REVIEW QUESTIONS

Chapter 3: Bonding

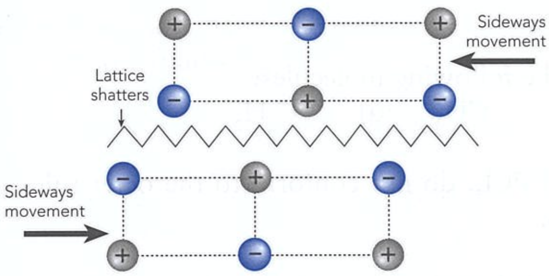
1. State which of the following elements; Mg, N, Cl, S, Li, Ca, F tend to get a full outer energy level by:

   (a) losing electrons
   (b) gaining electrons
   (c) sharing electrons

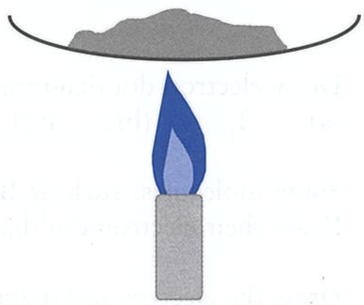
2. Why do the elements belonging to group I and II of the periodic table tend to form positive ions?

3. Each of the following diagrams illustrate a property typical of ionic substances. Use the nature of the ionic bond to explain the reason for each property.

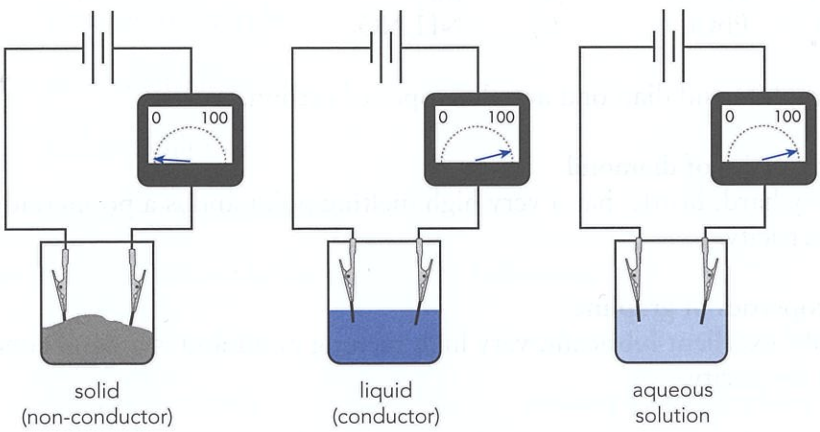
   (i) brittle



   (ii) high melting point



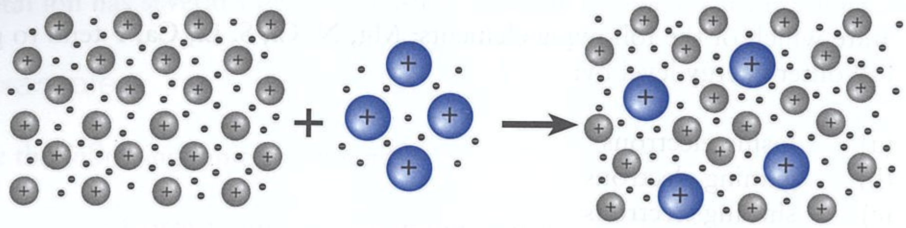
   (iii) conduct electricity only in solution or as a liquid



4. Explain why metals are such good conductors of electricity.

5. Potassium and calcium are both metallic elements made up of similar sized atoms. Which would you expect to have a higher melting point? In terms of metallic bonding, explain why.

6. Steel is an alloy formed by melting together iron with small amounts of other elements. The following diagram shows the formation of a steel alloy which results from the addition of larger 'inpurity' atoms.



Referring to the diagram above explain why such an alloy as that shown is likely to be much less malleable than pure iron.

7. A chlorine molecule forms when two chlorine atoms are covalently bonding together.
   (a) What force actually holds the atoms together?
   (b) How many electrons are shared?
   (c) How many non-bonded pairs of electrons are there?

8. Draw electron dot diagrams for the following molecules:
   (a) I_2 (b) PCl_3 (c) CH_4 (d) C_2H_2

9. Some molecules, such as BF_3 and PCl_5, do not conform to the octet rule. Draw their electron dot diagrams.

10. Draw the electron dot diagrams for the following polyatomic ions:
    (a) SO_4^{2-} (b) NO_3^- (c) H_3O^+

11. For each of the following compounds name the type of bonding involved:
    (a) NaCl (d) HNO_3
    (b) Pb (e) SO_2
    (c) $PbCl_2$ (f) NH_4NO_3

12. Graphite and diamond are allotropes of carbon.

Properties of diamond
Very hard, brittle, has a very high melting point and is a poor conductor of electricity.

