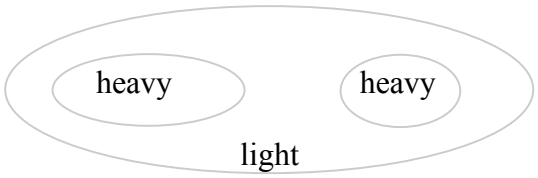
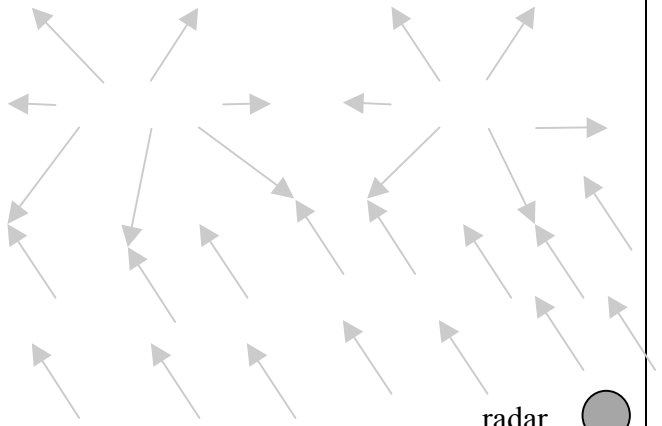
ATSC 201 **Midterm Exam** Name: _____
Prof. Stull (open book)
Fall 2008 Student Number: _____

1. (2 points) A 50 kPa pressure corresponds to <u>roughly</u> what altitude above sea level? _____(km)

2. (15 pts) Outline in words or short phrases the 4 most important similarities and the 4 most important differences between Basic and Supercell thunderstorms

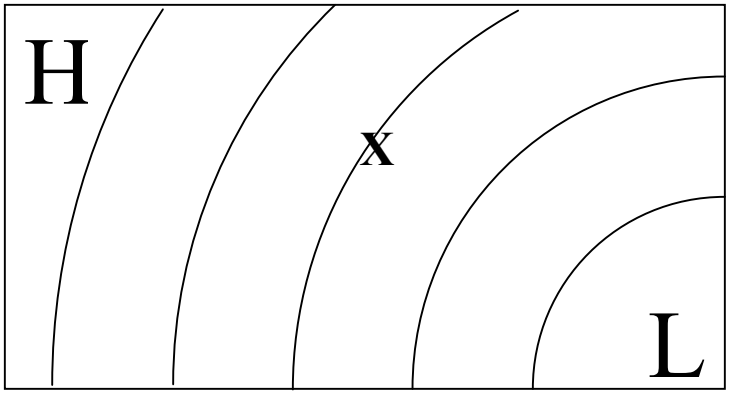
Similarities	**Differences**

3. (12 pts) The diagrams below show where it is raining, the winds, and the location of a weather radar. Draw on top of these diagrams how the radar reflectivity display would look, and how the Doppler display would look. (If you don't have colour pencils, just encircle different regions and write inside them what the colour would be.)

Rain (draw your reflectivity display here)	**Wind (draw your Doppler display here)**
 radar	 radar

4. (6 pts) For N. Hemisphere air above the boundary layer, draw in the box at right a thick arrow or a double arrow representing the equilibrium wind vector at the "X. Also draw and label the vectors for the forces that are acting on the air at "X". Also, the wind at X is called a/an

_____ wind.



5. (15 pts) At 55° N latitude the horizontal pressure gradient is 6 kPa / 1000 km. Find the magnitude G (m/s) of the geostrophic wind.

6. (5 pts) Suppose a 10 km thick air column at latitude 75°N has a potential vorticity of 1×10^{-8} m^{-1} s^{-1}. If that air moves south to latitude 50°N, find the new value of its potential vorticity (m^{-1} s^{-1}).

7. (10 pts) Answer either (a) or (b), but not both.

a) In a few words (or a drawing), explain how thunderstorms get their initial rotation to become mesocyclones.

b) In a few words, describe the terms in the surface heat budget, and explain how that heat budget relates to the surface radiation budget.

