Name: _____ Section/TA: _____

Atmospheric Sciences 101, Spring 2003
Homework #2 - Due in section Thursday/Friday, 17/18 April 2003

1. Seasons:

a. When does the longest day of the year occur in Sydney, Australia?

The longest night of the year?

Equal hours of day and night?

On what day(s) does Sydney receive the most energy from the sun, assuming it is a clear day?

b. If you lived on the equator, when would the longest day of the year occur?

The longest night of the year?

When during the year would you expect the sun to be directly overhead at noon?

When would it be the closest to the horizon at noon?

On what day(s) would you receive the most energy from the sun, assuming it is a clear day?

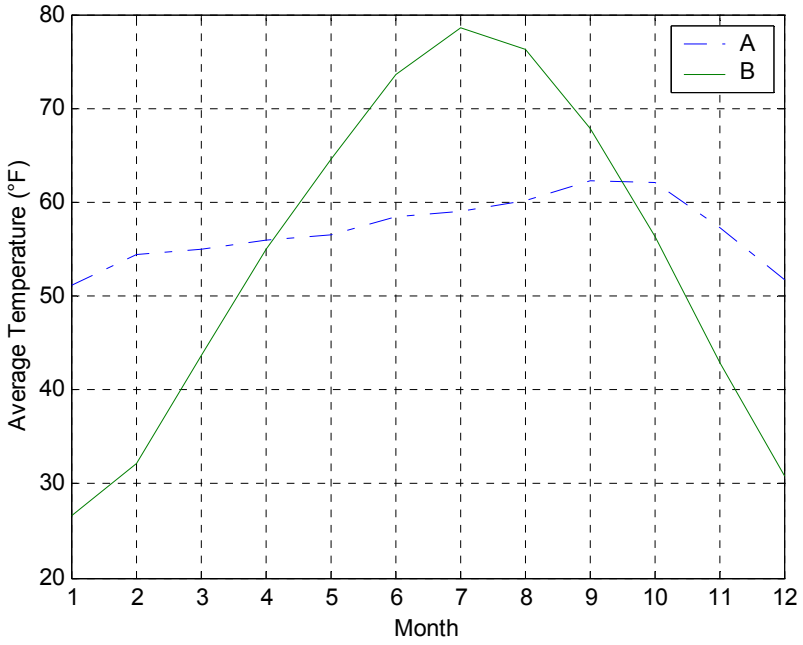
c. The angle of the Earth's tilt varies between about 22° and 24.5° over a period of 41,000 years. If, in 15,000 years, the Earths tilt is only 22°, would you expect Seattle to have warmer or cooler summers? Would we have warmer or cooler winters?

What about in New Zealand, would summers be warmer or cooler? Winters?

d. The plot below shows monthly mean temperatures at two different locations. Based on geographical characteristics that influence annual temperature variations, which curve do you think is from:

