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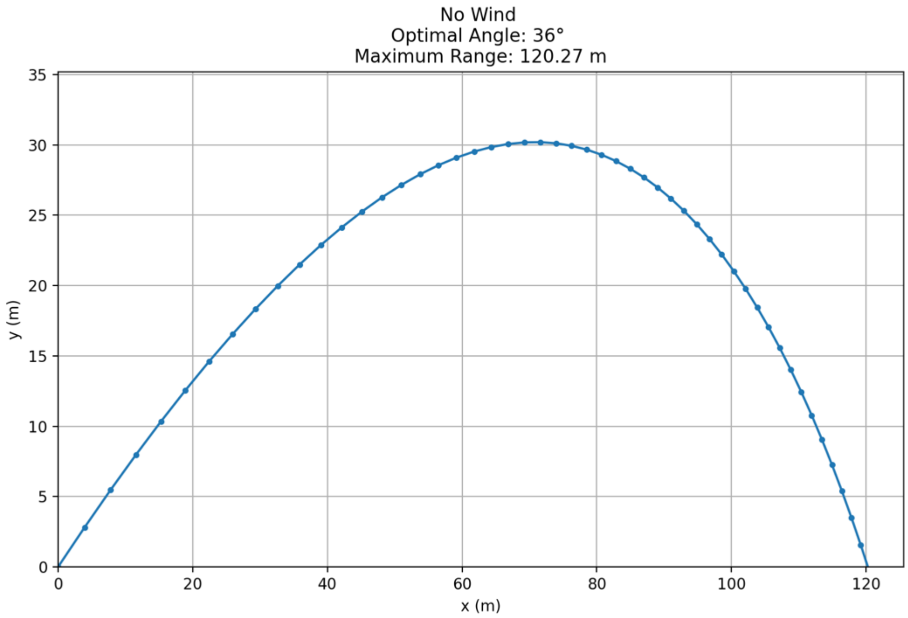
HW1: Computational Physics

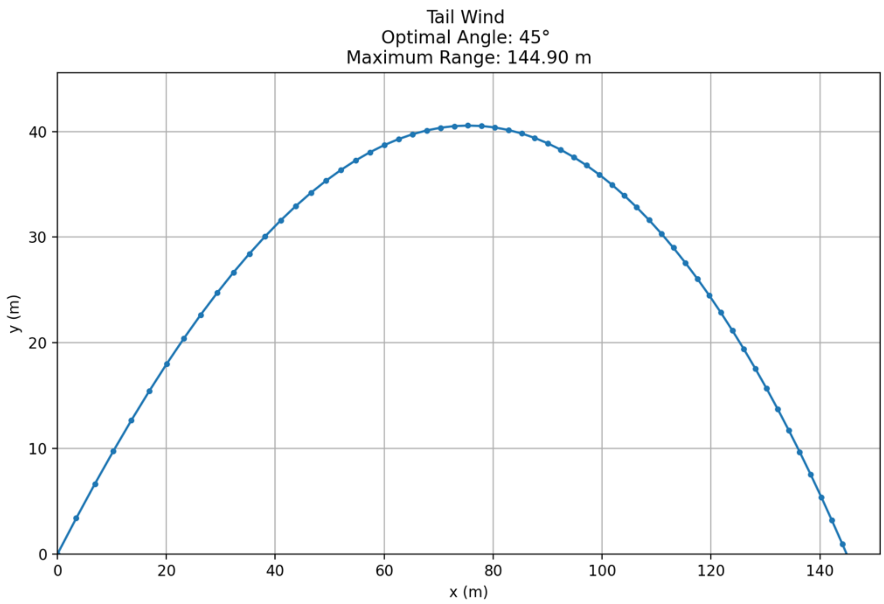
Note: for each question, all assumptions and details are written in the Jupyter notebook along the code. In this document, I present the results.

Question 2.13 a)

