Name: _____

MEA 443 SYNOPTIC WEATHER ANALYSIS AND FORECASTING
FALL 2010
Quiz 1, Thursday 8/26/2010

1.) In isobaric coordinates, the vertical velocity, omega, is given by $\omega = dp/dt$. **Use the chain rule of calculus and the hydrostatic relation to show that**

$$\omega \simeq -\rho g w, \qquad (1)$$

where the height-coordinate vertical motion, w, is

$$w = \frac{dz}{dt}. \qquad (2)$$

2.) Given equation (1) above, and the list of various magnitudes of meteorological quantities provided in the table below, answer the following:

a.) What is the typical order-of-magnitude value of omega for a synoptic-scale, mid-latitude weather system such as a cyclone?

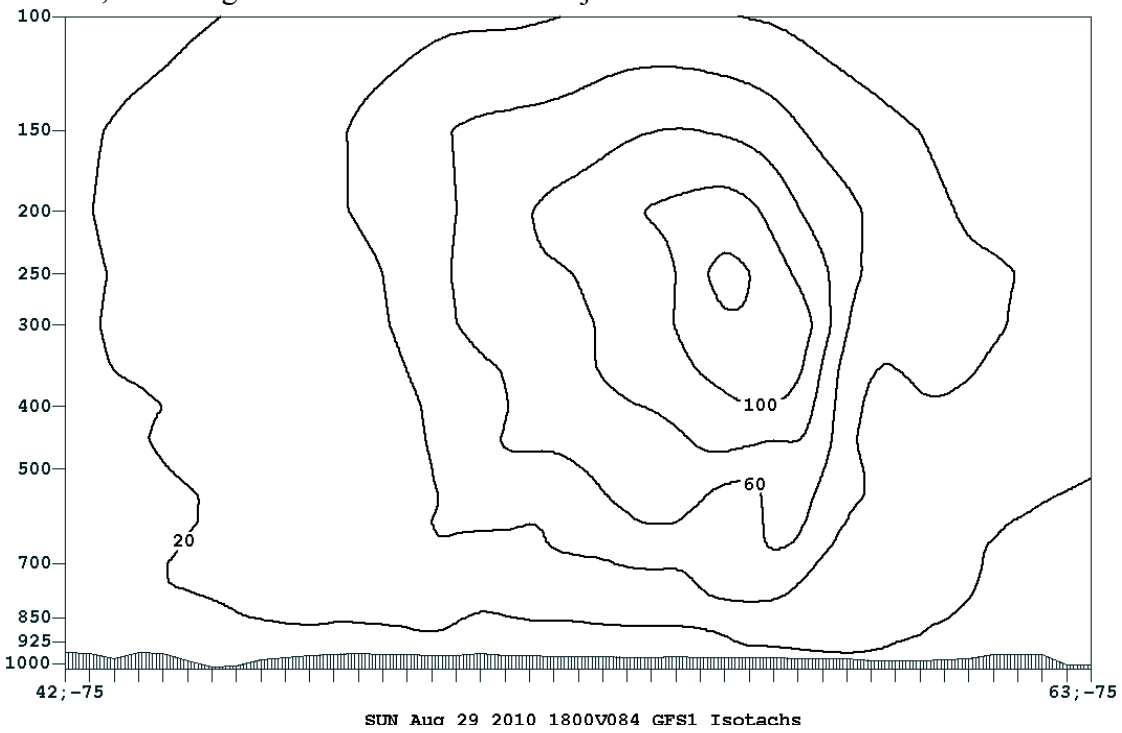
b.) What are the mks **units** of omega (expressed in meters, kilograms, and seconds)?

Scales of various parameters for midlatitude, synoptic-scale systems.

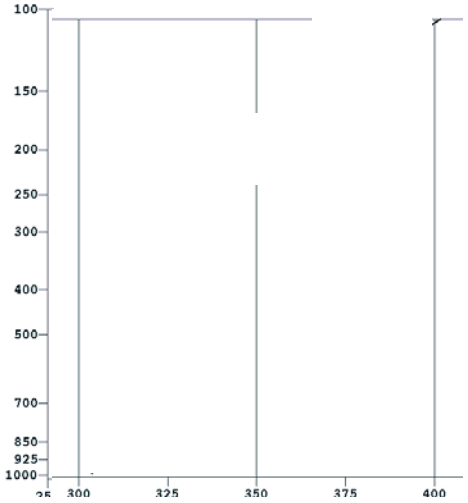
Symbol	Magnitude	Description
W	10^{-2} m s^{-1}	Vertical velocity scale
U	10 m s^{-1}	Horizontal velocity scale
H	10^{4} m	Depth of troposphere, vertical length scale
H_{PBL}	10^{3} m	Depth of planetary boundary layer
ΔP_z	10^{5} Pa	Vertical pressure change over troposphere
L	10^{6} m	Horizontal length scale
ΔP_h	10^{3} Pa	Horizontal pressure change across synoptic system
K_m	10 m^2 s^{-1}	Turbulent eddy viscosity coefficient
ρ	1 kg m^{-3}	Density scale for lower and middle troposphere
F	10^{-4} s^{-1}	Coriolis parameter

3.) A north-south oriented cross section for eastern North America is shown below (north is on the right); this is taken from the 84-h GFS forecast valid on Sunday afternoon. The contours are *isotachs* (contours of wind speed). Assuming that the flow is approximately geostrophic, we can use the thermal wind relation $(\frac{\partial u_g}{\partial z} \propto -\frac{\partial \theta}{\partial y})$ to deduce the temperature or potential temperature.

a.) Sketch ~4 isentropes in the cross section that are consistent with the thermal wind relation, including both above and below the jet core.

