FREE SAMPLE: THE FIRST QUESTION

Question One (13 marks)

(a) The table shows some physical properties of 3 substances.

(i) Classify each substance as ionic, metallic, simple molecular or covalent network, using the data.

(ii) Draw (or describe) the particles and the attractions in substance W, and explain how its structure explains its melting point and its electrical conductivity.

(iii) Explain how the property that makes substance W useful allows it to be used for an everyday purpose.

Substance	Melting point (°C)	Conducts when solid?	Conducts when molten?	Soluble in water?	Description
W	4	no	no	yes	soft, low density
X	225	yes	yes	no	shiny and malleable
Y	657	no	yes	yes	hard but brittle

[7 marks]

(b) A material is needed for a cooking pot base: it must pass heat quickly from the stove to the food and not melt.

The table gives data for four materials.

(i) Identify the material that is most suitable and justify your choice using the data in the table.

(ii) Explain why one of the other materials is not suitable, using its data.

(iii) Explain, in terms of particles and the attractions between them, why your chosen material

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has the properties you identified.

Material	Melting point (°C)	Thermal conductivity (W m⁻¹ K⁻¹)	Electrical conductivity (relative)	Density (g cm⁻³)	Hardness (Mohs scale)	Flexible
wood	300	0.15	0	0.6	2	no
stainless steel	1450	16	1.4	8.0	5	no
copper	1085	400	60	8.9	3	yes
sodium chloride (salt)	801	6.5	0	2.2	2	no

[6 marks]

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THE WORKED ANSWER TO THAT QUESTION

Question 1 (13 marks) [Properties and uses of materials]

(a) The table shows some physical properties of 3 substances. (i) Classify each substance as ionic, metallic, simple molecular or covalent network, using the data. (ii) Draw (or describe) the particles and the attractions in substance W, and explain how its structure explains its melting point and its electrical conductivity. (iii) Explain how the property that makes substance W useful allows it to be used for an everyday purpose.

(a) Answer: (i) W molecular; X metallic; Y ionic; (ii) small separate molecules held to each other by weak forces b

- Evidence level: Merit (decide from conductivity first, then melting point).
- (i) W is molecular; X is metallic; Y is ionic.
- (ii) Substance W is a simple molecular substance: its structure is small separate molecules held to each other by weak forces between the molecules (while the atoms in each molecule are joined by strong covalent bonds); it has low melting and boiling points because only weak forces between the molecules need to be overcome (the covalent bonds do not break); does not conduct electricity because there are no free charged particles.
- Achievement: (iii) Names a use and links it to a property.
- Merit: Links the use to the particle structure.
- Excellence: Full explanation: a simple molecular substance such as wax or ethanol melts or evaporates easily because the forces between molecules are weak, so it is used as a fuel or a solvent, and it is a good electrical insulator because it has no free charged particles

> **KEY TAKEAWAY**
> Classifying materials: conducts as a solid → metal; conducts only when molten or dissolved → ionic; no conductivity and low melting point → simple molecular; no conductivity and very high melting point → covalent network.

(b) A material is needed for a cooking pot base: it must pass heat quickly from the stove to the food and not melt. The table gives data for four materials. (i) Identify the material that is most suitable and justify your choice using the data in the table. (ii) Explain why one of the other materials is not suitable, using its data. (iii) Explain, in terms of particles and the attractions between them, why your chosen material has the properties you identified.

(b) Answer: (i) copper; (ii) wood fails thermal conductivity, melting point above 500°C

- Evidence level: Merit (match each requirement to the data).
- (i) copper is the only material that meets both requirements: thermal conductivity (high); melting point above 500°C (high).
- (ii) wood is not suitable because it does not meet thermal conductivity or melting point above 500°C.
- Achievement: (iii) States the structure of copper.
- Merit: Links the structure to the property.
- Excellence: Full explanation: copper is a metal: a lattice of positive ions in a sea of delocalised electrons; the free electrons carry electric charge and heat energy, so it conducts well; the lattice of strong attractions gives a high melting point

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KEY TAKEAWAY

Choosing materials: list the properties the use needs, check each material's data against them, then explain the property from the particles and bonding.

LOS: Properties and uses of materials (92023)

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