AS LEVEL CHEMISTRY

TOPIC 3 – STRUCTURE, BONDING AND THE PERIODIC TABLE

TEST

Answer all questions

Max 50 marks

Name ……..
Mark ……../50 ……....% Grade ……

1. Iodine and diamond are both crystalline solids at room temperature.
Identify one similarity in the bonding, and one difference in the structures, of these two solids.
Explain why these two solids have very different melting points.

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(Total 6 marks)

2. The table below shows the electronegativity values of some elements.

Element	H	C	N	O
Electronegativity	2.1	2.5	3.0	3.5

(a) State the meaning of the term *electronegativity*.

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(2)

(b) State the strongest type of intermolecular force in the following compounds.

Methane (CH_4) .....

Ammonia (NH_3) .....

(2)

(c) Use the values in the table to explain how the strongest type of intermolecular force arises between two molecules of ammonia.

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(3)

(d) Phosphorus is in the same group of the Periodic Table as nitrogen.
A molecule of PH_3 reacts with an H^+ ion to form a PH_4^+ ion.
Name the type of bond formed when PH_3 reacts with H^+ and explain how this bond is formed.

Type of bond .....

Explanation .....

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(3)

(e) Arsenic is in the same group as nitrogen. It forms the compound AsH_3
Draw the shape of an AsH_3 molecule, including any lone pairs of electrons. Name the shape made by its atoms.

Shape

Name of shape .....

(2)

(f) The boiling point of AsH_3 is –62.5 °C and the boiling point of NH_3 is –33.0 °C.
Suggest why the boiling point of AsH_3 is lower than that of NH_3

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(1)

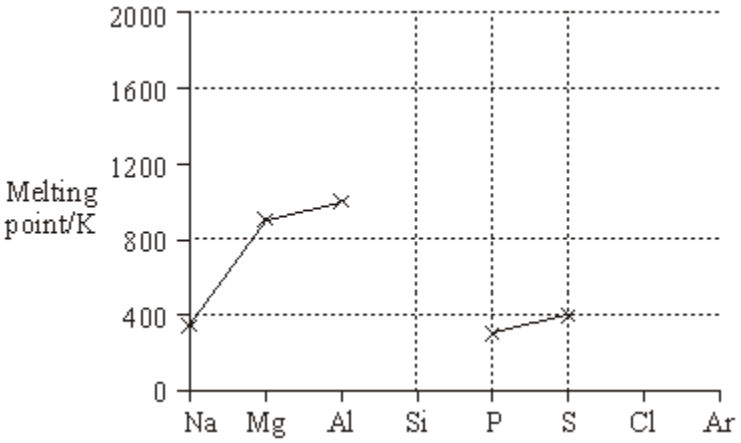
(g) Balance the following equation which shows how AsH_3 can be made.

..... $AsCl_3$ + ... $NaBH_4$ → ..... AsH_3 + ... NaCl + ... BCl_3

(1)

(Total 14 marks)

3. (a) The diagram below shows the melting points of some of the elements in Period 3.



(i) On the diagram, use crosses to mark the approximate positions of the melting points for the elements silicon, chlorine and argon. Complete the diagram by joining the crosses.

(ii) By referring to its structure and bonding, explain your choice of position for the melting point of silicon.

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(iii) Explain why the melting point of sulphur, S_8, is higher than that of phosphorus, P_4

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(8)

(b) State and explain the trend in melting point of the Group II elements Ca–Ba.

Trend .....

Explanation .....

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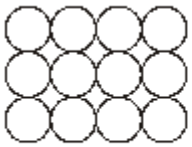
(3)

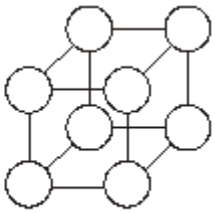
(Total 11 marks)

4. At room temperature, both sodium metal and sodium chloride are crystalline solids which contain ions.

(a) On the diagrams for sodium metal and sodium chloride below, mark the charge for each ion.



Sodium metal



Sodium chloride

(2)

(b) (i) Explain how the ions are held together in solid sodium metal.

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(ii) Explain how the ions are held together in solid sodium chloride.

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(iii) The melting point of sodium chloride is much higher than that of sodium metal. What can be deduced from this information?

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(3)

(c) Compare the electrical conductivity of solid sodium metal with that of solid sodium chloride. Explain your answer.

Comparison .....

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Explanation .....

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(3)

(d) Explain why sodium metal is malleable (can be hammered into shape).

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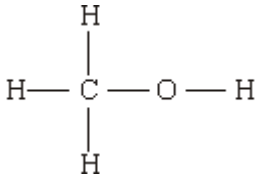
(1)

(Total 9 marks)

5. (a) Methanol has the structure



Explain why the O–H bond in a methanol molecule is polar.

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(2)

(b) The boiling point of methanol is +65 °C; the boiling point of oxygen is –183 °C. Methanol and oxygen each have an M_r value of 32. Explain, in terms of the intermolecular forces present in each case, why the boiling point of methanol is much higher than that of oxygen.

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(3)
(Total 5 marks)

6. Predict which one of the following has the highest boiling temperature.

A $CH_3COOCH_2CH_3$

B $CH_3CH_2CH_2CH_2OH$

C $CH_3CH_2CH_2CH_2CH_3$

D $CH_3CH_2CH_2CHO$

(Total 1 mark)

7. Which one of the following has a shape which is **not** influenced by a lone pair of electrons?

A CH_3OH

B H_2F^+

C BF_3

D NF_3

(Total 1 mark)

8. Which one of the following molecules or ions is pyramidal in shape?

A BF_3

B CH_3^+

C CH_3^-

D SF_3^-

(Total 1 mark)

9. The ester methyl ethanoate is hydrolysed as shown in the following equation.

$$CH_3COOCH_3(l) + H_2O(l) \rightleftharpoons CH_3COOH(l) + CH_3OH(l) \quad \Delta H^{\ominus} = +3 \text{ kJ mol}^{-1}$$

Which one of the following compounds from the reaction mixture has no hydrogen bonding between its molecules when pure?

A $CH_3COOCH_3(l)$

B $H_2O(l)$

C $CH_3COOH(l)$

D $CH_3OH(l)$

(Total 1 mark)

10. Which one of the following molecules is **not** planar?

A BF_3

B NCl_3

C C_2H_4

D HCHO

(Total 1 mark)