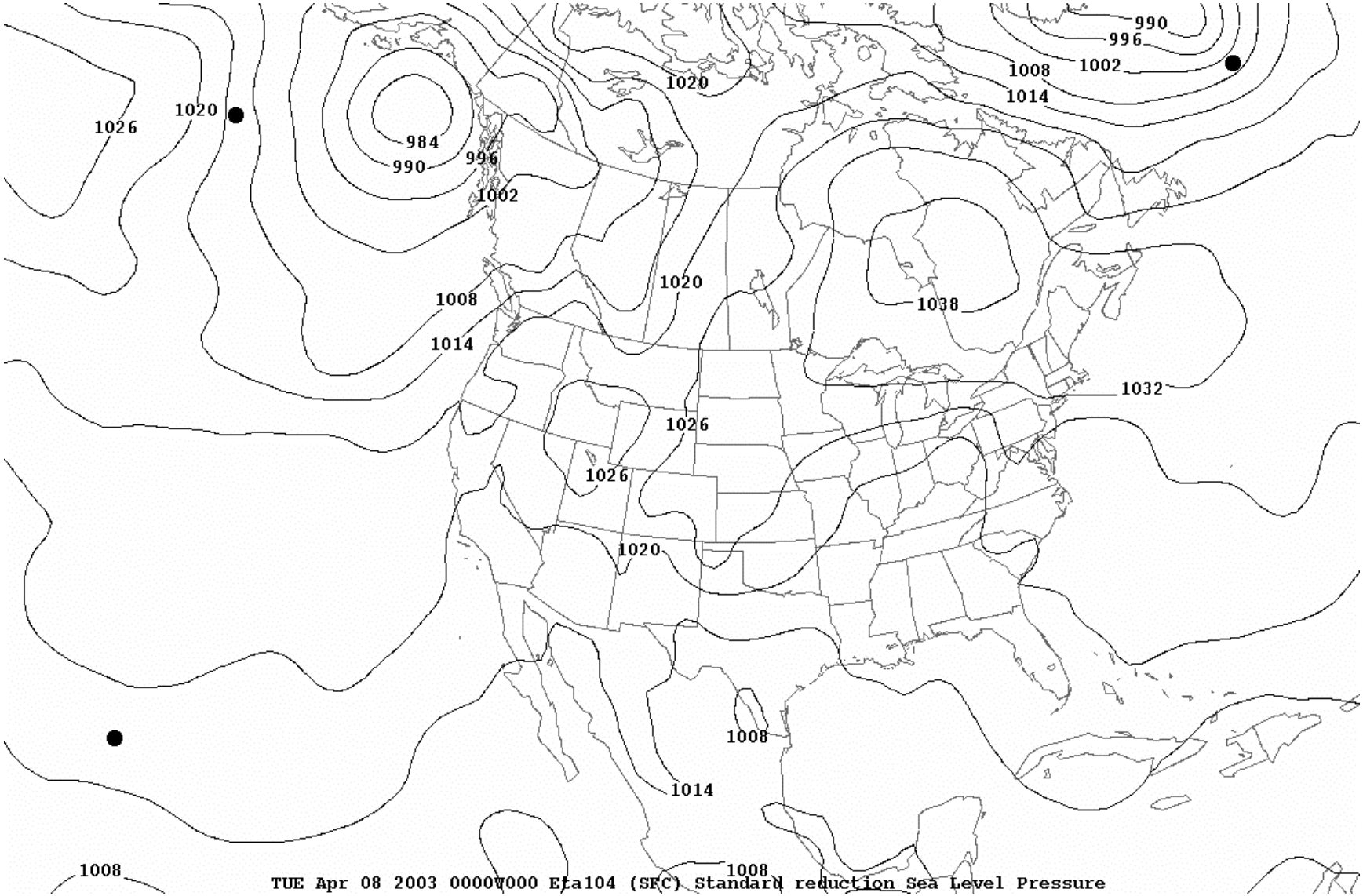
San Francisco, CA? _____ Topeka, KS? _____

Why?



2. The next page shows a sea-level pressure contour map of North America. What is the range of sea-level pressure that was observed over the continental United States?

On the map, label the locations of the highest and lowest pressure (with an H and an L, respectively). On each of the three dots, indicate the direction in which the pressure gradient force would accelerate an air parcel, with an arrow originating at the dot. Rank the magnitude (strength) of the pressure gradient force at each location by placing a 1 (strongest), 2, or 3 (weakest) next to the arrow.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TUE Apr 08 2003 0000V000 Eta104 (SFC) Standard reduction Sea Level Pressure

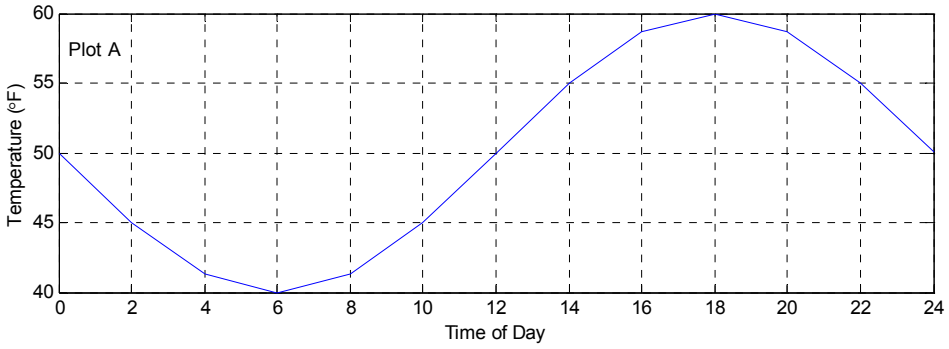
3. Consider the following temperature versus time plots showing the variation in air temperature for three different days during the month of April in Seattle. Which figure would best describe the diurnal temperature cycle during:

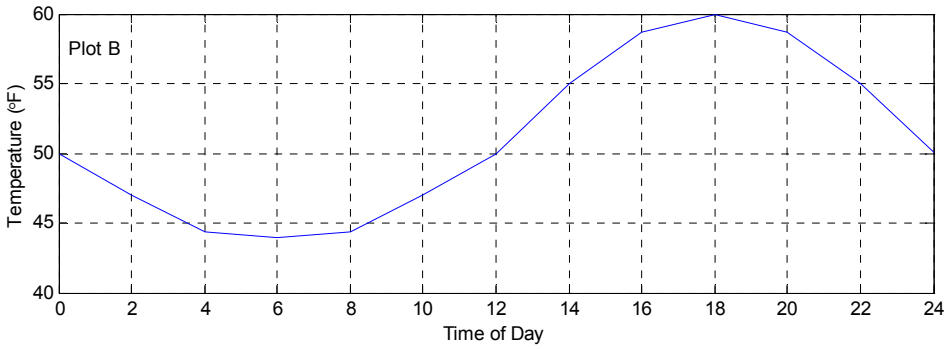
   a) a calm, cloudy day/night

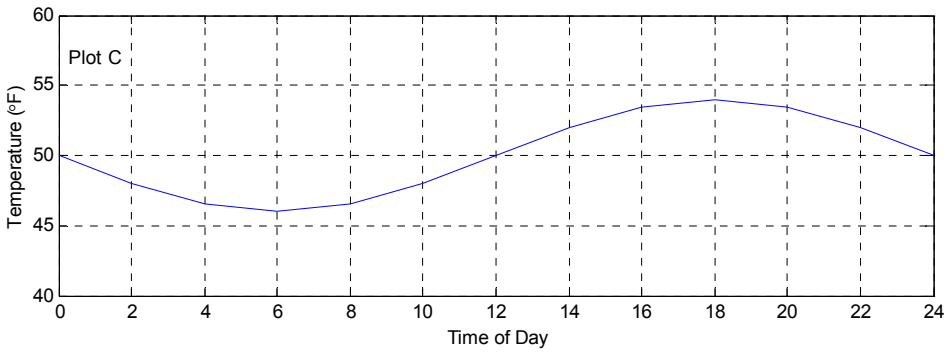
   b) a calm, clear (cloud free) day/night

   c) a windy, clear day/night

   Sunrise is at 6:00 a.m. and sunset is at 8:00 pm. Justify your answers.
   Note: Time is shown in 24-hour format: 0 = 12 midnight, 6 = 6 a.m., 12 = 12 noon, 18 = 6 p.m.







4. Compressibility and Lapse Rate

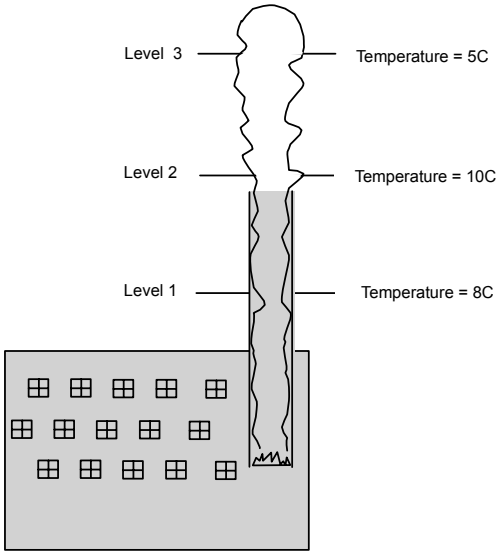
a. Julie finally gets two days off work, and decides to climb Mt. Rainier. She wakes up early on the second day at Camp Muir. While deciding how to dress for the summit, she notices the wind is blowing directly down from the top. Her watch thermometer shows that it is –15°C at her current elevation of 3000 m. If she assumes the air is descending adiabatically directly from the summit, what temperature should she expect it to be at the summit, which is at an elevation of 4400 m? Please show your work.