Properties of graphite
Soft, excellent lubricant, very high melting point and is a good conductor of electricity.

(a) Briefly explain why both diamond and graphite have very high melting points.
(b) Explain why these two forms of carbon have such differing properties of electrical conductivity and hardness.
(c) Use its structure and bonding to explain why graphite is able to act as a lubricant.

13. Classify the following substances by placing them into their correct classification:

carbon dioxide, silicon dioxide, magnesium oxide, dinitrogen tetraoxide, iron, lithium bromide, mercury, diamond (carbon), fluorine, lead (II) nitrate

IONIC	METALLIC	COVALENT MOLECULAR	COVALENT NETWORK

14. There are many different oxides of nitrogen. Give the correct name for each of the following:

(a) NO (b) NO_2 (c) N_2O

(d) N_2O_3 (e) N_2O_4 (f) N_2O_5

15. Write the correct formula for:

(a) phosphorus pentachloride

(b) diphosphorus pentaoxide

(c) nitrogen trifluoride

(d) carbon tetrafluoride

(e) sulfur dichloride

(f) dihydrogen monoxide

16. Write the correct formula for each of the following:

(a) copper (II) sulfite

(b) cobalt (II) nitrate

(c) manganese (II) oxide

(d) chromium (III) chloride

(e) aluminium phosphate

(f) calcium hydrogenphosphate

(g) sodium dihydrogenphosphate

(h) sodium hydrogenphosphate

(i) iron (II) hydroxide

(j) potassium permanganate

(k) iron (II) oxide

(l) sodium oxalate.

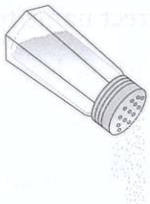
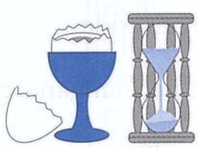
FOR THE EXPERTS

17. Many substances found commonly in the kitchen include:

- table salt (sodium chloride)
- ice (frozen water)
- aluminum
- sand (silicon dioxide)

These are all crystalline substances. However the bonding structures within them vary greatly.

Complete the following table to show the differences in their bonding structures.

SUBSTANCE	TYPE OF LATTICE STRUCTURE	PARTICLES WITHIN THE LATTICE	SIMPLE DIAGRAM OF LATTICE
salt 			
ice 			
aluminium 			
sand 			

3.23

barium chloride	$BaCl_2$
aluminium bromide	$AlBr_3$
aluminium nitride	AlN
caesium sulfide	Cs_2S
copper (II) sulfite	$CuSO_3$
zinc phosphate	$Zn_3(PO_4)_2$
cobalt fluoride	CoF_2
lead (II) oxide	PbO
zinc oxide	ZnO
zinc sulfate	$ZnSO_4$
barium ethanoate	$Ba(CH_3COO)_2$
calcium hydroxide	$Ca(OH)_2$
copper (II) hydroxide	$Cu(OH)_2$
ammonium chloride	NH_4Cl
ammonium hydrogensulfate	NH_4HSO_4
chromium (III) oxide	Cr_2O_3

3.24
(a) Sodium bromide
(b) Iron (III) nitrate
(c) Iron (II) sulfate
(d) Ammonium sulfate
(e) Barium oxide
(f) Copper (II) carbonate
(g) Potassium hydrogencarbonate
(h) Copper (II) hydroxide
(i) Iron (II) carbonate
(j) Barium phosphate

Review Questions

1.
(a) Mg, Li, Ca
(b) N, Cl, S, F
(c) N, Cl, S, F

2. *Group I and II elements have valence electrons which are not strongly held. When these electrons are lost, to say highly electronegative non metals, positive ions are formed.*

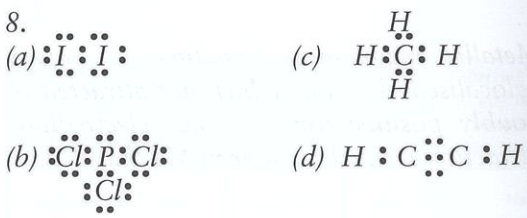
3.
(i) Brittle – Ionic substances are made up of oppositely charged ions held together by strong electrostatic forces. Layers of these ions are unable to move over other layers without causing separation and hence fracture.
(ii) High M.P. – As above, strong electrostatic forces prevent the oppositely charged ions from separating unless they have sufficiently high kinetic energy (high temperature).
(iii) Conduction – When solid, ionic substances cannot conduct electricity since all ions are in fixed lattice positions. When liquid or in solution all the individual ions are free to carry charge as they are no longer part of a lattice.

