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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, 2003

90308 Describe the nature of structure and bonding in different substances

Credits: Four
2.00 pm Monday 24 November 2003

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 2–10 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 structure and bonding.
Overall Level of Performance		

PERIODIC TABLE OF THE ELEMENTS

Atomic Number 1 **H** 1.0 Atomic Mass

1	2											13	14	15	16	17	18
												5 **B** 10.8	6 **C** 12.0	7 **N** 14.0	8 **O** 16.0	9 **F** 19.0	2 **He** 4.0
3 **Li** 6.9	4 **Be** 9.0																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** 32.1	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** 63.5	30 **Zn** 65.4	31 **Ga** 69.7	32 **Ge** 72.6	33 **As** 74.9	34 **Se** 79.0	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** 98.9	44 **Ru** 101	45 **Rh** 103	46 **Pd** 106	47 **Ag** 108	48 **Cd** 112	49 **In** 115	50 **Sn** 119	51 **Sb** 122	52 **Te** 128	53 **I** 127	54 **Xe** 131
55 **Cs** 133	56 **Ba** 137	71 **Lu** 175	72 **Hf** 179	73 **Ta** 181	74 **W** 184	75 **Re** 186	76 **Os** 190	77 **Ir** 192	78 **Pt** 195	79 **Au** 197	80 **Hg** 201	81 **Tl** 204	82 **Pb** 207	83 **Bi** 209	84 **Po** 210	85 **At** 210	86 **Rn** 222
87 **Fr** 223	88 **Ra** 226	103 **Lr** 262	104 **Rf**	105 **Db**	106 **Sg**	107 **Bh**	108 **Hs**	109 **Mt**									

Lanthanide Series	57 **La** 139	58 **Ce** 140	59 **Pr** 141	60 **Nd** 144	61 **Pm** 147	62 **Sm** 150	63 **Eu** 152	64 **Gd** 157	65 **Tb** 159	66 **Dy** 163	67 **Ho** 165	68 **Er** 167	69 **Tm** 169	70 **Yb** 173
Actinide Series	89 **Ac** 227	90 **Th** 232	91 **Pa** 231	92 **U** 238	93 **Np** 237	94 **Pu** 239	95 **Am** 241	96 **Cm** 247	97 **Bk** 249	98 **Cf** 251	99 **Es** 254	100 **Fm** 257	101 **Md** 258	102 **No** 255

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

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QUESTION ONE: Volcanic Eruptions

When volcanoes erupt, a number of gases may be released. These include sulfur dioxide (SO_2), carbon dioxide (CO_2), hydrogen sulfide (H_2S) and water vapour (H_2O). At the surface, sulfur dioxide may also oxidise to form sulfur trioxide (SO_3).

Complete the table below by:

(a) drawing a Lewis structure (electron dot diagram) for EACH of the formulae

(b) naming the shape for CO_2, H_2S and SO_3.

Formula of molecule	(a) Lewis structure	(b) Name of shape
SO_2		bent or V-shaped
CO_2		
H_2S		
H_2O		bent or V-shaped
SO_3		

(c) State whether EACH of the following molecules from the table on page 3 are polar **or** non-polar. Explain your answers. (You may use Lewis diagrams in your explanation.)

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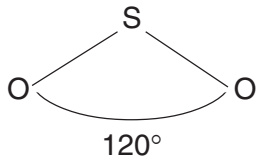
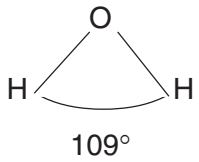
CO_2 _____

H_2S _____

Explanation: _____

(d) The shapes of SO_2 and H_2O molecules are both described as bent or V-shaped. The molecules are drawn below, with approximate bond angles shown.





Explain why the bond angles in these two molecules are different.

(e) Following an eruption, lakes and streams become more acidic due to SO_2 dissolving in the water and reacting with it.

Use the structure and bonding in H_2O and SO_2 to explain why SO_2 is soluble in H_2O.

QUESTION TWO: Changing States

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Complete the table below by:

(a) identifying the type of particle in EACH solid as atoms **or** ions **or** molecules

(b) naming the attractive force that is broken when EACH solid melts

(c) stating whether the relative melting point of EACH solid is high **or** low.

Name of solid	Type of solid	(a) Type of particle in solid – atoms or ions or molecules	(b) Attractive force broken when solid melts	(c) Relative melting point – high or low
ice (H_2O)	molecular			
silicon dioxide (SiO_2)	covalent network			
iron (Fe)	metallic			
potassium chloride (KCl)	ionic			

QUESTION THREE: Halogens and their Compounds

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The elements in Group 17 of the periodic table are called halogens.

(a) (i) Complete the table below to show the states of the first four halogens at room temperature (25°C).

Name of halogen	Formula	Melting point °C	Boiling point °C	State at 25°C
fluorine	F_2	–220	–188	
chlorine	Cl_2	–101	–35	
bromine	Br_2	–7	59	
iodine	I_2	114	184	solid

(ii) Describe how the state of bromine at room temperature (25°C) can be determined from the data given.

(b) The table below shows three properties of iodine crystals (I_2).

Explain, in terms of the **structure and bonding** within the solid, **why** the solid has EACH of the properties stated.

Property	Explanation in terms of structure and bonding within the solid
Iodine crystals will readily sublime (change from a solid to a gas) when heated gently over a Bunsen burner.	
Iodine crystals are more soluble in cyclohexane than in water.	
Iodine crystals do not conduct electricity.	

(c) Magnesium chloride ($MgCl_2$) and sulfur dichloride (SCl_2) are both chlorides of Row 3 elements.

Describe the type of bonding present in solid samples of EACH of these chlorides.

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QUESTION FOUR: Allotropes of Carbon

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Diamond and graphite are allotropes of carbon. This means that they are both made only of carbon atoms but the atoms are arranged differently, which results in different physical forms of the same element.

Some uses of diamond and graphite are shown below.

Allotrope	Use(s)
Diamond	• Used to make saws to cut marble
Graphite	• Used as a solid lubricant in machinery • Used to make electrodes

Discuss the **structure and bonding** within diamond and graphite, and relate this to the uses shown in the table above.

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

Question Number

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

Assessor's use only

Question Number