Use LORENTZ transformations (if problem is non-relativistic, quantify the size of relativistic correction).

1. Using Taylor expansion expand:
   a) \( f(x) = 10 \times \exp(2x) \) around \( x_0 = 0 \).
   b) \( f(x) = \sin(x/2) \) around \( x_0 = 0 \).
   c) the Lorentz factor (up to first 3 non-zero terms)

\[
\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}, \quad \text{for values of } v, \text{ which are very small compared to } c.
\]

2. Show that Galilean transformations can be obtained from Lorentz transformations if \( v \) is very small compared to the speed of light.

3. Two spaceships A and B are moving in opposite directions. An observer on Earth measures the speed of A to be \( 3 \times 10^4 \) m/s.
   and the speed of B to be \( 2 \times 10^8 \) m/s. Find the velocity of B with respect to A.
4. A motorcycle rider is moving with a speed of 80km/h past a stationary observer. If the rider tosses a ball in the forward direction with a speed of 20km/h with respect to himself, what is the speed of the ball as seen by a stationary observer? Assign and draw corresponding reference frames.

5. Two rockets are moving towards each other on a collision course. A stationary observer on Earth makes the following measurements:
   - the speed of Rocket A is 0.8c
   - the speed of Rocket B is 0.6c in the opposite direction
   - both rockets are 50m in length
   - rockets A and B are $2.5 \times 10^9 \text{ km}$ apart.

   The speed of light is constant $c = 3 \times 10^8 \text{ [m/s]}$.

   a) What is the proper length of Rocket A?
   b) What is the velocity of Rocket A as observed by a stationary observer in Rocket B?
   c) What is the length of Rocket A as observed by a stationary observer in Rocket B?
6. An observer on Earth sees a spaceship at an altitude of 435m moving downward toward the Earth at 0.97c. What is the altitude of the spaceship as measured by an observer in the spaceship?

7. A stick at rest in S’ has a length L’ and is inclined at angle $\theta'$ to the x’ axis. Find its length L and angle of inclination $\theta$ to the x as measured by an observer in S frame. S’ is moving at a speed v relative to S along x,x’ axes.