138

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Easy Questions

1 (a) This question is about states of matter.

Table 1 shows the melting and boiling points of some of the elements in Group 7.

Table 1

Element	Melting point in °C	Boiling point in °C
Fluorine	-220	-188
Chlorine	-101	-35
Bromine	-7	59

Give the state of each substance at 50 °C

Fluorine: _____

Chlorine: _____

Bromine: _____

.....
.....
..... (3 marks)

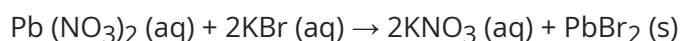
(b) Use the information from **Table 1** to complete the sentence:

Going down group 7, the melting points _____.

This is because the size of the molecules _____ so the forces between the molecules get _____.

(3 marks)

(c) A solution of potassium bromide will react with lead nitrate in the following reaction:



What information does the equation tell you about the products made in this reaction?

.....

.....

.....

(4 marks)

.....

2 (a) This question is about magnesium.

Magnesium can be shaped easily.

Tick (✓) **two** reasons which explain why metals can be shaped.

Reason why:	Tick
The atoms are all joined by ionic bonds.	
The atoms can slide over each other.	
The atoms are small.	
The atoms are in layers.	

(2 marks)

(b) Draw a line to match the following properties of magnesium with the correct explanation.

	Magnesium has layers of atoms that slide
High melting point	Magnesium has positively charged ions
	Magnesium has delocalised electrons
Conducts electricity	Magnesium has strong metallic bonds
	Magnesium has weak intermolecular forces

(2 marks)

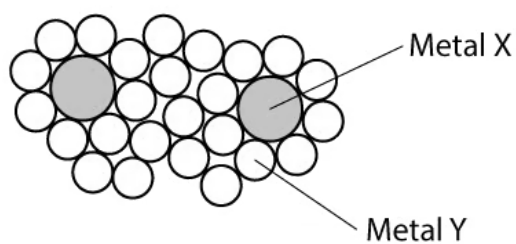
(c) What is meant by an alloy?

..... (1 mark)

(d) Magnesium can be mixed with other elements to form an alloy to make it harder.

The structure of an alloy is shown in **Figure 1**.

Figure 1



Complete the sentence to explain why an alloy is harder than a pure metal:

The atoms in an alloy are different _____ so the layers are unable to
_____ over each other when pressure is applied.

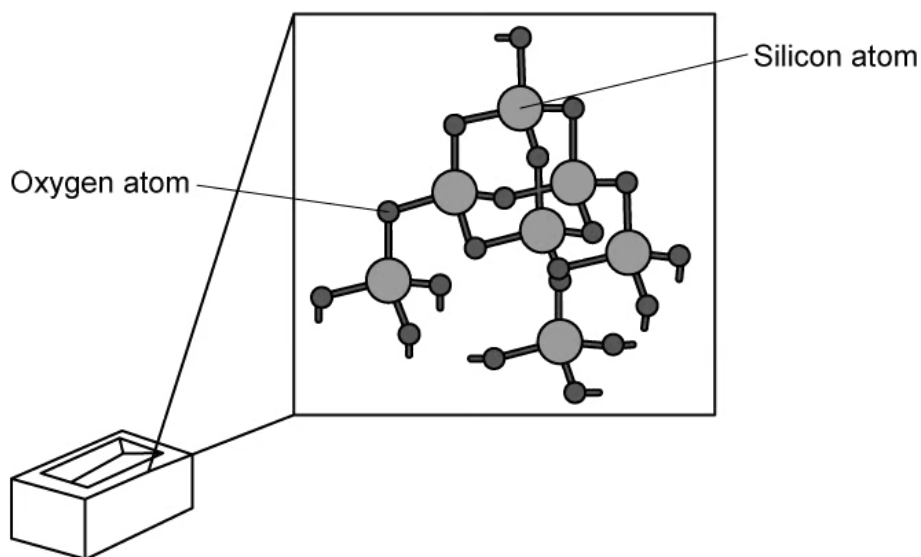
.....
..... (2 marks)

(e) Why is it incorrect to describe an alloy as a compound?

