

## **Mid-term Examination Study Questions**

### **Part I: The Scientific Enterprise**

1. What is the main difference between rationalism and empiricism? Give at least one example of a thinker representing each view. In general terms, how has the argument between rationalism and empiricism gone up to our day?
2. Explain the difference between deductive and inductive arguments. What roles do these types of argumentation play in scientific reasoning?
3. Contrast realism and instrumentalism as points of view on the interpretation of scientific theories, giving examples of thinkers who held each view.
4. What is meant by the term, “the hypothetico–deductive view”?
5. Define the term “underdetermination” and give an example of underdetermination from the history of science that we have so far reviewed.
6. Karl Popper proposed “falsifiability” as a criterion of demarcation between science and non-science. Explain what this idea means and illustrate it with at least two examples from the history of science that we have so far reviewed.

### **Part II: Ancient and Modern Models of the Universe**

7. Explain Aristotle’s view of the difference between natural and enforced motion. What kinds of causes are required to sustain the latter, according to Aristotle, and what are some of the peculiar consequences of this view?
8. Plato is said to have set the agenda for ancient cosmology with his challenge to the astronomers to “save the phenomena.” What did this mean and why did Plato and his contemporaries think it a reasonable goal for cosmology?
9. Explain, with an illustration, how Erastosthenes determined the size of the earth.
10. Give a sketch of the three main devices that Ptolemy used to model the motions of the planets.
11. What were Ptolemy’s principal “constraints” on the motions of the inner and outer planets? What observed motions of those planets were accounted for by these constraints? How are those motions “naturally” accounted for in the Copernican system?
12. Before Brahe and Galileo began to produce observational evidence that could be used to support the Copernican model of the planetary system, what were the chief of advantages and disadvantages of the Copernican system with respect to the Ptolemaic system?

### Part III: The Newtonian Universe

13. Explain what is meant by the distinction between inertial mass and gravitational mass in Newtonian physics. What is problematic about asserting that they are identical?
14. Reproduce Newton's proof that the centripetal acceleration of a planet is given by the formula  $a_c = v^2/r$ .
15. Reproduce Newton's proof that a planet moving under the influence of a central force will satisfy Kepler's second law.
16. What was the worry that led Newton to write the famous words "*hypotheses non fingo*"? What was the point that he was trying to make with this assertion?
17. Reproduce Newton's proof that a planet whose motion satisfies Kepler's third law must be moving under the influence of an inverse-square force.
18. In what sense can Newton be said to have destroyed the ancient distinction between the celestial and the terrestrial realms?

### Part IV: A Perspective

19. What was the view of the relationship between science and faith that Galileo argued for in his *Letter to the Grand Duchess*?
20. Explain how the realism–instrumentalism debate played a role in Galileo's clash with the Church over the Copernican system.
21. Explain how Roemer calculated the speed of light.
22. What was Newton's view on the distinction between absolute and relative space? How was the "bucket" thought experiment supposed to prove the reality of absolute space? What was Mach's reply?
23. What is meant by the claim that classical physics is deterministic? How can it be that physical determinism in the seventeenth century reinforced a belief in divine foreknowledge, whereas in the eighteenth century it tended to undermine belief in God, as in the case of Laplace?
24. Why is it necessary to distinguish a physical theory's being deterministic from its being able to give us stable predictions?