Name: _____ Laboratory Section: _____

Date: _____ Score/Grade: _____

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Exercise 10
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LAB EXERCISE 10

Earth's Atmosphere: Temperature and Pressure Profiles

Lab Exercise and Activities

SECTION 1

Temperature Profile of the Atmosphere

1. Using the graph in Figure 10.1, plot the standard temperature values given in Table 10.1. (The sea level value has been done for you.) After you plot the data points, connect them with a line graph to complete the profile. Label the layers of the atmosphere and the transition areas at the top of each layer.

   Analysis and completion questions about the standard temperature profile.

2. Briefly explain why the temperature decreases as altitude increases in the troposphere (at the normal lapse rate).

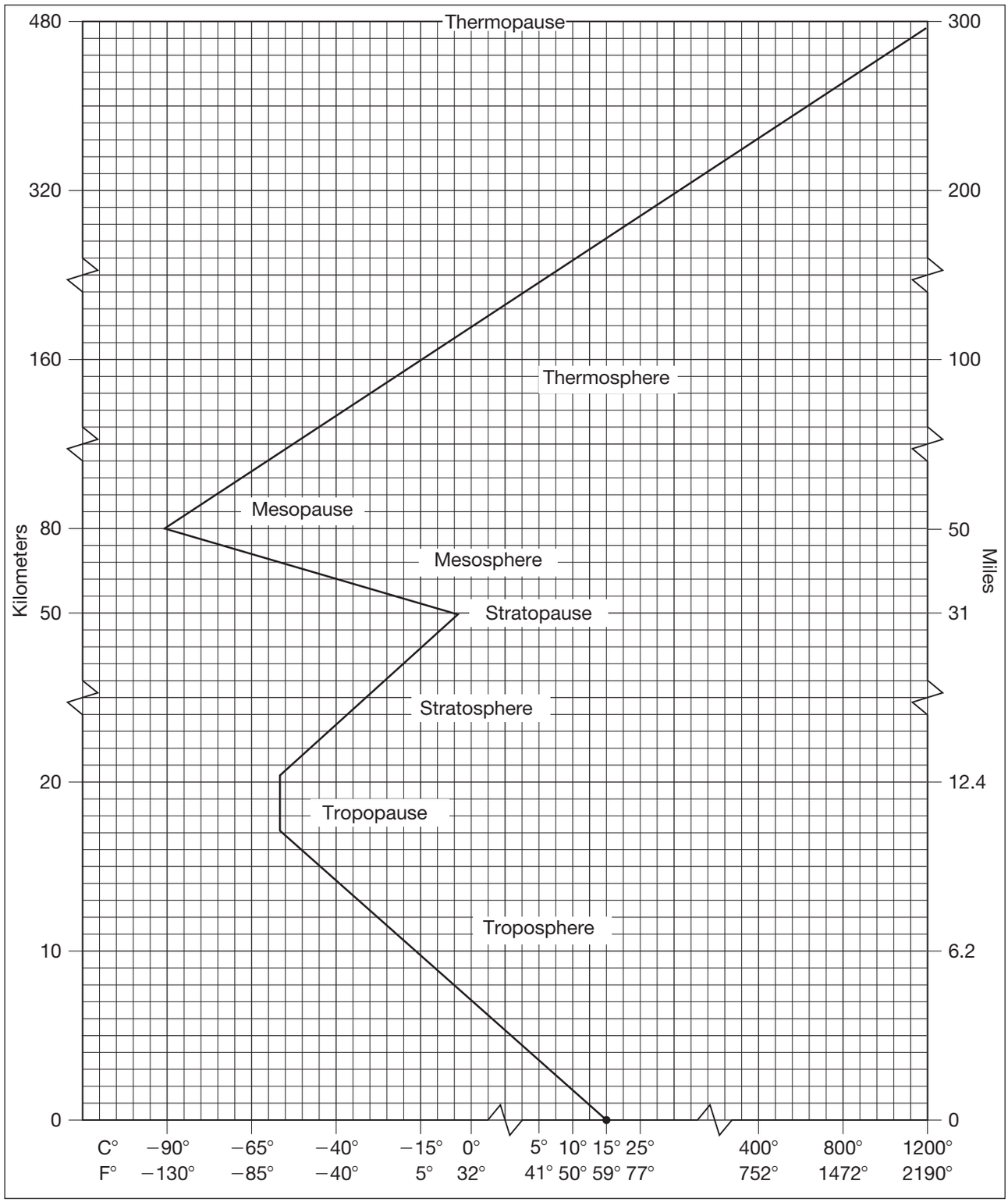
   As the atmosphere thins with altitude, its ability to absorb and radiate heat is reduced.

3. Why do temperatures increase throughout most of the stratosphere? Specifically discuss the process that produces this warming effect.

   Ultraviolet light is absorbed by ozone molecules and converted into infrared energy.

