

Name: _____

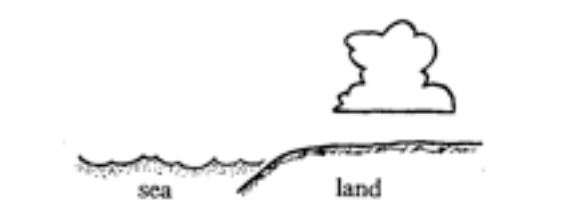
NATS 101 Introduction to Weather and Climate, Section 54, Fall 2005
Final Exam: Tuesday, 13 December 2005.

For multiple choice questions put your final answer on the line provided. **Only letters on the line will be graded.** [80 points]

For short answer essay questions read all the questions carefully and answer **all** parts of each question. Only answers **less than 6 sentences** will be graded. [20 points]

- c 1. The earth emits primarily in which region of the electromagnetic spectrum? [4]
a. Ultraviolet (UV).
b. Microwave.
c. Infrared (IR).
d. Visible.
- a 2. Which statement best describes the northern hemisphere solstice? [4]
a. It is the time of year when the north pole is tilted most towards the sun.
b. It is the time of year when the sun passes directly over the earth's equator.
c. It is the time of year when the earth is farthest from the sun.
d. It is the time of year when the earth is closest to the sun.
- d 3. The **smallest** annual range of temperatures are most likely found [4]
a. at middle latitudes near large bodies of water.
b. at polar latitudes over land.
c. at polar latitudes near large bodies of water.
d. at the equator.
- c 4. Which case is **least** likely to contribute to the *runaway* greenhouse effect? [4]
a. Contributing CFCs to the atmospheric window.
b. Increasing current levels of carbon dioxide in the atmosphere.
c. Increasing the earth's snow cover.
d. Increasing high-level cloud cover.
- b 5. The term "ozone hole" refers to a seasonal decrease in ozone concentration in the _____. [4]
a. mesosphere
b. stratosphere
c. tropopause
d. troposphere
- a 6. Which of the following is **not** a reason why water warms and cools much more slowly than soil? [4]
a. It takes more heat to raise the temperature of soil 1°C than to raise the same volume of water by 1°C.
b. Water has a higher heat capacity than soil.
c. Convection transfers heat deeper into the water.
d. Solar energy penetrates more deeply into water.

- c 7. Between sunset and sunrise, which of the following is true? [4]
- The earth emits and absorbs radiant energy at the same rate.
 - The earth gains more radiant energy than it loses.
 - The earth loses more radiant energy than it gains.
 - The earth does not lose or gain radiant energy during this time.
- d 8. The pressure at the bases of a warm and cold column of air are equal. Air pressure in the **warm** column of air will _____ with increasing height _____ than the **cold** column. [4]
- increase, more rapidly
 - decrease, more rapidly
 - increase, more slowly
 - decrease, more slowly
- d 9. An increase in the _____ in(of) a parcel of air will not cause the pressure to rise. [4]
- number of air molecules
 - density of air
 - temperature
 - volume
- c 10. Which of the following surface conditions would produce a cumulus cloud with the **lowest** cloud base? [4]
- air temperature of 80°F, dew point of 40°F
 - air temperature of 80°F, dew point of 50°F
 - air temperature of 80°F, dew point of 60°F
 - air temperature of 80°F, dew point of 20°F



- b 11. The clouds in the figure above would most likely form during the _____ when the land is _____ than the water. [4]
- day, cooler
 - day, warmer
 - night, cooler
 - night, warmer
- d 12. Polar air is considered “dry” because the dew-point temperatures are often quite low. However, the relative humidity of this cold, polar air is usually high because: [4]
- low dew points indicate that the relative humidity must be high.
 - low air temperatures indicate that the relative humidity must be high.
 - dry air has a high relative humidity.
 - the air temperature and the dew point are fairly close together.

