Review Sheet for APES TEST Unit 6: Atmospheric Fluid Dynamics & Air Pollutants

Test Format: 67 MC; 1 Short Answer; 3 FRQ (180 points)

Test Date: Friday / 30 May 2014

PLEASE NOTE: Continuing with this test, you will be expected to be able to answer questions from previous units. Additionally, short answer/free response questions may contain connections to previous units. Don’t stress about these questions, but, if you’ve noticed an area you have had trouble with in a past unit, DO review it.

STUDY RECOMMENDATIONS:

RECOMMENDATIONS FOR ACTIVE STUDYING:

1. Starting from scratch, try to draw a map of the tropospheric circulation cells and global surface wind patterns. Do as much as you can without referencing notes, websites, or your textbook. Then check yourself.
2. Using your map of global winds, determine the general climate (hot, warm, cool---wet or dry) for the world.
3. Draw the eastern equatorial Pacific under normal, El Niño, and La Niña conditions. Be sure to include relative water temperature and sea surface height anomaly in your drawings.
4. Diagram thermohaline circulation, from downwelling near the poles to upwelling sites and surface flow.
5. Draw a picture illustrating the conditions and reactions that lead to ozone depletion in the stratosphere.
6. Draw a high and a low pressure center in map view and cross-section. Tell what weather you would expect with each center.
7. Draw a cold front and warm front in cross section. Where would you expect precipitation relative to each front?

CONTENT REVIEW (and thinking) QUESTIONS:

Atmosphere Basics
1. What are the main gaseous components of the atmosphere?
2. How is the atmosphere divided into layers? What are the four layers? Which layer is ozone concentrated? Where are mountains found? Which layer has the most mass? In which layers does ozone play a significant role; how/why??
3. How is the atmosphere heated? How is the
4. How are weather and climate different? What three factors describe the atmosphere?
5. What is specific humidity? What is relative humidity? What is the dew point? Which is more useful?

Balances
6. The speed and direction of winds blow is primarily determined by what two things?
7. Weather, global air and water circulation occur to balance what?
8. The density of deep ocean water is determined by pressure and what two other things?

Weather and Global Winds
9. Can you draw the atmospheric circulation cells? What role do they play in redistributing the Earth’s heat inequities?
10. Are winds named from the direction in which they move, or the direction from which they come?
12. What is latent heat? Which process releases the most heat? Requires the most heat?
13. How/why is Latent Heat important in moving heat poleward and thereby reducing the latitudinal thermal gradients?
14. What are jet streams? Where do they form? How do they influence weather patterns?
15. What are: (1) adiabatic cooling? (2) orogenic effect (3) the “rain shadow” effect? What causes each?
16. What does a high pressure center look like in map view (from above) and in cross-section? What does a low-pressure center look like? Does it spin clockwise or counterclockwise in the northern Hemisphere?
17. Which direction do Coriolis Forces spin/deflect the winds in the northern hemisphere?
18. What kind of weather would you expect in a low pressure center? What about a high pressure center?
19. What is an air mass? What occurs at air mass boundaries?
20. What is a cold front? What is a warm front? Which one is more likely to spawn severe weather events?

Ocean Circulation
21. What characteristic(s) does water need to acquire to sink? How does this happen?
22. Where does it sink in the modern oceans? Where does it surface from great depth?
23. Why are there 2 distinct water masses below 1km water depth? Do they have the same source areas?
24. What is a surface current patterns? What drives these currents? (e.g., western boundary currents, eastern boundary currents, the 5 subtropical gyre, circum-global currents near 60° S, etc.)
25. What is thermohaline circulation? Can you draw Wally Broeker’s deep water circulation model?
26. What is the residence time of the NADW? What happens to the nutrient concentration as the deep water ages?
27. How do these circulation patterns influence Ocean Acidification?
El Niño, La Niña and Amigos
28. What are “normal” conditions in the eastern equatorial Pacific? Describe the pressure patterns, sea surface height, water temperature, precipitation patterns, as well as the nutrient concentrations of local coastal waters.
29. Define El Niño-Southern Oscillation. What are the effects of El Nino (think upwelling/fisheries/guano)?
30. What is La Niña? What are the effects of La Niña? How does El Niño cause flooding in Southern California and drought in Australia ... while La Niña causes a dry spell in Alabama, Peru and Africa?
31. Name two BIOTIC and 2 ABIOTIC effects of an El Niño/La Niña changes.
32. Name one economic BENEFIT and one economic COST associated with both El Niño/La Niña conditions.