..... (1 mark)

3 (a) This question is about silicon dioxide. It's structure is shown in **Figure 1**.

Figure 1



Which two elements are found in silicon dioxide?

(2 marks)

(b) Silicon dioxide is used in bricks that line furnaces which operate at high temperatures.

Use the words in the box to complete the sentences which explain why it can be used for this purpose.

high	energy	strong
low	small	six
ionic	giant	four

Silicon dioxide has a _____ structure.

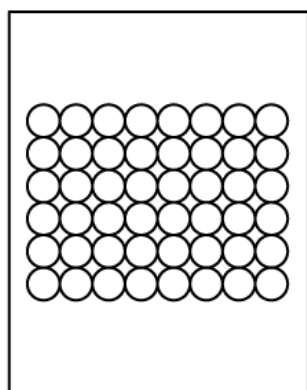
Each silicon atom is joined to _____ oxygen atoms by _____ covalent bonds.

These bonds need lots of _____ to break.

Silicon dioxide therefore has a _____ melting point.

(5 marks)

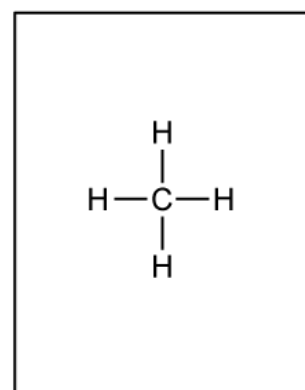
4 (a) The structures of five substances are represented below:



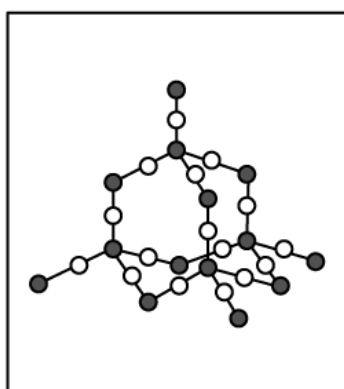
A



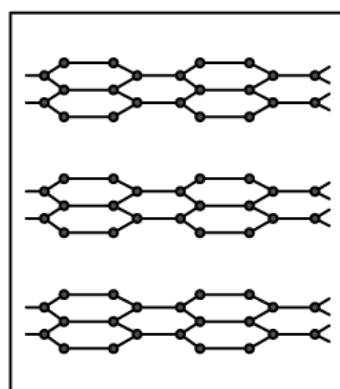
B



C



D



E

Give **one** substance, **A**, **B**, **C**, **D** or **E** that:

Is a metal	
Represents the structure of diamond	
Is soft and slippery	
Is a compound	

.....
.....
..... (4 marks)
.....

(b) Which element are substances **B** and **E** made from?

..... (1 mark)
.....

(c) Substance C is methane, CH₄.

Which two statements are correct about methane? Tick (✓) **two** boxes.

It has weak intermolecular forces	
It cannot conduct electricity	
It has a high melting point	
It can conduct electricity	
It has a low boiling point	

.....
..... (2 marks)
.....

5 (a) This question is about calcium chloride, CaCl_2 .

What is the total number of atoms in calcium chloride?

..... (1 mark)

(b) What type of bonding is found in calcium chloride?

Tick (✓) **one** box.

Ionic	
Covalent	
Metallic	

..... (1 mark)

(c) How many **negative** ions are there in the formula for calcium chloride?

..... (1 mark)

(d) Suggest **three** properties of calcium chloride.

.....

.....