4. Briefly explain why temperatures increase in the thermosphere.

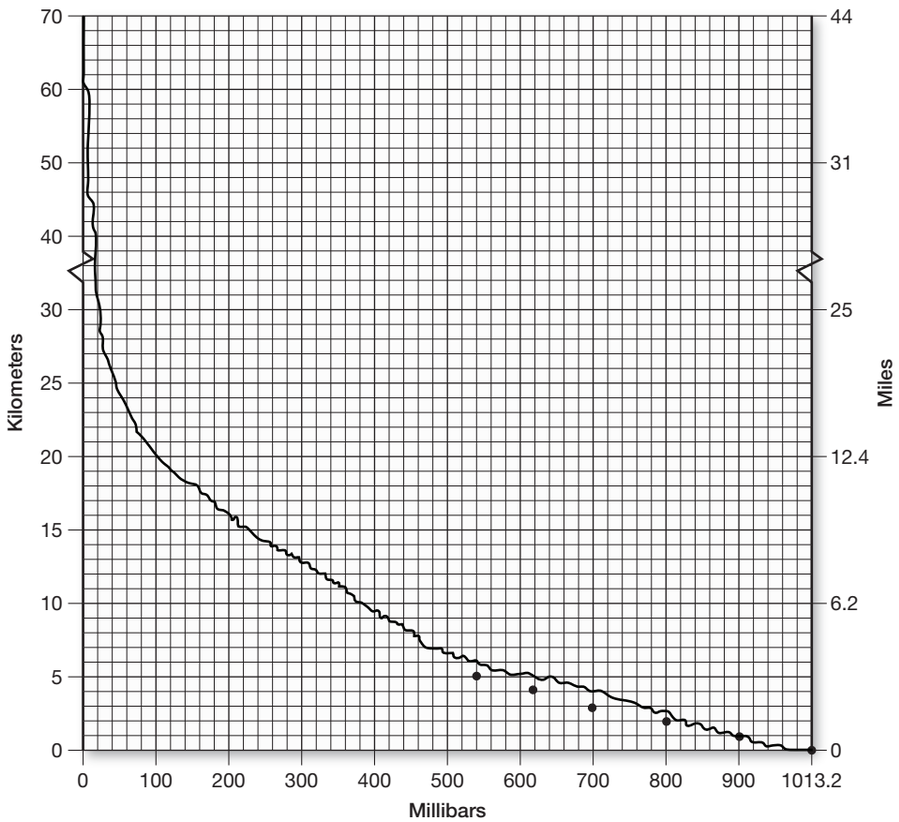
   The thermosphere is the first region that solar energy encounters so it is subjected to very high energy transmissions from the Sun.



▲ **Figure 10.1** Atmospheric temperature profile graph

SECTION 2

Air Pressure



▲ **Figure 10.2** Atmospheric pressure profile graph—the standard atmosphere—from the surface to 70 km.

1. Using the graph in **Figure 10.2**, *plot* the standard atmosphere of air pressure decrease with altitude presented in Table 10.2. After completing the plot, connect the data points with a line to complete the pressure profile of the atmosphere. The data points from 0 to 5 km are plotted for you.
2. The information in Table 10.2 allows a determination of the rate of pressure decrease with altitude, which is not at a constant rate. Remember that half of the weight of the total atmosphere occurs below 5500 m (18,000 ft); at that altitude only about half of the total atoms and molecules of atmospheric gases remain to form the mass of the atmosphere. Determine the decrease in pressure between the following altitudes. Express the difference in millibars and inches of mercury. (Conversions are presented earlier in this section.)

1 km interval difference in pressure:

0 and 1 km [114.49] mb; [3.38] in. Hg

2 and 3 km ***93.8*** mb; ***2.77*** in. Hg

5 and 6 km ***68.31*** mb; ***2.02*** in. Hg

8 and 9 km ***48.51*** mb; ***1.43*** in. Hg

9 and 10 km ***43.01*** mb; ***1.27*** in. Hg

10 km interval difference in pressure:

0 and 10 km [748.26] mb; [22.07] in. Hg

10 and 20 km ***209.7*** mb; ***22.07*** in. Hg

20 and 30 km ***43.32*** mb; ***1.28*** in. Hg

40 and 50 km ***2.08*** mb; ***0.06*** in. Hg

60 and 70 km ***0.17*** mb; ***0.005*** in. Hg

3. Using the graph you prepared in Figure 10.2, list the *approximate* answers to the following, assuming standard atmosphere conditions. The first answer is provided for you in brackets.

a) Mount Everest's summit is 8850 m (29,035 ft) above sea level. What is the barometric pressure there, according to the standard atmosphere? [*320 mb*]

b) Mount McKinley, 6194 m (20,320 ft); air pressure at the summit?

440 mb

c) Mount Whitney, 4418 m (14,494 ft); air pressure at the summit?

565 mb

d) Yellowstone Lake, Yellowstone N.P., 2356 m (7731 ft); air pressure?

760 mb

e) The Petronas Towers I and II, Kuala Lumpur, Malaysia, 452 m (1483 ft); air pressure?

945 mb

f) In a commercial airliner taking you from San Francisco to New York at 12,000 m (39,400 ft), what percentage of atmospheric pressure is below your plane? What percentage of atmospheric pressure resides above your flight altitude?

81%, 19%

4. Why does atmospheric pressure decrease so rapidly with altitude?

Air is a compressible gas and gravity compresses it to its densest state near Earth's surface where the force of gravity is strongest.

SECTION 3

Pressure Readings

Personal answers for Section 3.