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VCE Chemistry ½

Metals & Covalent Lattices [1.3]

Test Solutions

20 Marks. 1 Minute Reading. 16 Minutes Writing.

Results:

Test Questions	_____ / 15
Extension	_____ / 5

Section A: Test Questions (15 Marks)

INSTRUCTION: 15 Marks. 1 Minute Reading. 12 Minutes Writing.

Question 1 (3 marks)

True or False.

a. Sodium is an example of an alkali metal, whereas zinc is an example of a transition metal. (0.5 marks)

True

b. Metals such as sodium lose two electrons in order to have a full outer shell and become stable, according to the octet rule. (0.5 marks)

False

c. The sea of delocalised electrons allows for the cations to be held together through the formation of dispersion forces. (0.5 marks)

False

d. Metals can conduct electricity due to their ability to have moving cations in the lattice that move to carry the charge. (0.5 marks)

False

e. Malleability refers to a compound's ability to be stretched into a thin wire. (0.5 marks)

False

f. Sodium is denser and harder than silver since it is able to donate more electrons into the sea of delocalised electrons. (0.5 marks)

False

Space for Personal Notes

Question 2 (7 marks)

Sid takes a sample of copper and begins to hit it with a hammer in order to sculpt it into a round ball. However, when Sid tries to do the same on a large salt crystal, he notices that upon the first hit from the hammer, the salt crystal completely crumbles.

a. What property is Sid exploiting that allows the copper to be hammered into a new shape? (1 mark)

Malleability

b. Explain why copper has this property. (2 marks)

Copper has a metal lattice, in which each copper atom donates two electrons into the sea of delocalised electrons. These electrons then have the capacity to move, allowing the cations to not repel each other when force is applied, and thus allowing the shape of the copper to be changed.

c. While Sid was handling the copper ball, he noticed that the copper ball quickly became hot. Given that there was no heat source in the room, and it was only his hand touching the ball, explain how this is possible with reference to the properties of metals. (2 marks)

Copper, being a metal, is very thermally conductive. This means that the heat from Sid's palm must have been transferred to the ball. The heat is able to move through the ball easily, due to the sea of free-moving electrons, which allow heat to move through the lattice readily.

d. When Sid is done with his new ball, he notices that his copper ball is extremely shiny. What is the name given to this property, and why is this the case? (2 marks)

Lustre. This is the case because surface electrons from the sea of delocalised electrons are able to reflect light waves.

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Question 3 (5 marks)

Sana recently purchased a new set of diamond earrings. However, being an avid chemist, she is more interested in the properties and structure of diamonds rather than the appeal of the diamonds themselves. Sana knows that diamond is made purely of carbon, but that another key allotrope of carbon exists, which is found in pencils.

a. Outline the structure of the diamond, with reference to aspects that make it such a dense material. (2 marks)

Diamond is a covalent network lattice in which each carbon atom is covalently bonded to four other carbons. This means that the carbons are held together very tightly and thus are very strong and dense.

b. What is the other allotrope of carbon that Sana is considering, and why can it be used in pencils? (2 marks)

Graphite. Due to the graphite covalent layer lattice, it allows individual layers of graphite to be able to slide off of each other and onto paper.

c. Is diamond thermally conductive? (1 mark)

Yes. Vibrations readily spread through the lattice as it is all interlinked.

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Section B: Extension (5 Marks)

INSTRUCTION: 5 Marks. 4 Minutes Writing.

Question 4 (5 marks)

At an electronic parts factory, a chemical engineer is working on constructing certain parts for a motherboard. The chemist wishes to pick a metal that is as thermally conductive as possible, with the options available being copper and aluminium.

a. Which metal should the chemist choose, and why? (3 marks)

The chemist should choose aluminium. Aluminium forms the Al^{3+} ion which indicates that it loses 3 electrons, whereas copper forms the Cu^{2+} ion which indicates that it only loses 2 electrons. Since aluminium would have more electrons delocalised, it would allow thermal energy to spread through the lattice faster and more readily.

b. The chemist also needs to ensure that he is able to use a dry lubricant between moving parts in order to increase the longevity of these parts. What allotrope of carbon can be used and why? (2 marks)

Graphite. Due to the graphite covalent layer lattice, sheets of the lattice can slide over each other readily due to the presence of weak dispersion forces between layers that can be easily overcome. This allows it to be used as a lubricant because mechanical parts can have a barrier between them.

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