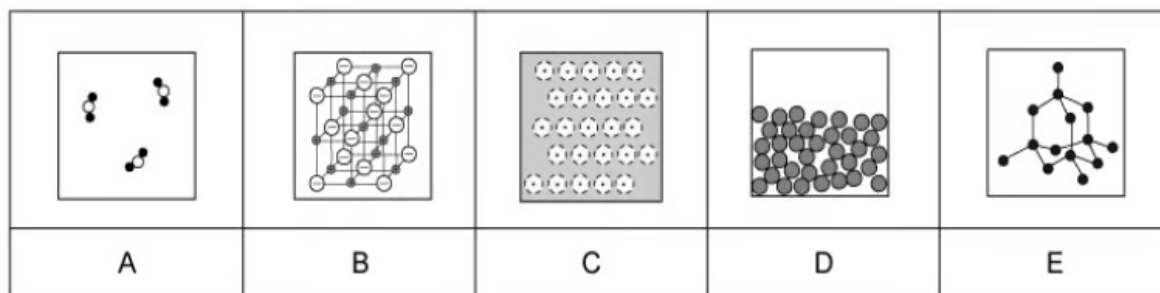
..... (3 marks)

Medium Questions

1 (a) This question is based on the structure of different substances.

Identify each substance in **Figure 1** by writing the letter next to the corresponding sentence.

Figure 1



This substance is a liquid: _____

This substance is a gas: _____

This substance is a metal: _____

This substance is diamond: _____

This substance is ionic: _____

.....

.....

.....

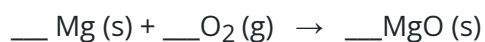
.....

.....

(5 marks)

(b) Magnesium is a reactive metal that combusts in air to form magnesium oxide.

Balance the equation for the reaction below and give the meaning of the state symbols (s) and (g).



.....

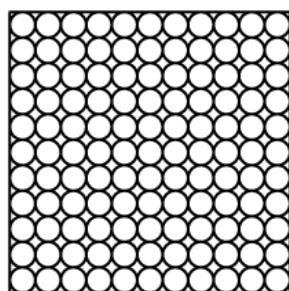
.....

..... (3 marks)

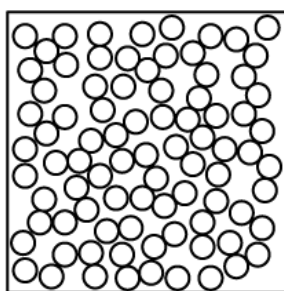
(c) Higher:

The following particle diagrams in **Figure 2** are routinely used to represent the three phases of matter:

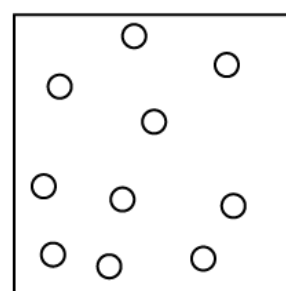
Figure 2



Solid



Liquid



Gas

State **three** limitations of these models.

.....

.....

..... (3 marks)

2 (a) A student was investigating a calcium salt labelled **Y**.

The student found that **Y**:

- has a very high melting point
- does not conduct electricity
- is water soluble and the solution produced conducts electricity

What type of bonding is present in salt **Y**?

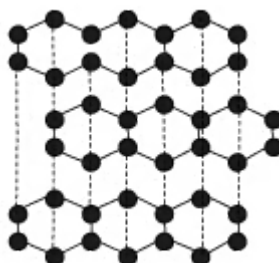
..... (1 mark)

(b) Explain why the solid **Y** does **not** conduct electricity but its aqueous solution does.

..... (2 marks)

(c) **Figure 1** shows the bonding arrangement of an element.

Figure 1



What is the element?

Tick (✓) **one** box.

Element	
Chromium	
Carbon	
Silicon	
Graphite	

..... (1 mark)

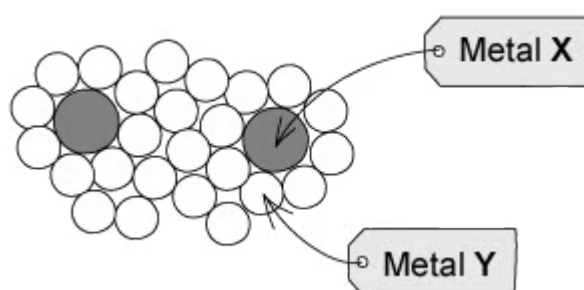
(d) The image in **Figure 1** is an allotrope.

