

Chemistry Unit C1: Structures, Trends, Chemical Reactions, Quantitative Chemistry and Analysis

C1.3 Structures

Content - CCEA Double Award Chemistry 1 - Fort Hill Integrated College	Got it	Nearly	Haven't a clue
C1.3 Structures			
Ionic structures			
Can you use the accepted structural model for giant ionic lattices to explain the physical properties of ionic substances such as sodium chloride, including melting point, boiling point and electrical conductivity (diagram of giant ionic lattice is not expected);			
Can you recall that most ionic compounds are soluble in water;			
Molecular Covalent structures			
Can you use the accepted structural model for molecular covalent structures to explain the physical properties of molecular covalent structures such as iodine and carbon dioxide, including melting point, boiling point and electrical conductivity;			
Can you demonstrate knowledge and understanding that the intermolecular forces between covalent molecules are weak forces called van der Waals' forces;			
Can you recall that many covalent molecular substances are insoluble in water;			
Giant covalent structures			
Can you demonstrate knowledge and understanding of the giant covalent structure of carbon (diamond) and carbon (graphite), and predict and explain their physical properties, including: <ul style="list-style-type: none"> • electrical conductivity; • hardness; • melting point and boiling point; and • their uses in cutting tools (diamond), lubricants and pencils (graphite); 			

Metallic structures			
Can you use the accepted structural model for metals to predict and explain their structure and physical properties including melting point, malleability, ductility and electrical conductivity.			
Can you demonstrate knowledge and understanding that an alloy is a mixture of two or more elements, at least one of which is a metal, and the resulting mixture has metallic properties;			
Structure and bonding of carbon			
Can you demonstrate recall that carbon can form four covalent bonds;			
Can you demonstrate knowledge and understanding of the structure of graphene (a single atom thick layer of graphite), explain its physical properties, including strength and electrical conductivity, and recall its uses such as those in batteries and solar cells;			
Can you demonstrate knowledge and understanding of the meaning of the term allotrope as applied to carbon (diamond), carbon (graphite) and graphene; and			
Classification of structures			
Can you use given information to classify the structure of substances as giant ionic lattice, molecular covalent, giant covalent or metallic.			

C1.4 Nanoparticles

Content - CCEA Double Award Chemistry 1 - Fort Hill Integrated College	Got it	Nearly	Haven't a clue
C1.4 Nanoparticles			
Can you recall that nanoparticles are structures that are 1-100 nm in size and contain a few hundred atoms; and			
Can you evaluate the benefits of nanoparticles in sun creams, including better skin coverage and more effective protection from the Sun's ultraviolet rays, and the risks, such as potential cell damage in the body and harmful effects on the environment.			

1 Graphene is a form of the element carbon. It consists of a single layer of carbon atoms joined together by covalent bonds. It is 200 times stronger than steel. It conducts electricity as efficiently as copper and is a good conductor of heat. It is almost completely transparent with possibly the highest melting point known.

(a) Explain why graphene is said to be an element.

 _____ [1]

(b) Give two pieces of information from the passage which suggest that graphene might be thought to be **metallic**.

1. _____

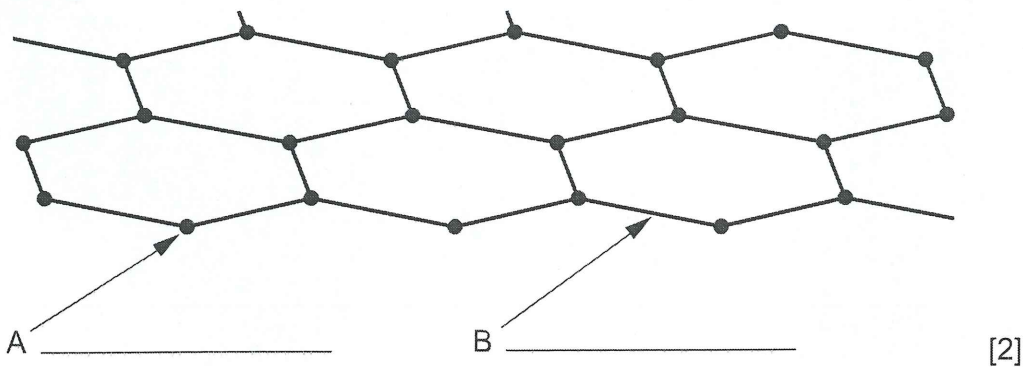
 2. _____
 _____ [2]

(c) Give two pieces of information from the passage which suggest graphene might be thought to be **non-metallic**.

1. _____

 2. _____
 _____ [2]

(d) Using the information in the passage, label A and B in the diagram of graphene below.



