

Final Project 1: Time of flight for a baseball

A pitcher is throwing the baseball from the height $h = 1.8m$ straight up with the initial velocity $v_0 = 20 \frac{m}{sec}$. Another time, he throws the baseball in the direction making angle α with the ground with the initial velocity v such that $v \sin \theta = v_0$. In the absence of air resistance, the time of flight will be the same for two throws, however, with air resistance it may be different. Find for which angle α the time of flight (until it hits the ground) is minimal. Please assume that pitchers cannot throw with velocity $v > 46 \frac{m}{sec}$ (this is an experimental fact).

Diameter of a baseball: $d = 0.0732m$;

Mass of a baseball: $m = 0.145kg$;

Drag coefficient: $C = 0.30$;

Air density: $p = 1.25 \frac{kg}{m^3}$.

Here typical heights are small so you may assume that the air density does not depend on height.