ATSC 201 **Midterm Exam** Name: _____
Prof. Stull (open book)
Fall 2009 (50 points) Student Number: _____

1. (4 points) Given $(U, V) = (-8, 12)$ m/s. **Wind speed** = _____ and **direction** = _____.

2. (6 pts) For the **hypsometric equation**, explain in your own words (very short answer, NOT eqs.):

(a) What are the key physical concepts behind it?
(b) What does it tell us about how the atmosphere behaves?

3. (5 pts) Compare **squall-line** vs. basic **airmass** thunderstorms.

(a) List 3 Similarities:	(b) List 2 Differences:

4. For weather radar:

(a) (3 pts) For a constant rainstorm, if the range doubles between the radar and the storm, then the Z value changes by what factor? _____ Why? *(very short answer)*
(b) (4 pts) If $Z = 400$ mm^6/m^3, then dBZ = _____ and approximate rainfall rate = _____

5. (a) (2 pts) If the sun-earth distance increased by 10%, then the new value of the solar constant would be _____ .

(b) (2 pts) In the surface radiation budget at night, $K\downarrow = 0$, but $I\downarrow \neq 0$. Why? *(very short answer)*

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6. Use the attached weather map. The isobars indicate pressure near the ground.
(a) (1 pt) On the weather map, draw a short arrow from point A, showing the wind vector for that air parcel.
(b) (2 pts) The name of this type of theoretical wind is: _____
(c) (3 pts) Copy that wind vector on to point A in the bottom window on that page. Then, in that same bottom window, show (and label) vectors for all the forces that are likely to be acting on that air parcel.

7. (4 pts) Use the attached hodograph. (Assume m/s.)
(a) For a normal supercell thunderstorm, determine its speed _____ and direction _____ .
(Show your work on the hodograph.)
(b) For a right-moving supercell thunderstorm, determine its speed _____ and direction _____.

8. (8 pts) Use the attached thermo diagram, showing the initial thermo state of an air parcel. Find:

(a) initial relative humidity = _____ . (b) initial potential temperature = _____

(c) lifting condensation level = _____. (d) if the parcel rises to a height where pressure is 40 kPa, then its final temperature is _____ .

9. (3 pts) For a N. Hemisphere tornado that rotates clockwise (instead of the normal counterclockwise rotation), the pressure in the center of this tornado is [**higher** or **lower** (circle one)] than the surrounding ambient environmental pressure at the same altitude.

Also, list the dominant horizontal forces that act on an air parcel at the radius of maximum tangential velocity in this tornado?

10. (3 pts) Describe one theory for how thunderstorms become electrified.

(very short answer)

OPTIONAL. (3 BONUS points) Name the terms that have similar meanings in the Eulerian momentum, heat, and moisture budget equations?

(very short answer)

-- END. (See attached: weather map, hodograph, & thermo-diagram.) --