8. Given the attached sounding. Write your name and student number near the top.

a. (5 pts) For air at the bottom of the sounding, what is its relative humidity (%)?. . . . . _____(%)

b. (5 pts) At what pressure (kPa) is the LCL? _____(kPa)

c. (5 pts) At what pressure (kPa) is the LFC? . . . . . _____(kPa)

d. (5 pts) At what pressure (kPa) is the EL? _____(kPa)

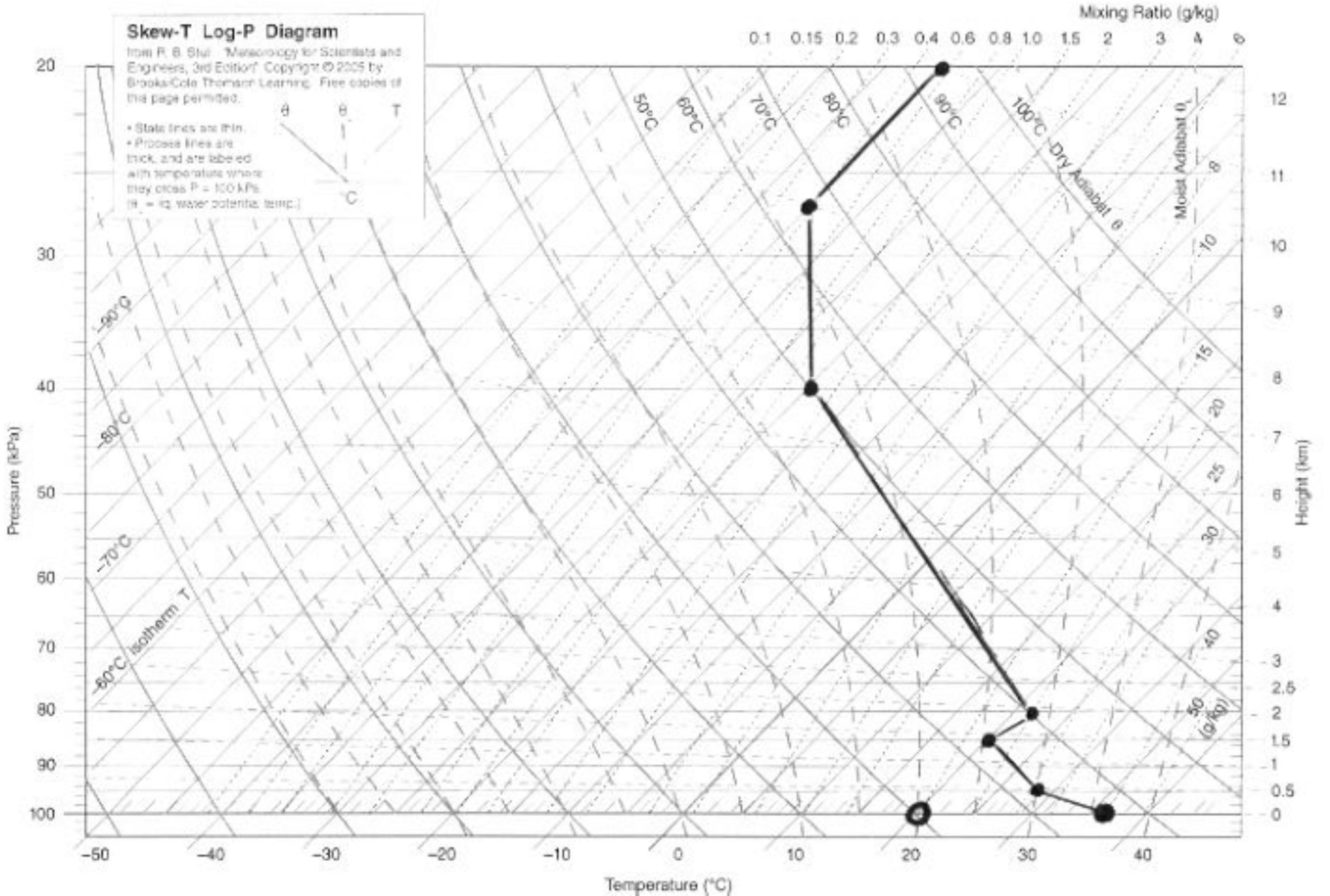
e. (5 pts) At what pressure (kPa) is the tropopause? . . . . . _____(kPa)

f. (5 pts) Shade in the CAPE area on the attached thermo diagram.

g. (5 pts) Is this sounding conducive to strong thunderstorms? (Circle one: Yes / No) Why?

9. (10 bonus points) Given the attached hodograph. Write your name and student number near the top of it. What is the likely translation speed (m/s) and direction of a thunderstorm in this environment? (Show your work on the hodograph.)