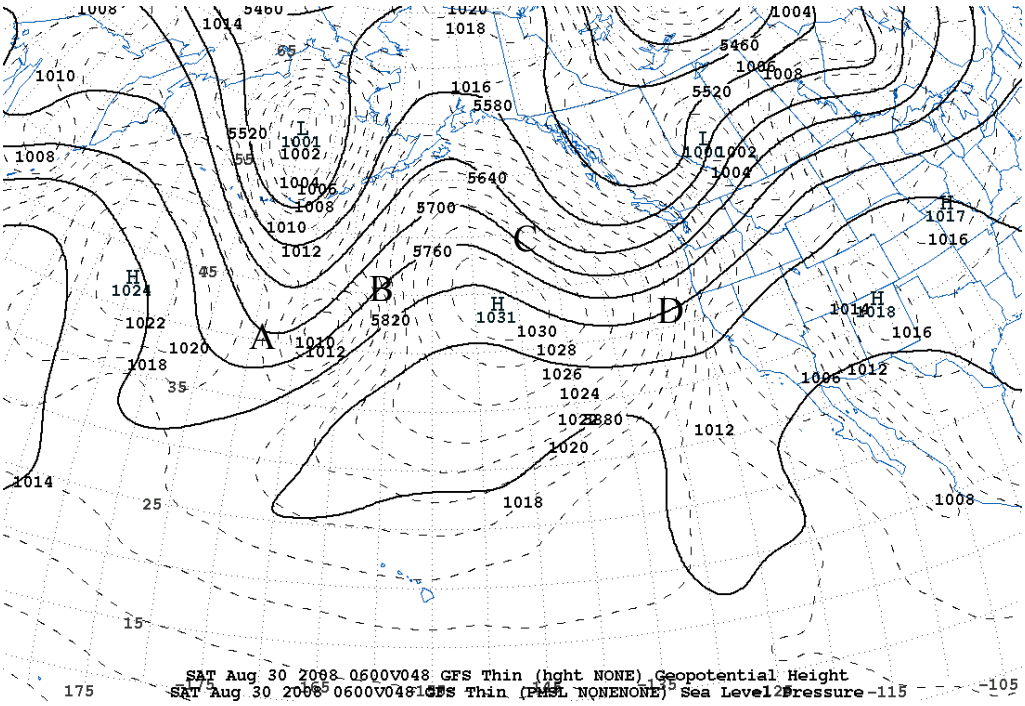


4.) On the blank diagram below, sketch a profile of potential temperature that exhibits the typical features of a late summer afternoon on a sunny day in the southeastern U.S. Label the key features on the diagram.

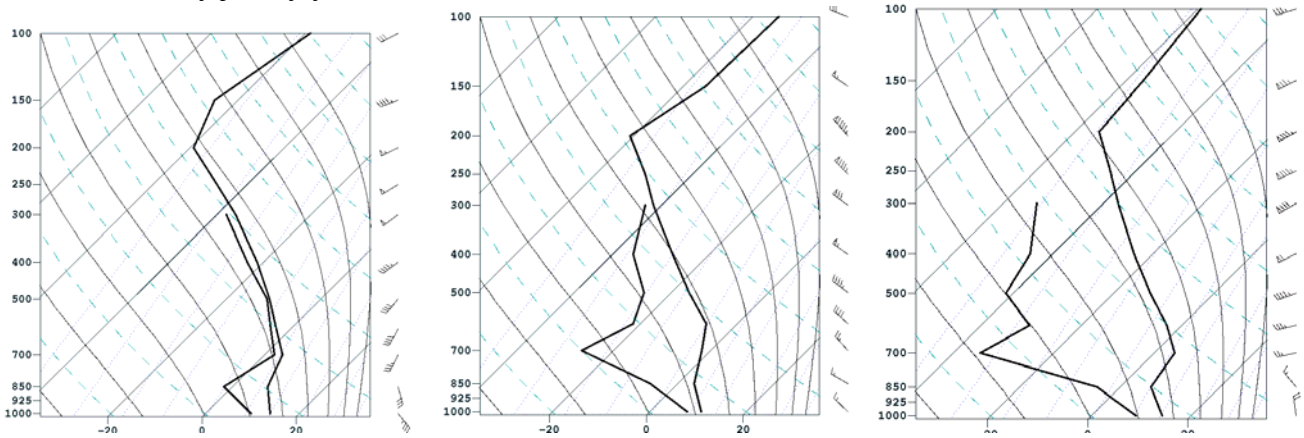


5.) Consider the GFS forecast for the North Pacific shown below. Dashed lines show sea level pressure, and solid lines represent the 500-mb height. For each of the points A-D, indicate the sign (+, _, or ~0) of the geostrophic thermal advection.

A: _____ B: _____ C: _____ D: _____



6.) Below each of the soundings shown below, indicate the letter of the most likely location for that sounding on the map above. In the space below each sounding, briefly justify your selection.



_____ _____ _____