

History and Foundations of Space and Time (NS-HP430m) June 30, 2010

Question 1

In the 19th century two rivals for Euclidian geometry were proposed. Describe briefly in what way these alternatives deviated from Euclidian geometry, and why they were proposed. Then discuss in what way we can convince ourselves that these alternative geometrical systems are to be taken seriously, i.e. that they are not inconsistent.

Question 2

In the discussion between Leibniz and Clarke, Leibniz gave three kinds of arguments against the existence of absolute space. Discuss these arguments in a concise way. What was Newton's main counterargument against Leibniz?

Question 3

While working on his General Theory of Relativity, Einstein was inspired – among other things – by the idea that not only inertial frames of reference but *all* frames should be equivalent in the new theory. Discuss whether, or to what extent, this desideratum is actually fulfilled in General Relativity.

Question 4

“In the twin paradox one of the twins undergoes acceleration. This shows that special relativity is not applicable to this case. When general relativity is applied, however, it is easily seen that the time difference is easily explainable as a gravitational effect.”

Write a brief (but cogent!) commentary on this quote.

Question 5

“In the theory of Lorentz, length contraction and time dilation were seen as dynamical effects. A great step forward was taken by Einstein, who demonstrated that these effects are not dynamical at all, but should rather be interpreted as differences in perspectives of different observers.”

Write a brief (but cogent!) commentary on this quote.

Question 6

The main dispute in more than 2000 years of philosophical argument about space and time has been between substantivalists and relationalists. Explain what this debate is about and then describe its current state, given the General Theory of Relativity.

Question 7

According to Poincaré the attribution of a geometrical system (Euclidian or non-Euclidian) to physical space is purely conventional. Explain what he meant by this.

Do you agree with Poincaré?