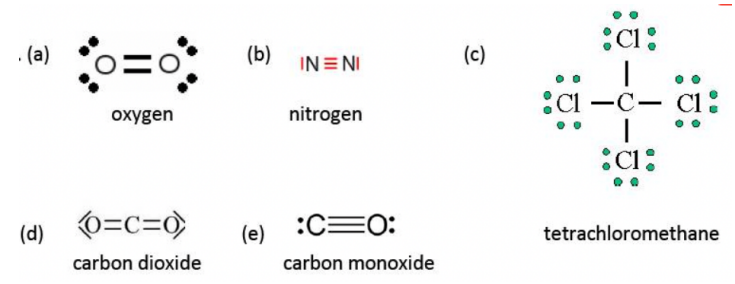
SL & HL Answers to Covalent structures (1) questions

1.



(Note that a line, two dots or a dot and a cross are all acceptable ways of showing a pair of electrons and different ways can be combined within the same molecule)

2. Three resonance structures for the carbonate ion can be drawn. Each contains one C=O double bond from the carbon atom to different oxygen atoms so that the average bond order for the carbon to oxygen bond is 4/3 and all the carbon to oxygen bonds are the same length and strength.

3. Aluminium chloride, $AlCl_3$, is covalent and there are only six electrons around the central aluminium atom. When it dimerises one of the chlorine atoms from another $AlCl_3$ molecule forms a coordinate bond with the aluminium atom so that each aluminium atom now obeys the 'octet rule'.

4. Ozone can be drawn as two resonance hybrids in which the bond order for the O to O bond is 3/2. This means that the O to O bond in ozone is weaker than the O=O double bond in oxygen so less energy is required to break it.

5. The phenyl group is essential a substituted benzene ring**.** It can be shown as two resonance structures in which the double and single C to C bonds alternate. Since all six C to C bonds are of equal length and strength a circle in the phenyl ring illustrates this better than showing alternate double and single bonds which would be of different length and strength.

6. Both diamond and graphite have giant molecular structures consisting of strong covalent bonds so they have high melting points. In diamond all the C to C bonds are equal and all the electrons are held in fixed positions arranged tetrahedrally around each carbon atom. In graphite three of the C to C bonds are fixed in a hexagonal shape with bonds angels of 120^o to give a flat layer. The layers are held together by weak bonds consisting of delocalised electrons. These delocalised electrons are free to move between the layers so that graphite is a good conductor of electricity.

7. Both diamond and silicon have a giant tetrahedral structure but C-C bonds are stronger than Si-Si bonds so are harder to break.

8. Silicon dioxide has giant molecular structure with strong covalent bonds resulting in a high melting point. Carbon dioxide contains individual molecules of carbon dioxide held together by weak intermolecular forces which are easily broken so it has a low melting point.