Atmospheric Science 101, Spring 2003
Review Sheet for Midterm 1

1. What is the atmosphere mainly composed of? Which of its constituents absorb infrared radiation and which absorb ultraviolet? What is the greenhouse effect, and how does it work?

2. Why does pressure always decrease with height?

   Near sea level, the weight of air above us is 14.7 pounds per square inch (over one ton per square foot). This is equivalent to having a car parked on every square foot of the roof of a building. Why don't buildings have to be built to support this weight?

3. Why does temperature generally decrease with height in the troposphere and increase with height in the stratosphere? Be able to draw a temperature profile and to determine wind speed and direction from a wind barb.

4. What is an inversion?

5. Understand the roles of radiation, conduction, convection, and latent heat absorption and release in the transfer of heat in the atmosphere. See Demo 1. How effective is each process?

6. Which is hotter, a red star or a blue star? How do you know?
   Assuming both stars are the same size, which one emits the most intense radiation?

7. The sun primarily emits radiation in the ultraviolet, visible and near-infrared. What type of radiation is emitted by the Earth, and how does it differ from the radiation emitted by the sun?

8. How does surface albedo affect the amount of sunlight absorbed at the surface? How does it affect the surface absorption of infrared radiation emitted by the atmosphere? How does it affect the emission of infrared radiation by the surface? See Demo 2.

9. Describe the processes involved in transferring heat between the earth's surface and the atmosphere in relation to the overall earth-atmosphere radiative balance (i.e. the development of thermals, the role of evaporation/condensation, and the influence of clouds and greenhouse gases).

10. Why do clouds at different altitudes look different on an infrared satellite image?

11. Why do you feel cool after you run under a sprinkler, even if the water temperature is the same as the air temperature?

12. If the Earth's rotation slowed such that a day lasted 48 hours instead of 24 hours, how would the daily cycle of temperature change? How would the Coriolis force change? What other factors can influence the diurnal temperature range.

13. On a winter night, would frost be more likely to form on a car:

    If it is clear or if it is cloudy?

    If it is windy or if it is calm?

14. Which would be more likely to keep the nighttime temperature warmer, low clouds or high clouds?

15. Why is precipitation typically associated with low-pressure systems?

16. Why is the annual range of temperature typically smaller in Southern Hemisphere mid-latitudes than in Northern Hemisphere mid-latitudes?

17. How do we normally measure the environmental lapse rate? If an air parcel is lifted 1000 meters and cools at the dry-adiabatic lapse rate, where the environmental lapse rate is 8°C per kilometer, will it continue rising, or return to its original height?

18. If there is low pressure to the west and high pressure to the east, which direction does the pressure gradient force act on an air parcel?

19. Answer the questions based on the wind barb pictured below:

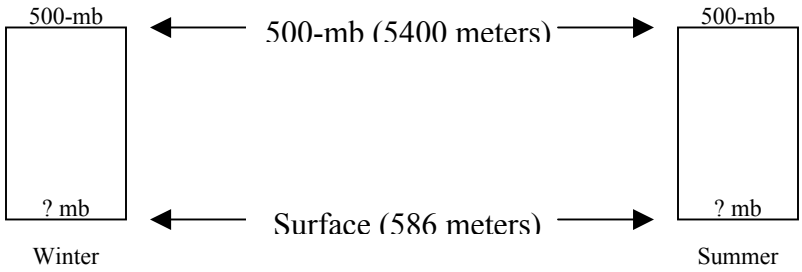
What direction is the wind?

What is the windspeed?

20. What do the values on a 500-millibar map show (i.e., what do the numbers on the chart represent)?

On some random day a 500-mb map shows heights of 5100 meters over Helsinki, Finland and 5320 meters over Athens, Greece. Is the <u>pressure at a height of 5200 meters</u> greater over Helsinki or over Athens?

