

GEO 302c Climate: Past, Present and Future Review Questions for Exam 2 Note that Exam 2 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. Most of the questions below are from the book.

1. What are carbon's major reservoirs and their relative sizes (e.g., which is the largest, smallest, intermediate, etc.)?
2. What are the relative rates of carbon cycling (e.g., fastest, etc.)?
3. What is photosynthesis? What is transpiration?
4. What is oxidation?
5. 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?
6. What regions of the ocean are most productive? Why?
7. How does life affect climate?
8. Atmospheric CO₂ trends measured over the last decades show two superimposed effects. What are they?
9. What human activities cause CO₂ to increase in the atmosphere?
10. Describe two examples of vegetation–climate feedbacks.
11. **Chapter 2** (p. 17-31) What are proxy climate data? How are they different from the instrumental data? Can a thermometer be exposed under sunlight when it is used to measure air temperature? Give your reasons.
12. What are the commonly used proxy data for climate studies? Where are they distributed? What climate information (or variables) can they tell us? What are their time spans and resolutions? How does the importance of each type of proxy data change according to the time scale being examined?
13. Why are ocean sediments and ice cores so important to study the past climate? Which two major groups of organisms are most important to climate reconstructions over the past several million years?
14. Why do we care about the past climate change?
15. What are greenhouse eras? What are icehouse eras? Give examples. How many icehouse eras have existed during the earth's history?
16. **Chapter 3** (pages 40-53) What factors explain why Earth has remained habitable for most of the 4.55 Byr history?
17. What climate factors affect the removal of CO₂ from the atmosphere by chemical weathering?
18. Be able to read (and explain in simple terms) a chemical reaction showing how chemical weathering remove CO₂ from the atmosphere. (p. 49)
19. Why is chemical weathering a plausible thermostat for Earth's climate?
20. If Earth's surface froze solid (i.e. the snowball earth), what would happen to CO₂ emissions from volcanoes and to CO₂ removal by chemical weathering?
21. **Chapter 4** Do glaciations *always* occur when continents are located in polar positions? (p. 64-67)
22. How could chemical weathering be both the driver and the thermostat of Earth's climate?
23. What explains the changes in Earth's climate over the last several hundred million years?
24. **Chapter 5** Why was Earth ice-free even at the poles 100 Myr ago?

27. How well do model simulations capture the distribution of temperatures 100 Myr ago?
28. What are the possible causes of mismatches between the models and geologic observations?
29. What regions of the continents were flooded by high seas 100 Myr ago?
30. **Chapter 6 Key terms:** Oxygen isotope ratios, fractionation (see also Appendix 1)
31. What caused Earth's climate to cool over the last 55 Myr?
32. What kinds of changes in vegetation and ice show that Earth has cooled in the last 55 Myr?
33. What do changes in $\delta^{18}\text{O}$ values in the last 55 Myr tell us about climate changes?
34. What hypotheses are available to explain the last 55 Myr cooling?
35. Explain how chemical weathering could drive the cooling and at the same time moderate it.
36. **Chapter 7 Key terms:** tilt (obliquity), eccentricity, precession (axial precession, precession the ellipse), solstices, equinoxes, perihelion, aphelion, wavelength, period, frequency, amplitude, modulation, insolation
37. Why does Earth have seasons?
38. When is Earth closest to the Sun in its present-day orbit? How does this position affect the amount of radiation received by Earth?
39. What is modulation of a cycle?
40. What aspect of Earth's orbit changes in cycles of 41,000 years? Of 100,000 years? Of 23,000 years?
41. Which latitudes are most affected by changes in the tilt of Earth's axis?
42. Earth's tilt is slowly *decreasing* today. As the tilt decreases, are the polar regions receiving more or less solar radiation in summer? In winter?
43. How does axial precession differ from the precession of the ellipse?
44. Sketch a complete cycle of the precession of the March 20 equinox in an eccentric orbit?
45. How does eccentricity combine with precession to affect long-term insolation on Earth?
46. What features of the ice core CH_4 signal suggest a link to tropical monsoons?
47. To what extent does a cooler glacial ocean surface explain lower CO_2 in the glacial atmosphere?
48. Which reservoir has the most carbon: the atmosphere, vegetation, or the ocean?
49. Where did the carbon (CO_2) removed from the atmosphere go during glaciations?