Global Warming and Global Warming
33. What two factors determine/influence the intensity of the sun at the Earth’s surface? (Why are polar latitudes cooler than equatorial latitudes?)
34. What causes seasonality? How does this contribute the thermal gradient between the poles and the equator?
35. What is ultraviolet (shorter wave) radiation? Infrared (longer wave) radiation? Which does our atmosphere trap before it gets to the earth’s surface… making it habitable? Which bandwidth does the earth emit each and every night?
36. What happens in absorption that is different from reflection?
37. What three main gases absorb incoming radiation? Besides water vapor, what main three gases absorb outgoing IR radiation?
38. What is albedo? How can albedo vary on the Earth’s surface?
39. What is the “greenhouse effect?” What are “greenhouse gases?” (Why isn’t the earth’s average temperature -18ºC?)
40. What is “global warming” or more accurately, global climate destabilization?

Ozone
41. What is stratospheric ozone depletion and how serious is this problem? What types of chemicals cause ozone depletion? How do these chemicals cause such depletion? What is being done to protect the ozone layer?
42. Explain how seasonal ozone thinning occurs each year over the earth’s poles, particularly over the South Pole.
43. Why is it good to have ozone in the stratosphere, but bad to have it in the troposphere?

Tropospheric Ozone
45. What are the key elements that create ozone in the troposphere?
46. Give the photochemical reaction sequence for producing tropospheric ozone.
47. What is the difference between industrial-air smog and photochemical smog?

General Air Pollution
48. What is the Air Quality Index (AQI)? How is it measured? Reported? What does it really mean?
49. Where does air pollution come from? Be able to list lots of sources… pt. & non-pt. sources.
50. What is the difference between mobile and stationary pollution? Between point and non-point sources? Between primary and secondary pollutants? Be able to give examples of each.
   a. Describe SOURCES and IMPACTS of each of the following AQI criteria air pollutants.
   b. Carbon Monoxide (CO)
   c. Carbon Dioxide (CO2)
   d. Volatile Organic Compounds (VOC’s)
   e. Nitrogen oxides (NOx)
   f. Sulfur oxides (SOx)
   g. Suspended Particulate Matter (PM 2.5 & 10)
   h. Ozone (O3)
   i. Lead (Pb) & Mercury (Hg)
   j. Radioactive Elements & Gases
51. Explain how each of the following primary pollutants are produced in the combustion process:
   A. Carbon Dioxide  B. Carbon Monoxide  C. Nitrogen Oxides (NOX)  D. Sulfur Oxides (SOX)  E. VOC’s
42. What is PM 2.5? Why is it segregated from other particulates? What is PM 10? What are their health effects?
43. What is VOC’s? What are the major sources? Why is it considered an air pollutant? Are there health risks?
44. Give the reaction sequences for making nitric acid and sulfuric acid in the atmosphere.
45. What is the difference between industrial-air smog and photochemical smog?
46. How do carbon monoxide, nitric oxide, nitrogen dioxide, and ozone concentration vary with season in an urban area?
47. What two factors determine the capacity of the atmosphere to dilute pollution? Explain both of them.
48. Don’t forget the layers of the atmosphere.
49. What is acid deposition? What are the different types of acid deposition? What are the effects of acid deposition? (Be able to list at least four effects.)
50. What are some indoor air pollutants? Is indoor air pollution regulated the same way as outdoor air pollution? Explain.
51. Be familiar with the following indoor air pollutants:
   A. Radon  B. Asbestos  C. Lead (rarely airborne)  D. Carbon Monoxide  E. Nitrogen Oxides  F. Formaldehyde  G. Cigarette Smoke  H. Radon
51. Explain how noise can be pollution.
52) Explain the “urban heat island” effect.
53) What are NAAQS? What law governs their establishment? When is it up for renewal?
54) Explain what a temperature inversion is, and how it relates to air pollution.
55) Remember that salinity is the salt content in ocean water. Under what type of pressure cell would you expect salinity to increase?

Acid Rain
56) How is the pH scale constructed? What is Neutral? Alkaline? Acidic?
57) What is the normal range of pH for rainwater? Ocean Water?
58) At what pH do aquatic systems begin to be affected by acid rain? At what pH do aquatic systems become uninhabitable to all indigenous fish (e.g., all fish die)?
59) What are the gases that contribute to acid rain? What are their sources? What are the reactions that result in acidic rainwater?
60) How does acid rain affect mountain forests of NC? Other forests (Temporal Deciduous vs. Boreal)? What about other biomes?

Miscellaneous Thinking Questions
55. Remember that salinity is the salt content in ocean water. Under what type of pressure cell would you expect salinity to drop? What would cause it to increase?
56. What other factors influence salinity?
57. Why can we confidently conclude that ocean currents and weather transfer heat from the equator towards the poles?
58. How do the oceans play a role in sequestering CO₂? How does it affect the alkalinity & pH of the oceans?
59. How do the ocean & atmosphere interact to affect weather?
60. How are surface ocean circulation and atmospheric circulation coupled?