WORKSHEET 16

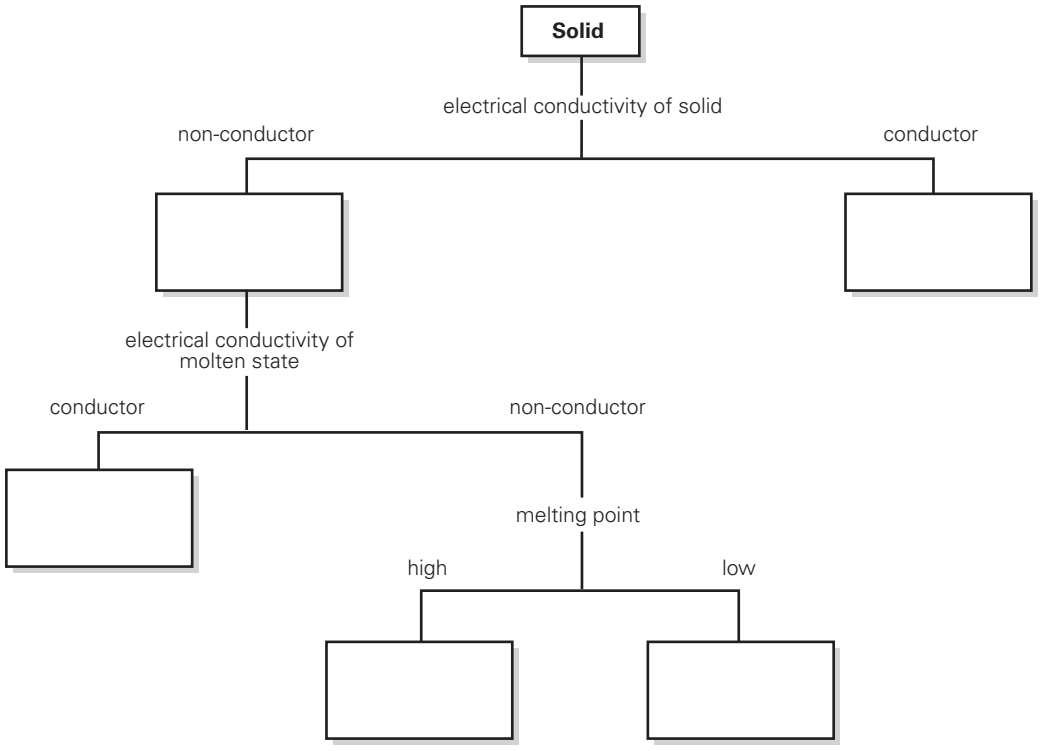
STRUCTURE, BONDING AND PROPERTIES

Syllabus reference 8.2.5

1 **All substances are made up of atoms, molecules or ions. The organisation of these particles within a substance determines the properties of that substance. Solids can be conveniently divided into four groups. Name them.**

_____ , _____, _____, _____

2 **Complete the following flowchart by filling in the boxes.**

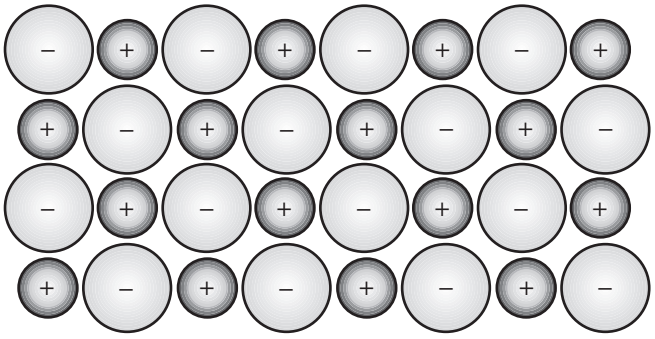


3 **Complete the table below comparing the properties of the four different groups of substances.**

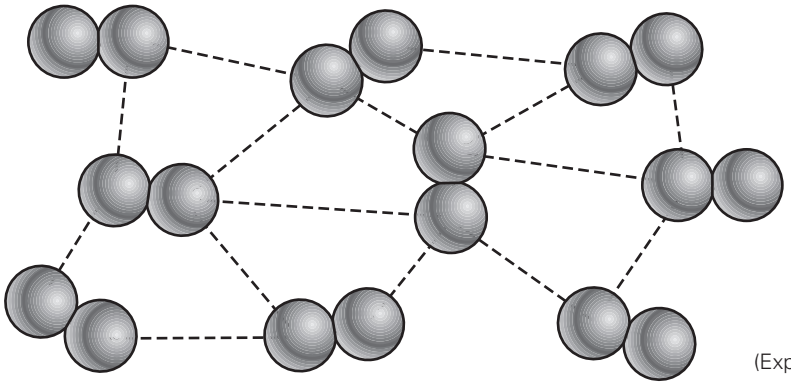
PROPERTY	METALS	IONIC COMPOUNDS	COVALENT MOLECULAR SUBSTANCES	COVALENT NETWORK SOLIDS
Melting point and boiling point				
Electrical conductivity				
Hardness and malleability				
Forces holding particles together in the solid				
Example of substance				

