

ATS 621: Midterm Review Questions

The following are some conceptual questions that you may want to go over in preparation for the midterm. This is a starting point for your studying, but I recommend reviewing your homework and going through additional problems from the book in preparation for the exam. Note that the exam is closed note, closed book and I expect you to be familiar with basic equations (eg. geostrophic wind, barometric law, ideal gas law) and basic reactions (eg. Chapman mechanism, NO_x-catalyzed O₃ loss)

1. What are the different measures of atmospheric composition? What are each of these measures best suited for?
2. What is the oxidation number of C in methane? In carbon dioxide? Is the atmosphere reducing or oxidizing?
3. What is a radical?
4. What is a three-body reaction?
5. How do you calculate the reaction rate for chain reactions?
6. If you have an unsaturated parcel of air in the atmosphere at a specified T and P how could changes in the environment lead to the formation of clouds or fog?
7. What is the pressure and temperature structure of the atmosphere and how do we explain it?
8. How would you calculate the mass of the troposphere?
9. Why does a cool ocean breeze accompany warm summer days on the beach?
10. How do the depth of the Martian and Venutian atmosphere compare to Earth? Why?

11. What does steady state mean?
12. What is the difference between an Eulerian and Lagrangian mass balance equation?
13. What is the definition of lifetime? What does it mean physically?
14. What controls atmospheric oxygen?
15. What have been the human impacts on the nitrogen cycle? How?
16. What is the seasonal cycle of O_2 and CO_2 ?
17. What are the sources and sinks of atmospheric CO_2 ?
18. Where has all of the CO_2 from fossil fuel burning gone?
19. Why is the ocean slightly basic?
20. Why is deep water formation important for atmospheric CO_2 ?
21. What role does the dissolution/formation of calcium carbonate shells play in atmospheric CO_2 levels?
22. What are the typical time scales for global horizontal and vertical exchange in the atmosphere?

23. Why are horizontal winds stronger in the winter?
24. Why is the Hadley Circulation wrong?
25. What are the connections between buoyancy, stability and mixing? How do you determine atmospheric stability?
26. Explain the three principal inversions mentioned in class:
 - a. Subsidence inversion
 - b. Night-time inversion
 - c. Stratosphere
27. For a continuous pollution source at the surface, what time of year and time of day would you expect to be breathing in maximum concentrations?
28. How is air transferred across the ITCZ?
29. How can you explain high pollution levels in LA?
30. What is a blackbody?
31. If a body #1 has a higher temperature than body #2 what are the relative differences in their blackbody curves?

32. What is Kirchoff's Law of radiation?
33. What does "effective temperature" mean? What does it depend on?
34. If you examine the terrestrial radiation spectrum from space, how can you establish the approximate height of different gases in the atmosphere?
35. What is the atmospheric window?
36. What is the greenhouse effect?
37. What makes a gas an effective greenhouse gas?
38. Explain the concepts of radiative forcing and greenhouse warming potential (GWP)
39. What kind of photon is required to break a (strong) O₂ bond? How do O₂ and O₃ photolysis differ?
40. What does a photolytic rate constant depend on?
41. What is the major source of OH in the atmosphere?
42. How can you identify a propagation reaction?

43. Explain the location of the ozone layer

44. Why do we treat species in chemical families (ie. Ox, NOx, etc.)?

45. What is the Chapman mechanism? What did calculations based on this mechanism reveal about the balance of O₃ production and loss in the stratosphere?

46. What are the stratospheric O₃ catalytic loss cycles? What are the sources/sinks of the catalysts?

47. What time of year does the Antarctic ozone hole appear? Why?

48. What process is responsible for ozone depletion in the Antarctic?

49. Why can PSCs form at T>185K?