

Some questions useful for preparation.

1. Write two postulates of Einstein's special theory of relativity. What are the implications of these postulates?
2. How does the length of an object change due to the object's motion with the relative speed? If a 1-meter long ruler is moving with the relative speed and is oriented under the 45 degrees angle to the relativistic movement then what will be the length and tilt angle of the ruler measured in the observer's frame of reference?
3. Write equations of Lorentz coordinate transformation (length, velocity, time). Do there exist such frame of reference moving relatively to the Earth in which Adoption of the first Polish Constitution in Warsaw (3rd May, 1791) and Dos de Mayo uprising in Madrid (2nd May, 1808) was:
 - a. at the same point in space?
 - b. at the same time?

The distance between Madrid and Warsaw is 2300 km.

4. Describe the twin paradox. How to explain this paradox?
 5. What is spacetime interval and what kinds of spacetime intervals can we distinguish?
 6. Define Lorentz transformation for energy and momentum.
 7. Write equation for energy-momentum four vector. Consider the molecule observed to move through the laboratory at high speed with energy $E=4.5 \times 10^{17}$ J and momentum $p=3.8 \times 10^8$ kg*m/s . What is the object's rest mass?
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8. What are the properties of electromagnetic waves? What kinds of electromagnetic waves can we distinguish.
 9. Write Maxwell's equations (in differential or integral form).
 10. Light interference. Types. Under what conditions the interference could be observed?
 11. Huyghens principle. Define and explain.
 12. Light polarization. Types of polarization. How can we polarize light. What optical elements can be used to polarize light?
 13. Light scattering. Types. Why sky is blue during at the noon, and orange during sunset.
 14. Describe light dispersion.