Study Guide Questions (March-23, 2010)
Peixoto, J.P. and A.H. Oort, 1992: Physics of Climate, Chapter 6, Springer, New York.

1. What does the dispersion relation of an electromagnetic wave traveling in air tell you?
2. How can you derive the Stefan-Boltzmann Law (intensity $\propto T^4$) from Planck's Law?
3. How can you derive Wien's Law ($\lambda_{max} \propto T^{-1}$) from Planck's Law?
4. What happens if the emissivity does not equal the absorptivity at one wavelength?
5. Why would you disagree with the statement that the optical depth of the atmosphere during a rainy day can approach 20 m?
6. Which two gases absorb most of the harmful solar ultraviolet radiation?
7. Why do climate models presently try to include "black carbon" which is soot particles from wood or unclean burning of fossil fuels?
8. Does "back carbon" scatter radiation $\propto \lambda^{-4}$ or according to λ^{-1}? You can assume that soot is like another aerosol for whose particle size $D \sim \lambda$.
9. Why does fog appear white or grey?
10. Why does the Atlantic Ocean water off Delaware appear greenish?
11. Why does the Arctic Ocean water in Nares Strait appear black?
12. Why are clouds such effective absorbers of terrestrial radiation which has its maximum intensity at (long) infrared wavelengths?
13. What is albedo?
14. Why is the albedo of a dense tropical forest larger than the albedo of fresh snow?
15. Does albedo depend on the frequency or wavelength of the incoming radiation?
16. Which physical law best explains the (true) statement that "… All bodies above 0 K emit energy whose quality (in terms of its frequency or wavelength) depend on their temperature …?"
17. How does the above statement conform or clash with the statement that emissivity equals absorptivity
18. What are the emissivities of land, water, and vegetation? Do they vary as a function of wavelength?
19. What is the most broad-banded (narrow-banded) MODIS band, that is, the band that averages reflectance over the largest (smallest) range of wavelengths?
20. What are the principal differences between solar and terrestrial radiation with regard to their spectral distribution $B(\lambda, T)$ and their directionalities?
21. How does the radiation balance of the atmosphere vary from day to night and what is the role of clouds in this balance?
22. How does the radiation balance at the earth's surface vary from day to night what is the role of clouds in the balance?
23. Why do we need to consider different wavelengths when considering the global radiation balance?