FUNDAMENTALS OF CHEMISTRY 1A (CHEM1001) - June 2013

2013-J-2

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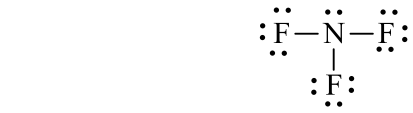
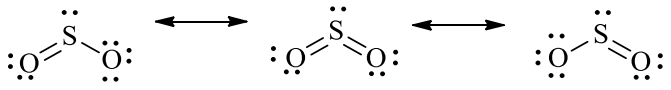
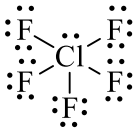
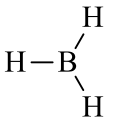
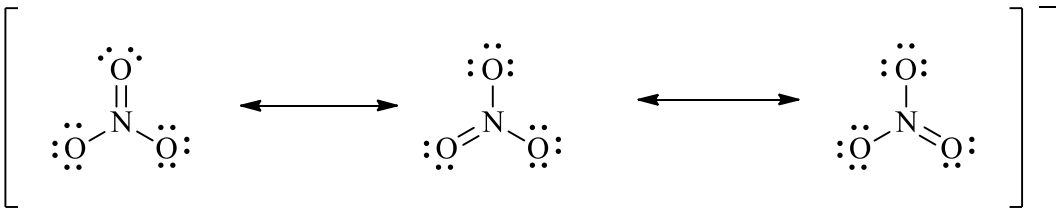
	trigonal pyramidal	yes
	angular or bent (at ~120°)	yes
	square pyramidal	yes
	trigonal planar	no

2013-J-3

• When two or more Lewis structures can be drawn for a molecule or ion, the true structure is none of the structures that is drawn, but a type of average made up of all the resonance contributors. Some structures may contribute more than others.



e.g. In NO_3^-, the ion does not contain 1 double and 2 single bonds, but is an average of the three structures shown. All of the N-O bonds are exactly the same length and the energy of the true structure is lower than the theoretical energy for any one of the given structures. This energy difference is known as resonance stabilisation energy.

• Oxygen is in Period 2 and the second shell can contain a maximum of 8 electrons. Sulfur is in Period 3 and the third shell may contain up to 18 electrons.

• Electrons in the outermost shell involved with bonding.

Uneven sharing of electrons in a covalent bond that occurs when different elements bond.

Properties that do not depend on the amount of material present e.g. temperature.

2013-J-4

- $Mg(s) + 2H^+(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$
  0.21 mol
  5.1 L

- CO_2 is a molecular covalent compound containing double bonds, O=C=O. There are weak forces between the molecules and hence CO_2 is a gas at room temperature.
  SiO_2 is a giant covalent structure containing an extensive lattice of Si–O single bonds that are difficult to break and hence it has a high melting point.

2013-J-5

- $PbCl_2$
  N_2O_3
  sodium sulfate
  sulfur hexafluoride

- For: All have [ ] s^1 electron configuration. (1 electron in outer (valence) shell)
  Forms H^+ cation.
  Combines with Group 17 elements in 1:1 ratio
  Valency of 1.
  Against: It is a non-metal. All other Group 1 elements are metals.
  Exists naturally as diatomic gas.
  Does not react violently with water.
  Forms H^- anion.

2013-J-6

- $Al(NO_3)_3(s) \rightarrow Al^{3+}(aq) + 3NO_3^-(aq)$
  $K_3PO_4(s) \rightarrow 3K^+(aq) + PO_4^{3-}(aq)$
  $Al^{3+}(aq) + PO_4^{3-}(aq) \rightarrow AlPO_4$
  0.0040 mol
  0.013 M

2013-J-7

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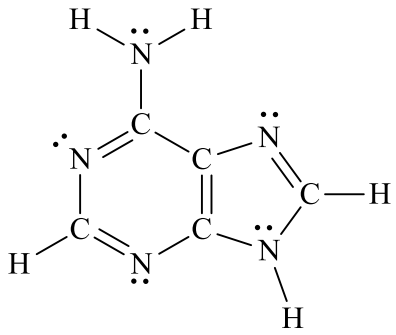

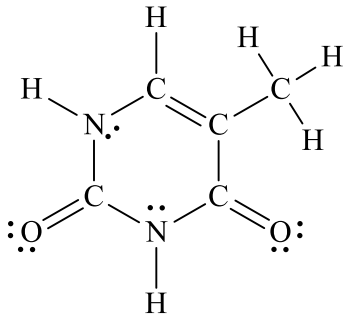

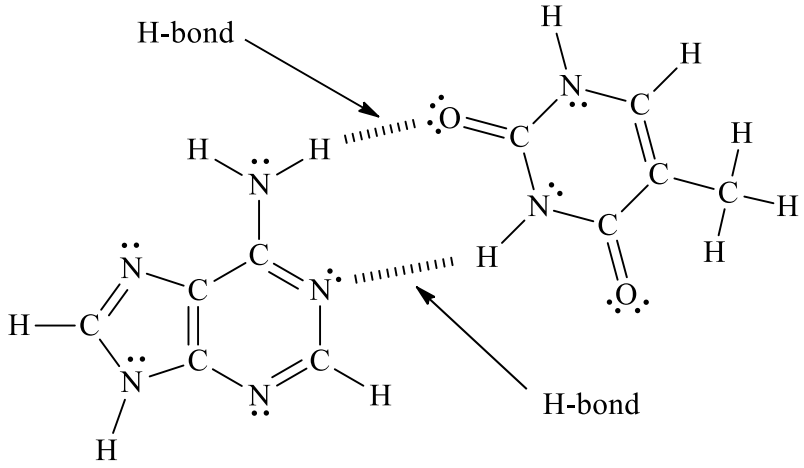

2013-J-8

• $Cd(s) + 2NiO(OH)(s) + 2H_2O(l) \rightarrow Cd(OH)_2(s) + 2Ni(OH)_2(s)$

1.42 V

Cell potential depends on the concentrations. No concentrations are changing as all reactants and products are solids and water is a pure liquid.

$Cd(OH)_2(s) + 2Ni(OH)_2(s) \rightarrow Cd(s) + 2NiO(OH)(s) + 2H_2O(l)$

4.28×10^{-3} mol

2013-J-9

• 25 L

32 J K^{-1} mol^{-1}

2013-J-10

- $K_c = \dfrac{[HCN]^2}{[N_2][C_2H_2]}$

  Because the number of moles of products is equal to the number of moles of reactants.

  $\frac{1}{2}N_2(g) + \frac{1}{2}C_2H_2(g) \rightleftharpoons HCN(g)$ $K_c = 0.015$ at 300 °C

  0.015 M

2013-J-11

- The main intermolecular force in both liquids is H-bonding. Both N and F are small electronegative atoms which results in highly polarised N–H and F–H bonds, characteristic of H-bonding. The H-bonding density in both liquids is the same - each molecule forming 2 H-bonds to its neighbour, 1 through the lone pair and 1 through an H atom. F is more electronegative than N and hence the H-bonds in HF are stronger than those in NH_3 and hence HF has the higher boiling point.

  The strength of the H-bonds in water are between those in HF and NH_3. But the density of bonds is double as each water molecule can form 4 H-bonds to its neighbours. The extra density of H-bonds is more significant than the stronger bonds in HF and hence water has the highest boiling point..

2013-J-12

- $\frac{1}{2}N_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons NO(g)$

  90.4 kJ mol^{-1}

- –577 kJ mol^{-1}