2010-N-2
* An additional electron in Be will have to go into a $2p$ orbital, which has a planar node through the nucleus and thus does not feel nuclear charge. Consequently this leads to a higher energy system. In F, the high nuclear charge and small atom offset the above effect and the extra electron is tightly bound.

    The electron removed from O ($1s^2\ 2s^2\ 2p^4$) is the one in the $2p$ orbital with 2 electrons in it. This electronic repulsion offsets the greater nuclear charge of O compared to N.

    The electron affinity of N is ΔH for the process $2p^3 \rightarrow 2p^4$.
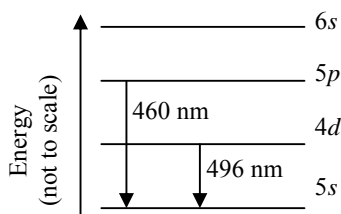   The ionisation potential for O is ΔH for the process $2p^4 \rightarrow 2p^3$.
    The only difference (apart from the direction of the reaction) is the nuclear charge on the atom.

2010-N-3
* $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2$

    No. 460 nm radiation is blue.

    0.20 eV (0.196 eV)

    The $5s$ orbital feels the nuclear charge more than the $4d$ due to the nodes in the d orbitals at the nucleus. d orbitals are therefore more shielded from the nucleus than the $5s$ and are at higher energy.

    A spin up $5p$ electron cannot drop into a $5s$ orbital if a spin up electron is already there as this would violate the Pauli Exclusion principle. As there is no lower energy orbital available that it can drop into, the species is long-lived.
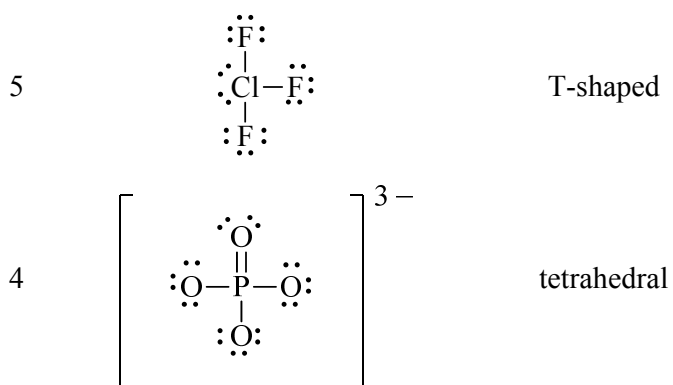
2010-N-4
* 1.02×10^{14} Bq
    86 years
    138 Ci g^{-1}

    Sr has similar electronic structure to Ca - both have s^2 valence shell configuration. The Sr^{2+} and Ca^{2+} cations have the same charge and are of similar size.

2010-N-5

-

:F:
|
:Cl—F:
|
:F:

5   T-shaped

$$\left[\begin{array}{c} \ddot{O} \\ \| \\ :\ddot{O}-P-\ddot{O}: \\ | \\ :\ddot{O}: \end{array} \right]^{3-}$$

4   tetrahedral

2010-N-6

- $C_{21}H_{30}O_2$
alkene
ether
109.5°
120°

2010-N-7

- $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
exothermic
−56 kJ mol^{-1}

2010-N-8

- left
  left
  right
  right
  no change
  right
- 2.0×10^2 g

2010-N-9

- 56

Reaction shifts to the right (towards products)

2010-N-10

- A reaction is at equilibrium when the rate of the forward reaction equals the rate of the backward reaction.

- $[Br_2(g)] = 0.095$ M $[Br_2(g)] = 0.095$ M $[BrClg)] = 0.25$ M

2010-N-11
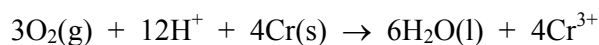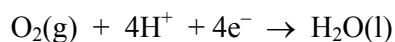
- $+228$ kJ mol^{-1}

2010-N-12

- 3.41 V

  E_{cell} decreases

  no effect

2010-N-13

- $Ni^{2+} + 2e^- \rightarrow Ni(s)$

  $Sc(s) \rightarrow Sc^{3+} + 3e^-$

  $3Ni^{2+} + 2Sc(s) \rightarrow 3Ni(s) + 2Sc^{3+}$

  $O_2(g) + 4H^+ + 4e^- \rightarrow H_2O(l)$

  $Cr(s) \rightarrow Cr^{3+} + 3e^-$

  $3O_2(g) + 12H^+ + 4Cr(s) \rightarrow 6H_2O(l) + 4Cr^{3+}$

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

  $Fe^{2+} + 2e^- \rightarrow Fe(s)$ $E° = 0.44$ V

  The emf of the battery $E_{cell} = E_{ox} + E_{red}$. Replacing the Zn^{2+}/Zn electrode (anode) with a Fe^{2+}/Fe electrode would reduce the emf of the battery by about 0.32 V (assuming standard concentrations).