Problem Set 5:

Ch 22: 3 A friend summarizes the special theory of relativity by saying “Everything is relative.” Explain why this statement is inaccurate.

Ch 22: 46 What is the Schwarzschild radius of a black hole whose mass is that of (a) Earth, (b) the Sun, (c) the supermassive black hole in NGC 4261 (Section 22-5)? In each case also calculate what the density would be if the matter were spread uniformly throughout the volume of the event horizon.

Ch 24: 12 Why are Type Ia supernovae useful for finding distances to very remote galaxies? Are there any limitations on their use for this purpose?

Ch 24: 38 The average radial velocity of galaxies in the Hercules cluster pictured in Figure 24-18 is 10,800 km/s. (a) Using $H_0 = 73$ km/s/Mpc, find the distance to this cluster. Give your answer in megaparsecs and in light-years. (b) How would your answer to (a) differ if the Hubble constant had a smaller value? A larger value? Explain your answers.

Ch 26: 35 Estimate the age of the universe for a Hubble constant of (a) 50 km/s/Mpc, (b) 75 km/s/Mpc, and (c) 100 km/s/Mpc. On the basis of your answers, explain how the ages of globular clusters could be used to place a limit on the maximum value of the Hubble constant.

Ch 26: 38 Use Wien’s law (Section 5-4) to calculate the wavelength at which the cosmic microwave background ($T = 2.725$ K) is most intense.