

O Level Combined Chemistry Structured

Chemical Bonding Test 1.0

Q1

The Fig 3.1 shows how the outer shell electrons are arranged in the compound.

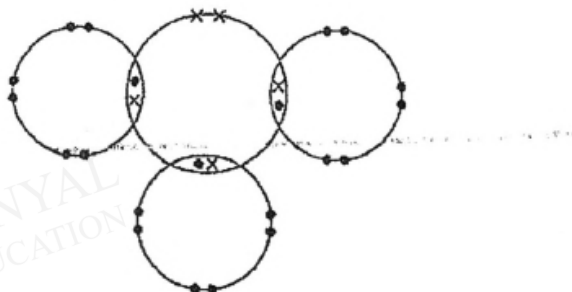


Fig. 3.1

- (a) Put ticks (✓) in the boxes to show whether the following statements about the compound are true or false:

statements	true	false
It is a saturated hydrocarbon.		
It could be ammonia, NH ₃ .		
It is a halogen compound.		
It is an ionic compound.		

[2]

- (b) Suggest whether the boiling point of this substance would be high or low. Explain based on its bonding and structure.

.....

.....

.....

..... [3]

- (c) Draw a similar diagram to show the arrangement of electrons in a molecule of carbon dioxide, CO₂. You only need to show outer shell electrons.

[2]

Q2

The physical properties of some substances A to F are shown in the Table 5.1.
Note that letters used are not the actual symbols of the elements.

Table 5.1

Substance	Electrical conductivity		Solubility in water	Melting point / °C	Boiling point / °C
	Solid	Liquid / Molten			
A	Poor	Poor	Soluble	- 101	- 34
B	Poor	Poor	Soluble	153	365
C	Excellent	Poor	Soluble	- 45	12
D	Excellent	Excellent	Insoluble	2050	5842
E	Poor	Poor	Soluble	0	100
F	Poor	Excellent	Soluble	34	127

Identify the substance(s) that is/are

(a) a solid at room temperature of 25 °C,

..... [1]

(b) the distillate of simple distillation of sea water,

..... [1]

(c) an ionic compound,

..... [1]

(d) likely to exist as metal,

..... [1]

(e) most likely to contain particles that move around rapidly at 75 °C.

..... [1]

Q3

Chlorine can form both ionic and covalent bonds when combined with other elements.

(a) Explain why chlorine can form both ionic and covalent compounds when combined with other elements. Use 'dot and cross' diagram to support your explanation. State clearly the other elements used in your explanation.

(i) Ionic compound

.....

.....

.....

.....

DANYAL
EDUCATION

[3]

(ii) covalent compound

.....

.....

.....

.....

DANYAL
EDUCATION

DANYAL
EDUCATION

[3]

(b) State two differences in the physical properties of ionic compound and covalent compound. Use your knowledge of the particles to explain the differences.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[4]

Q4

- (i) a carbon atom combines with oxygen atom(s),
 - (ii) a sodium atom combines with chlorine atom(s).
- (b) Draw a "dot and cross" diagram for either one of the substances formed in (ai) or (aii).

[2]

- (c) Explain in terms of bonding and structures the difference in the melting points of the substances formed in (ai) and (aii).

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[4]

Q5

Atoms of non-metallic elements can combine with other atoms to form many different compounds.

(a) One of these compounds is carbon tetrachloride, CCl_4 , an organic solvent with low melting and boiling point and is a non-conductor of electricity.

(ii) Name the type of chemical bonding present in carbon tetrachloride.

.....[1]

(ii) Draw a 'dot-and-cross' diagram to show the arrangement of electrons in a molecule of carbon tetrachloride in the space below. Show only the outermost electrons. [Proton numbers: C, 6 ; Cl, 17]

[2]

(b) Another of these compounds is magnesium chloride. Unlike carbon tetrachloride, this compound has a high melting and boiling point and is a conductor of electricity when molten.

Write the chemical formula of magnesium chloride.

.....[1]

(c) Use your knowledge of the bonding in carbon tetrachloride and magnesium chloride to explain the difference in their

(i) melting and boiling points;

.....

.....

.....[2]

(ii) electrical conductivity.

.....

.....

.....[2]

Answers

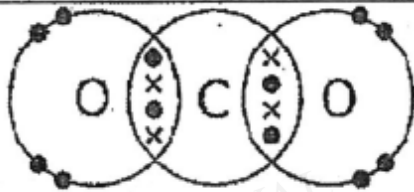
Chemical Bonding Test 1.0

Q1

(a)	statements	true	False	[2]
	It is a saturated hydrocarbon.		√	
	It could be ammonia, NH ₃ .		√	
	It is a halogen compound.	√		
	It is an ionic compound.		√	

½ mark for each correct answer.