Why does this allotrope conduct electricity?

..... (3 marks)

(e) **Figure 2** shows the particle diagram of an alloy.

Figure 2



Explain why this alloy is harder than pure metal Y.

.....
(2 marks)

(f) What kind of substances are alloys?

Tick (✓) **one** box.

Elements	
Mixtures	
Compounds	

..... (1 mark)

3 Different substances have characteristic melting and boiling points, depending on the strength of the bonds or forces holding them together.

Which explains why methane has a lower melting point than sodium chloride?

- A. Covalent bonds are weaker than ionic bonds
- B. Intermolecular forces are weaker than ionic bonds
- C. Covalent bonds are stronger than ionic bonds
- D. Intermolecular forces are stronger than ionic bonds

(1 mark)

4 Element X has the following properties:

- melts at 450°C
- boils at 1091°C
- Forms an ion with a 2+ charge

Which is most likely to be element X?

- A. Sodium
- B. Magnesium
- C. Carbon
- D. Oxygen

(1 mark)

- 5 (a) Marble slabs for kitchen countertops are cut from huge blocks of marble which are extracted from quarries. The extraction process involves cutting the marble blocks with a metal cable connected to a rotary motor. Water is sprayed onto the marble for cooling.

The cable used is made from a steel alloy.

Suggest **two** advantages of using an alloy instead of a pure metal for this process.

.....
..... (2 marks)

- (b) For particularly dense marble, or marble which contains grains of other rock types, the cutting cable is encrusted with diamond dust.

Suggest a reason why.

..... (1 mark)

- (c) Diamond has a very high melting points.

Explain why in terms of the bonding arrangement.

.....

.....

.....

..... (4 marks)

6 (a) Explain why diamond has a higher melting and boiling point than carbon dioxide.

.....

.....

..... **(3 marks)**

(b) Metals are good conductors of electricity.

Explain why.

.....

.....

..... **(3 marks)**

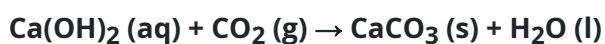
7 Sodium chloride is often known as 'table salt'.

Which compound represents sodium chloride?

	Conducts electricity when solid	Conducts electricity when molten	State at room temperature and pressure	Can be bent or shaped
A	Yes	Yes	Solid	Yes
B	No	No	Solid	No
C	No	Yes	Solid	No
D	No	No	Solid	Yes

(1 mark)

- 8 Limewater is the common name for calcium hydroxide solution, $\text{Ca}(\text{OH})_2 (\text{aq})$. It is commonly used as a test for carbon dioxide, whereupon the following reaction occurs:



Which of the following statements is **not** true about the reaction?

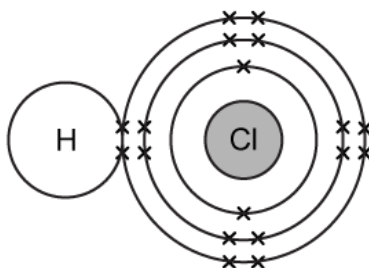
- A. Calcium hydroxide is dissolved in water
- B. One product is a gas
- C. The solution will turn cloudy
- D. The solution will become increasingly dilute during the reaction

(1 mark)

- 9 (a) The hydrogen halides (HF , HCl , HBr and HI) are compounds used to produce acids.

Figure 1 represents a molecule of hydrogen chloride.

Figure 1



What do the crosses (X) represent?

(1 mark)

- (b) What type of bonding is present in this molecule?

(1 mark)

- (c) Predict whether hydrogen chloride is a solid, liquid or gas at room temperature and pressure.

Explain your answer.

.....

.....

..... (3 marks)

10 (a) This question is based on the chemistry of polymers.

