

Problems from Bennett textbook, version 7:

Chapter 5: Light and Matter Problems 44, 47, 52

Chapter 6: Telescopes Problems 41, 43, 44, 45, 55 (a few paragraphs)

Optional problems using calculus.

For each of the following problems that you decide to do, you may omit two of the problems listed above. Please refer to Chapter 4 from Lissauer and de Pater's "Fundamental Planetary Science" for equation numbers referred to below. You can view or download the copyright-protected file of Chapter 4 from our eCommons website.

1) Write Planck's radiation law (eq. 4.3) in terms of wavelength  $\lambda$  rather than frequency  $\nu$ . Use your expression to derive equation (4.8),  $\lambda_{\max} = (2.9 \times 10^{-3})/T$ .

2) Derive equation (4.17) from the material in Section 4.1.3 of Lissauer and de Pater. Then answer the following questions:

During the ice ages, much more of the Earth's surface was covered in ice.

(a) Would that increase or decrease the Earth's albedo?

(b) Estimate a rough value for an "ice age" albedo for the Earth, and use it to compute the equilibrium temperature for the planet. How does it compare with today's temperature. Express both the "ice age" temperature and today's temperature in both the Celsius and Kelvin scales.

(c) Thinking about the solar energy balance, would temperature changes tend to be stable or unstable? In other words, if Earth's temperature decreased a bit, would you expect it to return to its previous value, or to decrease still further?