

1. K&K, chapter 8, problem 2. In this problem you are asked to consider a refrigerator whose energy is a heat source. Sounds a bit counter-intuitive doesn't it! But consider, with the appropriate reversible engines/refrigerators you could use the engine to extract heat from the reservoir hh (provided by the flame) do work and deliver waste heat to the reservoir h (room temperature). Then you could use the work you just obtained to run a refrigerator extracting heat from the low temperature reservoir l (the cold part of the refrigerator) and dumping heat in the reservoir h . Perhaps there is a way to do it without explicitly going to the trouble of producing mechanical work. One way is described in M. W. Zemansky, 1957, *Heat and Thermodynamics, 4th ed.*, (New York: McGraw Hill), pp. 235-7. Note that you don't actually need to know a physical implementation to work this problem!
2. K&K, chapter 8, problem 7. (In addition to a simple yes or no answer, please explain!)
3. K&K, chapter 8, problem 9.
4. K&K, chapter 9, problem 1. Note that the third law of thermodynamics is discussed by K&K at the end of chapter 2.
5. K&K, chapter 9, problem 4.
6. The corona of the Sun is very hot, much hotter than the surface of the Sun. (The corona can be seen during total eclipses of the Sun.) Since it is so hot, it contains many highly ionized atoms. In particular, lines from Ca XIII (12 times ionized calcium) and Ca XV (14 times ionized) are seen. The ionization potentials of these ions are 655 and 814 eV, respectively. The lines of Ca XIII are much stronger than the lines of Ca XV. Use this fact to **estimate** (order of magnitude!) the temperature of the corona. The ionization potential is the energy required to remove another electron from the ion. Note that Ca XV is an astronomical convention. The chemical symbol followed by a Roman numeral indicates the ionization state of the atom. Since the Romans never invented zero, the neutral atom is designated by I, the single ionized atom by II, etc. This problem comes from M. Harwit, *Astrophysical Concepts*, 1973, Wiley, p. 144.
7. K&K, chapter 10, problem 1.