CHEMISTRY 1A (CHEM1101) - November 2014

These answers have not been checked.

2014-N-2

- Spherical nodes = 2. Nodal planes = 1.

  $l = 3$, $m_l = -1, 0$ or 1 and $m_s = ½$ or $-½$

- The size of the cations and anions: the smaller the ions are, the higher the lattice energy.

  The charges on the cations and anions: the higher the charges on the ions, the higher the lattice energy.

  The crystal structure: broadly, the higher the number of anions around each cation (and vice versa), the higher the lattice energy.n

2014-N-3

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Si	[Ne] $(3s)^2$ $(3p)^2$	Si^-	[Ne] $(3s)^2$ $(3p)^3$
P	[Ne] $(3s)^2$ $(3p)^3$	P^-	[Ne] $(3s)^2$ $(3p)^4$
S	[Ne] $(3s)^2$ $(3p)^4$	S^-	[Ne] $(3s)^2$ $(3p)^5$

In order to form P^-, the extra electron must pair up with an existing electron in one of the *p*-orbitals. The extra repulsion involved leads to the electron affinity being lower for P than for Si despite the higher nuclear charge.

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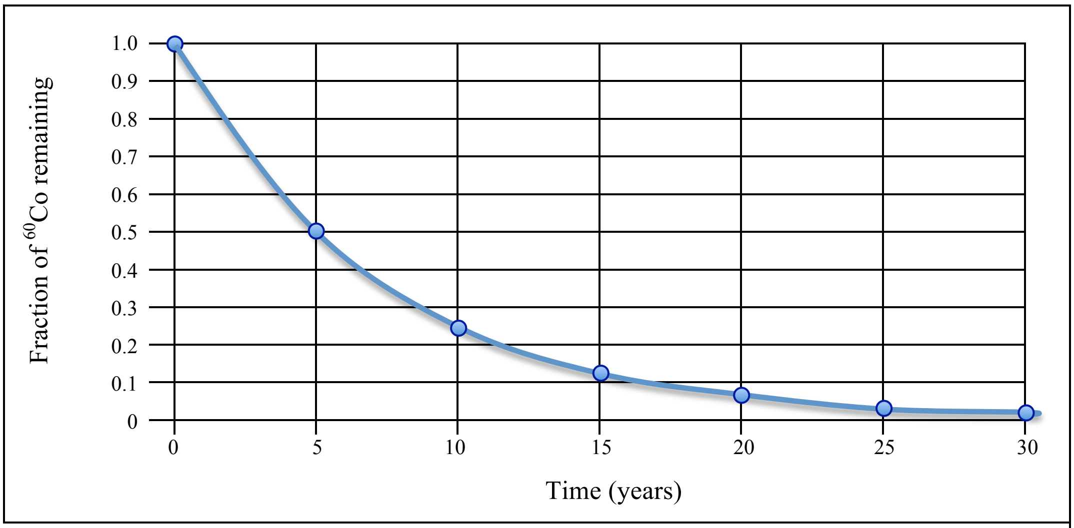
$Si^- < P^- < S^-$: The nuclear charge increase along the series so the electron affinities will increases: $Si^- < P^- < S^-$. The electron affinity of Si^- will also be further decreased because addition of an electron requires pairing again. However, this will not affect the order as Si^- is already has the lowest electron affinity. The electron affinities of these anions will be much lower than those of the parent atoms, as adding an electron to an already negatively charged species is much less favourable.

