Chemistry 1Adv/1SSP (CHEM1901/1903) June 2010

2010-J-2

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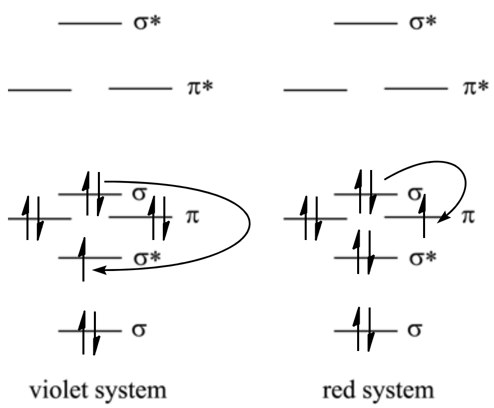

2010-J-3

The upper state of the violet system has a bond order of ½(8–1) = 3.5, while the ground state has a bond order of ½(7–2) = 2.5. Hence upper state has a stronger and shorter bond.

Blackbody emission from the sun is absorbed by Ca in the sun's atmosphere. the solar spectrum is then reflected by the comet.

Absorption from $n = 2$ to $n = 6$.

2010-J-4

• $^{232}_{90}Th + ^{1}_{0}n \rightarrow ^{233}_{90}Th$

$^{233}_{90}Th \rightarrow ^{233}_{91}Pa + ^{0}_{-1}e$

$^{233}_{91}Pa \rightarrow ^{233}_{92}U + ^{0}_{-1}e$

70 tonne

4.1×10^3 2.0×10^{16} 1.8×10^9

2010-J-5

6.1×10^5 years

• $F_2 < Cl_2 < Br_2 < I_2$ because the atoms are getting bigger and have more electrons and bigger more polarisable electron clouds and hence stronger dispersion forces.

HCl, HBr and HI have increasing dispersion forces and decreasing dipole-dipole forces. As the boiling points increase in the order HCl < HBr < HI, the dispersion forces must be more significant than the dipole-dipole forces.

HF has very strong hydrogen bonds because of the very small and electronegative F atom. This gives it an anomalously high boiling point.

2010-J-6

- *a* 3 trigonal planar
  b 2 bent
  c 4 tetrahedral
  The actual bond angle is 60° rather than the usual 109.5° as the oxygen is part of a 3-membered ring. Epoxides are much more reactive than normal ethers as there is only partial orbital overlap - the orbitals are oriented tetrahedrally, but the bond angles are 60°. Reactions that open the ring relieve ring strain and allow better orbital overlap.

2010-J-7

- –80.0 kJ mol^{-1}

2010-J-8

- 7.93 g
  9.00×10^3

2010-J-9

183
–36.3 J K^{-1} mol^{-1}
decreased
decreased
decreased
no change

2010-J-10

- 77.9 % (5.59 g)

  630 K

2010-J-11

ΔH = +30 kJ mol^{-1} and ΔS = 24 J K^{-1} mol^{-1}

Therefore ΔG = +15 kJ mol^{-1} at 632 K. Reaction is not spontaneous and FeO is stable.

FeO(s): Ionic bonding between the Fe^{2+} and O^{2-} ions. The ions are positioned regularly within a stable crystal lattice.

H_2(g): Covalent bonding between the H atoms in the H_2 molecule. No bonding interactions between the H_2 molecules.

Fe(s): Metallic bonding between the Fe atoms - the electrons are largely delocalised over many atoms.

2010-J-12

$Al(s) | Al^{3+}(aq) \| Cr^{3+}(aq) | Cr(s)$

0.95 V

4.9×10^{47}

- 50. s

2010-J-13

- Fuel cells use $H_2(g)$ and $O_2(g)$ as the reactants.
  Disadvantages: H_2 is highly flammable and a severe explosion hazard should the car be involved in a crash. It's likely cars would need to be heavier to prevent rupture of tanks. There are also handling difficulties as it's a gas.
  Advantages: The only product of a fuel cell is water, so they are non-polluting. High efficiency.

  Aluminium air battery uses Al(s) and O_2 as reactants.
  Advantages: The fuel (Al) is not explosive and can easily be replaced when it is exhausted. Aluminium is very light metal and 3 electrons lost in its oxidation to Al^{3+}, so a lot of energy generated per g of fuel. Aluminium is very plentiful and cheap. Steady voltage as [Al] and $[O_2]$ don't vary.
  Disadvantages: The $Al(OH)_3$ product needs to be recycled. Conversion back to Al metal involves large amounts of electricity and associated CO_2 output.