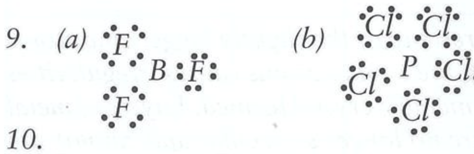
4. *Metals, essentially, are an array of positive ions in a sea of delocalised electrons. These electrons are easily influenced by any applied voltage and a flow of charge results.*

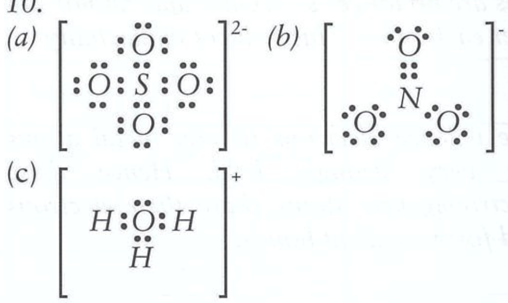
5. *Calcium would have a higher melting point than potassium. Calcium metal has twice as many delocalised electrons compared to potassium. These are attracted to doubly charged positive ions (Ca^{2+}). Hence electrostatic attractions in a calcium metal lattice would be much greater resulting in a higher M.P.*

6. *In the iron lattice it is possible for layers of positive ions to slide over each other within the 'sea' of electrons. However the presence of the larger cations in the lattice causes the layers to be less able to slide past each other. The larger impurity atoms act as locking pins to free movement. Hence less malleable.*

7.
(a) Electrostatic attraction between the nuclei of the two atoms and the covalently bonded electrons.
(b) Two electrons are shared, one from each atom.
(c) Six pairs of non-bonded electrons, three on each atom.

8.


9.


10.


11.
(a) *NaCl – ionic*
(b) *Pb – metallic*
(c) *$PbCl_2$ – ionic*
(d) *HNO_3 – covalent*
(e) *SO_2 – covalent*
(f) *NH_4NO_3 – covalent and ionic*

12.
(a) *Bonding in both diamond and graphite is strong covalent bonding. High temperatures are needed to break these bonds and cause melting to occur.*
(b) *Diamond is a poor conductor because all valence electrons are localised in strong covalent bonds. This also explains the hardness of diamond. Graphite is a good conductor because one electron per atom is delocalised and capable of moving throughout the lattice. The softness of graphite is explained in 12(c).*
(c) *Carbon atoms in graphite bond in such a way as to form sheets of carbon atoms. The attractive force between these sheets is weak and they are able to slide over each other. This gives graphite lubricant properties.*

13.
Ionic – magnesium oxide, lithium bromide, lead (II) nitrate.
Metallic – iron, mercury
Covalent molecular – carbon dioxide, dinitrogen tetroxide, fluorine
Covalent network – silicon dioxide, diamond

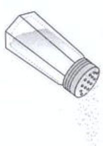
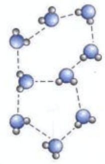
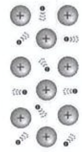
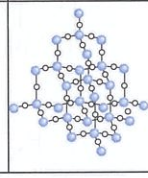
14.
(a) *nitrogen monoxide (also called nitric oxide)*
(b) *nitrogen dioxide*
(c) *dinitrogen monoxide (also called nitrous oxide)*
(d) *dinitrogen trioxide*
(e) *dinitrogen tetraoxide*
(f) *dinitrogen pentoxide*

15.
(a) PCl_5 (d) CF_4
(b) P_2O_5 (e) SCl_2
(c) NF_3 (f) H_2O

16.
(a) $CuSO_3$ (g) NaH_2PO_4
(b) $Co(NO_3)_2$ (h) Na_2HPO_4
(c) MnO (i) $Fe(OH)_2$
(d) $CrCl_3$ (j) $KMnO_4$
(e) $AlPO_4$ (k) FeO
(f) $CaHPO_4$ (l) $Na_2C_2O_4$

For the Experts

17.

SUBSTANCE	TYPE OF LATTICE (OR BONDING) STRUCTURE	PARTICLES WITHIN THE LATTICE	SIMPLE DIAGRAM OF LATTICE
salt 	ionic	ions Na^+, Cl^-	
ice 	covalent molecular	molecules	
aluminium 	metallic	positive ions and electrons	
sand 	covalent network	atoms	

CHP 4: CARBON CHEMISTRY

Chapter Questions

4.1
Sharing 4 of its electrons with 4 electrons from other atoms.

4.2
(a) *Oxygen, nitrogen and the halogens*
(b) *Carbon*
(c) *Carbon, nitrogen*

4.3

NUMBER OF C ATOMS IN CHAIN	ALKANE	ALKENE	ALKYNE	ALKYL GROUP
suffix	-ane	-ene	-yne	-yl
1	methane	-	-	methyl
2	ethane	ethene	ethyne	ethyl
3	propane	propene	propyne	propyl
4	butane	butene	butyne	butyl
5	petane	pentene	pentyne	pentyl
6	hexane	hexene	hexyne	hexyl
7	heptane	heptene	heptyne	heptyl
8	octane	octene	octyne	octyl

4.4
(a) *ethane*
(b) *pentane*