AMMENDED LAB 2

Lab 2 Exercise Name: _____

Introduction to the Atmosphere Lab Section: _____

Please show your work. If necessary please use additional paper to show work.

WEATHER verses CLIMATE

- For current conditions, go to http://www.weatherunderground.com. In the search box (upper right-hand corner, type in KMASALEM55. This is the NWS identifier for Salem State Emeritus Professor Arthur Francis's personal weather station data on Weather Underground. He lives right near South Campus at Forest River.
- While Professor Francis has collected weather data for many years, we seek a more long-term record when assessing climate. The closest observing site with the longest climate record is Boston's Logan International Airport. This is where the official observations for the City of Boston are recorded, including temperature and precipitation.
- To view this climate data, first open a new tab or window and again go to go to http://www.weatherunderground.com. Now at the top of the page choose the link to Historical Weather (Note: you might need to select MORE first, and then choose it from the menu) and then type in **KBOS**, the call signs for Gen. Edward Lawrence Logan International Airport. This will bring you to the information you need, including averages and records for the current date. You can also change the date and see the climate data for any date in the record.

1) Fill in the following **WEATHER INFORMATION** on the current conditions in Salem including the proper units of measure.

Date/Time	
T	
T_d	
RH%	
Wind	
P	
Clouds	
Current Conditions	

*Current weather in **Salem** Key:*
T = temperature
T_d = dew point temperature
RH = relative humidity in %
Wind speed/dir = wind speeds and direction (WNES)
P = pressure
Clouds = Type of cloud and cloud cover (as a % in 10's.... 10%, 20%, etc.)
Current weather = actual conditions present (rain, snow, sleet, clear, sunny, etc.)

2) Weather includes the recent past and the near future (weather prediction). Find the following **WEATHER INFORMATION** regarding the maximum and minimum temperature and precipitation.

	Date	Temperature Minimum	Temperature Maximum	Total Precipitation
Yesterday				
Today				
Tomorrow				

3) Now consider the **CLIMATE INFORMATION** for the same 3 dates, yesterday, today and tomorrow, using the website directions above (changing the dates for each inquiry). Find the average and record (one-time event) for each of the three dates and three criteria (Temp Min, Temp Max and Total Precip).

	Yesterday		**Today**		**Tomorrow**	
	Average	*Record*	*Average*	*Record*	*Average*	*Record*
Temp Minimum						
Temp Maximum						
Total Precipitation						

*Recent and historical weather in **Boston** key:*
Average = average for that day over time (climate average)
Record = Record for that day

4. How do the weather conditions for yesterday, today, and tomorrow compare with the climate information (averages and records)? For instance, is the maximum temperature above, near, or below average? Are there any records that are close to or being broken? Are there any extreme events taking place in the area (to see a map with current NWS advisories visit: http://www.weather.gov). Write a paragraph summarizing your findings and highlighting the differences between weather and climate.

*You need to compare the **actual weather in Salem** for these three days (yesterday and today's weather findings and tomorrows prediction) with the **long-term climate averages and record events for Boston**.*

5. Why might it be important to have information about extreme events and records become a part of the climate record for a location? Explain.

