30 Light Emission

Solutions to Chapter 30 Exercises

1. In accord with $E = hf$, a gamma ray photon has a higher energy because it has a higher frequency.

3. Higher-frequency higher-energy blue light corresponds to a greater change of energy in the atom.

4. More energy is associated with each photon of ultraviolet light than with a photon of visible light. The higher-energy ultraviolet photon can cause sunburn-producing chemical changes in the skin that a visible photon cannot.

15. In accord with $E \sim f$, the higher frequency ultraviolet photon has more energy than a photon in the visible part of the spectrum, which in turn has more energy than a photon in the infrared part of the spectrum.

18. When tungsten atoms are close-packed in a solid, the otherwise well-defined energy levels of outer electron shells are smeared by mutual interactions among neighboring atoms. The result of this close packing is an energy band composed of myriad separate levels very close together. Because there are about as many of these separate levels as there are atoms in the crystalline structure, the band cannot be distinguished from a continuous spread of energies.

19 The many spectral lines from the element hydrogen are the result of the many energy states the single electron can occupy when excited.

41. The metal is glowing at all temperatures, whether we can see the glow or not. As its temperature is increased, the glow reaches the visible part of the spectrum and is visible to human eyes. Light of the lowest energy per photon is red. So the heated metal passes from infra-red (which we can’t see) to visible red. It is red hot.

45. An incandescent source that peaks in the green part of the visible spectrum will also emit reds and blues, which would overlap to appear white. Our Sun is a good example. For green light and only green light to be emitted, we would have some other kind of a source, such as a laser, not an incandescent source. So “green-hot” stars are white.

Chapter 30 Problem Solution

1. (a) The B-to-A transition has twice the energy and twice the frequency of the C-to-B transition. Therefore it will have half the wavelength, or 300 nm. Reasoning: Since $c = f\lambda$, $\lambda = c/f$. Wavelength is inversely proportional to frequency. Twice the frequency means half the wavelength.
(b) The C-to-A transition has three times the energy and three times the frequency of the C-to-B transition. Therefore it will have one-third the wavelength, or 200 nm.