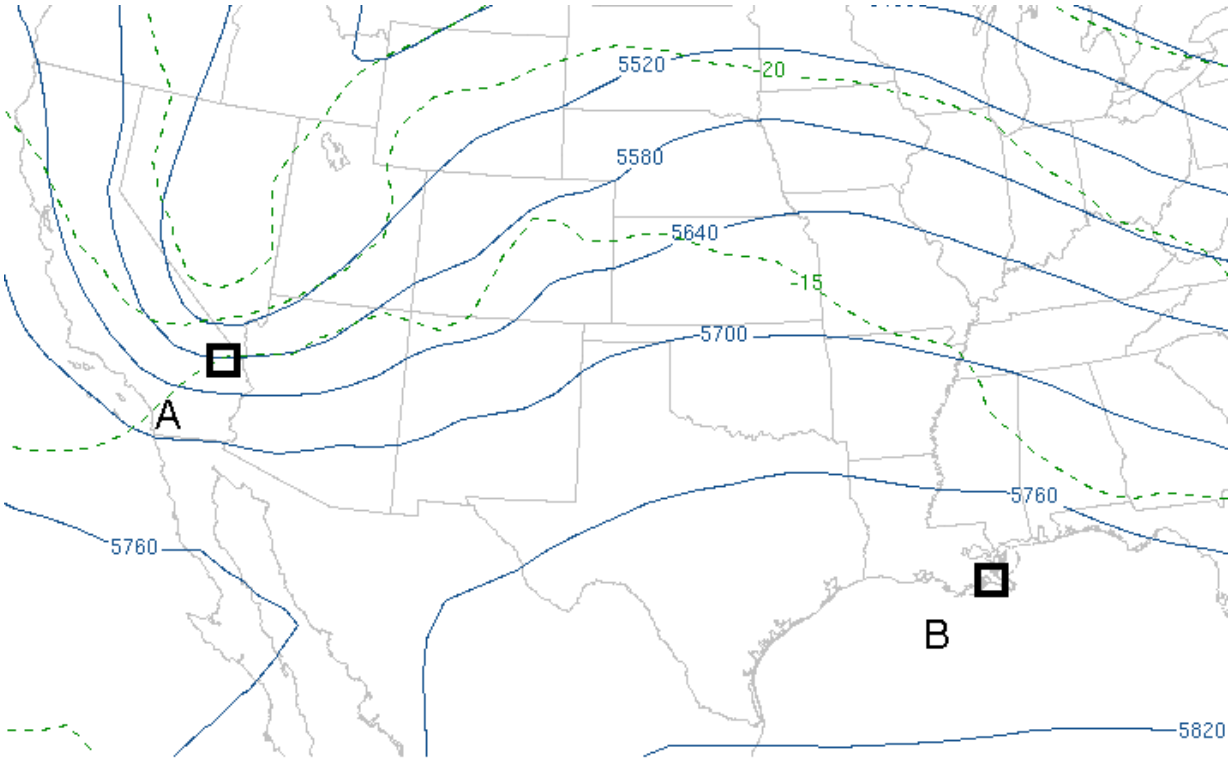
21. Suppose that on two days, one a cold winter day in January and the other a hot summer day in July, the values on 500-mb maps over Spokane are both 5400m.



Would the surface pressure be greater on the winter day or on the summer day? Why?

22. What are the forces that determine the wind direction at the surface and at 500mb? What is different at these levels and why?

23. The figure below shows the heights of the 500-mb pressure surface with the solid contours on February 2, 2003 over the US. (The dashed contours show temperatures on the 500-mb surface and may be ignored for this question.) Parcels of air at two locations are noted by squares and labeled. Use the map below to answer the following questions.



Around which air parcel (A or B) is the pressure gradient force the greatest?

Around which air parcel is the Coriolis force the greatest?

Around which air parcel is the geostrophic wind the greatest?

Sketch in and label the pressure gradient force, Coriolis force and geostrophic wind vectors at points A and B (with the tail ends of the vectors all beginning at the square and the arrowheads pointing outward from the square). Please draw to account for the relative magnitude of the force vectors and wind vectors (denoted by the length of the arrows) between air parcels A and B.

24. Describe the Hadley Circulation.

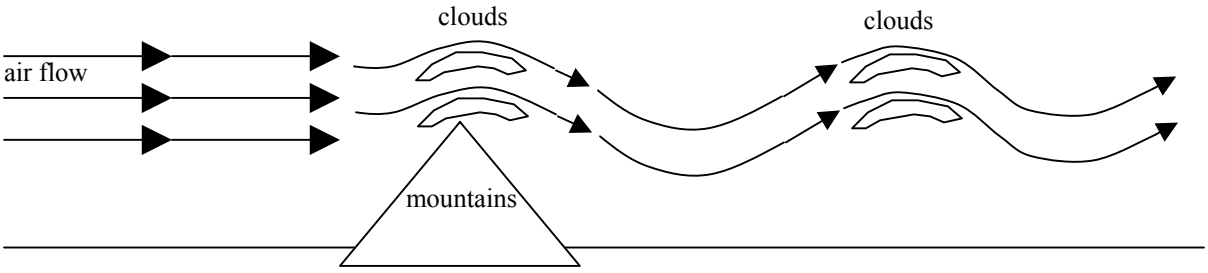
25. Why do land surfaces heat and cool differently than nearby bodies of water?

    How do these differences in heating and cooling of land and water cause land/sea breezes?

    Considering what causes sea breezes, would you expect a stronger sea breeze on an 85°F early summer day in coastal Texas where the sea surface temperatures of the adjacent Gulf of Mexico are 75-80°F or on an 85°F early summer day in coastal central California where the sea surface temperatures of the nearby Pacific Ocean are 55-60°F? Why?

    Describe how sea breezes influence summertime precipitation over the Florida peninsula.

26. If strong winds are blowing over a mountain peak (or more ideally a line of mountains) waves may form downstream. In such waves, parcels of air that are moving horizontally in the flow also move vertically up and down some distance away from their average height.



    Will such waves form in an environment that is stably or unstably stratified?