CHEMISTRY 1A (CHEM1101) - November 2006

2006-N-2

- a) Different structural forms of the same element eg graphite and diamond.

  b) The energy required to remove an electron from an atom.
  ΔH for the reaction $X(g) \rightarrow X^{+}(g) + e^{-}$

  c) A description of an atom or molecule that has no unpaired electrons.

  d) An undoped semiconductor that has a small energy gap between the conductance and valence bands. A few electrons will be thermally excited across the gap to allow a small current to flow.

  e) A bond formed by the end-to-end overlap of atomic orbitals. The maximum electron density is between the nuclei along the bond axis. It has lower energy than the atomic orbitals from which it was formed.

2006-N-3

- $^{4}_{2}He$

  $^{4}_{2}He$

  $^{14}_{6}C$

  stars

- α-Radiation is highly ionising and causes severe tissue damage, but it is not very penetrating and easily stopped by our skin. Gaseous α-emitters are high risk as they can be breathed in and lodge in the lungs and then be transported round the body. Solid α-emitters are not dangerous unless ingested, which only happens in rare circumstances. (*Radium Girls* by Claudia Clark and recent news reports on the death of Litvinenko by ^{210}Po poisoning make interesting reading.)

2006-N-4

- 2.65×10^{-18} J

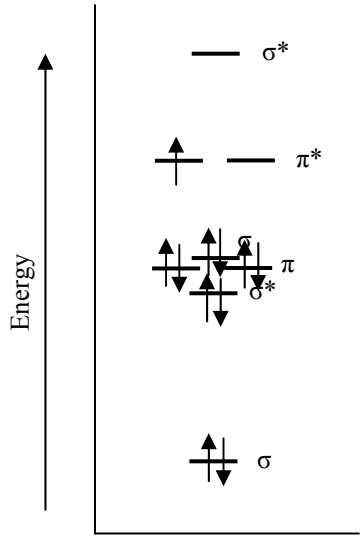
  75.0 nm

- The number of electrons and protons increase across a period. As all electrons are being added to the same shell, the effective nuclear charge increases (there is no increase in shielding) and the attraction between the nucleus and the electron cloud increases. This results in smaller atoms as we move from left to right across a period.

- X-ray spectrometry investigates high energy transitions involving core electrons. These electrons are not involved in bonding and hence insensitive to whether atom is bonded or not. AAS observes transitions involving the valence electrons. These change depending upon the bonding of the atom, so samples must be atomised.

2006-N-5

- 11

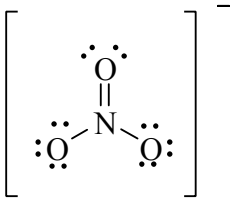


2.5

Paramagnetic as it contains an unpaired electron.

Strengthen. Electron would be removed from the highest energy orbital (which is π* anti-bonding), so bond order would become 3.

2006-N-6

- 24  trigonal planar

10 H—C≡N: linear

NH_3, HCN

2006-N-7

- $H_2 < CH_4 < H_2O < NaCl < SiO_2$

H_2 and CH_4 have weak dispersion forces. CH_4 is larger molecule with more electrons so is more easily polarised than H_2 and therefore CH_4 has greater dispersion forces and the higher m.p. H_2O has hydrogen bonds. NaCl is ionic compound with strong coulombic attraction between the Na^+ ions and the Cl^- ions. Silica is covalent network solid. Melting requires breaking of the very strong covalent Si–O bonds, so it has the highest m.p.

Only NaCl conducts when molten, due to having mobile Na^+ and Cl^- ions that can carry the charge.

2006-N-8

- -2794 kJ mol^{-1}

  -2530 kJ mol^{-1}

2006-N-9

ΔS will be greater for the reaction which produces $H_2O(g)$ as gases have greater entropy than liquids.

1.47 g

1.7 L

2006-N-10

-

0.211 M

$Q > K_c$ *i.e.* not at equilibrium. Reaction will shift to left (N_2O_4 is favoured).

2006-N-11

- bromine at anode, hydrogen at cathode

  $2Br^-(aq) \rightarrow Br_2(aq) + 2e^-$

  $2H_2O + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$

  $2H_2O + 2Br^-(aq) \rightarrow H_2(g) + 2OH^-(aq) + Br_2(aq)$

- 85 g

2006-N-12

- $PbSO_4(s) \rightarrow Pb^{2+}(aq) + SO_4^{2-}(aq)$

  $K_{sp} = 1.96 \times 10^{-8}$ M^2

- 0.06 V

  22