4.3 Intermolecular Forces & Metallic Bonding

Question Paper

Course	DP IB Chemistry
Section	4. Chemical Bonding & Structure
Topic	4.3 Intermolecular Forces & Metallic Bonding
Difficulty	Medium

Time allowed: 70

Score: /51

Percentage: /100

Question 1a

a) Magnesium is a lightweight metal used for the manufacturing of car seats.

Describe the structure and bonding present in solid magnesium.

[3 marks]

Question 1b

b) Magnesium has a considerably higher boiling point than sodium. Explain this difference, despite the fact both elements are in period 3.

[3 marks]

Question 1c

c) Explain, with reference to bonding, the principal property of a metal that makes it suited to manufacturing shaped objects such as railings.

[3 marks]

Question 1d

d) Many alloys are harder than their constituent metal elements alone.

Outline the reason for this with reference to the structure of metal alloys.

[2 marks]

Question 2a

a) Based on the type of intermolecular force present, explain why butan-1-ol has a higher boiling point than butanal.

[2 marks]

Question 2b

b) Ethane, C_2H_6, and disilane, Si_2H_6, are both hydrides of Group 4 elements with similar structures but different chemical properties.

Explain why disilane has a higher boiling point than ethane.

[2 marks]

Question 2c

c) Put the following molecules in order of increasing boiling point and explain your choice:

CH_3CHO CH_3CH_2OH $CH_3CH_2CH_3$

[3 marks]

Question 2d

d) Based on the type of intermolecular force present, explain the difference in solubility in water between ethane and ethanol.

[4 marks]

Question 3a

a) The elements sodium, aluminium, silicon, phosphorus and sulfur are in period 3 of the periodic table.

Describe and explain the general trend in melting points of the metals in period 3.

[4 marks]

Question 3b

b) Identify, with reasoning, which of the period 3 metals has the highest melting point.

[3 marks]

Question 3c

c) Explain, by reference to the intermolecular forces, why sulfur has a higher melting point than phosphorus.

[2 marks]

Question 3d

d) Although the molar masses of ICl and Br_2 are very similar, the boiling point of ICl is 97.4 °C and that of Br_2 is 58.8 °C.

Explain the difference in these boiling points in terms of the intermolecular forces present in each liquid.

[2 marks]

Question 4a

a) The melting points of some Group 1 elements are listed in **Table 1**.

Table 1

	Na	K	Rb
Melting point / °C	98	63	

Predict, with a reason, the melting point of Rb.

[3 marks]

Question 4b

b) Explain why ammonia, NH_3, is a gas at room temperature.

[2 marks]

Question 4c

c) Phosphine (IUPAC name phosphane) is a hydride of phosphorus, with the formula PH_3. Phosphine has a much greater molar mass than ammonia.

Explain why phosphine has a significantly lower boiling point than ammonia.

[3 marks]

Question 4d

d) Identify the type of interaction that must be overcome when liquid hydrazine, N_2H_4, vaporizes. Suggest, with a reason, whether hydrazine has a lower or higher boiling point than diimide, N_2H_2.

[2 marks]

Question 5a

a) Copper is a transition metal. Describe the bonding in metals.

[2 marks]

Question 5b

b) Aluminium and copper can be used to make the alloy duralumin.
Explain why an aluminium-copper alloy is harder than pure aluminium.

[2 marks]

Question 5c

c) This question is about the chlorides of copper and aluminium.

i) State the type of bonding present in copper(II) chloride which melts at 771 K.

ii) The chloride of aluminium, $AlCl_3$, melts 465 K. Suggest why the melting point is so much lower than that of $CuCl_2$.

[2 marks]

Question 5d

d) Both copper and benzene have delocalised electrons. Explain why both structures have delocalised electrons, copper conducts electricity, but benzene does not.

[2 marks]