

## Metallic structure and bonding

### Introduction

These questions are designed to help you to develop your mental models (pictures in your mind) of metallic structure and bonding. Use the icon in the margin to find out which level of understanding the question is developing.



**Macroscopic:** what we can see. Think about the properties that we can observe, measure and record.



**Sub-microscopic:** smaller than we can see. Think about the particle or atomic level.

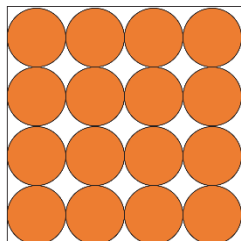


**Symbolic:** representations. Think about how we represent chemical ideas including symbols and diagrams.

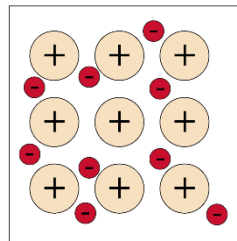
### Questions



1. Copper can be represented by two different models.



Model A



Model B

Model A shows the arrangement of metal atoms. Model B shows the delocalised electrons and the remaining positively charged ions.

The metal copper is ductile. It can be drawn into electrical wires.

- (a) State which model helps to explain why copper is ductile.

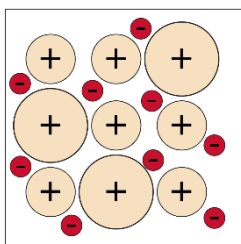
(b) Complete the sentence to explain why copper is ductile.

Copper is ductile because the atoms can \_\_\_\_\_

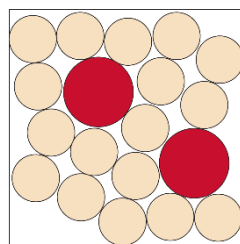
(c) State the type of sub-atomic particle that moves when copper conducts electricity.

(d) Explain why Model A cannot help to explain why copper conducts electricity.

-  2. Brass is an alloy of copper and zinc. Diagrams A and B show two different models of brass.



A



B

(a) Select the model that will best help you to explain why brass is stronger than pure copper. \_\_\_\_\_

(b) Give the reason for your choice.

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(c) Select the model that will best help you to explain why brass still conducts electricity. \_\_\_\_\_

(d) Give the reason for your choice.

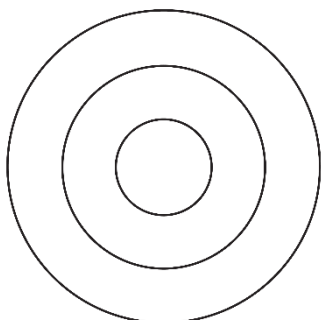
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3. A sodium atom has 11 electrons.

(a) Complete the diagram to show the arrangement of electrons in a sodium atom. Remember to add the symbol in the centre.



(b) Sodium atoms form positive ions with +1 charge ( $\text{Na}^+$ ). Draw an electron configuration diagram for a sodium ion.

(c) The nucleus of a sodium atom is made up of 11 protons and 12 neutrons. Give the charge of a sodium nucleus. \_\_\_\_\_

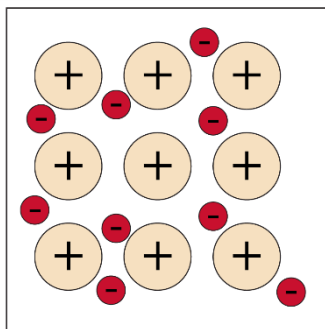
(d) Explain why a sodium ion is positively charged.

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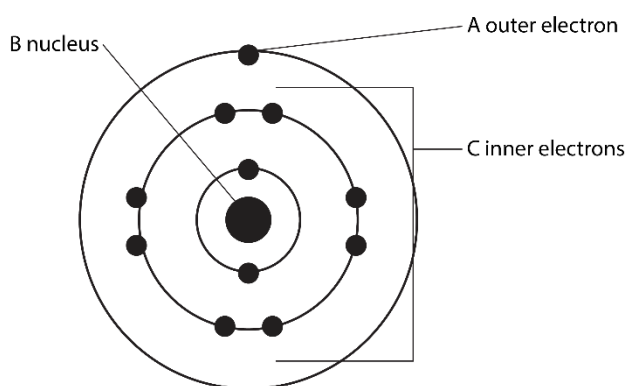
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4. A metallic bonding diagram shows a simplified model of the structure of a metal.



The following diagram shows the different parts of an atom.



In the metallic structure diagram, state which part (or parts) of an atom are represented by:

(a)  \_\_\_\_\_

(b)  \_\_\_\_\_



5. An aluminium atom has 13 electrons.

(a) Draw the electron configuration diagram of an aluminium atom.

(b) State the number of protons in the nucleus of an aluminium atom. \_\_\_\_\_

(c) Use the electron configuration diagram to determine the charge of an aluminium ion. \_\_\_\_\_

(d) Draw a diagram to show which part of an aluminium atom is represented by the following part of a metallic bonding diagram:



(e) Give the number of delocalised electrons from each aluminium atom. Give reasons for your answer.

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(f) Describe the nature of metallic bonding. Answer in terms of forces of attraction.

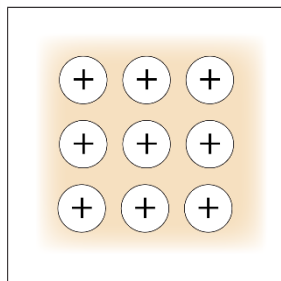
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6. Different diagrams are used to represent the model for metallic bonding. Sometimes the delocalised electrons are described as a 'sea of electrons'.

The diagram below shows a diagram of this model.



- (a) Describe how this model helps to explain why a metal can conduct electricity.

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- (b) Give two disadvantages of this model.

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