GEOL 4320/6320 Questions for Exams I and II  
Draft of August 3, 2015

Three to six of the following questions will account for at least 85% of the points on two closed-note closed-book 75-minute exams. Prior to each exam, the professor will announce which questions might be asked on the upcoming exam (for example, in 2013, students were responsible for Questions 1 to 17 on Exam I). Students will be expected to answer every question that is asked on the exam, so that they will be responsible for all of the following questions that are announced by the professor: they will not be allowed to choose the questions that they answer.

1. What are the different kinds of hydrocarbon resources exploited or potentially exploited by humans? Define each sufficiently to distinguish it from the others, and indicate any synonyms.

2. Explain the difference between continuous accumulations and discontinuous accumulations, and link each to a kind of petroleum resource.

3. What are the five fundamental or essential elements of a conventional petroleum accumulation? Define each.

4. What are, to date, the depths of the world's deepest onshore petroleum borehole, the world's deepest offshore petroleum borehole, and the world's deepest borehole of any sort? (Rounding to multiples of 5000 feet is acceptable for these answers.) Where was each drilled?

5. What solutes are typically most abundant in the deep waters of sedimentary basins? Put a star next to the one that is typically most abundant.

6. What are the three mechanisms that make the bit turn at the bottom of boreholes drilled in the early Twenty-first Century?

7. What is or are the role or roles of drilling mud in the drilling of a petroleum borehole?

8. What kinds of blowout preventers are used in drilling petroleum boreholes? Sketch the external appearance of a set of them and label the two principal kinds that should be evident from the outside.

9. Explain the differences between drilling pipe, drill collar, drilling riser, casing, and tubing.

10. What kinds of drilling mud have been and/or are presently used in drilling petroleum boreholes?

11. What is the relevance of the existence and kind of drilling mud used in a particular borehole to a geoscientist who, years later, has no physical connection to the drilling of that borehole?
12. What is overpressure, and why should a geoscientist care?

13. What information typically appears on a mud log?

14. What process and/or measurement does the logging tool do in generating a ______ log, and what lithologic characteristic(s) do we think the log tells us?

15. As you hand your completed exam to the instructor in the hallway, say the name of the oldest and most internationally recognizable well-logging company.

16. What can be the cause of missing section in the logs of a borehole?

17. What can be the cause of repeated section in the logs of a borehole?

18. Petroleum can be divided into five categories of organic compounds. For each, give the name and sketch a representative or small typical structure. Put a star next to the two that are most abundant in most crude oils.

19. What are the two more-or-less scientific explanations of the origin of petroleum, and what lines of evidence support each?

20. Envision a body of organic-rich sediment that is deposited on the sea floor and subsequently buried to great depth. At what stages, as defined by depth and/or temperature and/or time, in its history are hydrocarbons emitted from such a sediment, and what is their chemical nature?

21. What does Rock-eval do, what does it report, and what can be inferred from it?

22. What is API gravity, and what other characteristics of petroleum are commonly correlative with it?

23. Sketch a typical whole-oil gas chromatogram, labeling the axes and indicating the significance of the peaks.

24. What is primary migration, and how does it happen?

25. What kinds of rocks commonly function as seals for petroleum accumulations, and why do they do so?

26. What determines, at the most fundamental level, whether a particular stratum functions as a seal or as a migration pathway for a particular accumulation of petroleum?

27. What determines whether a fault functions as a seal or as a migration pathway for petroleum?
28. Define porosity and explain how geoscientists commonly quantify it.

29. Make a table showing a classification of porosity by its relationship to rock fabric and to its time of origin. Within this classification, what kind of porosity is most commonly envisioned by explorationists, or by their less-than-thoroughly-geologically-aware management, as the principle residence of hydrocarbons in petroleum accumulations?

30. What is the porosity of a typical moderately sorted sand? What is the range of porosities in sands? What range of porosity is found in petroleum reservoir rocks? What accounts for the difference between the second answer (for sands) and the third (for sandstones)?

31. What parameters or factors (not processes) control the porosity of a siliciclastic sandstone, and how does porosity typically vary with each? You can make a two-column table, with controlling parameter on left and trend in porosity on the right, but make sure that the relationship between parameter and trend is explicit and clear (e.g. “Porosity decreases with increasing X” or “Porosity less in sands with greater Y”).

32. What is permeability, by what unit or units do geoscientists commonly quantitatively measure it, and what is the range of quantitative values of permeability in reservoir rocks?

33. The attached diagram shows the results of mercury-injection tests of three reservoir rocks. Which is the curve for the most permeable reservoir rock? Explain why you make that inference from that curve.

34. Make one micro-scale sketch of grains and fluids in a typical petroleum reservoir before its exploitation and one of the same afterwards. Subdivide the fluids to the maximum extent possible.

35. Make a large-scale sketch of a petroleum reservoir, showing the locations of different fluids and labeling all of the relevant features.

36. Make a list of categories of trapping mechanisms, listing subsets where appropriate. Put a star (a five-pointed figure) next to the most common category, and put an asterisk (a six-to-eight-pointed figure) next to the most abundant subset of at least one category.

37. Define or explain the concept of the petroleum system.

38. What are the relative thermal conductivities of various siliciclastic sedimentary rocks, carbonate rocks, and salt (halite), and why is this of interest to petroleum geoscientists?

39. What determines whether one specific boundary between two infinitely thick strata generates a reflection of seismic energy as recognized in the seismic data used in petroleum exploration and exploitation?
40. Sketch a stratigraphic column consisting of three strata, the uppermost with greater acoustic impedance, the middle of smaller acoustic impedance, and the lower of the same acoustic impedance as the uppermost. In two different traces, sketch the response of seismic energy with a wavelength less than the thickness of middle stratum, as it interacts with the two stratal boundaries. In a third trace, show the sum of the two responses, and thus the response that would be shown in seismic data.

Repeat the above, but with the middle stratum much thinner, so that the seismic energy has a wavelength much greater than the thickness of middle stratum.

41. When given a seismic section, what questions should a geoscientist ask about that section or map before beginning to interpret it?

42. Explain, using a sketch or sketches, what goes into generating a single vertical seismic trace on a seismic section.

43. Make a sketch of what a gas-bearing petroleum accumulation trapped in an anticline would look like in a black-and-white seismic presentation (you don’t need to sketch individual traces, just the lighter and darker areas or lines). Then make the same sketch for a modern American-style color presentation (if you don’t have pencils or pens of the appropriate colors, just use two different shadings and label what color each represents). Then make the same sketch for a modern European-style color presentation (again, if you don’t have pencils or pens of the appropriate colors, just use two different shadings and label what color each represents, but be consistent with the scheme that you used for the American-style color presentation).