Terms and Concepts (through Week 4) ATMS 211 January 2011

1. weather vs. climate
2. temperature vs. temperature anomaly
3. surface temperature record: magnitude of changes over last century
4. seasonal cycle, diurnal cycle
5. anomaly, interannual variation, trend
6. Gaia hypothesis
7. Daisyworld
8. Feedback loops – negative, positive
9. energy, conversion of energy, conservation of energy
10. calories, Joules, Watts
11. temperature scales: Kelvin, Celsius, Fahrenheit
12. radiation energy spectrum: shortwave (UV, visible, near-IR), longwave (thermal IR)
13. the Sun: solar luminosity, solar constant, sunspot cycle
14. Inverse square law (radiation and distance from Sun)
15. emission of radiation: hotter objects emit at shorter wavelengths
16. Stefan-Boltzmann law: emission is proportional to the fourth power of temperature
17. albedo (surface albedo, cloud albedo, planetary albedo)
18. planetary radiation balance
19. effective temperature
20. effective radiating level
21. atmospheric molecules: O_2, N_2, H_2O, CO_2, O_3; their abundances, their vertical distributions, their absorption properties for shortwave and longwave radiation

21a. Mars-Venus-Earth comparison

22. troposphere vs. stratosphere
23. greenhouse effect: requires longwave absorptance greater than shortwave absorptance; results in surface temperature warmer than effective temperature.
24. radiative forcing
25. climate sensitivity = temperature response / radiative forcing
26. why high clouds warm the earth and low clouds cool the earth
27. why clouds cause cooling in the day and warming at night
28. geometry of Earth-Sun relation: eccentricity, tilt, declination, solstice, equinox, aphelion, perihelion
29. solar zenith angle

30. radiation received on a surface: the cosine law

Will be covered in Week 5:

31. atmospheric circulation driven by pressure differences, which are in turn driven by temperature differences
32. Hadley Cells, ITCZ, locations of deserts, timing of wet and dry seasons
33. water: molecular structure, hydrogen bonds, latent heat, density, vapor pressure

Sample questions for midterm exam.

Explain how the "greenhouse effect" works for a friend who has not taken an atmospheric sciences course. What is misleading about the use of the term "greenhouse effect"?

Describe the mean vertical temperature structure of earth's atmosphere and explain how the highs and lows of temperature are related to the absorption and emission of radiation.

Over an annual cycle, there is a net surplus in Earth's radiative budget near the equator and net deficits near the poles. How does the climate system balance the surplus and deficits?

Why does daily average incoming solar radiation have two maxima over the course of a year on the equator?

Why would there be no significant rise in sea level if sea ice were to melt?

As we continue to burn fossil fuels over the next century or two, do you think that loss of oxygen from the atmosphere is a major concern? Why or why not?

Explain why a cloudy day is cooler than a clear day, but a cloudy night is warmer than a clear night.

What is the latitude of the Tropic of Capricorn? When is the sun directly overhead there?

Identify:
Stefan-Boltzmann law
atmospheric window
sunspot cycle

Give approximate numerical values:
Average radiation (W m^{-2}) emitted by Earth to space
Wavelength of maximum emission, λ_{max}, for Sun and Earth
Average planetary albedo of Earth

What is the sign of the water-vapor feedback in climate? Explain how it works.

Why is summer hotter than winter?

You bring a pot of water to boil on the stove, then boil all the water away. Which takes longer, bringing the water to a boil, or boiling the water away? Why?

Sketch and explain the differences between the blackbody spectra for an airless planet whose temperature is 300K, the sun whose temperature is 6000K, and a nuclear explosion fireball, whose temperature is 1,000,000K.