Lesson 7 For Book 1

Review Exerice --- Drawing of unit cell

The lattice structure of BaO (s) is described as the interpenetration of two simple cubic lattices, one of Ba^{2+} ions and the other of O^{2-} ions.

a) Draw the unit cell of BaO (s), labelling the Ba^{2+} and O^{2-} ions.

(Hint = use a ruler to draw the cubic first.)

b) What is the coordination number of each O^{2-} ion in the structure?

→ You should remember the number (Lesson 6) unless you can find it by looking at what you have drawn.   (for the anion only!)   (8)

Definition of Radii

1. **Ionic radii** = the radii of an perfect ionic compound, that is, the internuclear
      distance → the **sum** of the cationic and anionic radii.

2. **Covalent radii** = half the internuclear distance between two atoms in a c_____
      bonded molecule
      → half of the bond length of **homoatomic** covalent molecules e.g.
      H_2, O_2…
      → the sum of the covalent radii of atom A and B (**heteroatomic**)

3. **Metallic radii** = half the internuclear distance between two metallic atoms/ ions
      in a metallic crystal.

4. **van der Waal's radii** = half the distance between the nuclei of two atoms in
                              adjcent molecules

→ You should bear in mind that the consideration of "radii" can help us compare some physical properties of different compounds e.g. strength of all bonds, m.p./b.p. of all compounds, electrical conductivity of m_____ , polarizability of a_____ , polarizing power of c_____.

Exercise 1   An iodine molecule can be represented bu the diagram below, with each dot representing an atomic nucleus.

i)   Using one or more diagrams of this kind, illustrate your
        understanding of the two terms "covalent radius" Rc and
   "van der Waal's radius" Rv.
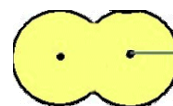
ii)   Which of the values (Rc or Rv) is larger than the another? Account for your
        anwser.

→ Be careful, you should be clear of the concept of covalent bond (**w____**a molecule) and intermolecular force (**b_____** two molecules).
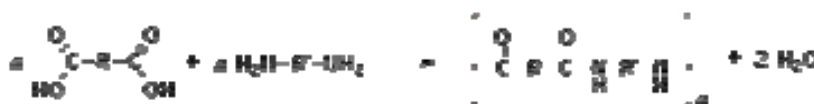
Different kinds of compounds

1. Molecular structure = S_____ molecular and M_____ structure

→ depends on molecule's size e.g. **Iodine** is s_____ molecule while some **plastic** is

   m_____ molecule as plastic consists of a large c_____.
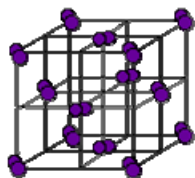
iodine in Face centred cubic   *General condensation polymerization*

reaction for nylon

→ They are made up of **discrete** molecules held by inter_____ force

(van _____ force and h_____ bond).

→ As for simple molecules, they have _____ b.p. / m.p. as the intermolecular force is

w____. They can____ conduct electricity as they have **no** delocalized electrons /

m____ ions.

→   The existence of H_____ bond will increase the boiling / melting point.

Exercise 2 --- Comparison of boiling point

a) Draw the Lewis structure of a H_2O molecule and F_2O molecule.

(Hint = Count the no. of valence electrons)

b) Which compound, H_2O or F_2O, would have a higher b.p.? Explain your anwser.

2. Giant Structure

→ all the atoms or ions present in the lattice are linked by strong bonding.

→ Giant Ionic (Lesson 6) , Giant covalent and Giant metallic (Lesson 6)

Giant Covalent Compounds

   Giant Covalent structure is one in which all atoms are linked together by a

continuous system of well-defined electron-pair bonds (c_____
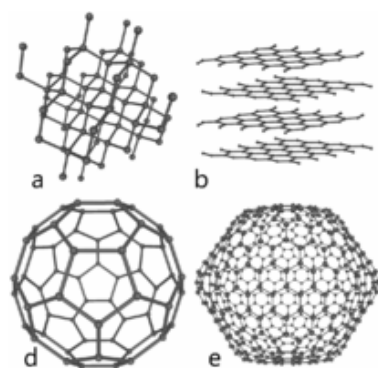
bonds). The bonds are thus **diectional**.

