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90308

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

Level 2 Chemistry, 2004

90308 Describe the nature of structure and bonding in different substances

Credits: Four
2.00 pm Wednesday 10 November 2004

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

A Periodic Table is printed on page 2 of this booklet.

You should answer ALL the questions in this booklet.

If you need more space for any answer, use the pages provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–11 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

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Achievement Criteria		
Achievement	**Achievement with Merit**	**Achievement with Excellence**
Describe the bonding in simple molecules and the nature of various types of solids. ☐	Link selected properties of simple molecules and different types of solids to their structure. ☐	Explain selected properties of substances in terms of their structure and bonding. ☐
Overall Level of Performance ☐		

PERIODIC TABLE OF THE ELEMENTS

1	*2*											*13*	*14*	*15*	*16*	*17*	*18*
																	2 **He** 4.0
3 **Li** 6.9	4 **Be** 9.0							Atomic Number 1 **H** 1.0 Atomic Mass				5 **B** 10.8	6 **C** 12.0	7 **N** 14.0	8 **O** 16.0	9 **F** 19.0	10 **Ne** 20.2
11 **Na** 23.0	12 **Mg** 24.3	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.0	17 **Cl** 35.5	18 **Ar** 40.0
19 **K** 39.1	20 **Ca** 40.1	21 **Sc** 45.0	22 **Ti** 47.9	23 **V** 50.9	24 **Cr** 52.0	25 **Mn** 54.9	26 **Fe** 55.9	27 **Co** 58.9	28 **Ni** 58.7	29 **Cu** 63.6	30 **Zn** 65.4	31 **Ga** 69.7	32 **Ge** 72.6	33 **As** 74.9	34 **Se** 78.9	35 **Br** 79.9	36 **Kr** 83.8
37 **Rb** 85.5	38 **Sr** 87.6	39 **Y** 88.9	40 **Zr** 91.2	41 **Nb** 92.9	42 **Mo** 95.9	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	71 **Lu** 175.0	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** 226.0	103 **Lr** 262.1	104 **Rf**	105 **Db**	106 **Sg**	107 **Bh**	108 **Hs**	109 **Mt**									

Lanthanide Series	57 **La** 138.9	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** 146.9	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 159.0	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0
Actinide Series	89 **Ac** 227.0	90 **Th** 232.0	91 **Pa** 231.0	92 **U** 238.0	93 **Np** 237.1	94 **Pu** 239.1	95 **Am** 241.1	96 **Cm** 247.1	97 **Bk** 249.1	98 **Cf** 251.1	99 **Es** 254.1	100 **Fm** 257.1	101 **Md** 258.1	102 **No** 255

You are advised to spend 45 minutes answering the questions in this booklet.

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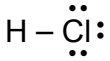
QUESTION ONE

The Lewis structure for hydrogen chloride, HCl, is  or 

Complete the table below by drawing a Lewis structure for each molecule.

Molecule	Lewis structure
CO_2	
PH_3	
CH_2Cl_2	
H_2CO	
F_2O	

QUESTION TWO

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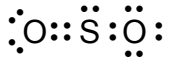
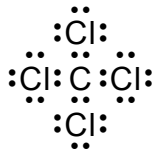
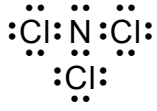
(a) Given the Lewis structures in the table below:

(i) name the shape of each molecule,

(ii) draw a diagram to clearly illustrate the named shape.

(b) State whether the molecule is polar or non-polar.

Molecule and Lewis Structure	(a) Shape	(b) Polar or Non–polar
H_2O 	Name: Diagram:	
SO_2 	Name: Diagram:	
CCl_4 	Name: Diagram:	
NCl_3 	Name: Diagram:	

(c) Explain why the molecules CCl_4 and NCl_3 are polar or non–polar (as you described on the previous page).

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(i) CCl_4

Explanation:

(ii) NCl_3

Explanation:

QUESTION THREE

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Melting points of the chlorides of selected third-row elements are given in the table below.

Name of substance	Formula	Melting point (°C)
sodium chloride	NaCl	801
magnesium chloride	$MgCl_2$	712
silicon chloride	$SiCl_4$	–68
sulfur dichloride	SCl_2	–80

(a) Describe the trend shown by the melting points of third-row chlorides in the table above.

(b) This trend in melting points is due to the type of bonding involved in each of the substances. For each of the substances below, describe the type of bonding that must be broken to melt the substance.

Name of substance	Formula	Melting point (°C)	Type of bonding
sodium chloride	NaCl	801	
magnesium chloride	$MgCl_2$	712	
silicon chloride	$SiCl_4$	–68	
sulfur dichloride	SCl_2	–80	

QUESTION FOUR

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Complete the following table by:

(a) stating the type of particle found in the solid substance as atoms, ions or molecules,

(b) specifying the attractive force that is broken when the solid substance melts,

(c) describing the attractive force existing between the particles of the solid as weak or strong.

Name of solid substance	**(a) Type of particle in solid – atoms, ions or molecules**	**(b) Attractive force broken when solid melts**	**(c) Attractive force between particles – weak or strong**
sulfur (S_8)			
copper (Cu)			
magnesium oxide (MgO)			
diamond (C)			

QUESTION FIVE

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Explain, in terms of structure AND bonding within each solid, why the solid has the property described.

Property	Explanation in terms of structure and bonding within the solid
Solid magnesium chloride, $MgCl_2$, is a poor conductor of electricity. However, when melted, magnesium chloride is a good electrical conductor.	
Chlorine, Cl_2, has a low melting point of –101°C.	
A piece of zinc, Zn, can be easily re-shaped without breaking into smaller pieces.	

QUESTION SIX

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Carbon and silicon are both elements found in Group 14 of the periodic table. Both elements show a combining power of +4 in forming oxides, with the respective formulae CO_2 and SiO_2.

Some properties of these oxides are as follows:

Oxide	Melting point (°C)	Conductivity of solid	Hardness of solid
CO_2	sublimes at –78	poor	brittle
SiO_2	1700	poor	very hard

Discuss the structure and bonding within carbon dioxide and silicon dioxide, and relate these to the properties shown in the table above.

Extra paper for continuation of answers if required.
Clearly number the question.

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Question number	

Extra paper for continuation of answers if required.
Clearly number the question.

Question number

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