FUNDAMENTALS OF CHEMISTRY 1A (CHEM1001) - June 2014

2014-J-2

- copper(II) sulfate
  sodium nitrate
  $MgCl_2$
  Fe_2O_3

  0.0074 M

  0.022 M

2014-J-3

- Lithium oxide is an ionic compound formed between a metal (Li) and a non-metal (O) by the complete transfer of electrons from Li to O to give Li^+ cations and O^{2-} anions. These ions are held in place in the crystal lattice by strong electrostatic attractions between the positively and negatively charged ions. This results in a solid compound with high melting point.

  Carbon dioxide is a molecular covalent compound. The carbon and oxygen atoms share their electrons forming strong covalent C=O double bonds. There is no formal bonding between the individual O=C=O molecules. The molecules are attracted to each other by weak dispersion forces. CO_2 is therefore a gas at room temperature.

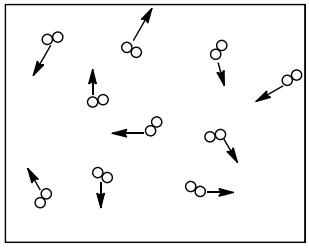
  :C≡O:

  Covalent bonds formed between atoms with different electronegativities are always polarised, hence CO is a polar molecule. Although the two C=O bonds in CO_2 are polarised, CO_2 is a linear molecule and the two dipoles cancel each other out. Hence CO_2 does not have a permanent dipole moment.

2014-J-4

- $2N_2H_4(g) + N_2O_4(g) \rightarrow 3N_2(g) + 4H_2O(g)$

  Diatomic molecules of N_2 fill the container, but the individual molecules are far apart. The molecules are travelling in different directions and at different speeds colliding with each other and the walls of the container.



  Equal volumes of gases at the same temperature and pressure contain equal numbers of molecules.
  mole ratio of N_2H_4 to N_2O_4 is 1:1.
  0.0409 mol

2014-J-5

- 3.88 L
  5.73 J K–1
  1.6 kJ
  1.72 g

2014-J-6

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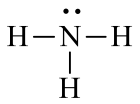
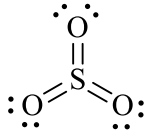
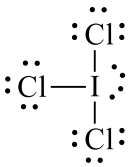
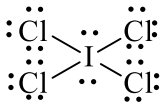
	trigonal pyramidal
	trigonal planar
	T-shaped
	square planar

2014-J-7

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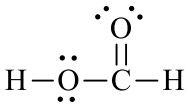

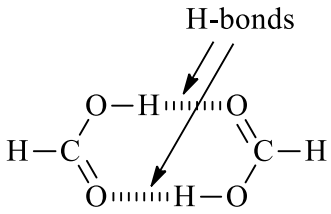

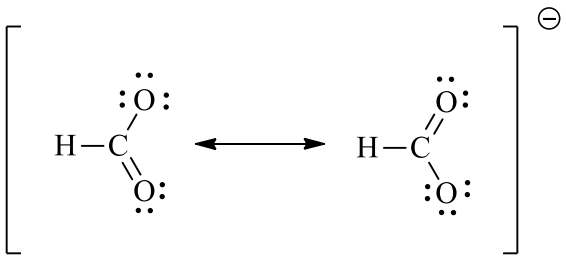

In formic acid, the C=O double bond is shorter than the C–O bond. In the formate ion, the two C–O bonds are identical because of resonance and hence are the same length.

2014-J-8

- trigonal planar

$$K = \frac{[H^+(aq)][HCO_2^-(aq)]}{[HCOOH(aq)]}$$

0.0042 M

1.8×10^{-4} M

0.0096 M

2014-J-9

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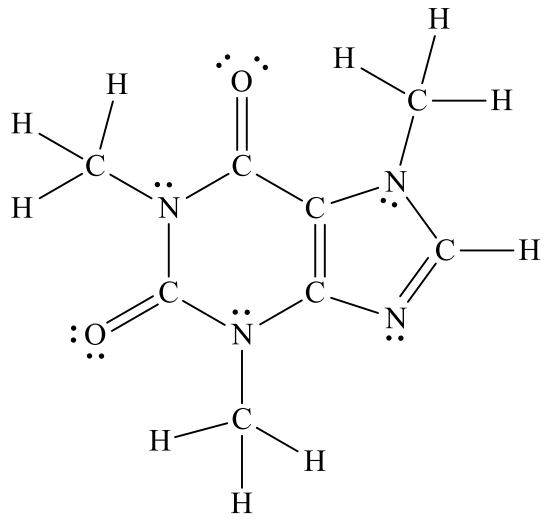

- Elements in the Periodic Table belong to groups and periods. For main group elements (i.e. those in Groups 1, 2 and 13-18), elements in a group have the same outer shell electron configuration (i.e they have the same number of valence electron). Each period (row) of the Table has a set number of inner electron shells, those holding the non-valence electrons.

dull, brittle, non-conductor	malleable, ductile, conductor
forms covalent bond with non-metals	forms ionic bonds with non-metals

Going down the group, the elements change from non-metals (C) to semi-metals (Si, Ge) to metals (Sn, Pb). As the atoms become bigger, the valence electrons are further from the nucleus and less tightly bound. Bonding therefore tends to involve loss of electrons, typical fo metallic behaviour.

2014-J-10

- $3Cd(OH)_2(s) + 2Al(s) + 12F^-(aq) \rightarrow 3Cd(s) + 6OH^-(aq) + 2AlF_6^{3-}(aq)$

  1.25 V

  decrease of 0.176 g

  $Cd(s) + 2H_2O(l) \rightarrow Cd(OH)_2(s) + H_2(g)$

  0.82 V

2014-J-11

- 380 kJ

  300 kJ mol^{-1}

- $S(s) + O_2(g) \rightarrow SO_2(g)$

  –297 kJ mol^{-1}

2014-J-12

- 173 kJ mol^{-1}

  Bond strength is dependent on the electron density between the atoms. The electron density around the Cl involved in bonding is higher in 3 Cl-F bonds in ClF_3 than it is in 5 Cl-F bonds in ClF_5. Hence the bonds in ClF_3 are stronger.

- Ethanol can from strong intermolecular hydrogen bonds. Dimethyl ether cannot, it can only form much weaker dispersion forces and dipole-dipole interactions.