San Francisco State University
Department of Earth & Climate Sciences

Name ______________________________
Spring 2018

ERTH 260: Lab #8 Key
Working with Soundings: Using Mixing Ratio Information
and Exploration into Meaning of Instability
(100 points)

For questions 1(e), 3(b), 4(d), 5(d) show calculations on separate sheet. For questions 5(a) and 5(e) answer in complete sentences and on separate sheet.

1. The sounding for KFWD for 12 UTC 31 March 2015 is attached. Note the mixing ratio lines (colored light blue and labeled near the bottom) that extend from bottom left to upper right).
    a. What is the actual mixing ratio at the surface? **13.5 g/kg**
    b. What is the saturation mixing ratio at the surface? **15 g/kg**
    c. Draw a **green** line on the sounding from the dew point at the surface upward to 500 mb, parallel to the mixing ratio line and label it with the value you found in (a). **See diagram.**
    d. Draw a **red** line on the sounding from the temperature at the surface upward to 500 mb parallel to the nearest mixing ratio line and label it with the value you found in (b). **See diagram.**
    e. What is the relative humidity at the surface (check class website presentation on humidity for formula)?
    RH = (13.5 g/kg /15 g/kg) X 100=90%
2. On the sounding you are working on in (1) above, now draw a **black** line that extends upward from the surface temperature parallel to the dry adiabatic rate to around the 500 mb level.
3. This line corresponds to the dry adiabat you'd use to determine what the temperature of an ascending air parcel would be. Note that it crosses your line you drew in 1 (c) above.
    a. Label this intersection point with a black X; **See diagram.**
    b. Say an air parcel is lifted from the surface to the elevation indicated by the X. What is the relative humidity of that air parcel when it gets to the X. Use the same formula you used in 1 (e). Think.
    RH = (13.5 g/kg /13.5 g/kg) X 100=100%
4. As discussed in class, once the air parcel's relative humidity is 100%, if it continues to rise, it no longer can cool at the dry adiabatic rate. It will continue to cool, but at a lesser rate, called the wet adiabatic rate. Those are shown by the curves that slope from bottom right to upper left on this diagram.
    a. Continue the line you drew in black to the X indicating the parcel's temperature change, but , now, from the X, draw the line parallel to the nearest of these curves. **See diagram.**

b. Note that this line crosses the original sounding. Label this crossing point with a Y and continue drawing the line past the tropopause. **See diagram.**

c. Shade in the portion of the parcel's "ascent curve" that shows the parcel colder than its surroundings in blue and that which shows the parcel warmer than its surroundings in red. **See diagram.**

d. How much warmer is the air parcel lofted to 500 mb in these steps than the surrounding air at the same elevation (in C^0)? **-16C – (-12C) = 4C warmer_________(5 pts)**

5. Figure 2 is the same Forth Worth Sounding plotted on a Stüve diagram. **(25 pts)**

a. Comment on the obvious VISIBLE differences between the way the sounding appears on Figure 2 and the way it appears on Figure 1. **(5 pts)**

The tropopause is more obvious, as are the stratospheric inversion and the capping inversion in the environmental lapse rate on the Skew T. Also, the environmental lapse rate seems more steeply sloped (more vertical) on the Skew T.