b. Upon reaching the summit, Julie realizes she is very thirsty, and finishes a bottle of Evian water. She then closes the bottle and returns it to her pack. That evening, when she unpacks her stuff in Seattle, she notices the bottle is crushed, even though it sat on the top of her pack. What crushed the bottle and why?

5. Billy Bob is walking down the street with friends when he noticed two adjacent factories ejecting emissions into the atmosphere. Having just read the section about air parcel stability in his 101 textbook, the friends are impressed by the deductions the student can make just from the character of the plumes.

Ignoring the influences of ambient air mixing into the plume, and assuming the character of the plume to be constant, answer the following (note that each indicated level is simply a level of the atmosphere):

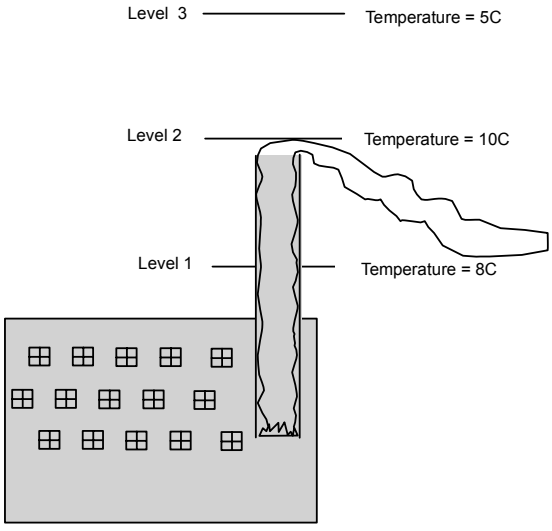
Factory A



For factory A, is the plume's temperature warmer or cooler than that of the ambient air? What leads you to your conclusion?

What can you deduce about the temperature of the emissions of Factory B compared to Factory A, i.e. Do they leave the smokestack at the same temperatures, or is one hotter/cooler than the other? Explain.