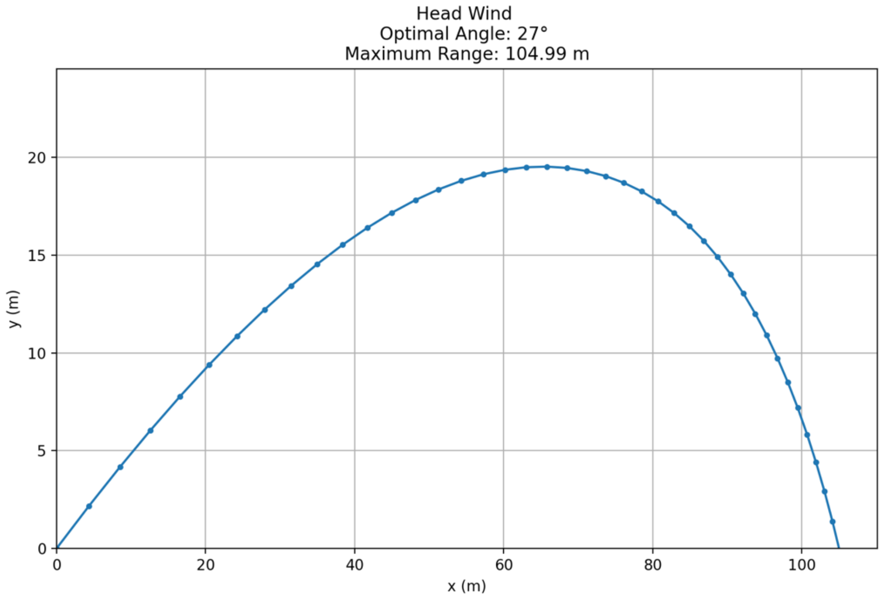


The maximum range is 120.27 m and is obtained with an initial angle of 36°

Question 2.13 b)

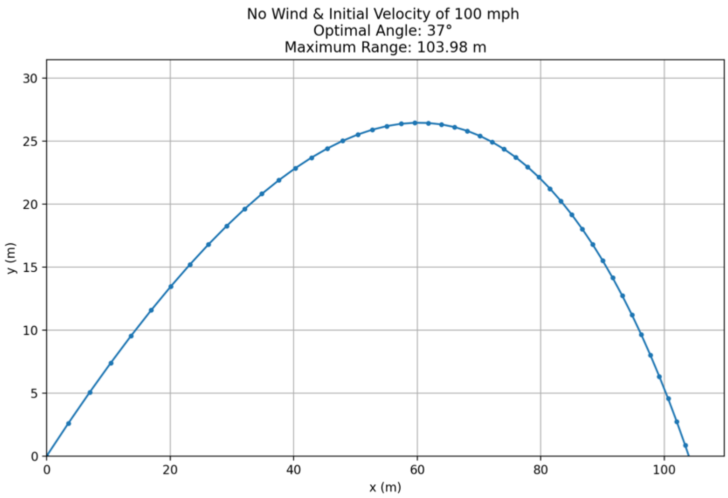


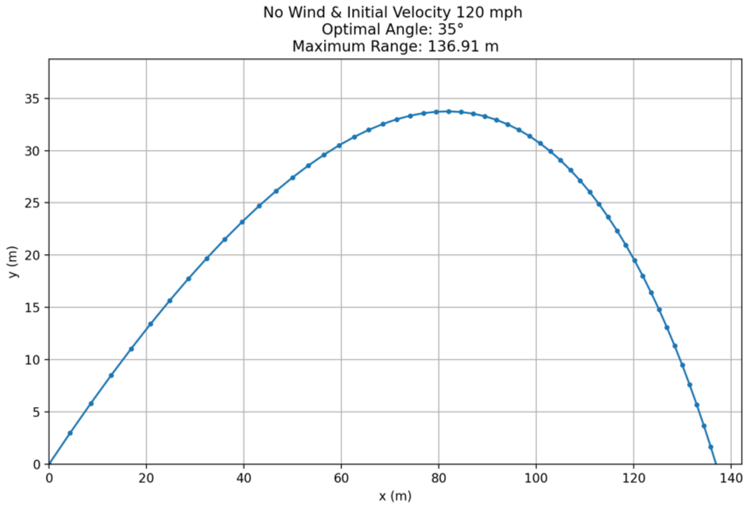
With **tail** wind, the maximum range is 144.90 m and is obtained with an initial angle of 45°.



With **head** wind, the maximum range is 104.99 m and is obtained with an initial angle of 27°.

Question 2.13 c)