The structure of the atmosphere

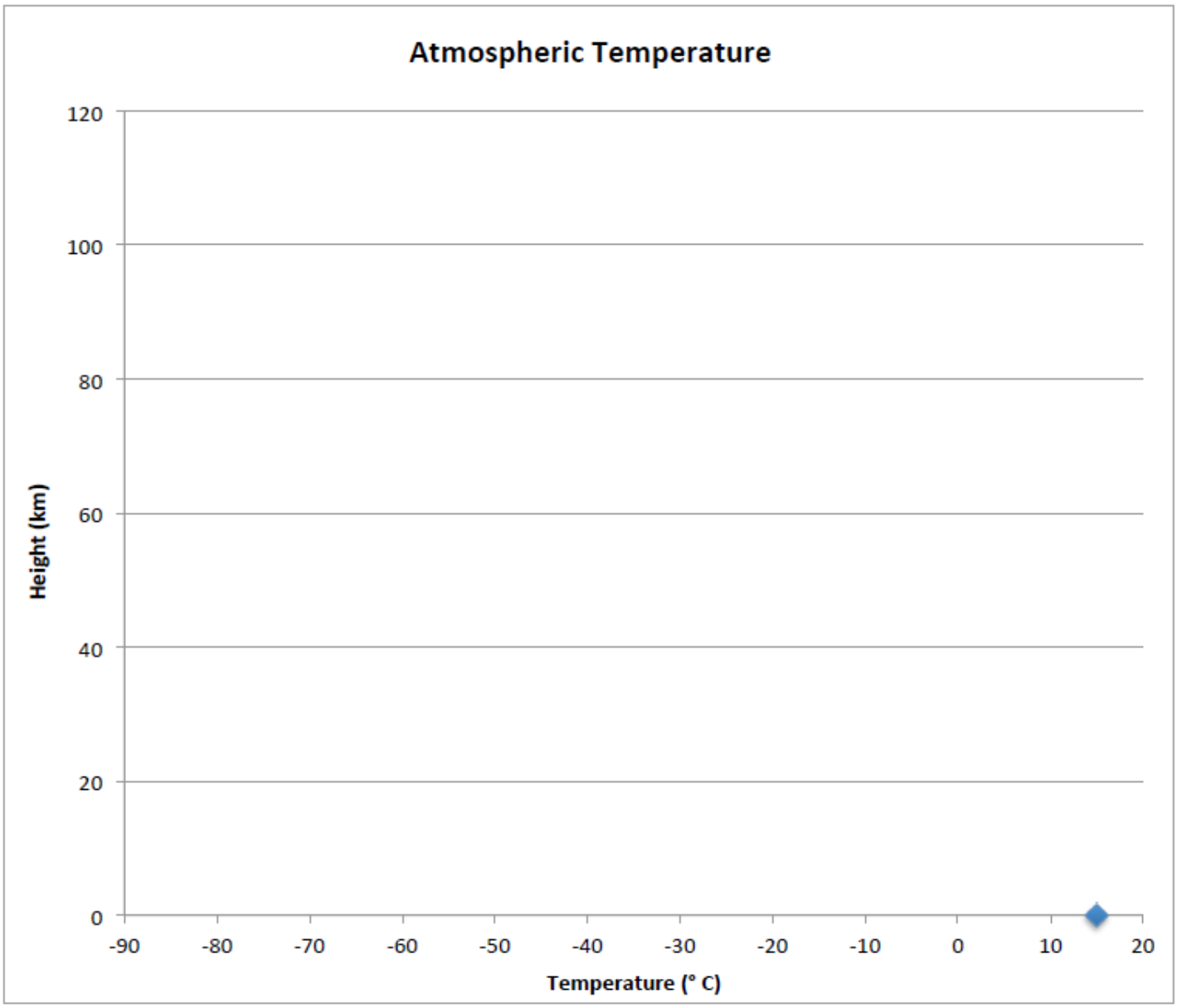
✎6. Using a pencil, plot the following information on the graph provided on the next page. Connect the points to form a line. The first point has been plotted for you.

Height (km)	Temperature (°C)
0	15.0
5	-17.5
11	-56.5
15	-56.5
20	-56.5
25	-51.5
30	-46.5
35	-36.1
40	-22.1
45	-8.1
47	-2.5
55	-13.7
60	-27.7
65	-41.7
70	-55.7
75	-66.5
80	-76.5
85	-86.2
90	-90
95	-90
100	-84
105	-70
110	-42
115	-30
120	0

✎7. Draw horizontal lines to separate the four layers of the atmosphere based on temperature. Use the descriptions of the layers from the lab introduction to help you.

✎8. Label each layer and its boundary, for example: troposphere and tropopause.

✎9. There are two places where the atmosphere is "isothermal" meaning that temperature stays the same with height. Draw arrows to point to these regions.



10. Based on the data provided, calculate the lapse rate for the troposphere. Recall the lapse rate is the decrease in temperature with altitude. Follow the instructions below.

a. Find the total temperature change from the surface to the tropopause:

_____

b. Find the total distance from the surface to the tropopause:

_____

c. Divide your answer from (a) by (b). This is your lapse rate in °C/km.

