# Question 1 of 4

Structure 2: Models of bonding and structure

Levels: ,

Marks: 10

**Paper 2: Short-answer and extended-response questions**

Answer **all** questions.

The two compounds boron trifluoride, $BF_3$, and aluminium fluoride, $AlF_3$, differ substantially in their physical properties: their melting points, for instance.

| Compound | Melting point / $^{o}$C |
|---|---|
| Boron trifluoride | –144 |
| Aluminium fluoride | 1291 |

**(a)** Deduce the type of bonding present in each of these compounds and sketch their Lewis formulas.

[4]

**(b)** Suggest why boron trifluoride and aluminium fluoride have different melting points.

[2]

**(c)** Boron trifluoride forms a compound with ammonia. The reaction occurs in the gas phase.

**(i)** Describe the type of covalent bond that is formed during this reaction.

[2]

**(ii)** Draw the Lewis diagram and structural formula for the compound (adduct) formed in this reaction.

[2]

# Question 2 of 4

Structure 2: Models of bonding and structure

Levels: ,

Marks: 10

**Paper 2: Short-answer and extended-response questions**

Answer **all** questions.

The type of bonding present in an element or compound can be used to explain its physical properties. Use your understanding of the key features of different types bonding and structure to explain the following:

**(a)** Explain why one form of carbon (diamond) is a very hard substance that does not conduct electricity whereas another form of carbon (graphite) is very soft and a good electrical conductor.

[6]

**(b)** Describe the bonding within and between the molecules of liquid bromine.

[2]

**(c)** Explain why an ionic solid such as lithium fluoride does not conduct electricity until it is heated above its melting point.

[2]

# Question 3 of 4

Structure 2: Models of bonding and structure

Levels: ,

Marks: 12

**Paper 2: Short-answer and extended-response questions**

Answer **all** questions.

Electrical wires often consist of copper with a plastic coating.

**(a)** Draw a labeled diagram showing the lattice structure of copper metal.

[2]

**(b)** State the particles in your diagram from part **(a)** that are responsible for the conductivity of metals.

[1]

**(c)** Predict and explain whether potassium or copper would have a higher melting point.

[3]

**(d)** Explain why copper is malleable and why this is an important property for a material that is to be used in wires.

[3]

**(e)** State why in a wire the metal is coated with plastic.

[1]

**(f)** A student measures the electrical conductivity of different metals and collects the data in the table shown below. State two mistakes that the student has made when displaying this information.

[2]

| Metal | Electrical conductivity |
|---|---|
| lithium | $1.10 \times 10^7$ |
| sodium | $2.1 \times 10^7$ |
| potassium | $1.4 \times 10^7$ |
| rubidium | $0.830 \times 10^7$ |

# Question 4 of 4

Structure 2: Models of bonding and structure

Levels: ,

Marks: 20

**Paper 2: Short-answer and extended-response questions**

Answer **all** questions.

Compounds have varying degrees of ionic and covalent character, as shown in the van Arkel–Ketelaar triangle in section 17 of the Data Booklet.

**(a)** The following oxides are formed from group 2 metals:

BaO, CaO, BeO

**(i)** Order the compounds in order of increasing ionic character.

[1]

**(ii)** Justify your answer in part **(a) (i)**.

[2]

**(b)** Aluminum can form the compounds aluminum iodide, $AlI_3$, and aluminum fluoride, $AlF_3$.

**(i)** Define the term electronegativity.

[1]

**(ii)** Calculate the electronegativity difference, $\Delta\chi$, and average electronegativity, $\Sigma\chi$, of each compound.

[2]

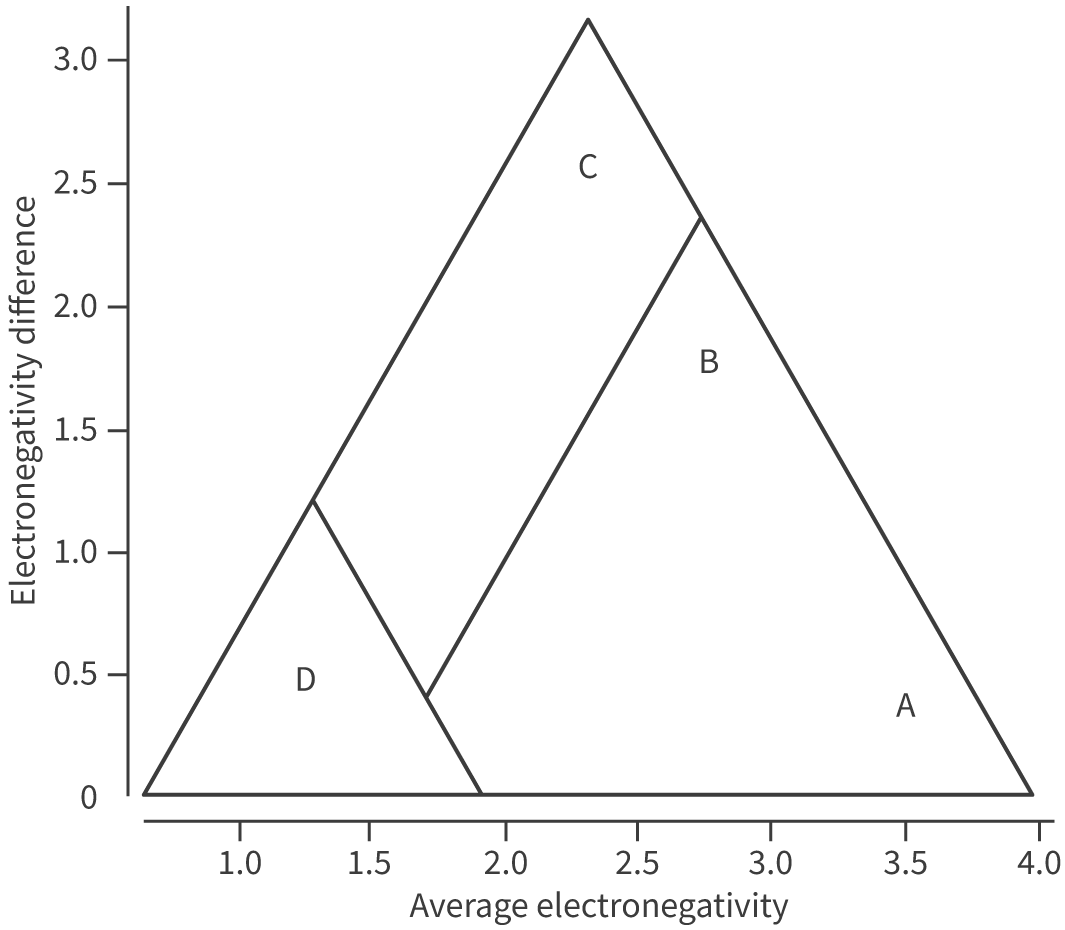
**(iii)** Using the values calculated in part **(b) (ii)** and section 17 of the data booklet, state the type of bonding in each compound.

[2]

**(iv)** State and explain which compound will have a higher melting point.

[3]

**(c)** Four compounds (A–D) are placed in the van Arkel–Ketelaar triangle shown below.




**(i)** State and explain whether A or B would have a higher boiling point.

[3]

**(ii)** State which compound conducts when solid and which compound only conducts when molten or dissolved.

[2]

**(iii)** Explain how the compounds in part **(c) (ii)** conduct electricity.

[2]

**(iv)** State and explain which compound would make a good material for a cooking pot.

[2]