

**GEO 302c Climate: Past, Present and Future
Review Questions for Exam 1**

Note that Exam 1 will have 50 multi-choice questions. The contents to be tested are mainly from the book (see below for specific chapters) plus some additional materials that have been emphasized in class.

Chapter 1 (p. 1-16)

1. What are the components of Earth's climate system?
2. How does climate differ from weather?
3. What is Earth's average surface temperature at the present?
4. What temperature scales are commonly used today?
5. How do scientists study past climates and project changes that lie in our future?
6. What factors drive changes in Earth's climate? Climate forcing (natural and anthropogenic) and examples (e.g., p. 10).
7. How do the many parts of Earth's climate system react to these driving forces and interact?
8. Response times of various climate system components (e.g., Table 1.1).
9. What is a positive feedback? What is a negative feedback? You should be able to give some examples (p. 15-16).
10. Do positive feedbacks always make the climate warmer? How could they make it colder?

The following questions (except otherwise explicitly stated) are based on the text downloadable from the course website at

http://www.geo.utexas.edu/courses/302c/EarthsClimate_Web_Chapter.pdf

11. What is radiation?
12. What is shortwave radiation? What is insolation? Understand differences in ultraviolet, visible light, and infrared radiation.
13. What is longwave radiation? How does solar radiation arriving on Earth differ from the radiation emitted by Earth?
14. What determines the amount of radiation emitted? Hint: read the 1st paragraph of p. 4.
15. On a long-term basis, what is the percentage of incoming solar radiation reflected to space? Absorbed by the surface? Absorbed by the atmosphere?
16. What is the greenhouse effect? Why is it good to life on Earth?
17. What kind of radiation is trapped by greenhouse gases? What is the effect on Earth's climate?
18. What are the two main gases in Earth's atmosphere? Are they greenhouse gases?
19. What are trace gases? Give examples of greenhouse gases.
20. What are the four layers of Earth's atmosphere? Based on what are these four layers defined? What are the main features associated with troposphere and stratosphere?
21. Which gas is a greenhouse gas and a pollutant and a gas that blocks ultraviolet radiation and a gas that is mostly located in the stratosphere?

22. Why does incoming solar radiation vary with latitude?
23. What is albedo? What are typical albedo values for snow, desert, forest, and the oceans?
24. What determines season?
25. What are the major forms of heat transfer in the climate system?
26. What is sensible heat? What is latent heat? Give examples.
27. What is conduction? What is convection? Give examples.
28. What are some important characteristics of water vapor that are important to the climate system? (e.g., the most important greenhouse gas, central to the hydrologic cycle, carries latent heat, its holding capacity in air strongly depends on temperature; see p. 12-14).
29. What is the fundamental cause for the circulation of the atmosphere and oceans? (cf. Fig. 2-14 A and B).
30. How does the atmosphere pressure change with altitude?
31. How many forces are acting on the winds?
32. What is the pressure gradient force? How does it affect the wind?
33. What is the Coriolis force? How does it affect the wind?
34. What is the frictional force? How does it affect the wind?
35. How does the wind blowing around a cyclone (i.e., a low pressure system) in the Northern Hemisphere? Will it result in a convergence or divergence? An upward (or rising) motion or downward (or sinking) motion? How will these change in the Southern Hemisphere?
36. How does the wind blowing around an anticyclone (i.e., a high pressure system) in the Northern Hemisphere? Will it result in a convergence or divergence? An upward (or rising) motion or downward (or sinking) motion? How will these change in the Southern Hemisphere?
37. Describe general circulation of the atmosphere (e.g., Fig. 2-16). You need to focus your attention on: a) approximate latitudes for pressure systems including ITCZ; b) latitudes for wind patterns (e.g., trade winds, easterlies, westerlies); c) latitudes for the Hadley cells and polar cells? d) latitudes for precipitation and evaporation; e) their differences and similarities in the Northern and Southern Hemisphere.
38. What are monsoons? How are they formed? Where are they? Which one is the largest? What causes the monsoon circulation to reverse from summer to winter?
39. How are clouds formed?
40. What are the steps to make precipitation? What is orographic precipitation? What is the lee or rain shadow?
41. What are the major characteristics of the oceans? [Recall I discussed this in length in class.]
42. How is the surface circulation of the oceans formed? What is its role in climate? What are warm currents? What are cold currents? You need to locate the Gulf Stream, the North Atlantic Drift, and the California Current.
43. What is a subtropical ocean gyre?
44. What causes upwelling? What is the Ekman Spiral? What is the Ekman transport?
45. What is thermocline? What is the thermohaline circulation? How does seawater density depend on temperature and salinity? What factors affect salinity?
46. Why does deep water form today at higher latitudes?

Questions 47-48 corresponds to Chapter 16, p. 299-302, Ch. 17, p. 321-324

47. What is El Nino? What is La Nina? What is the Southern Oscillation? What is the Walker Circulation? How do they affect climate?
48. What is NAO? What is PDO? How do they affect climate?
49. What are effects of sea ice on climate?
50. What are effects of glacial ice on climate?
51. What are differences between sea ice, mountain glaciers, and continental ice sheets?
52. What are carbon's major reservoirs and their relative sizes (e.g., which is the largest, smallest, intermediate, etc.)?
53. What are the relative rates of carbon cycling (e.g., fastest, etc.)?
54. What is photosynthesis? What is transpiration?
55. What is oxidation?
56. What are the major land biomes (e.g., polar ice cap, desert, tundra, savanna, grassland, conifer forest, deciduous forest, tropical rainforest) and where are they located? What are the relationships between their geographic distributions and precipitation conditions?
57. What regions of the ocean are most productive? Why?
58. How does life affect climate?
59. Atmospheric CO₂ trends measured over the last decades show two superimposed effects. What are they?
60. What human activities cause CO₂ to increase in the atmosphere?
61. Describe two examples of vegetation–climate feedbacks.

Ch. 2 (p. 31-39)

62. What are general circulation models? What components do they have? What processes do they represent? What are gridboxes? Why are GCMs useful? What are their limitations? Why are there also needs to develop simpler climate models?
63. What is called the control case? What are boundary conditions?
64. How are the climate models evaluated?
65. Why aren't models of the atmosphere and ocean coupled continuously to each other as they are run?

Ch. 3, 46-47; Ch. 3 (p. 53-58)

66. What is the Gaia hypothesis? Why is it useful? What are its limitations?