3-16. Find the temperature of a blackbody if its spectrum has its peak at (*a*) $\lambda_m = 700$ nm (visible), (*b*) $\lambda_m = 3$ cm (microwave region), and (*c*) $\lambda_m = 3$ m (FM radio waves).

3-17. If the absolute temperature of a blackbody is doubled, by what factor is the total emitted power increased?

3-18. Calculate the average energy $\overline{E}$ per mode of oscillation for (*a*) a long wavelength $\lambda = 10\, hc/kT$, (*b*) a short wavelength $\lambda = 0.1\, hc/kT$, and compare your results with the classical prediction kT (see Equation 3-9). (The classical value comes from the equipartition theorem discussed in Chapter 8.)

3-19. A particular radiating cavity has the maximum of its spectra distribution of radiated power at a wavelength of 27.0 μm (in the infrared region of the spectrum). The temperature is then changed so that the total power radiated by the cavity doubles. (*a*) Compute the new temperature. (*b*) At what wavelength does the new spectral distribution have its maximum value?

3-20. A certain very bright star has an effective surface temperature of 20,000 K. (*a*) Assuming that it radiates as a blackbody, what is the wavelength at which $u(\lambda)$ is maximum? (*b*) In what part of the electromagnetic spectrum does the maximum lie?

3-21. The energy reaching Earth from the Sun at the top of the atmosphere is 1.36×10^3 W/m^2, called the *solar constant.* Assuming that Earth radiates like a blackbody at uniform temperature, what do you conclude is the equilibrium temperature of Earth?

3-22. A 40-W incandescent bulb radiates from a tungsten filament operating at 3300 K. Assuming that the bulb radiates like a blackbody, (*a*) what are the frequency f_m and the wavelength λ_m at the maximum of the spectral distribution? (*b*) If f_m is a good approximation of the average frequency of the photons emitted by the bulb, about how many photons is the bulb radiating per second? (*c*) If you are looking at the bulb from 5 m away, how many photons enter your eye per second? (The diameter of your pupil is about 5.0 mm.)