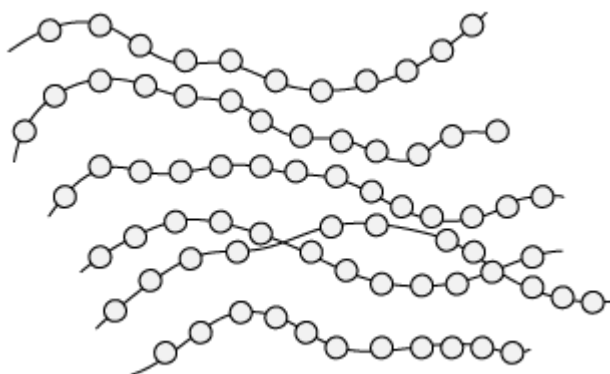
Polyvinyl chloride (PVC) is a commonly used polymer.

State the term used to describe the units from which polymers are made and name the type of bonding between these units.

(2 marks)

(b) Figure 1 represents short chains of PVC.

Figure 1



Although hard material is used in water pipes and drains, PVC softens and melts when heated.

Use the diagram and your knowledge of structure and bonding to explain why this occurs.

(3 marks)

(c) The basic unit of polyvinyl chloride is C_2H_3Cl .

The polymer chain consists of many of these base units bonded together.

In the space provided, draw a section of a chain of PVC showing three units joined together.

(3 marks)

Hard Questions

1 (a) This question is about the bonding in different substances.

Table 1 shows some information about substances **A - E**.

Table 1

Substance	Melting point in °C	Boiling point in °C	Does it conduct electricity when solid?	Does it conduct electricity when dissolved or molten?
A	-208	-200	No	No
B	-220	-180	No	No
C	802	1415	No	Yes
D	115	450	No	No
E	1080	2563	Yes	Yes

Use **Table 1** to answer the following questions.

Give the state symbol of substance **B** at -202 °C.

..... (1 mark)

(b) Substance **E** can conduct electricity when solid and molten.

Explain why.

.....

.....

..... (3 marks)

.....

(c) One of the substances in the table is sodium chloride.

Identify which substance is sodium chloride.

Give a reason for your answer.

.....

..... (2 marks)

.....

(d) Explain why substance **A** has a relatively low boiling point.

.....

..... (3 marks)

.....

2 (a) This question is about the bonding and structure of silicon dioxide.

Figure 1 shows the structure of part of silicon dioxide.



Explain why silicon dioxide can be used to line furnaces.

.....

.....

.....

(4 marks)

(b) Explain why silicon dioxide cannot conduct electricity.

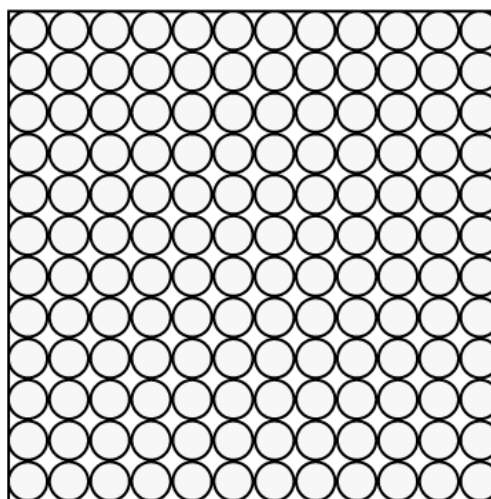
.....

(2 marks)

(c) Silicon dioxide is a solid at room temperature.

Solids can be represented using the particle model in **Figure 2**.

Figure 2



Solid

Describe **two** limitations of this model.

(2 marks)

(d) Explain how, using particle theory, silicon dioxide would change state from a solid to a liquid.

(2 marks)

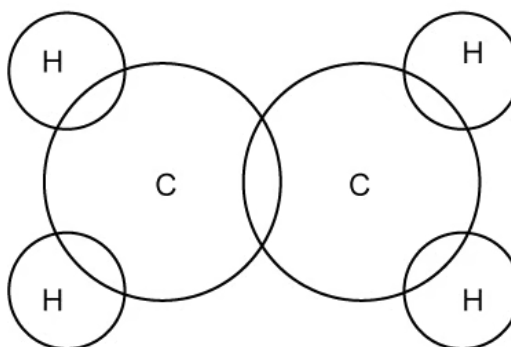
3 (a) This question is about the structure and bonding in ethene.

