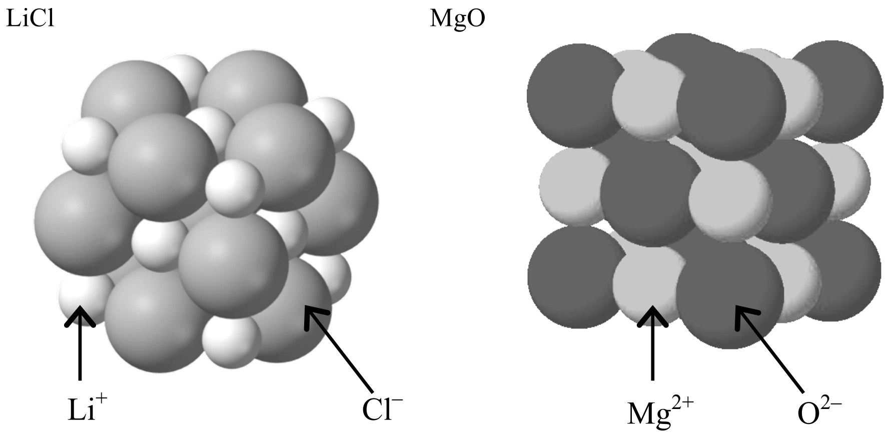
CHEMISTRY 1A (CHEM1101) June 2014

NB These answers have not been checked

2014-J-2

- 3.3 ppm

  The excitation of valence electrons into higher energy states.



MgO. The bigger charges in MgO compared to LiCl means the coulombic attraction between the ions is greater in MgO and hence MgO has the higher melting point.

2014-J-3

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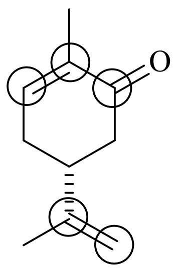


All the molecules experience dispersion forces. Dispersion forces are related to the polarisability of a molecule and increase as the number of electrons in the molecule increases (i.e. they increase with molecular size).

Dispersion forces are the only intermolecular forces present in isoprene and myrcene, but are stronger for the larger myrcene, so it has the higher boiling point.

Myrcene, citronellal and geraniol are all of similar size, so have similar dispersion forces.. Citronellal has a polar C=O group so can engage in dipole-dipole interactions so has a higher boiling point than myrcene.

Geraniol contains an –OH group so can engage in hydrogen bonding, a particularly strong intermolecular force, so it has a higher boiling point than citronellal.

2014-J-4

- $^{0}_{-1}e$

  $3.2 \times 10^{-5}\ s^{-1}$

  1.9×10^{19} Bq mol^{-1}

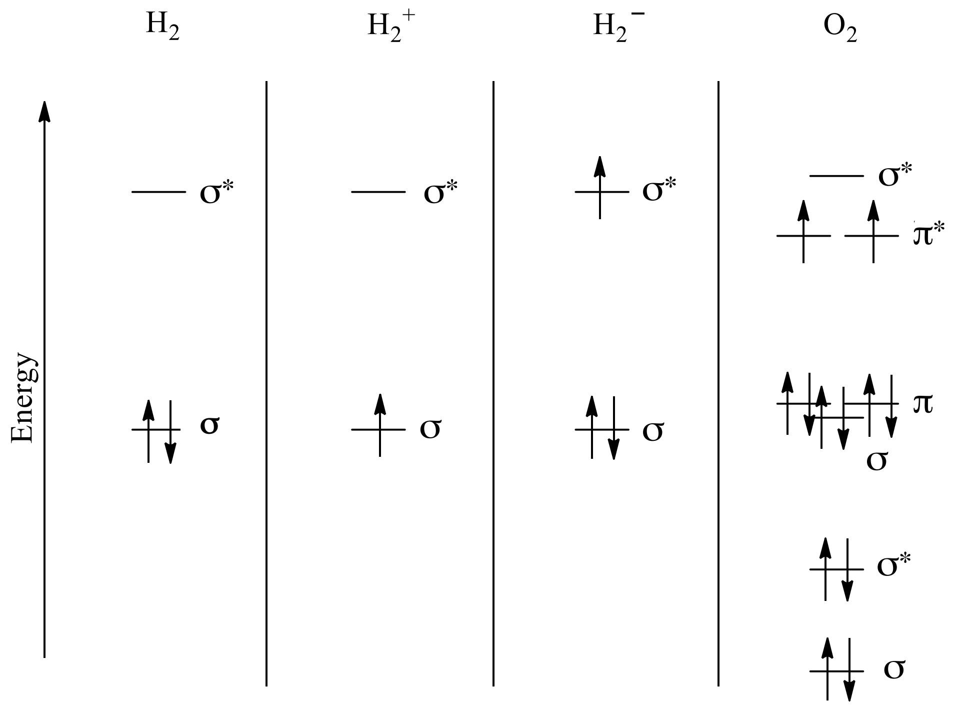
  20 hours

  Appropriately short half-life allows time for production of nuclide, administration to patient, and for it to accumulate in the tissue of interest. Activity is high enough to give good quality image with small amount of nuclide.