→ High melting and boiling point

Example Allotropes of carbon

a is d_____ ; b is g_____ ;

d is C_{60} and e is C_{540};

→ Which one/two of the allotropes has/have the Lowest m.p? ____

and ____ as they are just **discrete molecules**.!

Exercise 3 Something about hydrides

    Consider the hydrides of three period 3 elements: SiH_4, PH_3 and H_2S.

a) For each hydride, draw a 3-D structure showing the bond electron pairs and lone electron pair (s), if any, of the central atom.
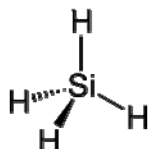
For SiH₄   *For PH₃*   *For H₂S*

Valence electron = 8

central lone pair electron = 0

b) Explain why H_2S has a higher boiling point.

(**hint** = Actually, they are all simple molecule. The difference in b.p. is not due to their types of structure.)

Extra Concept

1) Solubility of compounds in some solvent

→ In Lesson 5, you should learn that what solubility depends on, i.e. intermolecular force.

→ In detail, Solubility is the property of a s_____, l_____ or g_____ chemical substance (i.e. **solute**) to dissolve in a solid, liquid, or gaseous **solvent** to form a homogeneous solution of the solute in the solvent

→ How well the solute can mix with the s_____

→ It depends on the use of solvent (p_____ or non p____) and the kinds of solute (polar or non polar)

Like-disolve-like concept

    To dissolve a solute, we need to break the s_____ and s_____ interactions (I_1). Then, we have the new formation of s_____ and s_____ interactions (I_2).

→ If I_2 is stronger / more exo_____ than I_1, the solute is said to be soluble in that solvent.

→ In fact, polar solute likes polar solvent while ___ polar solute like non polar solvent as the type of interactions involved should be similar.

→ We should know that **organic solute** can "only" be dissolved by _____ solvent.

New concept --- For ionic compound

    As for ionic compounds and water as solvent, to dissolve them, we need to break the *i*_____ lattice. What is forming is the electrostatic attraction between p____ water molecule and those m_____ ions. Thus, we have,

$$\Delta H_{soln} = \Delta H_{hydration} - \Delta H_{lattice}$$ → Energetical aspect!

Exercise 4 Determination of solubility
Try to arrange the solubility of CO_2, NH_3 and O_2 in water in descending order with
explanation.   ($NH_3 > CO_2 > O_2$)

2) The value and the sign ofΔH lattice of ionic compounds

ΔH lattice measures the energetical stability of an I_____ crystal/salt, which is
formed by the combination of an a_____ and a cation.

→ if the sign is negative, the ionic crystal is energetically stable.

Soft ions and Hard ions

● **Soft ions** = those ions with high r_____ to charge ratio, i.e., have a large electron
    cloud and have a high polarizability
    e.g. Rb+, I-

● **Hard ions** = those ions with low radius to c_____ ratio, i.e. have a small ionic
    Size and have a high polarizing power.
    e.g. Li+ , F-

Concept = Soft ions like s_____ ions while hard ions like h_____ ions

→ Similar ions with similar size will combine to form a more stable ionic compound
as they can have a better overlapping/ packing in lattice.

soft cations +soft anions / **hard cations +hard anions** can form a more stable ionic
salt!

Vapour pressure of a solution

All liquid will evaporate to form vapour at all temperature (except at absolute
zero) as the molecules are gaining K.E. . The term vapour pressure relates to the
tendency of particles to escape from the liquid.

→ If a liquid has a high tendency to evaporate, the liquid is said to
be V_____.

→ Hence, the liquid has a high/low ? vapour pressure. (at a certain
temp.)
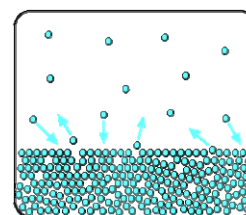
Look at the diagram, you should realise that if a liquid is volatile, there are more
molecules exerting a force to the container → higher vapour pressure.

Concept = A liquid with high vapor pressure will have a lower/higher boiling point.

Extra Knowledge --- Ionic Fluid

● An ionic liquid (IL) is a **salt** in the liquid state. They can be used as powerful
    solvents and **electrically conducting** fluids (i.e. electrolytes).

● Ionic liquids are often moderate to poor conductors of electricity
    (as they have ___ mobile ions), non-ionizing (e.g. non-polar), **highly**
    viscous and frequently exhibit **low vapor pressure** (Why? As the bond involved
    is ___ bond!).