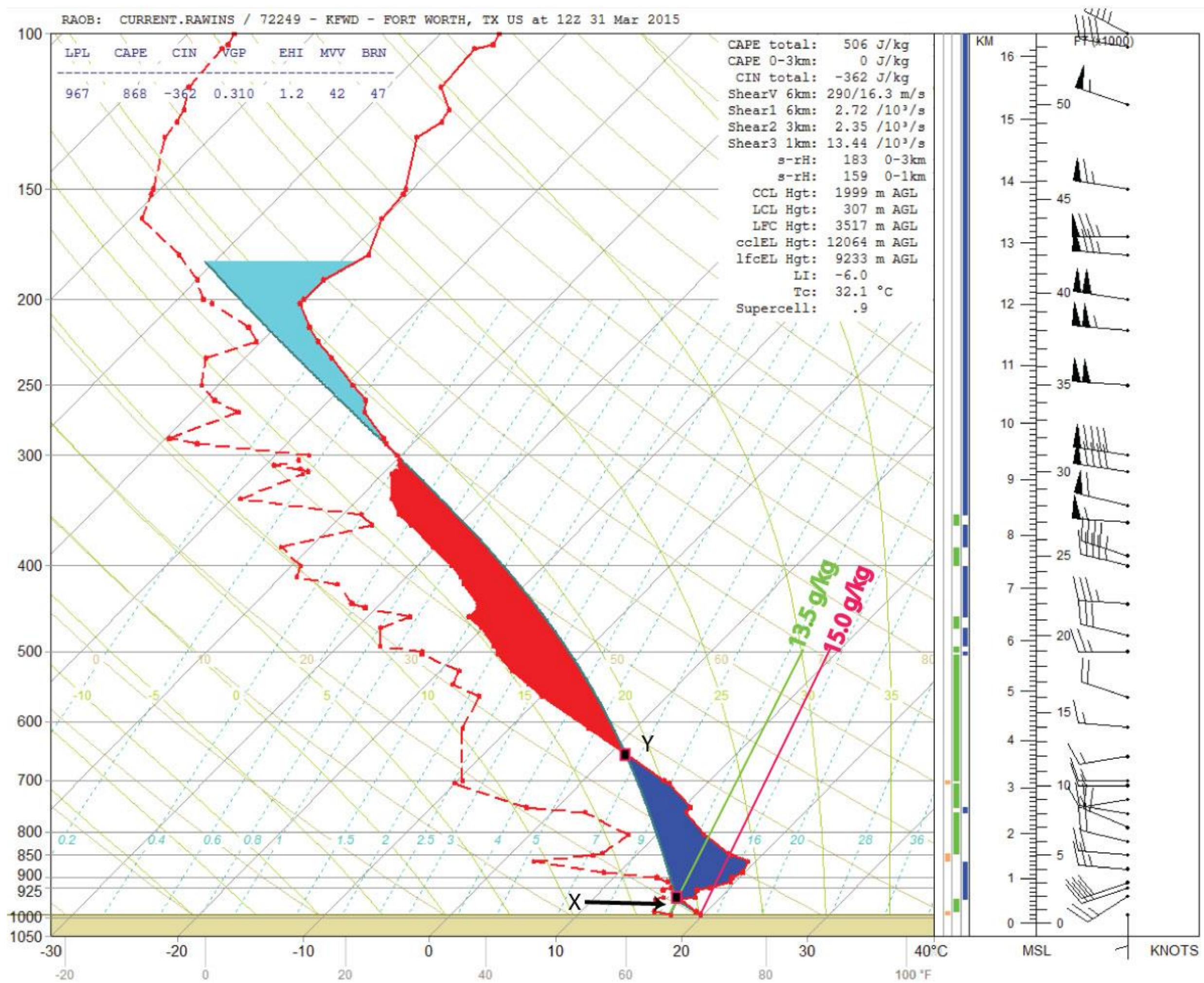
b. Assume that the environmental lapse rate stays the same, but that the dew point temperature is so low it does not appear on the diagram. On Figure 2, lift the surface air parcel and draw a **blue** line that extends upward from the surface temperature parallel to the dry adiabatic rate to the 500 mb level. (On diagram, neatly) **(5 pts)**

c. What is the temperature of the air parcel once it is lofted to a pressure elevation of 500 mb? . (in C^0)? **-32.5 C (5 pts)**

