

Announcements

The updates, homework assignments, and useful links for APC can be found on the [SchoolNova webpage](#). We will discuss these problems at the meeting on **Sunday, October 4**. Problem 1 is carried over from Assignment 1. Bring written work and be ready to present at least one solution.

How to work

For each problem, show your assumptions and reasoning, not only the final answer. When relevant, check various limiting cases and the dimensions of the formulas you obtain.

Problems

Starred problems are challenge problems.

- 1.★ A billiard table has length a and width b . A ball is launched from the middle of the side b at some angle α to that side. Find all α such that after several collisions the ball returns exactly to the initial point?
2. Solve problems 1 and 2 of the 2021 F=ma exam that you can find by following the link:
https://www.aapt.org/Common2022/upload/2021_Fma_exam.pdf
3. Imagine that you are watching a movie in reverse, so that people are walking backwards, spilled water goes back directly into the glass, etc. If you watch a scene with an accelerating car, how does the velocity of the car compare to the velocity of the same car in the normal movie? How about the acceleration of the car?
For a visual example, watch the short video *Playing With Time*.
4. Two bodies start moving towards each other along a straight line with initial velocities v_1 and v_2 . They have accelerations a_1 and a_2 , respectively, and each acceleration is opposite to the corresponding velocity for both of them. What is the maximal initial distance between them l_{max} such that they will meet each other?
5. A bus moving on a straight road at an initial speed of 15 m/s is approaching a stop. It spends 20 seconds traveling the last 350 meters before stopping. Prove that the acceleration of the bus has changed direction during these 20 seconds.
6. A particle moves with a constant velocity. After traveling a distance L from its source it decelerates with a constant acceleration a until finally stopping. What is the initial velocity such that the overall time of the particle's motion is minimal?
7. Two balls are launched vertically upwards from the same point with the same initial velocity v , with a relative delay Δt . How much time passes after the second ball is launched until the balls collide?
- 8.★ You are standing on a platform next to a train scheduled to depart at 12:00:00. It is precisely 12:00:00 by your watch, and the second-to-last carriage is already starting to pass you, going past you completely in 10 s. Then the last carriage goes past you in 8 s. The train has departed on time and it is moving with a constant acceleration. How much does your watch fall behind?