

## Atmospheric Sciences 5230 Study Guide

Answer each questions in the space below the question.

1. What is the speed of a typical cumulonimbus updraft?
  
  
  
  
  
  
  
  
  
  
2. What is a supercell?
  
  
  
  
  
  
  
  
  
  
3. Why does a supercell have a long lifetime?
  
  
  
  
  
  
  
  
  
  
4. What forces determine the speed of a supercell updraft?
  
  
  
  
  
  
  
  
  
  
5. ~~What are the most important factors for large (greater than 1 inch diameter) hailstone formation?~~
  
  
  
  
  
  
  
  
  
  
6. Why do tornadoes in the U.S. usually rotate cyclonically (counterclockwise)?
  
  
  
  
  
  
  
  
  
  
7. Why do supercells usually move to the right of the mean wind direction?
  
  
  
  
  
  
  
  
  
  
8. What factors favor dry microburst formation?
  
  
  
  
  
  
  
  
  
  
9. What are the three stages in the lifecycle a convective cell?

10. Describe the updrafts, downdrafts, and precipitation in each of the three stages in the lifecycle a convective cell.
11. What is the role of the cold pool in the maintenance of a squall line?
12. In the absence of significant vertical wind shear, what determines the speed of an updraft in a cumulonimbus cloud?
13. Discuss the roles of buoyancy (CAPE) and vertical wind shear in determining the structure or type of deep convection.
14. ~~What factors are favorable for tornado formation?~~
15. In the following Doppler velocity images, which one displays a pattern for small-scale rotation and which one a pattern of small-scale divergence?
16. What factors favor strong downdrafts driven by rain evaporation?
17. ~~What factors are favorable for flash floods?~~
18. Mid-latitude synoptic-scale motions are hydrostatic and geostrophic, while individual convective updrafts are non-hydrostatic and ageostrophic. Are mesoscale motions hydrostatic or non-hydrostatic? Geostrophic or ageostrophic?

19. What is the main advantage of a longer-wavelength radar compared to a shorter-wavelength radar (such as S-band versus C-band) for detecting precipitation?
20. What is better for detecting clouds: A shorter-wavelength radar or a longer-wavelength radar?
21. How does dual-polarization radar differ from single-polarization radar?
22. Why can better estimates of precipitation rates be made with dual-polarization radar compared to single-polarization radar?
23. What determines the reflectivity of spherical liquid drops of uniform size?
24. Differential reflectivity ( $Z_{DR}$ ) is  $Z_{HH}/Z_{VV}$ , which is the ratio of the horizontally polarized radiation that is reflected without change of polarization to the vertically polarized radiation that is reflected without change of polarization. What is  $Z_{DR}$  for spherical drop? What is  $Z_{DR}$  for a large raindrop?
25. What factors are favorable for supercell formation?
26. What is the primary factor that determines storm type (single cells, multicells, supercells)? Describe the dependence of storm type on this factor.
27. Why is the strength of the rear-inflow jet (in a squall line with a trailing stratiform rain region) related to the instability (CAPE)?

28. What is the sign of the pressure perturbation associated with a maximum of vorticity squared?
29. How is vertical wind shear related to horizontal vorticity?
30. How is vertical vorticity produced by a convective updraft in vertical shear?
31. Where are the resulting vertical vorticity maximum and minimum located (relative to the updraft)?
32. Once vertical vorticity is produced, it can be amplified by stretching. What configuration of convective updraft and vertical vorticity is most favorable for stretching?
33. If the storm-relative wind is perpendicular to the environmental vorticity (associated with vertical shear), then we have *crosswise* vorticity. If the storm-relative wind is parallel to the environmental vorticity, then we have *streamwise* vorticity. Which of these will tend to align the updraft with the vertical vorticity?
34. What is a dryline? How is a dryline related to a capping inversion? How does a capping inversion affect deep convection?
35. What is the Enhanced Fujita (EF) Scale of tornado intensity? How does it differ from the original Fujita (~~EF~~) Scale?

36. What type of thunderstorm produces almost all strong tornadoes?
37. There is disagreement on the source (or sources) of low-level vertical vorticity that produces strong tornadoes. Name at least one proposed source of this low-level vertical vorticity.
38. ~~What is the source of low-level vertical vorticity for non-supercell tornadoes?~~
39. ~~What is the general method called that is used to predict the regions and probability of tornado occurrence?~~
40. ~~What two factors are used to forecast tornadoes but not supercells? Why are these two factors relevant to tornado occurrence and intensity?~~
41. ~~A sting jet is a mesoscale phenomenon associated with rapidly deepening synoptic-scale extra-tropical cyclones. Damaging winds can reach 50 m/s and affect an area 50 km wide and several hundred km long. It is associated with a particular type of cyclone evolution and occurs in a specific location in the cyclone. What is the cyclone type? Where does the sting jet occur?~~
42. ~~Once a hailstone has stopped growing, is it more favorable for the hailstone to fall through (a) a saturated updraft or (b) an unsaturated air outside of an updraft? Why?~~
43. ~~If a *return period* is 10 years for an event, that means that there is a 1 in 10 (or 10%) chance that the event will occur in any one year. What is the probability that such an event will occur during any 10-year period?~~