ATM 311
Theta / Theta-e Assignment

Name: _____

Recall that potential temperature (θ) is the temperature of an air parcel if it were to be brought (compressed or expanded) to 1000 mb following a dry adiabat. Using your Skew-T, note that the potential temperature of a parcel of air with T = 10°C at 800 mb is ~29°C, or ~302 K.

Equivalent potential temperature (θ_e) is the temperature of an air parcel if it first were lifted to its LCL, then continued to rise until *all* of its water vapor condensed into liquid water, then brought dry adiabatically back down to 1000 mb. A parcel of air with T = 10° C and T_d = 0° C at 800 mb would have a θ_e of ~44° C, or ~317 K. Basically, θ_e includes the potential warming due to the condensational heating of the water vapor in a parcel.

1a. Given an observation taken at 900 mb, where T = 20°C and Td = 5°C, find θ and θ_e using your Skew-T.

1b. Now, say the 900-mb observation still has a temperature of 20°C, but the dew point is -15°C. Find θ and θ_e using your Skew-T.

1c. Why, physically, is there such a large difference in θ_e in your answers to parts (a) and (b)?

2. Can θ_e ever be *less* than θ? If so, under what conditions might this occur? If not, why not?

For the next problems, refer the 850-mb θ_e and θ maps from 0000 UTC 19 May 2013. Both maps have 850-mb wind barbs (in knots) drawn as well. The color fill is ***not*** *the same for the two maps.* ***There are links to these maps on the ATM 311 website.***

3a. Approximately where, geographically, is the center of 925-mb cyclonic circulation?

3b. Approximately where, geographically, is the strongest equivalent potential temperature (θ_e) gradient? Is there a shift in wind direction along this gradient?

3c. Where are the strongest potential temperature (θ) gradients?

Compare the θ and θ_e maps. Notice how the highest θ is located in a region where the θ_e is relatively low (eastern N.M., west Texas, north to southwest Kansas), and how the highest θ_e is located in a region where the θ is relatively low (central Kansas south through central Texas).

4a. What does this discrepancy tell you about the airmass in west Texas and New Mexico? (i.e., is it relatively warm/cold/moist/dry, etc.). How do you know?

4b. What about the airmass in central/eastern Texas, central Oklahoma, and central Kansas?

4c. Is the θ_e gradient in west Texas associated with a dryline, cold front, warm front, or trough? How do you know?