General Meteorology	**Laboratory #7**
Name ___________________________	Date _______________
Partners _________________________	Section _____________

Atmospheric Stability

Purpose:

Use vertical soundings to determine the stability of the atmosphere.

Equipment:

Station Thermometer	Min./Max. Thermometer
Anemometer	Barometer
Psychrometer	Rain Gauge
Psychometric Tables	Barometric Correction Tables

I. Surface observation.

Begin the first 1/2 hour of lab performing a surface observation. Make sure you include pressure (station, sea level, and altimeter setting), temperature, dew point temperature, wind (direction, speed, and characteristics), precipitation, and sky conditions (cloud cover, cloud height, & visibility). From your observation generate a METAR and a station model.

A. Generate a METAR for today's observation

B. Generate a station model for today's observation.

II. Plot the sounding

On the skew T-ln p plot the CHS sounding. Locate the lifting condensation level (LCL), the level of free convection (LFC), and the equilibrium level (EL).

1. The LCL is found by following the dry adiabat from the surface temperature and the saturation mixing ratio from the dew point temperature. Where there two paths intersect, we would have condensation taking place. This is the LCL and represents the base of the cloud.

2. The LFC is found by following a moist adiabat from the LCL until it intersects the temperature sounding. Beyond this level a surface parcel will become warmer than the environment and will freely rise.

3. The EL is found by following a moist adiabat from the LFC until it intersects the temperature sounding again. At this point the surface parcel will be cooler than the environment and will no longer rise on its own accord.

III. Stability of individual layers of a sounding

The stability of the atmosphere depends on the environmental lapse rate and the humidity in the air. The lapse rate is categorized as either absolutely stable, saturated neutral, conditionally stable, dry neutral, and absolutely unstable. Our goal in this exercise is to analyze the stability of each reported layer in the vertical sounding. The sounding data is given for CHS (Charleston, SC) 0000Z May 1, 1998.

1. **Calculate the lapse rate -** Calculate the temperature difference between adjacent reported levels of the sounding and divide by the height difference.

$$\gamma = -\frac{T_2 - T_1}{h_2 - h_1}$$

After calculating the lapse rate record the results on the data sheet.

2. **Assign stability to each level of the sounding -** Look at the lapse rate between each reported level of the sounding as calculated in part 1. Compare this with the plotted data on the included skew T-ln p. The plot will not correspond exactly to the layers over which we calculated because only the mandatory levels have been maintained. Look at the plotted sounding and determine if this lapse rate is less than, equal to, or greater than the moist adiabatic lapse rate, γ_m, at that level. Do the same comparison with the dry adiabatic lapse rate, γ_d, at that level. Assign a stability based on the following criteria.

$\gamma > \gamma_d$ and $\gamma > \gamma_m$	au (absolutely unstable)
$\gamma = \gamma_d$	d (dry neutral)
$\gamma < \gamma_d$ and $\gamma > \gamma_m$	cu (conditionally unstable)
$\gamma = \gamma_m$	m (moist neutral)
$\gamma < \gamma_d$ and $\gamma < \gamma_m$	as (absolutely stable)

(In class we stated that the dry adiabatic lapse rate is 10 °C and the moist adiabatic lapse rate is 6 °C. These are estimates near the surface. To get better results use the skew T-ln p included with this lab.)

3. **Evaluate overall stability of each level of the sounding -** Look at the different levels and determine if they are saturated or dry. Under the following conditions the air will be considered saturated.

$T - T_d \le 2$ °C	when $T > 0$ °C
$T - T_d \le 3$ °C	when -10 °C $< T < 0$ °C
$T - T_d \le 4$ °C	when $T \le -10$ °C

If the level is conditionally unstable and it is saturated, then the level is unstable. Go through all of the levels and declare them either stable or unstable.

DATA SHEET
Stability of layers

CHS 0000Z May 1, 1998

P_1 (mb)	P_2 (mb)	γ (°C/km)	Stability	Saturated	Overall Stability
1011	1009				
1009	1000				
1000	975				
975	925				
925	862				
862	850				
850	778				
778	700				
700	652				
652	604				
604	517				
517	508				
508	500				

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Date:0000Z  1 MAY 98
Station: CHS
WMO ident:  72208
Latitude:   32.90
Longitude: -80.03
Elevation:  14.00
-------------------------------------------------------------------------------
LEV PRES  HGHT  TEMP  DEWP  RH  DD   WETB DIR SPD THETA THE-V THE-W THE-E   W
     mb     m     C     C    %   C     C  deg knt   K     K     K     K   g/kg
-------------------------------------------------------------------------------
SFC 1011    14  20.0  18.3  90  1.7  18.9  90  11 292.2 294.6 291.6 329.6 13.20
  1 1009    32  20.2  16.9  81  3.3  18.0  90  11 292.6 294.8 290.8 326.9 12.09
  2 1000   112  19.4  17.6  89  1.8  18.2  90  12 292.5 294.8 291.3 328.8 12.76
  3  975   330  17.2  16.7  97  0.5  16.9  94  13 292.5 294.7 291.0 327.5 12.35
  4  925   779  14.8  14.3  97  0.5  14.5  80   6 294.4 296.4 290.7 326.4 11.14
  5  862  1375  12.6  12.1  97  0.5  12.3 256  11 298.1 300.0 291.2 328.3 10.34
  6  850  1493  12.4   9.7  84  2.7  10.7 260  12 299.1 300.8 290.3 325.3  8.92
  7  778  2232   9.2   3.2  66  6.0   5.9 260  15 303.4 304.5 289.4 322.0  6.20
  8  700  3100   3.8   2.6  92  1.2   3.1 250  21 306.7 307.9 290.8 326.8  6.61
  9  652  3673   0.6  -5.4  64  6.0  -2.1 250  26 309.4 310.1 289.3 321.7  3.92
 10  604  4284  -1.5 -10.5  50  9.0  -5.2 250  30 313.8 314.3 289.6 323.0  2.84
 11  517  5502 -10.1 -20.1  44 10.0 -13.1 215  32 317.7 318.0 289.6 322.7  1.50
 12  508  5638  -9.7 -34.7  11 25.0 -14.9 215  33 319.8 319.8 289.1 321.2  0.40
 13  500  5760 -10.1 -41.1   6 31.0 -15.6 215  34 320.7 320.8 289.2 321.5  0.21
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