Ethene belongs to the homologous series of alkenes and has the formula C_2H_4 .

Complete the dot and cross diagram in **Figure 1** to show the bonding of ethene.

Only show the outer shell electrons.

Figure 1



(2 marks)

(b) **Table 1** shows information on the boiling points and structures of ethene and two other alkenes.

Table 1

Name	Ethene	Propene	Butene
Structure	$\begin{array}{cc} H & H \\ & \\ C & = C \\ & \\ H & H \end{array}$	$\begin{array}{c} H & & H \\ & \diagdown & \\ & C = C & - C - H \\ & / & \\ H & & H \end{array}$	$\begin{array}{ccccccc} H & & H & & H & & H \\ & \diagdown & & & & & \\ & C = C & - C & - C & - H \\ & / & & & & \\ H & & & H & & H \end{array}$
Boiling Point in $^{\circ}C$	-104	-47	-6.3

Use your knowledge of structure and bonding to describe and explain the trend in boiling point as the number of carbon atoms increases.

.....
.....
..... (3 marks)

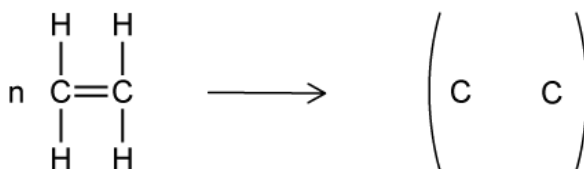
(c) Ethene can undergo addition polymerisation to form the polymer poly(ethene).

Why is poly(ethene) a solid at room temperature?

.....
.....
..... (3 marks)

(d) Complete the structure for poly(ethene) in **Figure 2**.

Figure 2

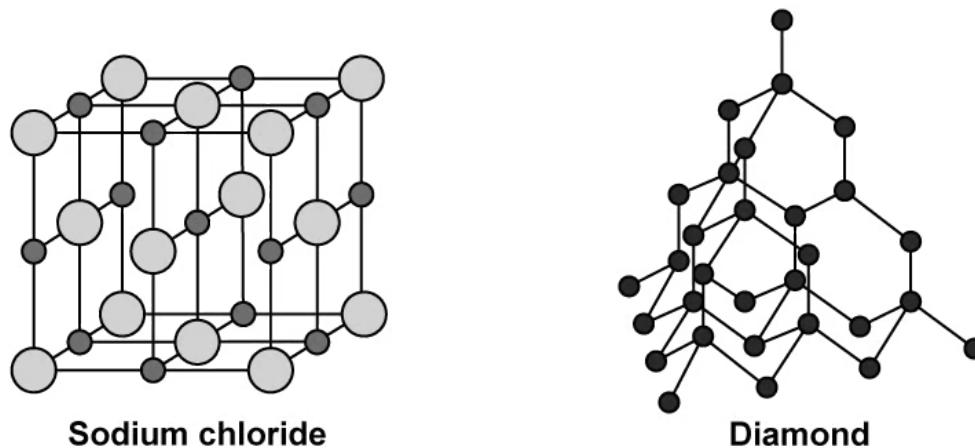


(3 marks)

4 (a) This question is about sodium chloride and diamond.

Figure 1 shows the structure of sodium chloride and diamond.

Figure 1



Sodium chloride has a melting point of 801°C .

Explain why sodium chloride has a high melting point.

.....

.....

.....

..... (4 marks)

(b) Diamond has a melting point of 4500°C .

Explain why diamond has a higher melting point than sodium chloride.

Refer to the structure of diamond in your answer.

.....

..... (2 marks)

(c) Compare the electrical conductivity of sodium chloride and diamond.

Explain your answer.

(4 marks)