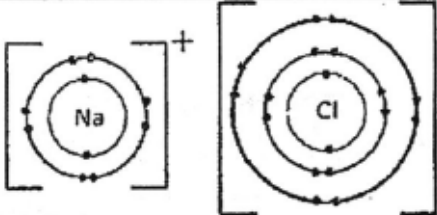
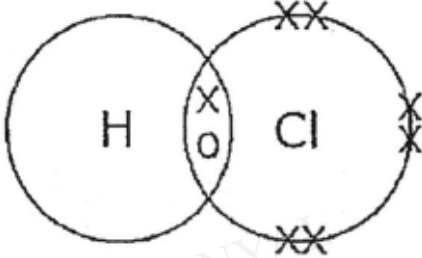
(b)	The boiling point of the substance would be low. The compound has a molecular structure with weak intermolecular forces , thus low amount of energy required to break the bond.	[1] [2]
-----	--	------------

(c)	 <p>Correct number of overlapping circles = ½ mark Correct number of electrons shared = ½ mark Correct number of valence electrons = ½ mark Correct representation of dot and cross = ½ mark</p>	[2]
-----	---	-----

Q2

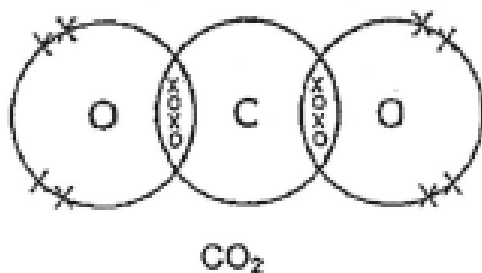
(a)	B, D and F Any one correct answer. N ½ mark if incorrect answer included	[1]
	E ½ mark if incorrect answer included	[1]
	F ½ mark if incorrect answer included	[1]
	D ½ mark if incorrect answer included	[1]
	A and C (1/2 mark for each correct answer)	[1]
(a)	$\text{Mg(s)} + 2\text{HCl(aq)} \rightarrow \text{MgCl}_2\text{(aq)} + \text{H}_2\text{(g)}$ 1 mark : correct balanced equations 1 mark : correct state symbol	[2]

Q3

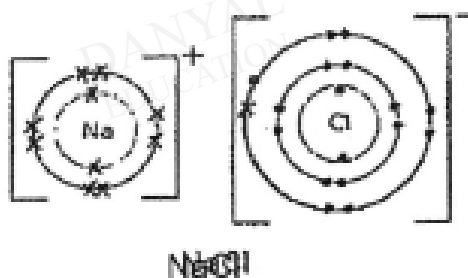
(a)(i)	It needs gain 1 electron from another metal to become stable	[1]
	Eg: sodium, lithium, any metals stated in the expansion	[1]
	 <p>Bonding showed through brackets : ½ mark Correct representation dot and cross, charges and metals used in explanation : ½ mark</p>	[1]
(a)(ii)	Chlorine can share electrons with another non-metal.	[1]
	Eg : hydrogen, chlorine, any appropriate non-metal stated clearly	[1]
	 <p>Bonding showed through overlapping circle : ½ mark Correct representation of dot and cross, number of electrons shared and non-metal used in the explanation : ½ mark</p>	[1]
(b)	Ionic compound has high melting and boiling point (1/2 mark) while covalent compounds has low melting and boiling point (1/2 mark)	[1]
	Large amount of energy required to break the strong electrostatic forces between the oppositely charged ions, in ionic compounds. (1/2 mark)	[1]
	Weak intermolecular forces in covalent compounds required low amount of energy to break the forces of attraction. (1/2 mark)	[1]
	Ionic compound conducts electricity in molten and aqueous stat ((1/2	[1]
	mark), while covalent compound does not conduct electricity (1/2 mark)	
	This is due to the presence of mobile ions in ionic compounds(1/2 mark) and there are no mobile ions in covalent compound (1/2 mark)	[1]

Q4

b



correct no. of valence electrons
correct no. of shared electrons



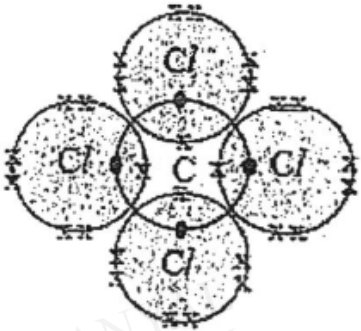
correct no. of valence electrons
correct charge

c

Sodium chloride is an ionic compound. Sodium ions and chloride ions are held together by strong electrostatic forces of attraction. Sodium chloride has high melting point because a lot of heat is required to overcome these forces of attraction.

Atoms in carbon dioxide molecules are held by covalent bonds. Molecules are held by weak forces of attraction/weak intermolecular forces of attraction. Carbon dioxide has low melting point because little heat is required to overcome the weak intermolecular forces of attraction.

Q5

<p>(a)(i) covalent (bonding) ; precise spelling</p>	<p>1m</p>
<p>(a)(ii)</p> 	<p>1m: correct sharing of electrons between C and Cl 1m: correct number of valence electrons in all atoms</p>
<p>(b) $MgCl_2$</p>	<p>1m</p>
<p>(c)(i) melting and boiling points</p> <p>Carbon tetrachloride has low melting and boiling point, as <u>little energy</u> is required to <u>overcome weak intermolecular forces of attraction</u>. On the other hand, <u>more energy</u> is required to overcome <u>strong electrostatic forces of attraction between Mg^{2+} and Cl^- oppositely-charged ions</u> resulting in a high melting and boiling point.</p> <p>(c)(ii) Electrical conductivity</p> <p>Carbon tetrachloride is a non-conductor of electricity as it has <u>no free moving/mobile ions or electrons</u> which can act as charge carriers. On the other hand, molten magnesium chloride is a conductor of electricity as the <u>Mg^{2+} and Cl^- ions are mobile and can act as charge carriers</u>.</p>	<p>2m; 1m – difference in amt of energy required 1m – provide accurate info on the types of attraction</p> <p>2m; 1m – mention that CCl_4 has no mobile ions & electrons while $MgCl_2$ has mobile ions 1m – relate the mobility of ions to ability to conduct electricity</p>