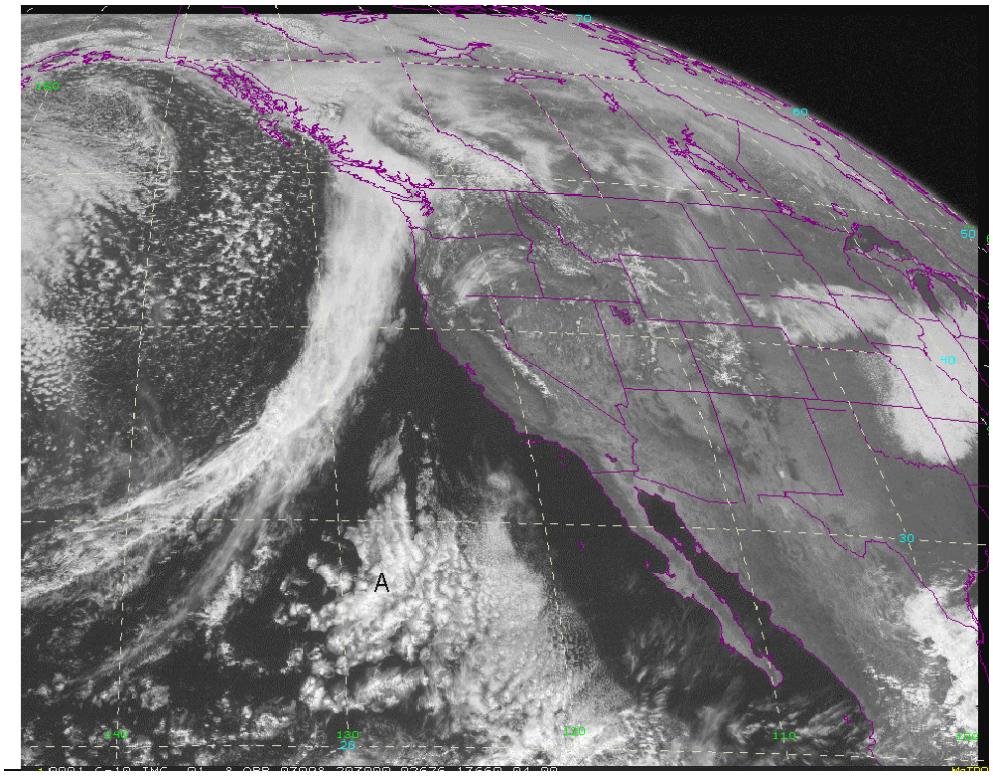
Factory B



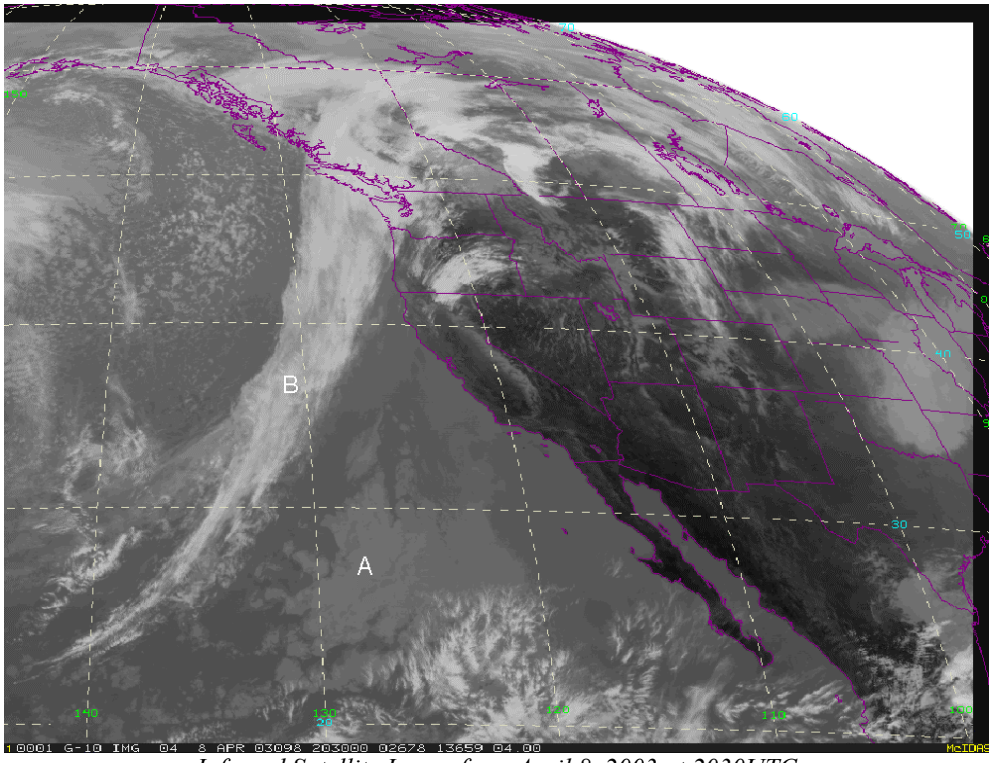
We notice that between level 1 and level 2, the ambient temperature warms with height. What do we call regions like this?

How might the owner of factory B ensure that the plume rises instead of falling?

6. Use the following Visible and Infrared Satellite Images from 1:30 p.m. April 8, 2003 to answer the questions below: (see section "Satellites and Weather Forecasting," beginning on page 233.)



Visible Satellite Image from April 8, 2003 at 2030UTC



Infrared Satellite Image from April 8, 2003 at 2030UTC

a. Why is the area around point A brighter in the visible image than the infrared image?

b. What difference between the clouds at locations A and B is illustrated by the difference in brightness in the infrared image at those two points?

c. In the upper right corner of these two images we can see what outer space looks like on a visible and infrared image. Why do we see space differently in the visible and infrared?