_____

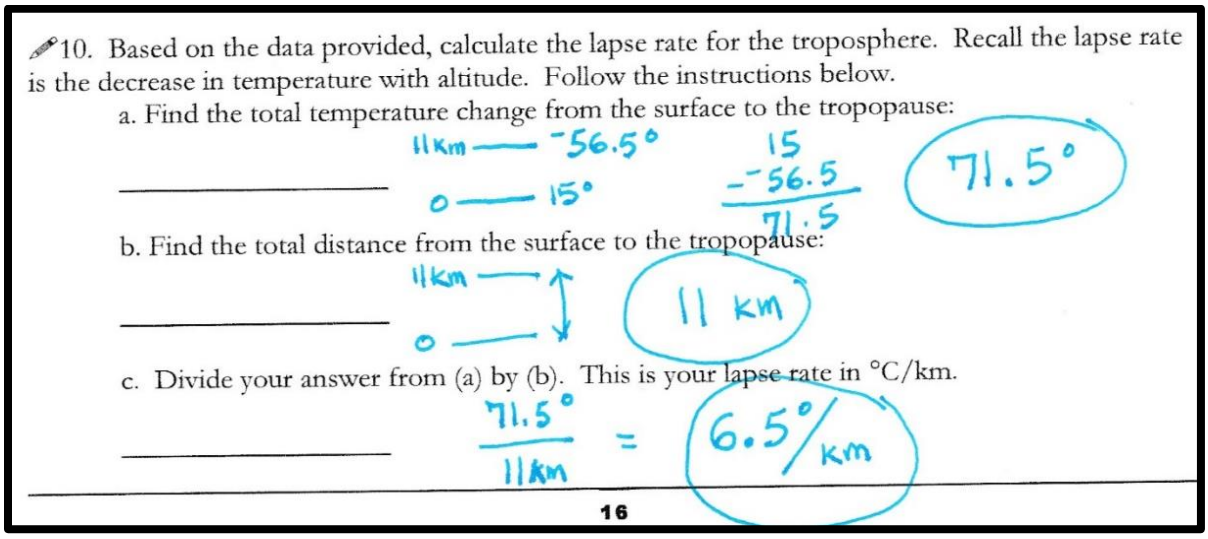
✎11. The lapse rate can be used to estimate temperatures above the surface in the troposphere. Suppose today you decide to take a trip from Salem to Mt. Washington in New Hampshire. Based on the current temperature in Salem, you could predict what the temperature at the top of the mountain will be. The elevation of Mt. Washington is 6289 ft (1917 m). Using the current temperature in Salem and the lapse rate, what would be the temperature on the top of Mt. Washington? Salem has an elevation of 26 ft (8 m). Hint: make sure to keep an eye on your units where °C = (°F-32)/1.8.

✎12. Visit www.mountwashington.org. What is the current temperature at the summit of Mt. Washington? Compare this to your answer for 11 above. What might be a reason for any differences between these two values?

How to solve the Lapse Rate problem in Lab 2: *USING AND EXAMPLE PROBLEM*

NOTE: We will use the findings from question 10 to solve a **similar problem to question 11**

After you plot the points from the dataset onto the graph, you can locate the tropopause and understand where the troposphere ends. Then use the change in temperature (from sea level (0 km) to the top of the troposphere (11 km)) and divide this by the change in altitude to determine the lapse rate.



10. Based on the data provided, calculate the lapse rate for the troposphere. Recall the lapse rate is the decrease in temperature with altitude. Follow the instructions below.

a. Find the total temperature change from the surface to the tropopause:

11km — -56.5°

0 — 15°

15 − -56.5 = 71.5°

b. Find the total distance from the surface to the tropopause:

11km

0

11 km

c. Divide your answer from (a) by (b). This is your lapse rate in °C/km.

71.5° / 11km = 6.5°/km

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Now that we have found the lapse rate for this area/date, you can proceed to the next step.

In problem 11 we are asked to determine the temperature for the peak of Mt. Washington based on the current temperature in Salem MA by using the lapse rate from question 10.

We will use a different, but very similar example.

11-x) The lapse rate can be used to estimate temperatures above the surface in the troposphere. Suppose today you decide to take a trip from Salem to the top of Mt. Greylock in Adams, MA (highest peak in MA). Based on your knowing the elevation of Salem and the peak of Mt. Greylock, as well as the current temperature in Salem and the lapse rate (from Q10)…

Predict what the temperature would be at the peak of Mt. Greylock.

