CHEMISTRY 1A (CHEM1101) - November 2013

These answers have not been checked.

2013-N-2

- cadmium
- $1s^2\ 2s^2\ 2p^6\ 3s^1$ Ne has a noble gas configuration. The extra electron needs to go into the 3*s* orbital which is higher in energy.

  $1s^2\ 2s^2\ 2p^4$ N has all 3 electrons in different *p* orbitals with parallel spins. Adding an extra electrons forces one of these electrons to become paired which is a higher energy situation.

2013-N-3

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

$^{238}_{92}\mathrm{U}$

- The negatively charged electron is attracted to the positively charged nucleus. The electron behaves like a standing wave (a matter wave) and as it approaches the nucleus it becomes more confined (or localised) and its wavelength decreases. As shown by the de Broglie equation ($\lambda = h/m\upsilon$), as the wavelength of a matter wave decreases, its momentum (and hence kinetic energy) increases. Its final location is a balance between its potential energy (*i.e.* attraction to the nucleus) and its kinetic energy.

2013-N-4

- (b) is $n = 4 \rightarrow n = 2$

  (c) is $n = 3 \rightarrow n = 2$

  434 nm

2013-N-5

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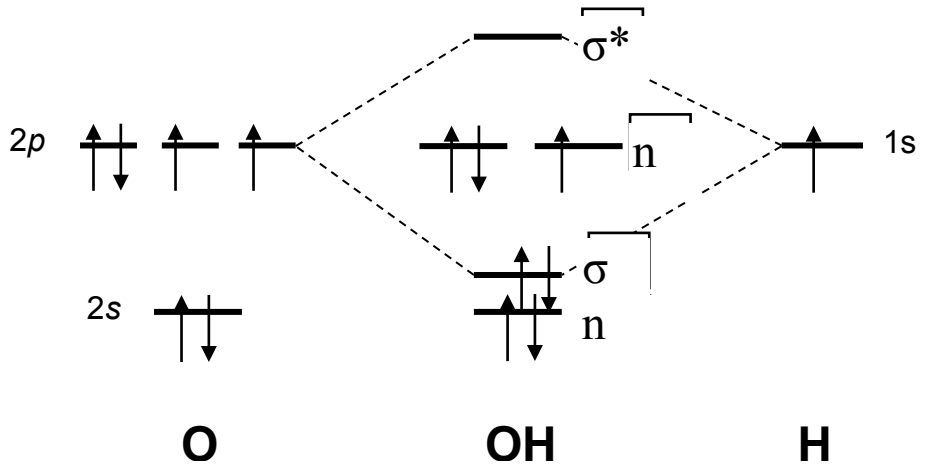

1

It has an unpaired electron in a non-bonding orbital. This electron is found in the n orbital on the above MO diagram.

2013-N-6

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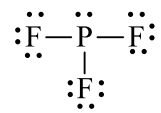
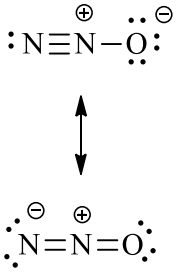


trigonal pyramidal

Yes



linear

Yes

2013-N-7

• The optimal n:p ration increases as *Z* increases. Splitting a large nucleus in two will almost certainly produce nuclides with similar n:p ratios to the parent, which will now be too high. They will emit negative charge to convert neutrons to protons, bringing about a more satisfactory n:p ratio. *i.e.* they will be β emitters.

3.19×10^{12} Bq g^{-1}

2013-N-8

• Water has hydrogen bonds, so has the highest boiling point. All the others just have dispersion forces, so the number of electrons and the surface area determine the overall magnitude of the dispersion forces. Ethane is smallest molecule, so has lowest b.p. Butane is a longer molecule than 2-methylpropane (which has a spherical shape). Butane is better able to entangle with other butane molecules and has larger contact surface area, so its b.p. is greater than that of 2-methylpropane.

2013-N-9

• 78 °C

2013-N-10

• 2.37 mol

3.57×10^4 kJ mol^{-1}

$C_{30}H_{62}(s) + 45.5O_2(g) \rightarrow 30CO_2(g) + 31H_2O(g)$ or

$2C_{30}H_{62}(s) + 91O_2(g) \rightarrow 60CO_2(g) + 62H_2O(g)$

For $CO_2(g)$: 1608 kJ mol^{-1} For $H_2O(g)$: 926 kJ mol^{-1}

2013-N-11

-1.86×10^4 kJ mol^{-1}

4.40×10^4 kJ

2013-N-12

- $K_p = \dfrac{p(Cl_2)p(CO)}{p(COCl_2)}$

  5.98×10^{-13}

  to the left (reactants)

2013-N-13

1.23×10^{-12} atm

2013-N-14

- Mg is much more electropositive than Zn, so MgO is more ionic in character than ZnO. As the electrons in Mg are more readily given up than those of Zn, the K_p of formation for MgO will be higher than that of ZnO. This can be confirmed from the table of electrode reduction potentials on the data page:

  $Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$ $\quad E° = –0.76$ V

  $Mg^{2+}(aq) + 2e^- \rightarrow Mg(s)$ $\quad E° = –2.36$ V

  Conversely, it should require less energy (and hence lower temperature) to convert ZnO into Zn and $O_2(g)$.

- $IO_3^-(aq) + 6H^+(aq) + 5I^-(aq) \rightarrow 3I_2(aq) + 3H_2O(l)$

2013-N-15

- 3.04 V

  2.68 V

  E_{cell} will decrease.

  E_{cell} will increase.