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3 (a) Describe the structure and bonding in a metal such as calcium.

Structure: _____

Bonding: _____
_____ [4]

(b) Calcium reacts with fluorine to form the ionic compound, calcium fluoride.

(i) Ions are either cations or anions. Explain what is meant by the term **cation**.

_____ [1]

(ii) What is the electronic structure (electronic configuration) of a calcium ion and of a fluoride ion?

calcium ion: _____

fluoride ion: _____ [2]

(iii) What is the formula of the compound calcium fluoride?

_____ [1]

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(c) (i) Draw a dot and cross diagram to show the bonding in a **molecule** of oxygen.

[3]

(ii) Explain why oxygen has a low boiling point.

[3]

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3 Aluminium is combined with small amounts of some other elements to produce a new material called X. This new material has improved properties making it tougher and stronger than pure aluminium. It has excellent corrosion resistance and very good resistance to seawater.

The table below gives some information about material X.

elements used to make X	% by weight	relative atomic mass
aluminium		27
magnesium	0.8	24
silicon	0.6	28
iron	0.7	56
zinc	0.2	65
copper	0.4	64

(a) Why can X be described as an alloy?

_____ [2]

(b) (i) Calculate the **total** percentage by weight of all the other elements added to aluminium in this alloy.

_____ [1]

(ii) Calculate the percentage by weight of aluminium in this alloy. Show your working.

_____ % [2]

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- (c) (i) From the information given in the passage opposite and your own knowledge, explain why **X** would be very suitable in the manufacture of aircraft.

[2]

- (ii) Suggest another use for **X** based on the information in the passage and the table.

[1]

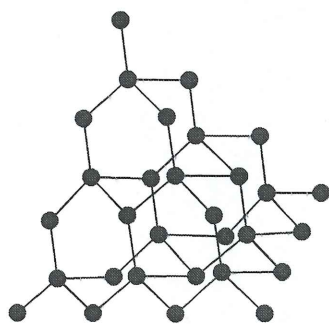
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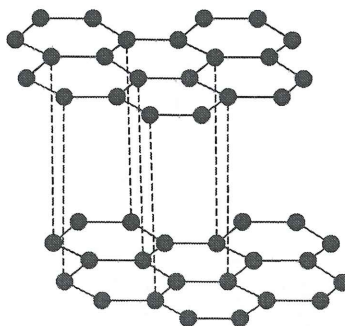
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4 Two structural models are shown below.



A



B

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(a) (i) Name a substance which has:

Structure A _____

Structure B _____ [2]

(ii) What do the black dots in the structural models represent?

_____ [1]

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In part (b) you will be assessed on your written communication skills including the use of specialist scientific terms.

- (b) Compare and contrast the physical properties of the substances which have structures **A** and **B**.

Your answer should include similar physical properties and physical properties which are different.

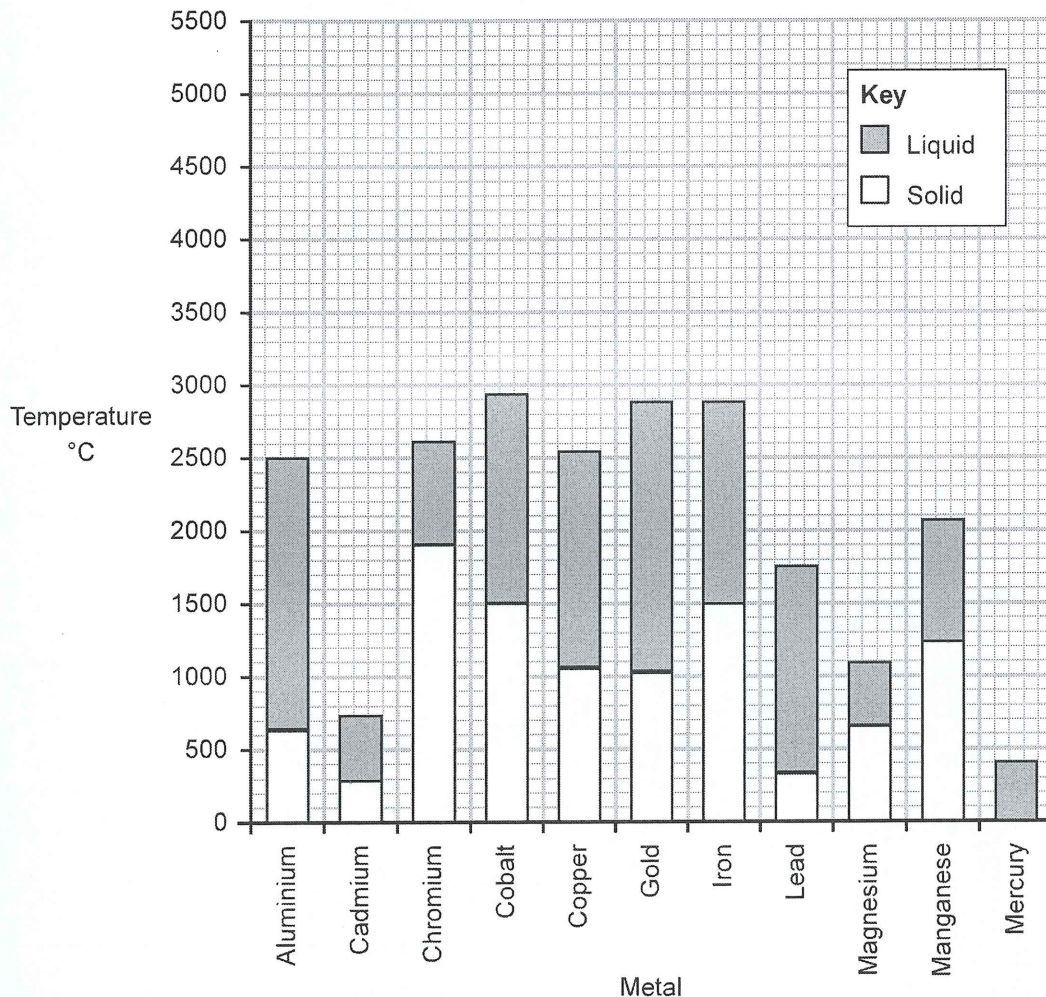
[6]

