2.7: In-Text References

1. Species with unpaired electrons are called radicals or free radicals—they are typically highly reactive and are thought to be implicated in many processes involving cellular damage and aging. ↵
2. Fortunately there exist cellular mechanisms that can detect and repair (most) these kinds of radiation-induced mutations. ↵
3. http://nivea.psycho.univ paris5.fr/FeelingSupplements/AncientVisions.htm ↵
4. Other related molecules are found throughout the biological world, for more examples see http://www.ncbi.nlm.nih.gov/pubmed/3416013 ↵
5. http://phototroph.blogspot.com/2006/...n-spectra.html ↵
6. A video of various vibrations is here https://www.youtube.com/watch?v=iy-8rguvGnM ↵
7. Snakes can see in the infrared which allows them to hunt mammals. In contrast, an ability to see in the infrared would not generally help a mouse see a snake. Can you explain why? ↵
8. As the temperature of the object gets higher the energy of the electromagnetic radiation also increases, until it moves into the visible region. This is why very hot objects glow red and then white as they get even hotter. ↵
9. In addition to vibrational transitions, we can also investigate transitions from one rotational energy level to another which are associated with microwave radiation, leading to microwave spectroscopy. ↵
10. For animated versions of these modes see https://en.Wikipedia.org/wiki/Molecular_vibration ↵
11. In fact, for linear molecules the number of vibrational modes is $3\mathrm{N}-5$, and for non-linear molecules it is $3\mathrm{N}-6$, where $\mathrm{N}=$ the number of atoms in the molecule. Therefore, $\mathrm{CH4}$ has $5\times3-6=9$ possible vibrational modes, although they are not all IR active. ↵
12. Spectra are plotted as the % of light transmitted v wavenumber. The units of wavenumber are $1/\mathrm{cm}(\mathrm{cm}-1)$, which, if you think about it, are directly related to the frequency of the light (remember that frequency $\times$ wavelength = constant (the speed of light). So units of 1/wavelength are in fact directly related to the frequency. ↵
13. The vibrations of a molecule can be modeled by thinking of the bonds as springs, and using Hooke's Law which states that the vibrational frequency is proportional to the bond strength, and inversely proportional to the masses of the atoms in the bond. Therefore, the smaller the masses, the higher the vibrational frequency ↵
14. Although it is true that all functional group behavior is affected by the local chemical environment, it is usually possible to predict how this will affect the properties of the functional group. ↵
15. This spin arises from the sum of the spins of their component parts, protons and neutrons, which in turn arise from the sum of their component quarks. ↵
16. In contrast, more energetic electromagnetic radiation, such as microwaves, are absorbed by water; when absorbed they are converted into kinetic energy, and heat the sample—something that would quickly damage (and kill) living tissue. ↵
17. The Earth's magnetic field ranges from $25-60\times10^{-6}$ Tesla ↵
18. Although some types of $\mathrm{C}-13$ NMR spectroscopy can tell us about connectivity it is too complex to discuss here. ↵
19. Some of the $\mathrm{C}-13$ nuclei take much longer to relax back to the lower spin state than others (and the energy that is emitted is what is recorded), so it is not really feasible to integrate the peaks. ↵