4 **Consider the diagrams of each of the types of substance. For each diagram write a paragraph to describe the types of particles and bonding represented by the diagram.**

a **Ionic**

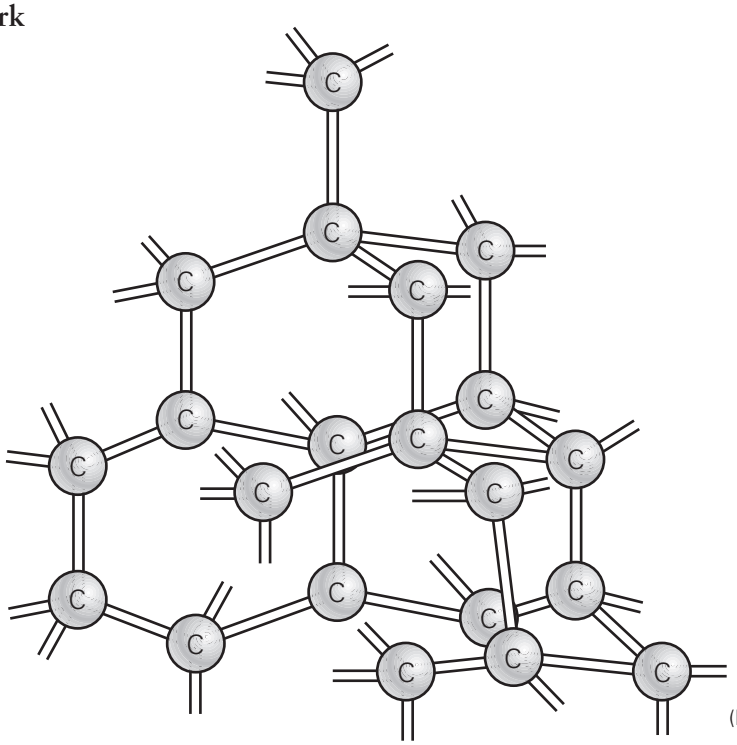


b **Covalent molecular**



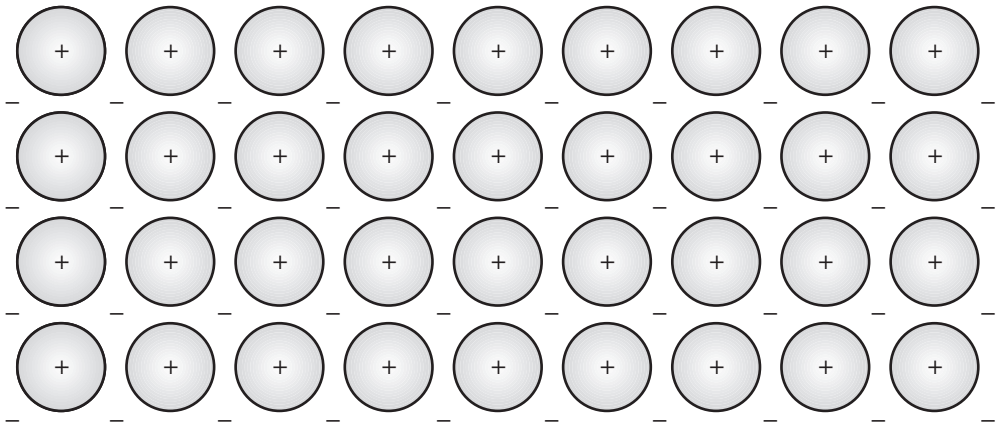
(Expanded view)

c **Covalent network**



(Expanded view)

d Metallic



5 a Explain why covalent molecular substances are mostly soft while the other three types of substances are usually hard.

b Explain why metallic and molten ionic substances conduct electricity while covalent substances do not.

6 Phosphorus trichloride is a liquid with a boiling point of 74°C; it does not conduct electricity. Calcium chloride is a solid with a melting point of 772°C; when molten it conducts electricity. Explain, in terms of bonding, why these compounds have such different properties.

7 Classify each of the solids listed below as ionic, covalent molecular, metallic or covalent network.

magnesium _____ **tetrabromomethane** _____

barium chloride _____ **phosphorus triiodide** _____

silicon dioxide _____ **lithium sulfide** _____

iodine _____ **diamond** _____

8 Five solids have the properties listed below. The relevant properties of sodium chloride and copper are also given.

	MELTING POINT (°C)	RELATIVE ELECTRICAL CONDUCTIVITY OF SOLID	OF LIQUID	SOLUBLE IN WATER?	HEXANE?	'HAMMER' TEST
A	327	5	2	no	no	flattens
B	2030	0	0	no	no	shatters
C	91	0	0	no	yes	forms powder
D	734	0	0.2	yes	no	forms powder
E	2870	0	0	no	no	shatters
NaCl	801	0	0.2	yes	no	forms powder
Cu	1083	60	4	no	no	flattens

Note: the hammer test describes what occurs when the material is continually hit with a hammer.

a Classify each of the solids A, B, C, D and E as ionic, covalent molecular, covalent network or metallic.

A _____ **D** _____

B _____ **E** _____

C _____

b Explain why sodium chloride and copper have the conductivity properties listed in the table.

c For either covalent molecular compounds or covalent network compounds, explain why they have the melting points, conductivities and solubilities shown in the table.

9 **The data below are for six elements A to F. Study the table, then answer the questions which follow.**

ELEMENT	MELTING POINT (°C)	BOILING POINT (°C)	CONDUCTS ELECTRICITY AT 25°C?	VOLUME THAT CONTAINS 1 MOLE OF ATOMS UNDER ROOM CONDITIONS (cm^3)	SOLUBILITY IN COLD WATER
A	659	2470	yes	10.0	insoluble
B	–101	–34	no	12 000	slightly soluble
C	–39	357	yes	14.8	insoluble
D	sublimes above 3700°C		yes	5.4	insoluble
E	–249	–246	no	24 000	insoluble
F	–7	58	no	25.6	soluble

a **Which element is a metal strong enough for use as a building material? Explain your choice.**

b **Which element could be a noble gas? Why?**

c **One of the elements is mercury. Which one? Why?**

d **Suggest, with reasons, two elements from this list that might be in the same group of the periodic table.**