Givens:

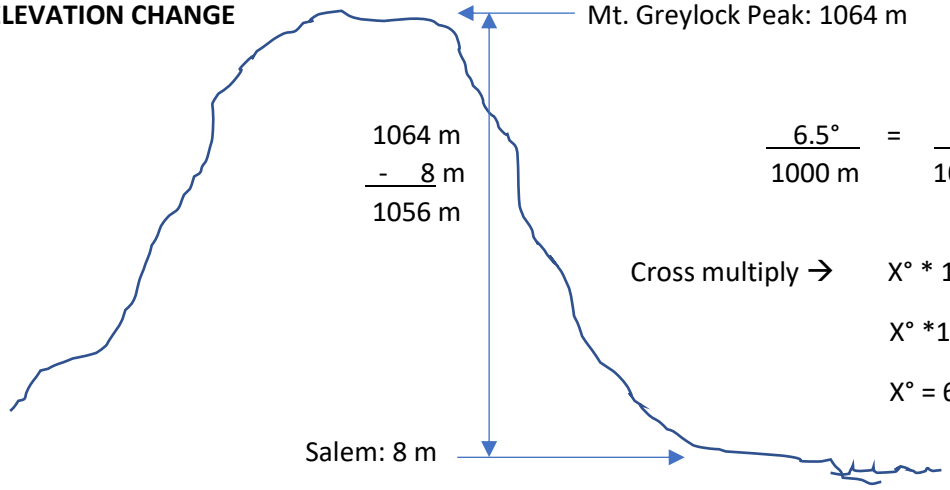
Salem Elevation	8 Meters (26 feet)	Difference in Elevation Mt. Greylock	1064 m
Mt. Greylock Elevation	1064 meters (3,491 feet)	Salem	- 8 m
			1056 m
Salem Temperature	16° F… ***But we need C***	(16°F − 32) × 5/9 = -8.889°C (or **-8. 9°**C)	
Lapse Rate (from Q10)	6.5°/1000m or 6.5°/1km		

Here you must calculate the elevation change between Salem (8 m) and Mt. Greylock (1064 m). This will be the elevation you will calculate your temperature change from.

Remember, there are 1000 m per 1 km, so… 6.5°C / 1 km → 6.5°C / 1000 m

Now you'll use this rate to determine the change in temperature from Salem to Mt. Washington.

ELEVATION CHANGE



$$\frac{6.5°}{1000\ m} = \frac{X°}{1056\ m}$$

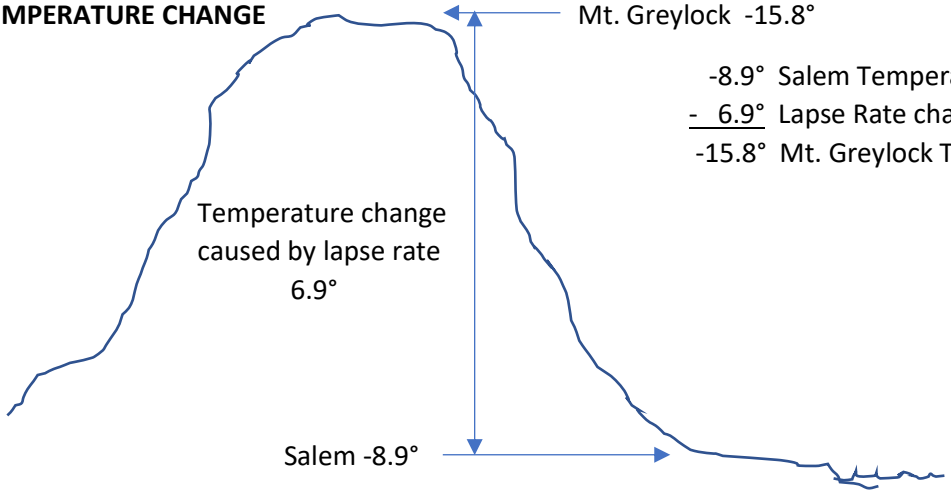
Cross multiply → $X° * 1000m = 6.5° * 1056$

$X° * 1000\ m = 6864\ °m$

$X° = 6.864$ = A change of 6.9°

Remember… If we are going UP in the troposphere, the temperature will DECLINE. Thus as we go from the current temperature in Salem (-8.9° C) UP TO Mt. Greylock, we will need to **DROP IN TEMPERATURE** by 6.9° C.

TEMPERATURE CHANGE



-8.9° Salem Temperature (given)
- 6.9° Lapse Rate change for 1056 m
-15.8° Mt. Greylock Temperature (calculated)