CHEMISTRY 1A (CHEM1101) June 2004

2004-J-2

- No two electrons in an atom can have the same quantum numbers. An atom with a specific number of protons and neutrons. Empty MOs that are higher in energy than the valence band. The valence and conductance bands are contiguous in metals. The energy gap between them is small in semi-conductors and large in insulators. The energy required to remove an electron from an atom in the gas state.

2004-J-3

- $^{55}_{25}$Mn
- $^\gamma$
- $^\Gamma$
- 28.09
- $2.916 \times 10^3$ Ci mol$^{-1}$

2004-J-4

- 12

Yes. It has two unpaired electrons (in the $\pi^*$ orbital).
SOCl$_2$

- MgO and ZnO are ionic. Electronegativity difference > 2 is classified as ionic.

- 3.37 \times 10^{-19} \text{ J}
- 299 \text{ kJ mol}^{-1}

- OH$^-$ (aq) + H$^+$ (aq) $\rightarrow$ H$_2$O
  - exothermic
  - $\Delta H = -56.0 \text{ kJ mol}^{-1}$

- Water is reduced rather than aluminium ions due to the relevant reduction potentials.
  - $2\text{H}_2\text{O} + 2\text{e}^- \rightarrow 2\text{OH}^- (\text{aq}) + \text{H}_2 (\text{g})$ $E^\circ = -0.83 \text{ V}$
  - $\text{Al}^{3+} (\text{aq}) + 3\text{e}^- \rightarrow \text{Al}(\text{s})$ $E^\circ = -1.68 \text{ V}$

- Al$_2$O$_3$ has a very high melting point. Adding cryolite (Na$_3$AlF$_6$) produces a mixture of much lower melting point (an important energy consideration in industrial processes) and provides a source of ions, Na$^+$ and [AlF$_6$]$^{3-}$, so that the melt conducts a current.

- 2C$_3$H$_6$N$_6$O$_6$(s) + 3O$_2$(g) $\rightarrow$ 6H$_2$O(l) + 6CO$_2$(g) + 6N$_2$(g)
  - There is no O$_2$(g) as one of the reactants. The products will be slightly different, eg H$_2$(g), H$_2$O(g), CO(g).
  - High nitrogen content results in large $-\Delta H$ for combustion/explosion reaction. $\Delta H^\circ$ of +65 kJ mol$^{-1}$ results in large $-\Delta H$ for combustion/explosion reaction.
  - Large number of moles of gas produced per mole of explosive.
  - High oxygen content promotes explosive reaction.
  - 948 kJ mol$^{-1}$

- 3CuO(s) + 2Al(s) $\rightarrow$ Al$_2$O$_3$(s) + 3Cu(s)
  - CuO: 4.09 kJ g$^{-1}$ Fe$_2$O$_3$: 3.96 kJ g$^{-1}$
  - CuO/Al is better fuel than Fe$_2$O$_3$/Al
2004-J-10

- Zn is the anode
  \[ \text{Zn(s)} + 2\text{e}^- \rightarrow \text{Zn}^{2+}(aq) \]

  The graphite electrode is the cathode
  \[ 2\text{MnO}_2(s) + 2\text{NH}_4^+(aq) + 2\text{e}^- \rightarrow \text{Mn}_2\text{O}_3(s) + \text{H}_2\text{O} + 2\text{NH}_3 \]

2004-J-11

- The reagents are solids or very concentrated solutions.
  Both the anode and cathode are solids so can be placed in the same electrolyte.
  The products are solids so remain trapped in the same electrode. External voltage can therefore reverse the reaction and regenerate the cathode and anode.

- \[ [\text{Pb}^{2+}]/[\text{Sn}^{2+}] = 0.5 \]

2004-J-12

- \( 7.1 \times 10^2 \text{ M}^{-1} \)

2004-J-13

- 34%
- none