

## Structure and Bonding: Review Assignment

The approximate time to be spent on each question is given in brackets.

1. "Diamond and graphite both consist of giant structures of carbon atoms whereas iodine crystal is made up of iodine molecules." Explain the meaning of this statement and show how the properties of each substance can be related to its structure. (30 minutes)

[Hint: diagrams should be included of the structure of each substance.]

2. Phosphorus molecules have covalent bonds, and can occur in two different forms (isomorphs) as shown:

white phosphorus,  $P_4$  molecules:

red phosphorus,  $P_n$  molecules:

(where 'n' is a very large number)

Which of these would you expect (a) to have the lower melting point, and (b) to be more soluble in a suitable solvent. Explain the reasons for your answers. (10 minutes)

3. Draw a diagram of the arrangement of ions in a sodium chloride crystal. How many sodium ions are around and attracted to each chloride ion? How many chloride ions are around and attracted to each sodium ion? Are there any individual molecules in the crystal? Are there any weak bonds in the crystal? How does the structure of sodium chloride affect its physical properties? (20 minutes)

4. Sulphur can exist as rings of atoms or as long chains. It changes from rings to chains as liquid sulphur is heated:

At room temperature sulphur normally exists as  $S_8$  rings, and when boiling as chains.

a) what would you expect to happen to the viscosity (stickiness) of the liquid as the sulphur changes from rings to chains?

b) when boiling sulphur is suddenly cooled by pouring into cold water the chains do not reconnect up as rings. The product, plastic sulphur, is rather elastic. Suggest why this may be so. (10 minutes)

5. Make a Venn diagram to show how the following electrical properties are related:

conductor when solid, conductor when molten, conductor in solution in water, non conductor

Mark on this diagram in the correct positions metals, non-metals, ionic compounds, molecular covalent compounds, giant -macromolecular-network covalent compounds (except graphite), graphite, and acids.

6. Solid A is a molecular solid and solid B is an ionic solid. Both substances appear as white crystalline solids. Outline **three** methods that you would use to distinguish each solid.

7. State the type of structure likely for substances A to F:

(8 minutes)

Substance	melting point (°C)	conductivity when solid	conductivity when molten	solubility in water	conductivity in aqueous solution
A	1700	good	good	insoluble	–
B	850	none	good	good	good
C	- 180	none	none	slightly soluble	none
D	4000	good	none	not soluble	–
E	1200	none	none	not soluble	none
F	- 90	none	none	very soluble	good

8. Consider the following properties of three substances.

<u>Substance</u>	<u>Boiling Point (K)</u>	<u>Electrical Conductivity</u>	
		<u>of solid</u>	<u>of liquid</u>
I	1770	poor	good
II	2220	good	good
III	2630	poor	good

Identify each substance as a molecular solid, network solid, metal or ionic compound.

Briefly justify your choice.

(10 minutes)

9. Consider the following properties of three substances:

<u>Substance</u>	<u>Boiling Point (K)</u>	<u>Electrical Conductivity</u>	
		<u>of solid</u>	<u>of liquid</u>
I	1770	poor	good
II	2220	good	good
III	2630	poor	poor
IV	629	good	good

a) Which of the above substances is likely a metal? Justify your answer by showing how the structure of metal would account for the properties given.

b) Which of the above substances is likely an ionic solid? Justify your answer by showing how the structure of an ionic solid would account for the properties given.

(15 minutes)