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5 (a) What is meant by the term **melting point**?

Melting point is: _____
 _____ [1]

(b) The data shown below gives information about the melting and boiling points of some metals.



(i) Which metal, in the table, has the lowest boiling point?

_____ [1]

(ii) Which metal, in the table, has the highest melting point?

_____ [1]

(iii) From the data in the table, in what way are gold and aluminium very similar?

 _____ [1]

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(c) The following table gives information about the relative ductility and malleability of some metals.

Most ductile	Ductility	Malleability	Most malleable
↓	gold	gold	↓
	iron	aluminium	
	copper	copper	
	aluminium	tin	
	zinc	lead	
	tin	zinc	
	lead	iron	
Least ductile			Least malleable

Describe similarities and differences you can notice in the relative ductility and malleability of these seven metals.

[3]

(d) Explain, in terms of their electrons and positive ions, how the structure of all metals allows them to be both malleable and ductile.

[4]

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- 5 The table below gives information about the melting point, boiling point and electrical conductivity of 4 substances, A, B, C and D. Use the information in the table to answer the questions which follow.

substance	melting point/ $^{\circ}\text{C}$	boiling point/ $^{\circ}\text{C}$	electrical conductivity	
			solid	molten
A	-182	-161	does not conduct	does not conduct
B	660	2500	conducts	conducts
C	808	1465	does not conduct	conducts
D	3652	4200	conducts	conducts

- (a) Identify the substance A, B, C or D which:

(i) is a gas at room temperature

_____ [1]

(ii) exists as oppositely charged ions in a giant ionic lattice

_____ [1]

(iii) exists as small molecules

_____ [1]

(iv) could be aluminium

_____ [1]

- (b) Graphite has a giant covalent structure. Explain why the melting point of graphite is extremely high.

 _____ [3]

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(c) Explain why graphite can conduct electricity.

_____ [2]

(d) Diamond and graphite are allotropes of the element carbon.

What are allotropes?

Allotropes are _____

_____ [2]

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5 Diamond and graphite are two allotropes of carbon. Carbon dioxide is one of the many compounds of carbon.

(a) Complete the table below which gives information about the bonding, structure and melting points of diamond and carbon dioxide.

	Bonding	Type of structure	Melting point /°C
Diamond	covalent		3350
Carbon dioxide	covalent		-78

[2]

(b) What are allotropes?

[2]

(c) (i) Suggest a melting point for graphite.

[1]

(ii) Explain your answer to (c)(i).

[1]

(d) Explain, in terms of its structure, why diamond has an extremely high melting point.

[3]

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- (e) Explain, in terms of its structure, why carbon dioxide has a very low melting point.

[3]

- (f) Explain, in terms of its structure, why diamond cannot conduct electricity.

[1]

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- 6 Substances may be classified according to their physical properties.
Use the table below to answer the following questions.

