

Geology 414/514
Introductory Geochemistry
SAMPLE EXAM QUESTIONS

NOTE: These are samples of the types of questions you may expect on class exams. They are not intended to be a comprehensive listing of exam questions or topics. You should also include the Study Questions at the end of each Chapter.

1. Set up the expressions for K_T , K_1 , K_2 and K_3 for $\text{Al}(\text{OH})_3$.
2. Assuming simple solubility relationships (i.e., no interfering reactions), what is the solubility of strontianite?
3. How would you test the effect of temperature on the K_{eq} of a specific reaction?
4. Calculate the value of K when a soluble Ba salt is added to a solution containing excess SrCO_3 . Write all pertinent reactions and equations.
5. a. Write the reaction(s) for the hydrolysis of CdSO_4 .
b. Set up the expression by which you could calculate $K_{hydrolysis}$ for CdSO_4 .
6. For the hydrolysis of CuSO_4 , what is the pH of a 10^{-3} M solution?
7. Define and differentiate between a homogeneous and a heterogeneous chemical system.
8. What is a stable geochemical system, i.e., how do we define stability?
9. Define ionic strength. Why is this an important parameter in solution geochemistry?
10. What is buffering? What types of components are necessary for a system to exhibit buffering?
11. Give an example of buffering. For full credit, include all specific chemical reactions.
12. What are the reactions/factors that must be considered in determining the solubility of pure calcite in pure water? Give pertinent expressions and describe and/or discuss the reactions and/or factors which must be considered and are specific to this case.
13. What are the important properties/characteristics of:
(a) hydrophobic colloids and (b) hydrophilic colloids?
13. Is there more or less uncertainty in the laboratory determination of the K_{sp} for dolomite than for the other common carbonates? Explain.
14. What is the geochemical contradiction associated with the presence of aragonite in present day surface sediments?
15. Discuss the factors affecting the stability of colloidal systems. Why/how is this an important geochemical consideration in natural systems? Be thorough!
16. Define/describe ion exchange in natural components of soils and sediments.
17. Describe one or more situations where knowledge of the interactions of trace metals with geochemical phases of soils can be applied to management of contaminated sites.
18. What are the two major types (sources) of electrical charges on soil colloids?
19. Is there any significant difference in the solubility of amorphous silica and quartz? If so, describe any implications of this difference.
20. What are the most important factors needed to describe the weathering pattern of feldspars into phyllosilicate clays?
21. Are supersaturated conditions common in natural geochemical systems? Cite at least one example of a substance/mineral that may be found at supersaturated conditions.
22. Describe the effects of organisms on carbonate solubility.

23. How does the solubility of calcite vary as a function of temperature and pressure?
24. Are all cations in soil/sediment solutions bound to the solid phases by the same mechanism? What evidence can you present to justify your answer?
25. Calculate the ΔH° for the formation of CaCO_3 . What can you interpret concerning the ease or spontaneity of the reaction to form CaCO_3 from the calculated ΔH° ?
26. Calculate the ΔG° for the following reaction:

$$\text{MgCO}_3 + \text{PbSO}_4 \rightleftharpoons \text{PbCO}_3 + \text{MgSO}_4$$
 - a) Is this reaction spontaneous?
 - b) What can you interpret concerning the rate or ease of reaction from the ΔG° ?
27. For the reaction: $\text{FeCO}_3 + \text{O}_2 + \text{H}_2\text{O} \rightleftharpoons \text{Fe}_2\text{O}_3 + \text{H}_2\text{CO}_3$
 - a) Balance the equation:
 - b) Calculate the ΔG° for the reaction.
 - c) Is the reaction spontaneous? What is the basis for your answer?
 - d) Calculate the K_{eq} for this reaction.
28. (a) What is Eh?
 (b) What are some difficulties associated with Eh measurement?
29. The chemistry of Fe and Mn is similar, yet compounds (minerals) of each, although associated, are usually found physically separate in natural deposits. What are some of the possible reasons for the separation of Fe from Mn compounds?
30. Interpret the attached Eh-pH diagram by discussing the stability fields of each mineral form present and the boundaries between each of the minerals.
32. What are some of the applications/uses of Eh-pH diagrams. What are some of the major limitations?
32. What is the importance of ion exchange in colloids?
33. Discuss the significance of isomorphous substitution in clay minerals.
34. What types of organic compounds are thought to be the primary precursors of petroleum?
35. How may organic compounds interact with mineral colloids?
36. What is the importance/influence of organic colloids on metal transport in the surface environment?
37. What are the kinds of colloidal systems important in geology?
38. What is a theory on the formation of "Liesegang Rings?"
39. Discuss the stability of different types of colloidal systems.
40. What ionic properties generally govern the adsorption of ions by colloids?
41. What is the probable origin of chert?
42. Discuss the distribution of silica in natural waters.
43. Relate the structure and composition of silicate clays to their most important properties.
44. The Eh measured in mine waters draining sulfide minerals is usually well below the theoretical maximum for the $\text{O}_2 - \text{H}_2\text{O}$ couple. Discuss some of the possible reasons for this observation.
45. What is an important difference in the weathering of galena as compared to that of pyrite?
46. What factor controls the solubility, hence the behavior of a given metal in an aqueous system?