  It is a gamma emitter – highly penetrating radiation that can be detected outside the body and is not damaging to human tissue as it is non-ionising.

  Its chemical properties allow it to be incorporated into molecules that will be absorbed by the organs to be investigated.

2014-J-5

- 

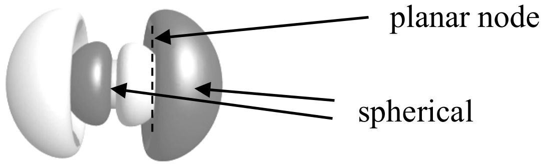
  1 0.5 0.5 2

  H_2^+, H_2^-, O_2

  H_2^- will be longer. Both have bond order of 0.5, but H_2^- is a multi-electron system so is destabilised by electron-electron repulsion. H_2^+ is single electron system so has no electron-electron repulsion.

2014-J-6

- 1 1



$n = 3$ The number of nodes is 1 fewer than the principal quantum number.

Electrons closer to the nucleus partially block the attractive force of the nucleus on the electrons that are further away, resulting in a lowering of the effective nuclear charge on such electrons.

The elements in a group of the Periodic Table have similar reactivities but ionisation energies decrease and sizes increase.

2014-J-7

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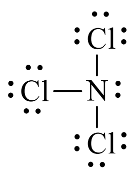
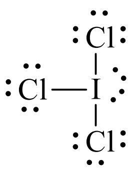
26		trigonal pyramidal
28		T-shaped

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The first structure is more stable as it has minimised the formal charges.

2014-J-8

- 370 mL

2014-J-9

- 1.2×10^{29}

- The freezing of water is exothermic and the heat evolved is passed to the surroundings. This causes an increase in the entropy of the surroundings equal to $\Delta S_{surroundings} = q/T$ where q is the heat gained by the surroundings and T is the temperature of the surroundings.

As long as the *T* is *low* enough, the *gain* in entropy in the surroundings, $\Delta S_{surroundings}$, overcomes the loss in entropy in the water, ΔS_{system}, so that the entropy of the universe increases. Freezing is spontaneous at temperatures below the freezing point.

2014-J-10

- NO_2: 0.0094 mol N_2O_4: 0.038 mol   ($[N_2O_4]$ = 0.0766 M from quadratic)

2014-J-11

- $C_4H_{10}(g) + {}^{13}/_2O_2(g) \rightarrow 4CO_2(g) + 5H_2O(l)$

  –2877 kJ mol^{-1}
- 82 L

2014-J-12

- $Sn(s) + CO(g) \rightarrow SnO(s) + C(s)$

  $2Al(s) + 3SnO(s) \rightarrow Al_2O_3(s) + 3Sn(s)$

  $C(s) + ZnO(s) \rightarrow CO(g) + Zn(s)$

  $Al_2O_3(s)$

2014-J-13

- Cu(s) produced at cathode: $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

  O_2(g) produced at anode: $2H_2O \rightarrow O_2(g) + 4H^+(aq) + 2e^-$

  $Cu^{2+}(aq) + 2H_2O(l) \rightarrow Cu(s) + O_2(g) + 4H^+(aq)$

  0.89 V

  At pH = 7, the $[H^+(aq)]$ is much less, so from Le Chatelier's principle the forward reaction will be favoured to produce more H^+(aq). Hence lower voltage would be required.

2014-J-14

- 0.031 M

  1.9×10^{10}

  –58 kJ mol^{-1}

2014-J-15

- $[Ni^{2+}(aq)]$ will reduce in the more concentrated solution and Ni(s) will be deposited on the electrode. Simultaneously, $[Ni^{2+}(aq)]$ will increase in the less concentrated solution and the Ni(s) electrode will dissolve.

  Entropy. The overall enthalpy change of the reaction is zero. Maximum entropy is reached when the concentrations of the two cells are equal.