2014-N-4

- $^{60}_{27}\mathrm{Co} \rightarrow {}^{60}_{28}\mathrm{Ni} + {}^{0}_{-1}e$

  4×10^{-9} s^{-1}

  3×10^{15} Bq mol^{-1}



~ 0.2

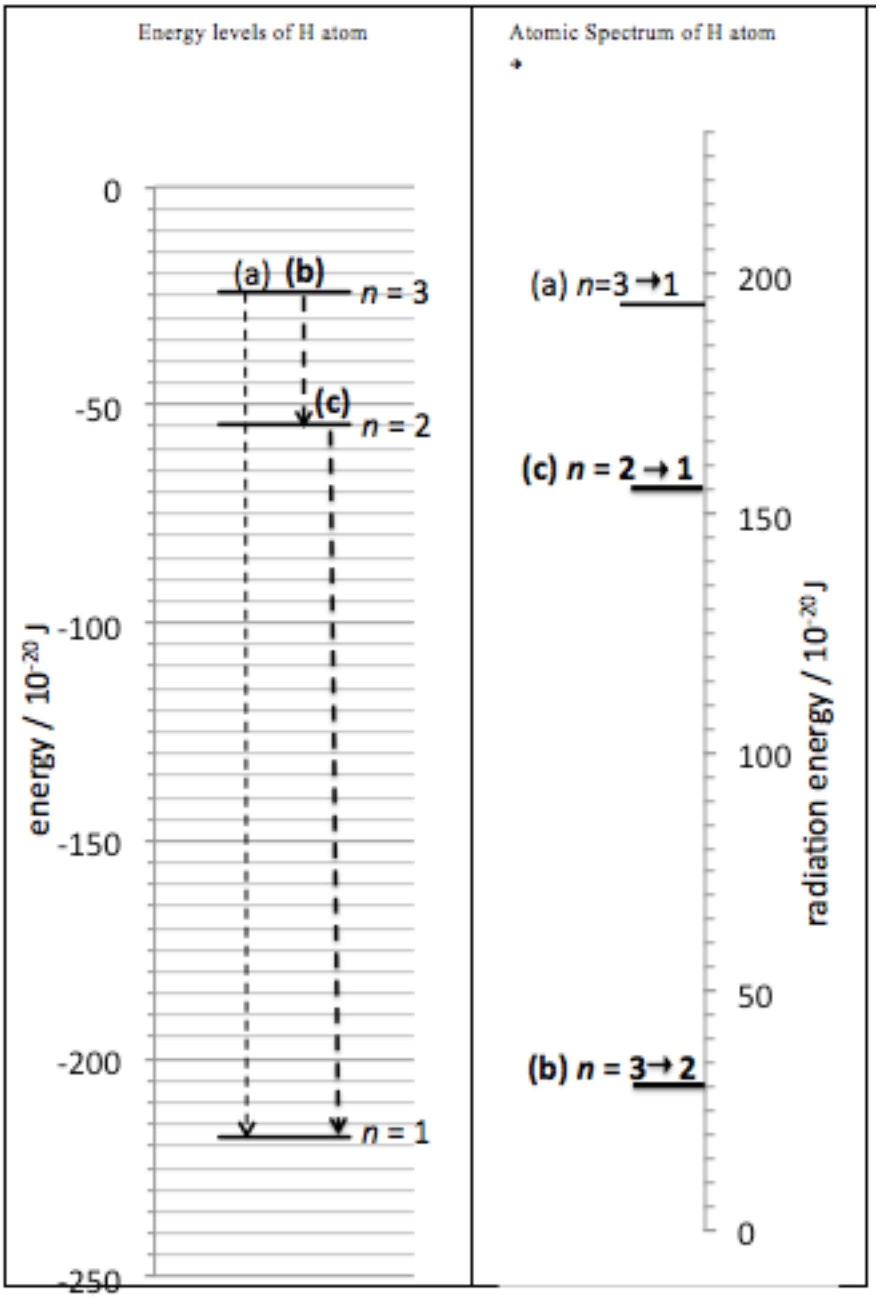
2014-N-5 and 2014-N-6

- See diagram below.

  (b) $n = 3 \rightarrow 2$: $\Delta E = 30.6 \times 10^{-20}$ J (c) $n = 2 \rightarrow 1$: ΔE 164×10^{-20} J

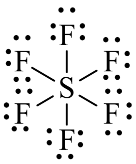
  Only transition (c) will occur in the visible. It will occur in the red / orange region.

  Shorter wavelength.

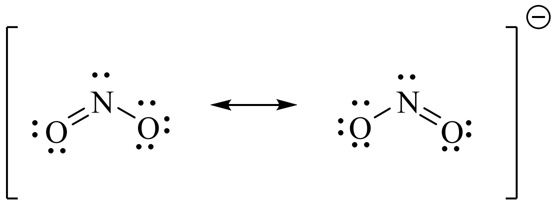


2014-N-7

- See below.



No



Yes

- Left: bent with H-bonding, dipole-dipole and dispersion forces.
  Right: tetrahedral with dipole-dipole and dispersion.
  The strong hydrogen bonding

2014-N-8

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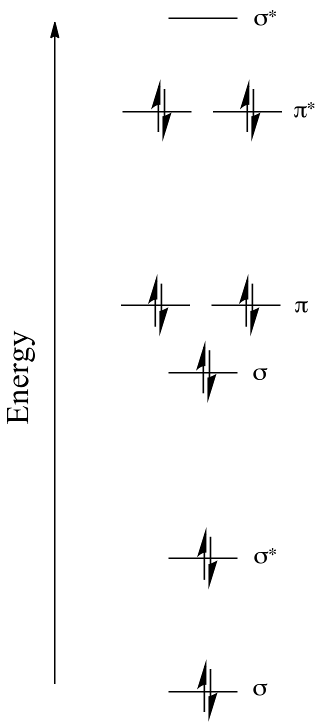
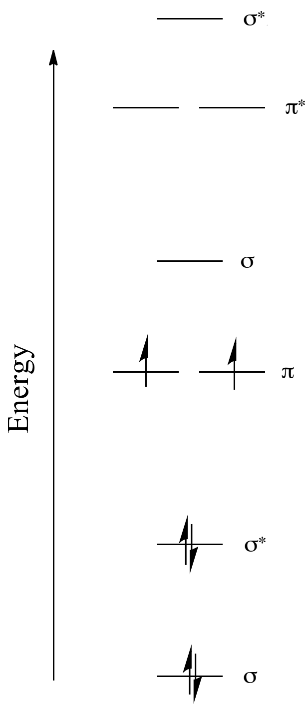


½ (8 – 6) = 1



½ (4 – 2) = 1

diamagnetic **paramagnetic**

2014-N-9

- 230 g

2014-N-10

- 1.2×10^{29}
- Freezing is an exothermic process: heat is given out to the surroundings. This increases the entropy in the surroundings. If the temperature is low enough, the entropy gain in the surroundings more than offsets the loss in the system.

2014-N-11

- -1409.1 kJ mol^{-1}

  470 L

  The volume of the liquid is tiny compared to that of the gases.

2014-N-12

- $K_p = \frac{P_{CO}P_{Cl_2}}{P_{COCl_2}}$

  5.98×10^{-13}

  $Q_p = \frac{(0.50)(0.01)}{(1.00)^2} = 0.005$. As $Q_p > K_p$, the reaction will proceed towards reactants.

2014-N-13

- No reaction

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

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

  Al_2O_3

2014-N-14

- 0.023 M

  4.2×10^{19}

  -110 kJ mol^{-1}

2014-N-15

- anode: $Cl_2(g)$; cathode: $H_2(g) + OH^-(aq)$

  $2H_2O(l) + 2Cl^-(aq) \rightarrow Cl_2(g) + H_2(g) + 2OH^-(aq)$

  2.19 V

  RuO_2 acts as a catalyst.

2014-N-16

- +0.059 V

Current will flow with the reduction and oxidation reactions above occurring until the concentrations are equal.