Substance	Melting point	Boiling point	Electrical conductivity	
			as solid	as liquid
A	650	1100	good	good
B	114	184	poor	poor
C	3550	4827	poor	poor
D	776	1500	poor	good
E	-79	-56	poor	poor
F	327	1760	good	good

- (a) (i) Which substance A, B, C, D, E or F has a molecular covalent structure and is a solid at room temperature?

_____ [1]

- (ii) Suggest a name for this substance.

_____ [1]

- (b) Which substance A, B, C, D, E or F could be an electrolyte?

_____ [1]

- (c) Which substance A, B, C, D, E or F is a metal with the lowest boiling point?

_____ [1]

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- (d) (i) Describe the state and structure of substance E at room temperature.

_____ [2]

- (ii) Would you expect substance E to dissolve in water?

_____ [1]

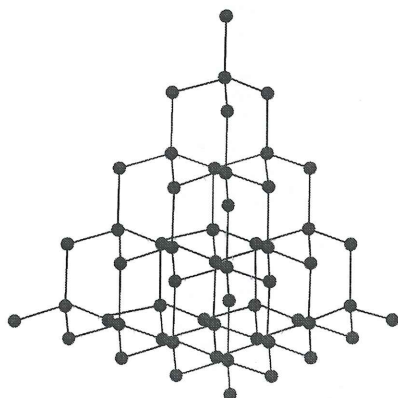
- (iii) Explain your answer to (d)(ii).

_____ [1]

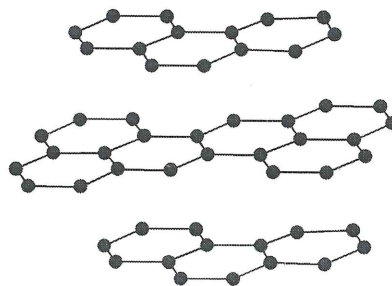
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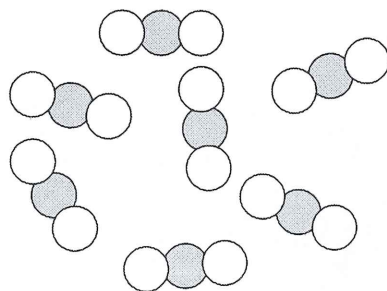
6 The diagrams below represent the structures of two allotropes of carbon, diamond and graphite, and of carbon dioxide. The atoms of each substance are held together by covalent bonds.



diamond



graphite



carbon dioxide

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(a) What are **allotropes**?

Allotropes are _____

 _____ [2]

(b) Explain how a **covalent bond** is formed.

 _____ [1]

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- (c) Draw a dot and cross diagram to show the bonding in a molecule of carbon dioxide. **(Show all the electrons)**

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[3]

- (d) Complete the table below, by adding the name of the type of structure of each substance. The first one is done for you.

Substance	Type of structure
diamond	giant covalent
graphite	
carbon dioxide	

[2]

Graphite is used in pencil leads.

- (e) Explain, with reference to the structure of graphite, why it is used in pencil leads.

[2]

- 7 Substances can be classified by their structures as ionic lattice, molecular covalent, giant covalent or metallic.

Substance	Melting point (°C)	Boiling point (°C)	Electrical conductivity	
			Solid	Liquid
A	-210	-196	does not conduct	does not conduct
B	600	2350	conducts	conducts
C	808	1465	does not conduct	conducts
D	114	184	does not conduct	does not conduct
E	3550	4827	does not conduct	does not conduct

- (a) Which substance, A, B, C, D or E, is a gas at room temperature?

_____ [1]

- (b) Which substance, A, B, C, D or E, has an ionic lattice structure?

_____ [1]

- (c) Which substances, A, B, C, D or E, have a molecular covalent structure?

_____ and _____ [1]

- (d) Which substance, A, B, C, D or E, is most likely to be soluble in water?

_____ [1]

- (e) Substance E can be used in cutting tools.

Name substance E and give a **physical** property which makes it suitable for use in cutting tools.

name: _____ [1]

physical property: _____ [1]

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9 The table below gives some information about five substances A, B, C, D and E.

Substance	Boiling point °C	Melting point °C	Electrical conductivity when solid	Electrical conductivity when liquid
A	1760	327	good	good
B	69	- 95	poor	good
C	1499	777	poor	good
D	4828	3551	poor	poor
E	2751	1539	good	good

(a) (i) Which **two** substances A, B, C, D or E have delocalised electrons?

_____ and _____ [1]

(ii) Explain your answer. _____

_____ [2]

(b) Explain why substance **D** could be diamond.

_____ [2]

(c) Explain why substance **C** can be used as an electrolyte.

_____ [2]

