Questions for Exam 2

Scientific Thought II

Spring 2010

Exam 2 will consist of a selection of these questions.

1. State the meaning of the term "calcareous earth" and give some examples of calcareous earths.
2. What is the fire theory of lime? Describe how this theory explains two facts about lime.
3. Is there a gain or loss of weight when lime is produced? How was this explained by advocates of the fire theory like Vitruvius?
4. What happens when calcareous earth is calcined, according to Black's theory?
5. What was the result when Marggraf distilled calcareous earth? What did Black infer from this? Explain how this conclusion follows.
6. State Black's explanation for the following:
   (a) Lime is more active than calcareous earth.
   (b) Calcareous earth effervesces in acids.
   (c) Lime is soluble in water and calcareous earth is not.
   (d) A crust forms on lime water.
   (e) Lime makes alkalis caustic.
7. According to Meyer's theory, what happens when calcareous earth is calcined? What is lime? Why is there a loss of weight?
8. What is Meyer's explanation for the result Marggraf obtained when he distilled calcareous earth?
9. State Meyer's explanation for the following:
   (a) Calcareous earth effervesces in acids.
   (b) Lime is soluble in water and calcareous earth is not.
   (c) A crust forms on lime water.
   (d) Lime makes alkalis caustic.
10. Describe two experiments of Black that, assuming his theory, determine the percentages of lime, air, and water in calcareous earth. What are these percentages and how are they inferred from these experiments?
11. Let B and M be as in Table 1. For each of the following three pieces of evidence, say whether it favors B or M over the other and justify your answer using the law of likelihood.

	B	M
1	Calcareous earth = lime + fixed air + water.	Calcareous earth = lime - causticum + water.
2	Strongly heating calcareous earth drives off the fixed air and water and adds nothing.	Strongly heating calcareous earth drives off the water and adds causticum.
3	In Marggraf's distillation of calcareous earth, no water was converted into air.	In Marggraf's distillation of calcareous earth, some water was converted into air.
4	When calcareous earth is placed in acid, the air released comes from the calcareous earth.	When calcareous earth is placed in acid, the air released comes from the acid.
5	Lime has greater attraction for fixed air than for water.	Causticum is acidic.

Table 1: Identification of B and M

E_1 When Marggraf distilled calcareous earth he obtained water that equaled 3% of the weight of the calcareous earth used. When Black dissolved calcareous earth in acid there was a loss of weight equal to 40% of the weight of the calcareous earth. When Black calcined calcareous earth it lost 43% of its weight.

E_2 (a) A crust of calcareous earth forms on the surface of lime water exposed to the atmosphere. (b) When calcareous earth is combined with any ordinary acid and then exposed to the atmosphere, the acid doesn't leave the earth and go into the air.

E_3 Calcareous earth combined with any ordinary acid either leaves syrup of violets blue or turns it red (depending on whether or not there is excess acid). Lime turns syrup of violets green.

12. One of Darwin's arguments that species have been produced by natural selection is based on the experience of breeders. State the argument.

13. The distinction between species and varieties is unclear. Does this fact favor natural selection over independent creation as the origin of species? Justify your answer using the law of likelihood.

14. State a fact about how new species have appeared that Darwin cited as supporting his theory. Does this favor natural selection over independent creation as the origin of species? Justify your answer using the law of likelihood.

15. State a fact about the extinction of species that Darwin cited as supporting his theory. Does this favor natural selection over independent creation as the origin of species? Justify your answer using the law of likelihood.

16. State a fact about the relation between species at different times that Darwin cited as supporting his theory. Does this favor natural selection over independent creation as the origin of species? Justify your answer using the law of likelihood.

17. What did Darwin regard as perhaps "the most obvious and serious objection" against his theory? What was his answer to this objection?

18. For each of the following facts, say whether it favors natural selection over independent creation as the origin of species and justify your answer using the law of likelihood.

    (a) Species on different continents are different, even when the physical conditions are similar.

    (b) Species on the same continent are similar, even when the physical conditions are different.

    (c) Oceanic islands have relatively few native species.

    (d) A large proportion of the native species on oceanic islands are endemic.

    (e) Oceanic islands don't have native terrestrial mammals but they do have unique native species of bats (aerial mammals).

    (f) The native species on oceanic islands are related to, but not identical to, those on the nearest continent.

19. Do the observed homologies between different species favor natural selection over independent creation as the origin of species? Justify your answer using the law of likelihood.

20. Does the similarity of embryos of different species favor natural selection over independent creation as the origin of species? Justify your answer using the law of likelihood.

21. Does the existence of rudimentary organs favor natural selection over independent creation as the origin of species? Justify your answer using the law of likelihood.

22. What did Einstein mean by "the rest system"?

23. What procedure did Einstein envisage for determining the position of a particle at rest in the rest system?

24. Einstein said: "It might seem as if all difficulties involved in the definition of 'time' could be overcome by substituting 'position of the small hand of my clock' for 'time'." Under what circumstances did Einstein think this definition is (a) adequate and (b) inadequate? What is the reason for the difference?

25. State Einstein's definition of what it means for clocks at different places to be synchronous.

26. How did Einstein define the rest-system time of an event?

27. What is Einstein's (1905) principle of relativity? What are two reasons for believing this principle mentioned by Einstein?

28. Did electrodynamic theory, as understood in 1905, satisfy Einstein's principle of relativity? Explain.

29. State Einstein's principle of the constancy of the velocity of light. Your statement should indicate what coordinate system(s) the principle refers to and what it claims does not alter the velocity of light.

30. Suppose a rigid rod is moving with constant velocity in the rest system. What does Einstein mean by (a) the length of the rod in the moving system, and (b) the length of the rod in the rest system?

31. If a rigid rod has length l when at rest in the rest system, what is its length when it is moving with uniform velocity in the rest system, if by length we mean length in the moving system? Explain how your answer follows from Einstein's principles.

32. Let a rigid rod with endpoints A and B be moving in the rest system with constant velocity in the direction from A to B. Suppose there are clocks on the rod at A and B that tell rest-system time. Prove that these clocks aren't synchronous in the moving system.

33. Einstein argued that clocks synchronized in one coordinate system aren't synchronized in a coordinate system moving relative to the first. How does it follow from this that "we cannot ascribe *absolute* meaning to the concept of simultaneity"?

34. A rod is traveling in the rest system, in the direction of its length, at half the speed of light. If the rod is 2 meters long in the moving system, how long is it in the rest system? Show how you obtained your answer.

35. In the moving system, are clocks at rest in the rest system running fast, slow, or neither? Justify your answer.

36. What is Einstein's general principle of relativity? How does it differ from the special principle?

37. Let S_1 and S_2 be two fluid bodies, each far from all other bodies and each rotating in a coordinate system in which the other is at rest. Suppose the surface of S_1 is a sphere and the surface of S_2 is an ellipsoid. How would Newton's mechanics explain this difference? What was Einstein's epistemological objection to Newton's explanation? Is the objection correct? Justify your answer to the latter question.

38. Let K be a coordinate system in which Newton's laws of motion hold and let K' be another system that is uniformly *accelerated* relative to K. Why might it seem that Newton's laws don't hold in K'? What was Einstein's method for avoiding this apparent counterexample to general relativity?

39. Explain Einstein's argument that, if we accept the general principle of relativity, then we must reject Euclidean geometry.