

Chemistry 1Adv/ISSP (CHEM1901/1903) June 2014

2014-J-2

^{131}I has $Z = 53$ and $N = 78$ giving an N/Z ratio of 1.47. This ratio suggests that β^- will be the primary decay mechanism. This decay route will lower this ratio as it involves a neutron being converted into a proton and a β^- particle: N will decrease by 1 and Z will increase by 1.

$$1.00 \times 10^{-6} \text{ s}^{-1}$$

111 g

2014-J-3

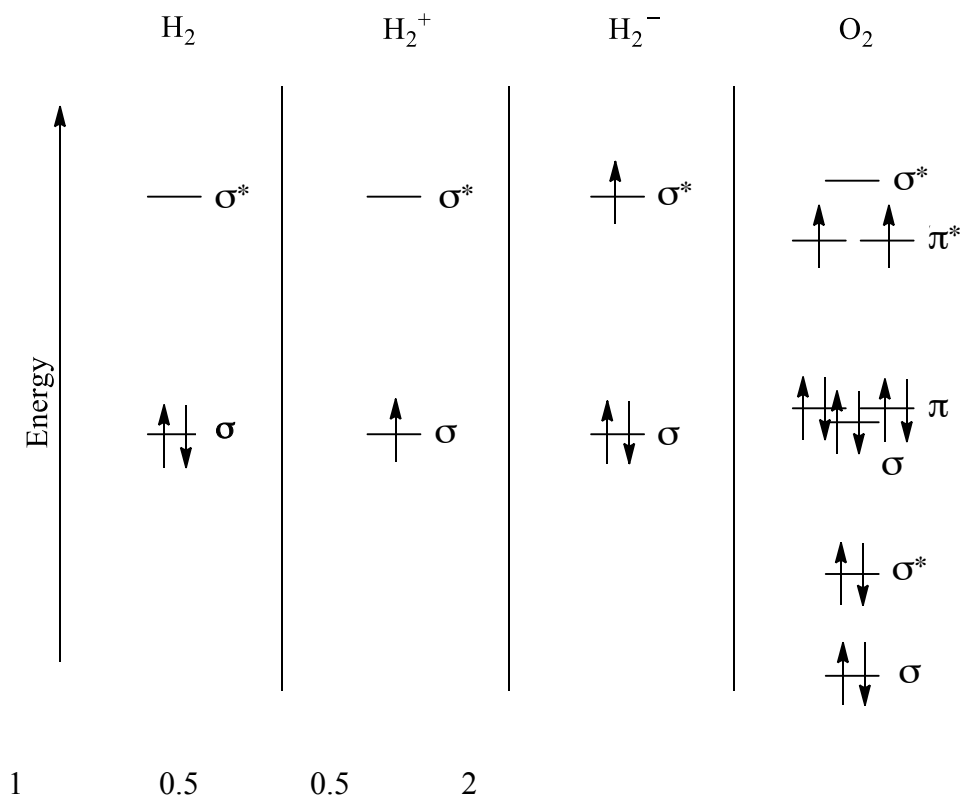
• ^{131}I : $3.80 \times 10^{-24} \text{ Bq}$

^{137}Cs : $1.27 \times 10^{16} \text{ Bq}$

• As a +1 ion, Cs^+ is chemically similar to Na^+ and K^+ . Cs^+ is larger than either of these ions. This will lead it to have higher coordination numbers: more anions will fit around it in ionic solids and more donor atoms (such as OH_2) will coordinate to it than can fit on Na^+ or K^+ .

2014-J-4

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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.

2013-J-5

- From $n = 12$ to $n = \infty$

Examples include:

- The diffraction of electron beams. Electrons can be diffracted just like light waves.
- The standing wave structure of atoms leading to atomic line spectra. Electrons can only exist in discrete orbits with certain energies, leading to absorption and emission at certain wavelengths rather than at every wavelength.

The more energy it takes to do break up the lattice, the higher the melting point will be.

- Br^- is bigger than Cl^- so KCl has a higher lattice energy and a higher melting point than KBr.
- K^+ is larger than Na^+ so NaCl has a higher lattice energy and a higher melting point than KCl.

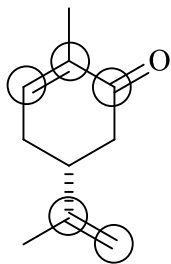
When the relative electronegativity of the anion and cation are very different as in NaCl and KCl, the bonding is predominately ionic. Melting the solid requires breaking up the ionic lattice with its strong and long distance interactions. Ag^+ is much less electronegative than Na^+ and K^+ , AgCl is much less ionic than NaCl and KCl. There is considerable ionic character to the bonding in AgCl.

2013-J-6

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	109.5°	tetrahedral
	$90^\circ, 120^\circ$ and 180°	‘see-saw’
	90° and 180°	‘T-shaped’
	$90^\circ, 180^\circ$	T-shaped

2014-J-7



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-8

- 2.3×10^{-4}
 2.4×10^{-3}

2014-J-9

- 1.11 atm

2014-J-10

- CH₃D will adopt the same crystal structure as CH₄ as there is no difference in its shape or size. The relative position of the D atom in neighbouring molecules, however, will be completely random as there will minimal energy difference between them. A crystal of CH₃D will not be perfect even at absolute zero.

The overall process occurring is to equalise the concentrations:

- In the beaker containing 0.002 M NiCl₂, oxidation of Ni(s) will occur to produce Ni²⁺(aq) ions. This will increase [Ni²⁺(aq)] in this beaker.
- The electrons from this oxidation will flow through the wire to the electrode in the second beaker.
- In this second beaker containing 1 M NiCl₂, reduction of Ni²⁺(aq) will occur. This will decrease [Ni²⁺(aq)].

The cell will continue to operate until the concentrations have equalised.

There is enthalpy change in this process: the standard electrode potential is zero. The process is driven entirely by entropy: it is unfavourable for the concentration difference to be present.

2014-J-11

- Fe₂O₃: reduction to produce CO and to produce CO₂ are both possible.
Li₂O: reduction by C will not occur.

2014-J-12

- 0 V
 $[\text{Cd}^{2+}(\text{aq})] = 1.30 \text{ M}$ $[\text{Ag}^{+}(\text{aq})] = 2.6 \times 10^{-21} \text{ M}$

2014-J-13

- Ionic bonds.
The structure contains channels through which the Li^{+} ions can diffuse. When Li^{+} is removed, the oxidation of Mn increases to ensure that charge balance is maintained.
The Li^{+} ions can occupy ('intercalate') the space between the layers of carbon atoms that make up graphite. For every Li^{+} that is incorporated, an electron is transferred onto the carbon atoms and is delocalised over the sheets.

2014-J-14

- $\text{Li}_{1-x}\text{Mn}_2\text{O}_4 + x\text{Li}^{+} + xe^{-} \rightarrow \text{LiMn}_2\text{O}_4(\text{s})$
 $\text{Li}_x\text{C}_6 \rightarrow x\text{Li}^{+} + xe^{-} + \text{C}_6$
 $\text{Li}_{1-x}\text{Mn}_2\text{O}_4 + \text{Li}_x\text{C}_6 \rightarrow \text{LiMn}_2\text{O}_4(\text{s}) + \text{C}_6$

Na is heavier than Li: the batteries will need to be heavier.

Na^{+} is larger than Li^{+} so the diffusion of the ions will be slower: the rate at which the battery discharges and recharges will be slower.

Na is more reactive: there are safety and stability considerations due to reactions with water for example.