Raffles Institution Raffles Programme
Year Three Chemistry

Name: _____ ( ) Class: _____ Date: _____

2021 MID YEAR REVISION – Bonding and Structure and Properties

1 Complete the following table.

Structure	Simple molecular	Giant covalent	Giant Ionic	Giant Metallic
Particles in the solid			positive ions (cations) and negative ions (anions)	
Bonds between the particles				strong metallic bonds
Physical state at room conditions				solid (except mercury)
Melting and boiling points		high	high	
Electrical conductivity	does not conduct			
Solubility in water		insoluble in both water and non-polar solvents		
Examples	oxygen, water, carbon dioxide, iodine	diamond and graphite (the 2 allotropes of carbon), silicon dioxide	sodium chloride, magnesium oxide	iron, copper, sodium, calcium

2 How to explain why a substance has high or low melting point.

Key points: state what structure is present; state what type of bond is broken during melting; state whether the bond is strong or weak; state whether large or small amount of energy is needed to break bonds

Explain why tetrachloromethane, CCl_4, has a low melting point.

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3 How to explain why a substance conducts electricity.

Key points: state whether the ions present are freely moving/ state whether delocalized electrons are present/ state whether the particles present are neutral atoms or neutral molecules

Explain why sodium chloride cannot conduct electricity in the solid state, but can conduct electricity in the liquid or aqueous state.

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4 How to explain why a substance would dissolve in water.

Key points: state whether the particles present are charged particles such as ions or partially charged particles such as polar molecules; state that water molecules are polar molecules; state the interaction of water molecules with the charged or partially charged particles

Explain why sodium chloride can dissolve in water.

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5 Compare the arrangement of atoms between diamond and graphite, and explain why

(a) graphite can conduct electricity while diamond cannot,

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(b) graphite is soft and slippery while diamond is hard.

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6 The following diagram shows part of the Periodic Table with the electronegativity value of each element.

						H 2.1									
Li 1.0	Be 1.5										B 2.0	C 2.5	N 3.0	O 3.5	F 4.0
Na 0.9	Mg 1.2										Al 1.5	Si 1.8	P 2.1	S 2.5	Cl 3.0
K 0.8	Ca 1.0														Br 2.8

(a) Calculate the following ΔEN values and state which bond, H-F or H-Cl, is more polar.

ΔEN(H-F) = ……. ΔEN(H-Cl) = …….

……...

Based on polarity of the molecules alone, which of the three substances, hydrogen fluoride, hydrogen chloride or hydrogen bromide, is the most soluble in water?

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(b) Write "δ+" and "δ−" on the structures below to show the polarity of the bonds.

$Al — Cl$ $Cl — O$

7(a) In general, the type of bond formed between a metal and a non-metal is ionic, while that formed between 2 non-metals is covalent.
Draw the dot-and-cross diagram (showing only valence electrons) of

(i) carbon dioxide
[proton number: C, 6; O, 8]

(ii) sodium oxide
[proton number: O, 8; Na, 11]

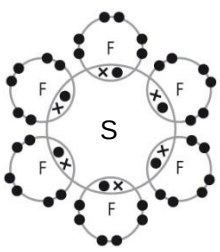
7(b) However, there are some compounds formed between metal and non-metal that are covalent, not ionic. An example is lead(IV) chloride, $PbCl_4$.

(i) We know such compounds are covalent and not ionic because of their …….. melting points and inability to conduct …….. in their molten state.

(ii) Draw the dot-and-cross diagram of a molecule of $PbCl_4$, showing only valence electrons. Assume Pb has 4 valence electrons.

7(c) Not all bonding processes obey the octet rule, i.e. many stable compounds are formed where an atom is not surrounded by 8 valence electrons.

(i) Sulfur hexafluoride, SF_6, has the following dot-and-cross diagram:



How many valence electrons does the sulfur atom have?

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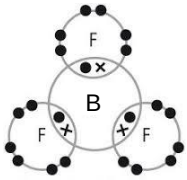
(ii) Boron trifluoride, BF_3, has the following dot-and-cross diagram:



How many valence electrons does the boron atom have?

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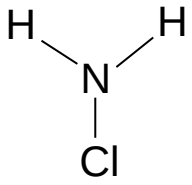
8 Convert the following structural formula of chloramine into a dot-and-cross diagram.
[proton number: H, 1; N, 7; Cl, 17]

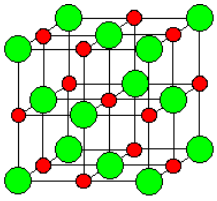


(a) What is the total number of electrons in the molecule? ……

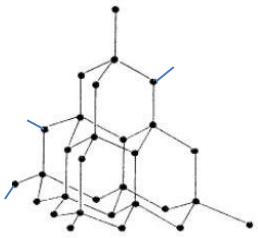
(b) What is the total number of electrons involved in bonding ? ……

(c) What is the total number of lone pair of electrons? ……

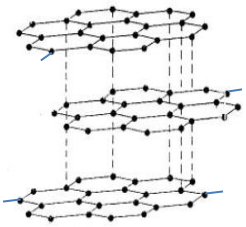
9 The following are representations of various substances.



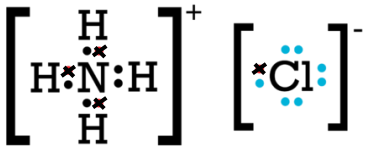
sodium chloride



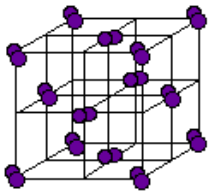
diamond



graphite



ammonium chloride



solid iodine

Use the substances above to answer the following questions.

(a) Which substances contain only one type of bond?

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(b) Which substances contain more than one type of bond? State the types of bond present in each of them.

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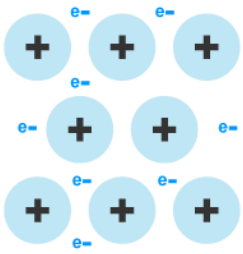
10 The following diagram represents a solid metal.



(a) This solid can conduct electricity. Explain why.

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(b) This solid is malleable. Explain why.

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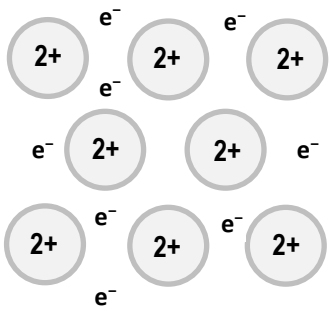
(c) A student drew a diagram to represent another solid metal:



He was marked wrong. Explain why

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