FIG. 1: A particle of charge $q$ and mass $m$ confined to the pinball court. What is the largest $y$ that with a set of jolts $\pm J$ (as outlined in the various levels of the game) you can send it too? In (3) note that the bottom, at $y = -h$ absorbs the particle and ends the game prematurely.

CPL- second winter challenge

**Magnetic Pinball**

In a magnetic pinball machine a charged particle (charge $q$, mass $m$) is confined to the x-y plane. The controls connect to a capacitor which, when you press a button, delivers an impulse $J\hat{y}$ to the particle. The minimum time between impulses (pressing the button...) is $\tau$, which you can assume is very small ($\tau \ll m/qB$). Your goal as a player is to get the particle from $y = 0$ to as big a $y$ as possible with $n$ presses of the button. The $x$ and $y$ directions are unbounded essentially (upto level 3). This would be easy had it not been for a magnetic field in the $z$ direction, normal to the pinball plane.

1. What is the best strategy you can come up with? what is the distance with your strategy?

2. Pinball level 2 is such that the jolt given is of opposite direction everytime you press: $J, -J, J, -J$ etc. (starting with positive).
   What is your best strategy with $n$ presses and the maximum $y$?

3. Level 3 is the most challenging: The pinball board has a lower absorptive cutoff at $y = -h$. This time you have an unlimited number of *alternating* (as in 2) jolts at your disposal. How far up $y$ can you get the particle to without it being absorbed in the bottom end of the court?