CHEMISTRY 1A (CHEM1101) June 2005

2005-J-2

- No two electrons in an atom can have the same quantum numbers.

  The name given to an electron wavefunction in an atom or molecule. It describes the amplitude of a wave as a function of position in space.

  A semiconductor made by doping with Group 13 atoms with vacant orbitals of slightly higher energy than the top of the valence band. Electrons can be excited into these vacant orbitals leaving "positive holes" in the valence band to produce the primary conductance mechanism.

  The antiparticle of an electron. It has a charge of +1 and is formed in some nuclear decay processes.

2005-J-3

- $^{36}_{16}\mathrm{S}$

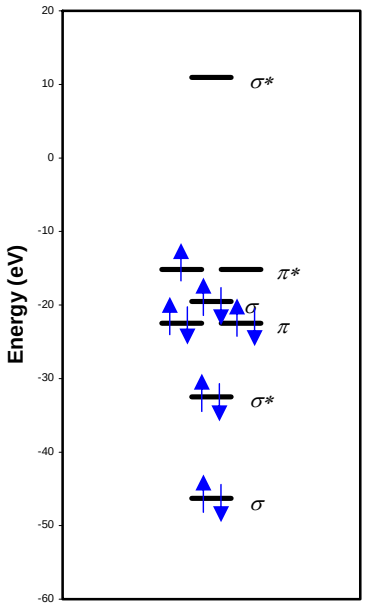
  $^{0}_{1}\mathrm{e}$ or $^{0}_{1}\beta^{+}$

  $^{14}_{6}\mathrm{C}$

- 32.1
- 1.40×10^{8} Ci mol^{-1}

2005-J-4

- 11



2.5

Yes. It has two unpaired electrons (in the π* orbital).

2005-J-4 (cont)

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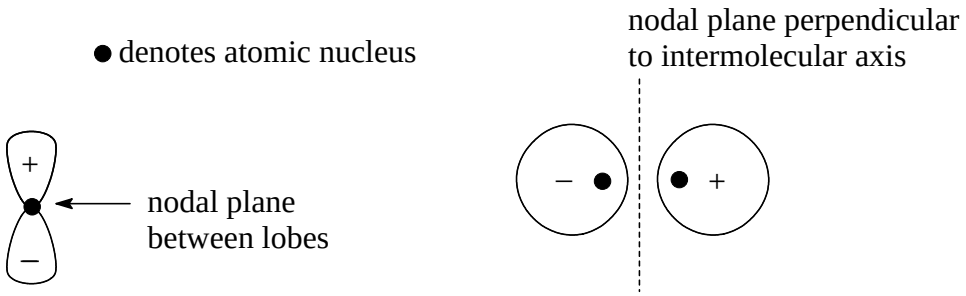

2005-J-5

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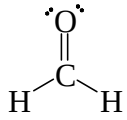
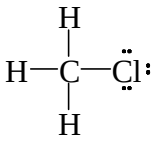
12  trigonal planar

14  tetrahedral

both have dipole moments

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

2005-J-6

• 2.65×10^{-18} J 75.0 nm

• The visible spectrum of hydrogen showed distinct bands at certain wavelengths only. This showed that energy was quantised (ie not continuous) and that only certain energy levels were allowed.

Certain aspects of the photoelectric effect could only be explained by considering light as particulate - a steam of photons. The energy of the photons was proportional to the frequency (not intensity) of the light. This explained the facts that there was a minimum threshold energy and that there was no time lag.

2005-J-7

• $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O$

2.74 kg

1.40×10^3 L

Greater, as methane causes greater "greenhouse effect" than carbon dioxide.

2005-J-8

• $\frac{1}{2}N_2(g) + \frac{1}{2}O_2(g) \rightarrow NO(g)$

90.4 kJ mol^{-1}

–577 kJ mol^{-1}

2005-J-9

- 0.354 M

  2.5×10^{-3} %

2005-J-10

- 84 kg

  Water is reduced rather than aluminium ions due to the relevant reduction potentials, so electrolysis of aqueous solution of Al^{3+} ions will not produce Al(s).

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

  $Al^{3+}(aq) + 3e^- \rightarrow Al(s)$ $\quad E° = -1.68$ V

  Al_2O_3 has a very high melting point. Adding cryolite (Na_3AlF_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.

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

  $2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$

  $E°_{ox}$ for Cl^- ions (above reaction) is –1.36 V.

  The $E°_{ox}$ for water is –1.23 V: $\quad 2H_2O \rightarrow O_2(g) + 4H^+(aq) + 2e^-$

  Water should be oxidised preferentially based on $E°_{ox}$ values, but there is an overpotential of about 0.6 V associated with production of $O_2(g)$. This means that in practice, $Cl_2(g)$ is formed instead.

2005-J-11

- 0.02 V

  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.

- $[Zn^{2+}]^3/[Cr^{3+}]^2 = 1 \times 10^2$

- F is much smaller atom than Cl. F is more electronegative than Cl.