Speed (m/s) = _____ Direction (°) = _____ -end of exam-


Skew-T Log-P Diagram
from R. B. Stull, "Meteorology for Scientists and Engineers, 3rd Edition" Copyright © 2005 by Brooks/Cole Thomson Learning. Free copies of this page permitted.
• State lines are thin.
• Process lines are thick, and are labeled with temperature where they cross P = 100 kPa.
(θ_e = eq. water potential temp.)
θ θ_e T
C
Mixing Ratio (g/kg)
0.1 0.15 0.2 0.3 0.4 0.6 0.8 1.0 1.5 2 3 4 6
50°C 60°C 70°C 80°C 90°C 100°C Dry Adiabat θ
Moist Adiabat θ_e
6 10 15 20 25 30 40 50 (g/kg)
-90°C -80°C -70°C -60°C isotherm T
Pressure (kPa)
20 30 40 50 60 70 80 90 100
Height (km)
12 11 10 9 8 7 6 5 4 3 2.5 2 1.5 1 0.5 0
Temperature (°C)
-50 -40 -30 -20 -10 0 10 20 30 40

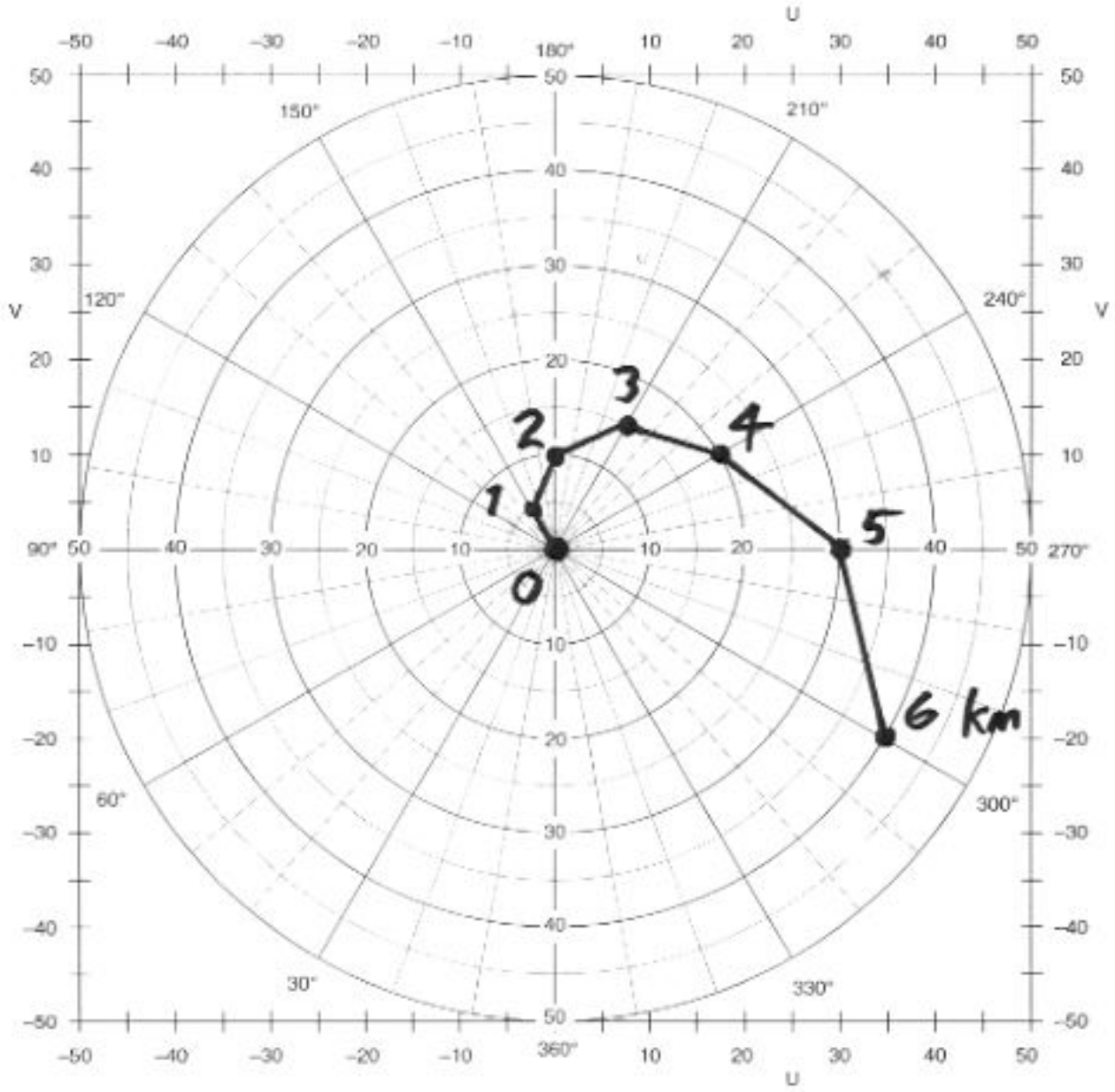


Figure 16.51
Blank hodograph for you to copy and use. Compass angles are direction winds are from. Speed circle labels can be changed for different units or larger values, if needed.