

Classical Mechanics 2025
Homework 3

Exercise 1.

Using formula (6) from Lesson 3 notes, obtain equation (9) and prove result (10).

Exercise 2.

Explain why Coulomb's law is not Lorentz invariant. Discuss.

Exercise 3.

Show that at low velocities (67) is the correct approximation to (66) in Lesson 3 notes.

Exercise 4.

A particle moving with velocity V dissociates "in flight" into two particles. Determine the relation between the angles of emergence of these particles and their energies.

Exercise 5.

For the pairs of events whose coordinates (t, x, y, z) in some frame are given below, classify their separations as timelike, spacelike, or null.

- (a) $(0, 0, 0, 0)$ and $(-1, 1, 0, 0)$,
- (b) $(1, 1, -1, 0)$ and $(-1, 1, 0, 2)$,
- (c) $(6, 0, 1, 0)$ and $(5, 0, 1, 0)$,
- (d) $(-1, 1, -1, 1)$ and $(4, 1, -1, 6)$.

Exercise 6.

Show that the hyperbolae $-t^2 + x^2 = a^2$ and $-t^2 + x^2 = -b^2$ are asymptotic to the lines $t = \pm x$, regardless of a and b .