

### Reading Guide #2 - Space and Time

Newton, from *Principia*

1. How does absolute time differ from relative time? Characterize each.
2. How does absolute space differ from relative space? Characterize each. What is the difference between place and space?
3. What is the relation between absolute space and absolute motion?
4. How do fluctuations in the solar day support Newton's argument for absolute time?
5. How do we measure space and time? Does this method support the relationalist or the absolutist?
6. How do basic facts about space and time conflict with Cartesian accounts of motion as relative to surrounding bodies?
7. Describe Newton's bucket experiment. What does it show, and how?
8. Is it possible to determine true motion from our observations? Explain, using Newton's example of the spinning globes.
9. How does Newton argue for the existence of God?
10. Why does Newton call gravity a hypothesis? What does he believe is the status of hypotheses?
11. How, according to Newton, do we arrive at general laws?

Leibniz, from *Letters to Clarke*

12. For Leibniz, what does it mean that space and time are "merely relative" (LIII.4)?
13. How does Leibniz use the principle of sufficient reason to object to absolute space? How does he use that principle to object to absolute time?
14. How, according to Leibniz, is gravity miraculous?
15. Is absolute space a substance or an attribute? Explain.
16. "Two states indiscernible from each other are the same state" (LIV.13). Explain.
17. According to Leibniz, is the universe finite or infinite?
18. How does Leibniz argue that the universe is a plenum?

## Zimmerman

19. What conclusions (the two questions at the heart of the debate about time) does Zimmerman defend?
20. Distinguish the A-properties from the B-relations. What is an A-theorist? What is a B-theorist?
21. What is presentism?
22. How might an A-theorist not be a presentist? Consider the role of the spotlight.
23. What is the growing-block view of time? How is it intermediate between presentism and the spotlight theory?
24. How do some A-theories have a thin conception of the present? How, according to McTaggart, is this thinness a problem for the A-theory?
25. Why doesn't Zimmerman defend either the moving-spotlight or growing-block theory of time?
26. How do Smith and Williamson attempt to save the spotlight and moving-block theories? Consider spatial and intrinsic properties. What problem arises for such non-presentist views?
27. What is a truthmaker? How might an argument against presentism rely on truthmakers?
28. How does Zimmerman respond to the truthmaker criticism of presentism?
29. How might the theory of relativity pose a problem for presentism over choosing a three-dimensional slice of the four-dimensional universe?
30. "A simple 'physics doesn't see it' objection to the A-theory is not a radically new kind of objection that only became available after Einstein. If relativity is to provide a powerful new argument against the A-theory, the A-theorist must be convicted of something worse than merely positing a layer of space-time structure that relativity fails to mention" (220). Explain.
31. How is the A-theory commonsensical?

## Smart

32. What are tensed and tenseless locutions?
33. What is a tenseless theory of time?
34. How are mathematical and physical theories expressed tenselessly?
35. How, according to Reichenbach, can sentences about past events (e.g. the battle of Waterloo) be rendered tenselessly?
36. How does Davidson's solution (the date theory) differ from that of Reichenbach (the token-reflexive theory)? What are its advantages?
37. What is Prior's no-present theory? How is it an A-theory?
38. For a B-theorist, what is change?
39. "Arthur Prior laid stress on the feeling, after a period of suffering that has come to an end, 'Thank goodness that's over'. The A-theorist thinks that this sort of consideration and an appeal to immediate experience more than compensate for the ontological economy and scientific plausibility of the B-theory" (233). Explain.
40. How does Smart re-interpret questions about the direction of time? How is Smart's position informed by the theory of evolution?
41. Why is the question of how fast time flows devastating for the A-theorist?
42. How is the A-theorist's world dynamic while the B-theorist's is static?
43. What is fatalism? Must the B-theorist be a fatalist?