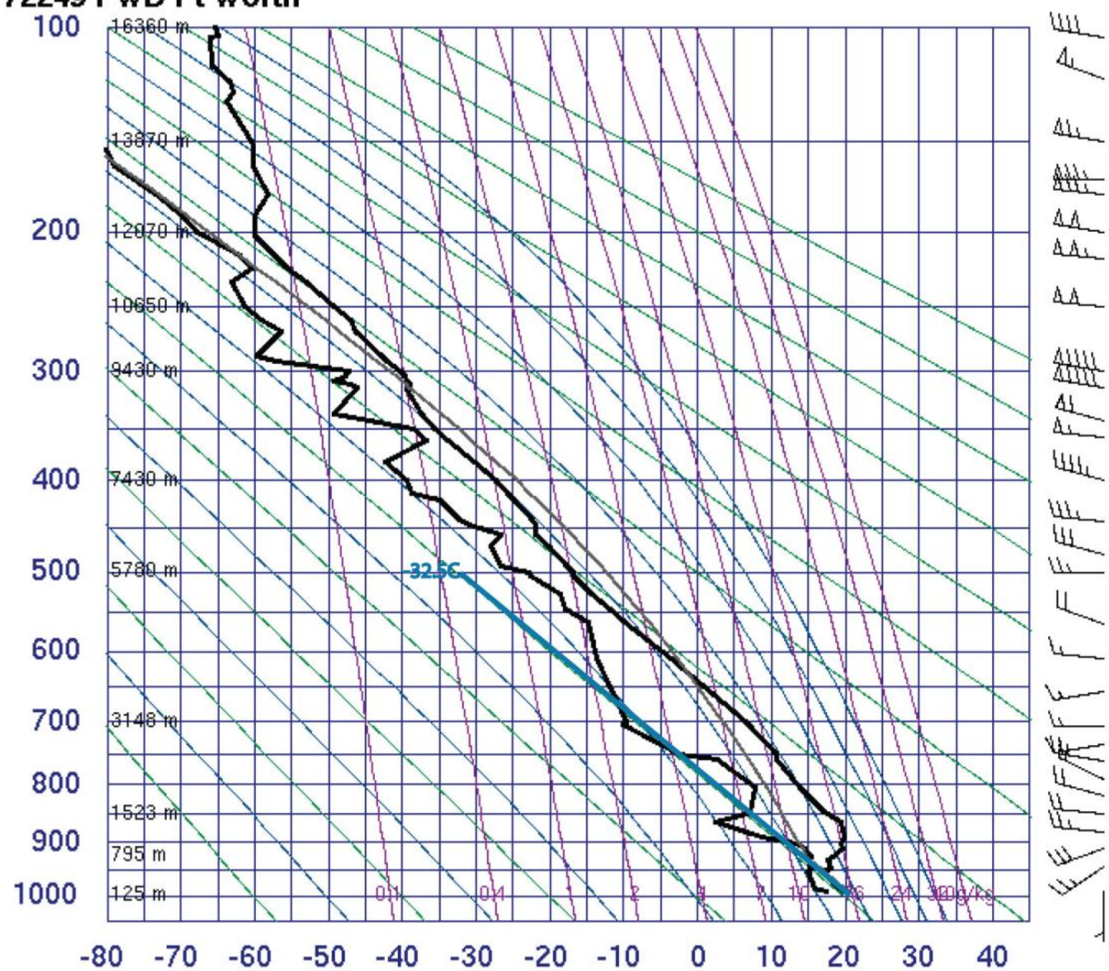
d. How much warmer or colder is the air parcel lofted in step (b) than the air parcel's temperature you obtained in 4 (d) above. (in C^0)? **-32.5 C – (-12C) = 10.5 C colder_5 pts)**

e. Explain why there is a difference between these two temperatures? **(5 pts)**

The lofted air parcel temperature obtained in 4(d) was obtained assuming wet adiabatic ascent from the elevation at which the original air parcel became saturated. The temperature difference of 10.5C is entirely due to latent heat of condensation.


RAOB: CURRENT.RAWINS / 72249 - KFWD - FORT WORTH, TX US at 12Z 31 Mar 2015
LPL CAPE CIN VGP EHI MVV BRN
967 868 -362 0.310 1.2 42 47
CAPE total: 506 J/kg
CAPE 0-3km: 0 J/kg
CIN total: -362 J/kg
ShearV 6km: 290/16.3 m/s
Shear1 6km: 2.72 /10³/s
Shear2 3km: 2.35 /10³/s
Shear3 1km: 13.44 /10³/s
s-rH: 183 0-3km
s-rH: 159 0-1km
CCL Hgt: 1999 m AGL
LCL Hgt: 307 m AGL
LFC Hgt: 3517 m AGL
cclEL Hgt: 12064 m AGL
lfcEL Hgt: 9233 m AGL
LI: -6.0
Tc: 32.1 °C
Supercell: .9
13.5 g/kg
15.0 g/kg
Y
X
KM
FT (x1000)
MSL
KNOTS
40°C
100 °F

72249 FWD Ft Worth



12Z 31 Mar 2015 **University of Wyoming**

SLAT	32.83
SLON	-97.30
SELV	171.0
SHOW	-3.94
LIFT	-4.52
LFTV	-4.80
SWET	323.2
KINX	25.10
CTOT	23.50
VTOT	34.50
TOTL	58.00
CAPE	623.2
CAPV	669.7
CINS	-439.
CINV	-388.
EQLV	312.8
EQTV	312.8
LFCT	633.5
LFCV	646.2
BRCH	24.86
BRCV	26.72
LCLT	288.1
LCLP	928.0
MLTH	294.3
MLMR	11.65
THCK	5655.
PWAT	28.99