- b** 13. When naming clouds, the term "nimbo" means
- thick clouds.
 - rain clouds.
 - low altitude clouds.
 - layer clouds.
- d** 14. The North American Monsoon summer rains result from, [4]
- a southwest shift in the Bermuda High bringing westerly winds into northern Mexico and the southwest US.
 - a southwest shift in the Bermuda High bringing southeasterly winds into northern Mexico and the southwest US.
 - a northeast shift in the Bermuda High bringing westerly winds into northern Mexico and the southwest US.
 - a northeast shift in the Bermuda High bringing southeasterly winds into northern Mexico and the southwest US.
- a** 15. A conditionally unstable atmosphere is _____ with respect to *unsaturated* air and _____ with respect to saturated air. [4]
- stable, unstable
 - unstable, unstable
 - unstable, stable
 - stable, stable
- b** 16. Mid-latitude cyclones that form into large wintertime storms generally develop and dissipate over a period of several, [4]
- hours
 - days
 - weeks
 - months
- c** 17. The primary mechanism that leads to rotation in a supercell thunderstorm is [4]
- strong westerly winds aloft
 - the earth's rotation (Coriolis force)
 - tilting of rotating tubes of air from the horizontal to the vertical direction
 - cold air occlusion at the surface
- c** 18. If a tornado rotating counter-clockwise is traveling towards the north, the fastest winds will be on its, [4]
- south side.
 - north side.
 - east side.
 - west side.
- a** 19. An atmospheric condition not conducive to the formation of hurricanes is, [4]
- strong upper-level winds.
 - warm, humid surface air.
 - an area of organized thunderstorms.
 - a region of converging surface winds.

- b 20. In a hurricane, the eye represents [4]
- a. the inflow region of the storm.
 - b. a region of light winds and low pressure at the center of the storm.
 - c. a zone of intense thunderstorms around the center.
 - d. a layer of cirrus cloud encircling the top of the storm.

21. During the 1997 El Niño, the fishing industry off the coast of Peru, located near the equator and on the east side of the Pacific Ocean, was devastated. Fish in this region rely on nutrients below the warm surface waters found across the equatorial Pacific. Briefly explain why these nutrients were not available to these fish during El Niño. [4]

The nutrients from below the surface layer were not available because El Niño years have reduced upwelling in the eastern Pacific due to reduced trade winds. The trade winds are reduced due to a smaller pressure gradient across the tropical Pacific.

22. From what you have learned in this class, as surface temperatures around the globe rise due to increased greenhouse gases in the atmosphere, would you expect water vapor to increase, stay the same, or decrease in the lowest levels of the atmosphere? Briefly explain your answer. [4]

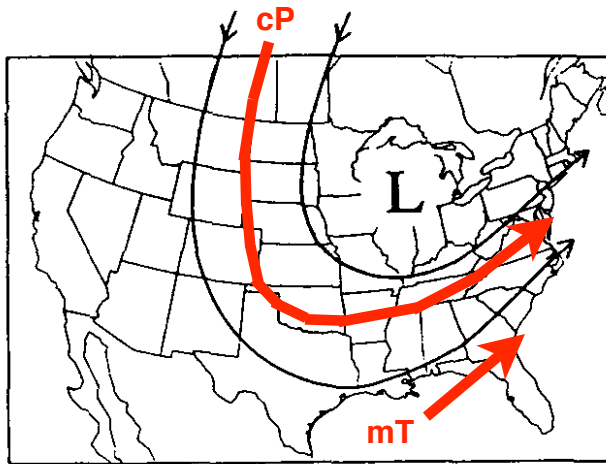
I would expect water vapor to increase since warmer air holds more water vapor. [Note: The situation is more complicated than this. Wind patterns and cloud processes in a warmer climate may actually result in a drier lower troposphere. Uncertainties are still large surrounding this aspect of climate models.]

23. The Bermuda high is located at its most southern position (just above the intertropical convergence zone) during the summer and fall. How might the path of a hurricane, moving toward the west from Africa, be affected by the Bermuda High as the hurricane approaches the United States? [4]

The Bermuda high pressure system could affect hurricanes by affecting the strength of the northeasterly trade winds that converge on the ITCZ, where hurricanes generally are formed. For instance, a stronger high would increase convergence along the ITCZ and thus possibly encourage the development of hurricanes. The north-south position of the high is also important. If the high is further south, as it is during NH winter, the ITCZ is generally on or south of the equator and hurricane formation is rare. This is because of complex ocean-atmosphere-land interactions, but also because the Coriolis force goes to zero at the equator so large, rotational storms will not develop.

24. Thunderstorm cloud bases are generally higher above the ground in Arizona than in Florida. Why do you think this is true? [4]

Thunderstorm bases are higher in Arizona because the air is drier and thus must be lifted to a higher level in order to saturate. That is, the LCL is higher in Arizona, in general, than in Florida.



25. [4]

a. For the upper air flow on the map above, what air mass would most likely bring cold air into the eastern US? Draw a single arrow on the map representing this air mass and label it with the appropriate 2-letter symbol.

cP

b. Also referring to the map above, what air mass would most likely bring warm, moist air along the southeast coast of the US? Draw a single arrow representing this air mass on the map and label it with the appropriate 2-letter symbol.

mT