

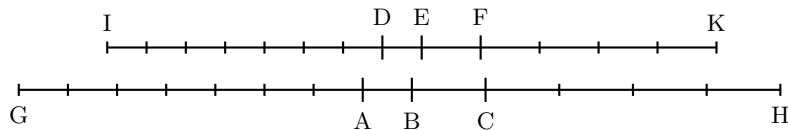
Questions for Exam 3

Scientific Thought I

Fall 2009

Exam 3 will consist of a selection of the following questions.

1. Galileo says he has discovered some properties of motion “which have not hitherto been either observed or demonstrated.” Explain the difference between observing and demonstrating properties of motion.
2. How does Galileo define uniform motion?
3. State one of Galileo’s “axioms”. What would such “axioms” be called in Euclid’s terminology, and in Aristotle’s terminology? Explain.
4. A particle moves uniformly through distances AB, BC, and the times to traverse these distances are DE and EF, respectively. Let GB and IE be m times AB and DE, respectively; let BH and EK be n times BC and EF, respectively.



Explain why the following statements are true; say where Galileo’s definition and axioms for uniform motion are used.

- (a) The time required to traverse GB is IE
 - (b) The time required to traverse BH is EK
 - (c) If $GB > BH$ then $IE > EK$
 - (d) If $GB = BH$ then $IE = EK$
 - (e) If $GB < BH$ then $IE < EK$
 - (f) $AB:BC = DE:EF$
5. What did Galileo mean by “naturally accelerated motion” and “uniformly accelerated motion”?
 6. What two reasons did Galileo give for thinking that naturally accelerated motion is uniformly accelerated? Which reason did he regard as the most important?
 7. Did Galileo demonstrate that freely falling bodies are uniformly accelerated? Explain.
 8. Was Galileo trying to find the cause of naturally accelerated motion? Justify your answer.

9. What reasons for believing the following assumption were suggested by Galileo? To which reason did he give the greatest weight?

The speeds acquired by one and the same body moving down planes of different inclinations are equal when the heights of these planes are equal.

10. Explain Galileo's proof of the following theorem:

The time in which any space is traversed by a body starting from rest and uniformly accelerated is equal to the time in which that same space would be traversed by the same body moving at a uniform speed whose value is the mean of the highest speed and the speed just before the acceleration began.

11. Explain Galileo's proof of the following theorem:

The spaces described by a body falling from rest with a uniformly accelerated motion are to each other as the squares of the time-intervals employed in traversing these distances.

12. Explain why the following is a corollary of a theorem of Galileo's:

For a body accelerating uniformly, the spaces traversed in equal intervals of time, starting at the beginning of motion, are in the ratio of the odd numbers 1, 3, 5, 7, ...

13. Explain Sagredo's proof of the following theorem for uniformly accelerated motion:

If one and the same body, starting from rest, falls along an inclined plane and also along a vertical, each having the same height, the times of descent will be to each other as the lengths of the inclined plane and the vertical.

14. What was Galileo's experimental evidence for his claim that naturally accelerated motion is uniformly accelerated? Why is that evidence relevant?

15. What was Galileo's experimental evidence for the following assumption? Why is that evidence relevant?

The speeds acquired by one and the same body moving down planes of different inclinations are equal when the heights of these planes are equal.

16. (a) What did Descartes say is needed for knowledge to be perfected? (b) What is the first condition he said principles must satisfy? (c) How does what Descartes says here differ from Aristotle?

17. What is the first principle of Descartes's philosophy? What is his argument for it?

18. What is an argument that Descartes gives for the existence of a perfect being? Is the argument valid? Explain.

19. Having established (a) the existence of a perfect being, Descartes argues that it follows that (b) we cannot be mistaken about the things of which our mind has a very clear and distinct perception. Explain fully Descartes's argument that (b) follows from (a).

20. What is the nature of matter, according to Descartes?
21. Compare and contrast Descartes's account of matter with that of Democritus. Where they differ, explain Descartes's reason for not accepting Democritus's view.
22. What is Descartes's definition of movement properly speaking? If a balloon is being carried along in a breeze, does it have movement properly speaking? Explain.
23. What are Descartes's first two laws of nature? State three ways that these laws differ from Aristotle.
24. What did Descartes cite as an objection to Ptolemy's astronomy? Why is it an objection?
25. Does Descartes hold that the earth moves? Does he hold that it orbits the sun? Explain how he reconciles his answers to these questions.
26. State one respect in which Descartes's astronomy agrees with Copernicus (and differs from Ptolemy). State four respects in which Descartes's astronomy differs from Copernicus.
27. Descartes said that his theory of vortices, and his theories about the invisible parts of bodies, could be false. Would he say that if he had got them by following the methodology that, at the beginning of *Principles of Philosophy*, he said should be followed? Explain.
28. What is an argument that Descartes gave for saying that his theories about the invisible parts of bodies could be false?
29. Descartes claimed that his theories about the invisible parts of bodies were "morally certain." What does this mean? How did Descartes argue for this claim?
30. Descartes gave an argument that his theory of vortices, and his theories about the invisible parts of bodies, are absolutely certain; but in each case he soon backed away from the argument. What is the argument? Is the argument a good one? Explain.
31. In each of the following pairs, explain the difference between the relative and absolute concepts. Support your explanation with an example.
 - Relative and absolute time
 - Relative and absolute space
 - Relative and absolute motion
32. A stone is thrown horizontally and eventually falls to the ground. Explain how Newton's laws of motion imply that there is a force acting on the stone after it has been thrown, and the direction of this force. (Assume the earth is at rest.)
33. A magnet and a piece of iron are floating in separate dishes in a basin of water. The magnet is twice as heavy as the iron. The iron has acceleration a towards the magnet. Use Newton's laws of motion to determine the magnitude and direction of the acceleration of the magnet; indicate which laws you are using and where they are used.
34. According to Newton, what is the direction of the force that keeps the moon in its orbit? From what did Newton deduce this?

35. According to Newton, how is the force on the moon related to the moon's distance from the earth? From what did Newton deduce this?
36. Explain how Newton argued, from the properties of the force that keeps the moon in its orbit, that this force is gravity. Say where Newton's rules of reasoning are used in this argument.
37. Explain how, after arguing that the moon is kept in its orbit by gravity, Newton argued that all planets have gravity. Say where Newton's rules of reasoning are used in this argument.
38. How did Newton argue that the center of gravity of the system of the world is at rest? How does it follow from this that the earth moves?
39. (a) When Newton said that "hypotheses . . . have no place in experimental philosophy," did he mean that hypotheses should not be stated? Justify your answer with at least one reference to Newton's writings. (b) Did Newton accept the method of hypothesis? What was his reason?
40. According to Newton, what is the right way to establish causes and general laws in science? Did Newton follow this method when he argued that the moon is held in its orbit by gravity? Justify your answer to the latter question. Give specific details.
41. What evidence did Newton offer for the following?
 - (a) There is an ethereal medium that fills even what we would ordinarily regard as a vacuum.
 - (b) The density of this ether is greater the less matter is present in a place.
 - (c) Outside a dense body this ether is less dense close to the body than it is further away.
42. What did Newton suggest is the cause of gravity? According to this explanation, what is the reason why stones near the earth's surface fall? What is the reason why the planets orbit the sun?