CHEMISTRY 1A (CHEM1101) - November 2004

2004-N-2

- $^{0}_{1}\beta$ or $^{0}_{1}e$

  $^{1}_{1}H$ or $^{1}_{1}p$

  $^{4}_{2}He$

  In stars

- 5.49×10^{16} Bq 1.62×10^{7} Ci mol^{-1}

2004-N-3

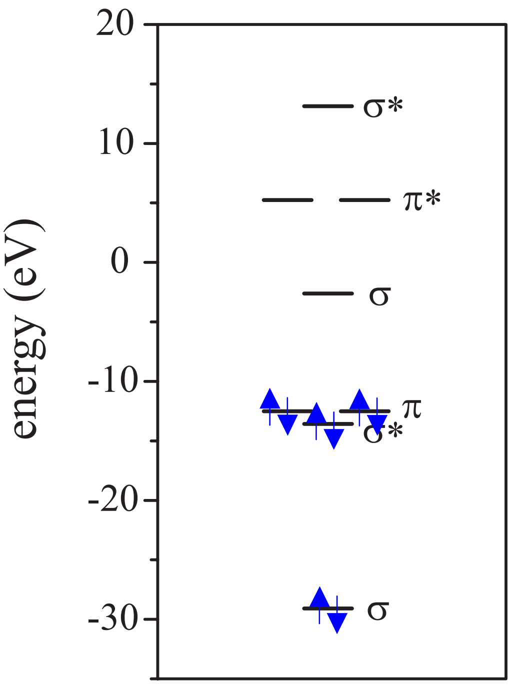
- The visible spectrum of hydrogen showed distinct bands at certain wavelengths only. This showed that energy was quantised (ie not continuous) and that only certain energy levels were allowed.

  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.

- Hafnium (element with atomic number = 72)

2004-N-4

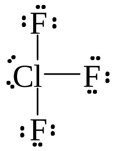
- 8

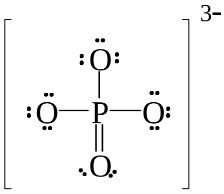


2

1.1×10^{-6} m

2004-N-5

- 5  T-shaped

  4  tetrahedral

- 2*p* electrons are N: ↑ ↑ ↑ O: ↑↓ ↑ ↑
  The paired electron in O results in electron-electron repulsions that raise the energy of the 2*p* orbital. Removing this electron relieves the repulsions and leaves a stable half-filled 2*p* subshell. The fourth electron therefore comes off more easily than the third.

- $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^4$
  $1s^2\ 2s^2\ 2p^1$

2004-N-6

- alkene
  ether

  109.5° 120°

  It's due to the OH group, which has a stretching vibration at ~3600 cm^{-1}.

2004-N-7

- Student 1: 0.633 J K^{-1} g^{-1} Student 2: 0.452 J K^{-1} g^{-1}

  Student 2's answer is more accurate as the hot water (Student 1's experiment) will lose a lot of its heat to the surroundings. This effect is minimal in Student 2's experiment because the water is at room temperature.

2004-N-8

- $Cu^+(aq) + e^- \rightarrow Cu(s)$ × 2 $E° = +0.53$ V

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

  $2Cu^+(aq) \rightarrow Cu(s) + Cu^{2+}(aq)$ $E° = +0.19$ V

- Water is oxidised in the presence of Co^{3+} ions due to the relevant reduction potentials.

  $2H_2O(l) \rightarrow 4H^+(aq) + O_2(g) + 2e^-$ $E° = –1.23$ V

  $Co^{3+}(aq) + e^- \rightarrow Co^{2+}(aq)$ × 2 $E° = +1.82$ V

  $2Co^{3+}(aq) + 2H_2O(l) \rightarrow 2Co^{2+}(aq) + 4H^+(aq) + O_2(g)$ $E° = +0.59$ V

2004-N-9

- 4.1
- 0.0113 atm

2004-N-10

- $CH_3(CH_2)_{14}COOH(s) + 23O_2(g) \rightarrow 16H_2O(l) + 16CO_2(g)$

  -888.8 kJ mol^{-1}

  38.9 kJ g^{-1}

2004-N-11

- 4.9×10^{-4} M

  67 mL

2004-N-12

- The very small and very electronegative atoms form H-bonds. The order of atom size is F < O < N. The order of electronegativity is F > O > N. Both of these effects mean that the order of H-bond strength will be in the order HF > HO > HN.

  The boiling point depends on the total energy of all intermolecular forces. H_2O can form 4 H-bonds per molecule, compared with 2 by each of HF and NH_3.

2004-N-13

- 4.23
- Ether: major intermolecular forces are dispersion forces and dipole-dipole forces.
  Ethanol: major intermolecular force is H-bonding.
  Ether has the weaker intermolecular forces and therefore has the lower boiling point and higher vapour pressure.

  Mercury: major intermolecular forces are metallic bonds.
  Water: major intermolecular force is H-bonding.
  Mercury has the stronger intermolecular forces and therefore has the greater surface tension.