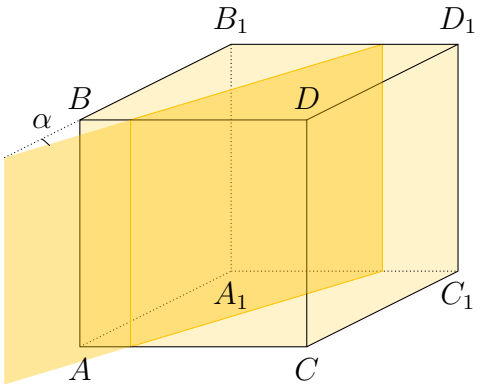
LPR Cube

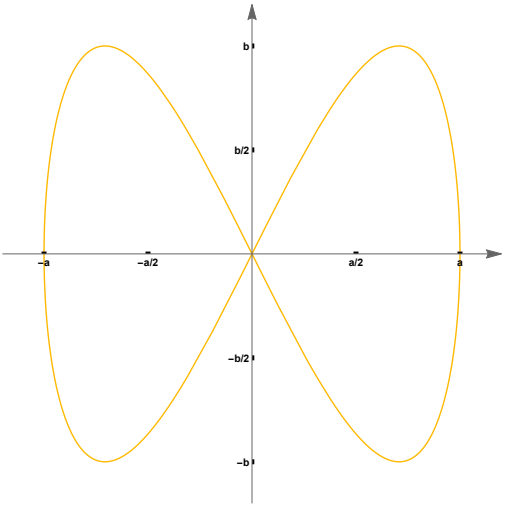
11.s03.e01

What happens often no longer hurts so much.
Erich Maria Remarque
«Flotsam»

3d6

Two pairs 1 (ABB_1A_1 and CDD_1C_1) and 2 ($ABDC$ and $A_1B_1D_1C_1$) of opposite faces of a cube with edge length L are charged with surface charge densities $\sigma_1 = -\sigma$ and $\sigma_2 = \sigma$, respectively, where $\sigma > 0$ is a known value, and pair 3 is with some surface charge density σ_3. A particle with mass m and charge $q > 0$ can move along a plane containing the center of the cube, perpendicular to pair 3 and forming a dihedral angle $\alpha = \pi/6$ with pair 1.





There are no forces of gravity and friction. The electrical constant is equal to ε_0.

1. *(4 points)* At what values of σ_3 is the particle's equilibrium position stable?
2. *(3 points)* In this and the following tasks, the trajectory of the particle has the shape of a figure-eight passing through the center of the cube, while the parameters a and b of the trajectory are much smaller than L and are known. Find the surface charge density of the third pair of faces σ_3.
3. *(3 points)* Determine the speed of the particle v_0 when passing through the center of the cube.

First hint — 18.04.2022 14:00 (Moscow time)
Second hint — 20.04.2022 14:00 (Moscow time)

Final of the first round — 22.04.2022 22:00 (Moscow time)