CHEMISTRY 1A (CHEM1101) - November 2008

2008-N-2

- $^{14}_{6}C \rightarrow {}^{14}_{7}N + {}^{0}_{-1}\beta$

  1.65×10^{11} Bq

  Scintillation counter

  2.2×10^{-5} %

2008-N-3

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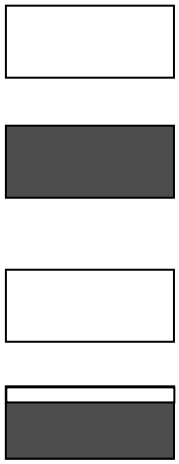

Si doped with Ga

The band gap in pure Si (between the full valence band and the empty conductance band) is large. Normal thermal energy does not give the electrons enough energy to make the jump and so Si is an insulator.

Replacing some Si atoms with Ga (or other Group 13 element), means that the valence band will not be completely occupied with electrons. The gaps act as positive holes and allow the material to act as a semiconductor of the p-type.

2008-J-4

- 1861 kJ mol^{-1}

  1.748. The Cl^- ions are already as close-packed as possible and Li^+ is a smaller ion than Na^+. Therefore substitution of Na^+ with Li^+ will result in less stress on the crystal structure and hence LiCl will have the same structure and Madelung constant as NaCl.

2008-J-5

- The effective nuclear charge (Z_{eff}) increases going from left to right across the period. The electrons feel a greater pull from the nucleus as Z_{eff} increases as they are all being added to the same $n = 2$ orbital. This leads to a decrease in the size of the atom across the period.

  When the 11th electron is added for Na, it goes into the $n = 3$ shell and is very well shielded from the nuclear charge by the electrons in the $n = 2$ shell. This causes a big increase in the radius of the atom going from Ne to Na.

2008-J-6

- Hg (mercury)
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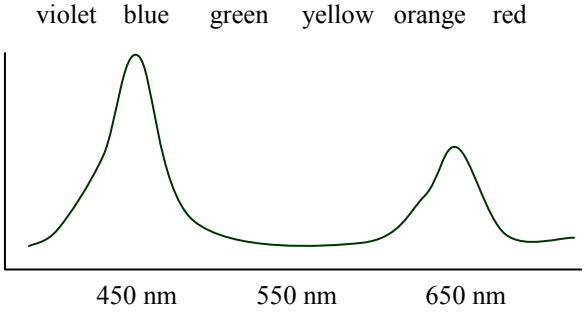
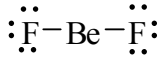
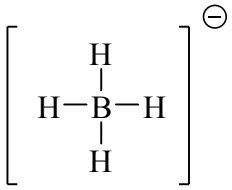
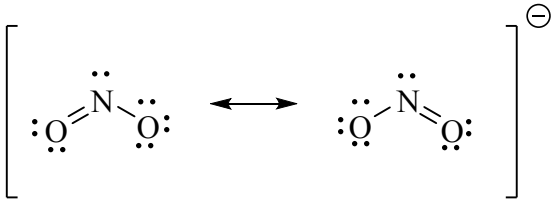


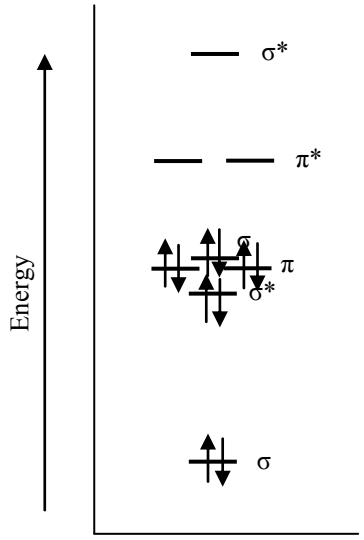
2008-N-7

- 16  linear

8  tetrahedral



2008-N-8

- 

N_2 They are isoelectronic, hence they have the same bond order.

The extra electron would go into the π* antibonding orbital. The bond order would consequently drop from 3 to 2.5 and hence the bond would be weaker.

The orbital energies of oxygen are lower than those of carbon as oxygen is the smaller atom and the orbitals are closer to the nuclear charge. The bond would therefore be polarised.

2008-N-9

- 0.211

2008-N-10

- exothermic

  -56.2 kJ mol^{-1}

  $H^+(aq)$ is the limiting reagent. It was all used up with just 10.0 g of NaOH, so no further reaction occurs when using 12.0 g instead.

2008-N-11

- $CH_4(g) + NH_3(g) + {}^3/_2O_2(g) \rightarrow HCN(g) + 3H_2O(l)$

  13.3 L

- to the right

  to the right

  to the left

2008-N-12

- $2Cl^-(aq) + 2H_2O(l) \rightarrow Cl_2(g) + H_2(g) + 2OH^-(aq)$

  The two "top 10s" are NaOH and Cl_2. H_2 is not harnessed as it is produced more cheaply in other ways.

  Water is reduced preferentially.

  $2H_2O(l) + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$ $\quad E°_{red} = -0.83$ V

  $Na^+(aq) + e^- \rightarrow Na(s)$ $\quad E°_{red} = -2.71$ V

2008-N-13

- $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ $\quad \Delta H = +180$ kJ mol^{-1}

  The formation of NO(g) is endothermic, so it is favoured at the high temperatures that exist in the car engine. The high temperatures also speed up the reaction.

  It reacts with oxygen in the atmosphere to give $NO_2(g)$.

  $$2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$$

2008-N-14

- impure Cu is anode, pure copper is cathode

  $Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$ $\quad E°_{ox} = -0.34$ V

  E_{ox} for noble metals is more negative so Cu (and metals with higher E_{ox}) are preferentially oxidised.

  $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$ $\quad E°_{red} = +0.34$ V

  $Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$ $\quad E°_{red} = -0.76$ V

  $Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$ $\quad E°_{red} = -0.44$ V

  Cu is preferentially deposited as it has the higher $E°_{red}$.

  2.85 kg

2008-N-15

- Zn

  $Zn(s) \rightarrow Zn^{2+} + 2e^-$

  graphite

  $2MnO_2(s) + 2H^+ + 2e^- \rightarrow Mn_2O_3(s) + H_2O$

  It completes the circuit and thus allows electrical neutrality to be maintained. This is accomplished by the ions in solution carrying the current.