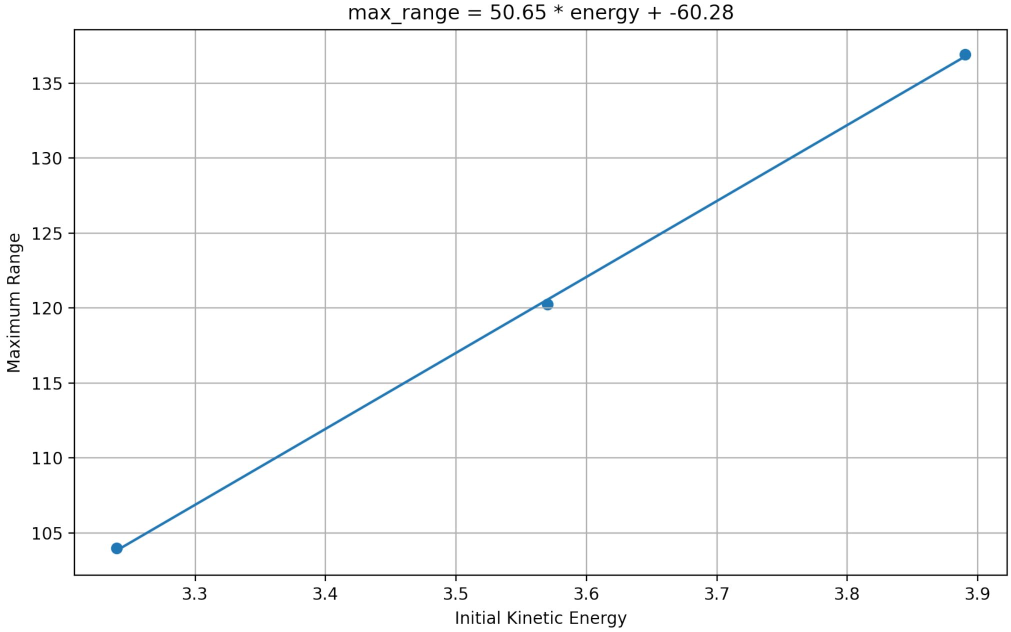




Assuming that the baseball mass is 0.145kg:

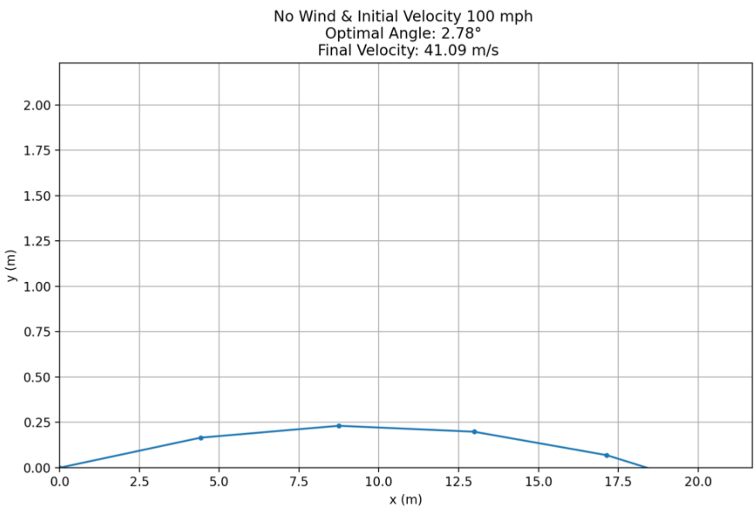
Initial velocity	Initial kinetic energy	Maximum range
100 mph (44.7 $m.s^{-1}$)	3.24 $kg.m^{2}.s^{-2}$	103.98 m
110 mph (49.18 $m.s^{-1}$)	3.57 $kg.m^{2}.s^{-2}$	120.27 m
120 mph (53.65 $m.s^{-1}$)	3.89 $kg.m^{2}.s^{-2}$	136.91 m

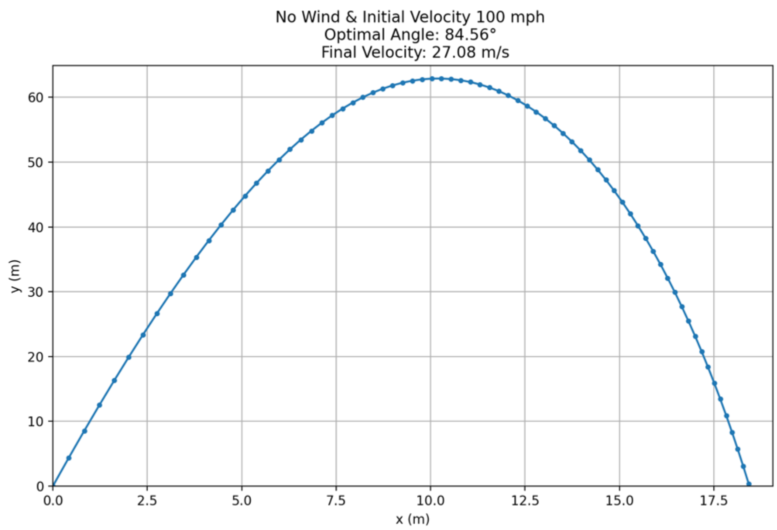
Based on the next plot, we can see that the maximum range linearly scales with the initial kinetic energy of the ball.



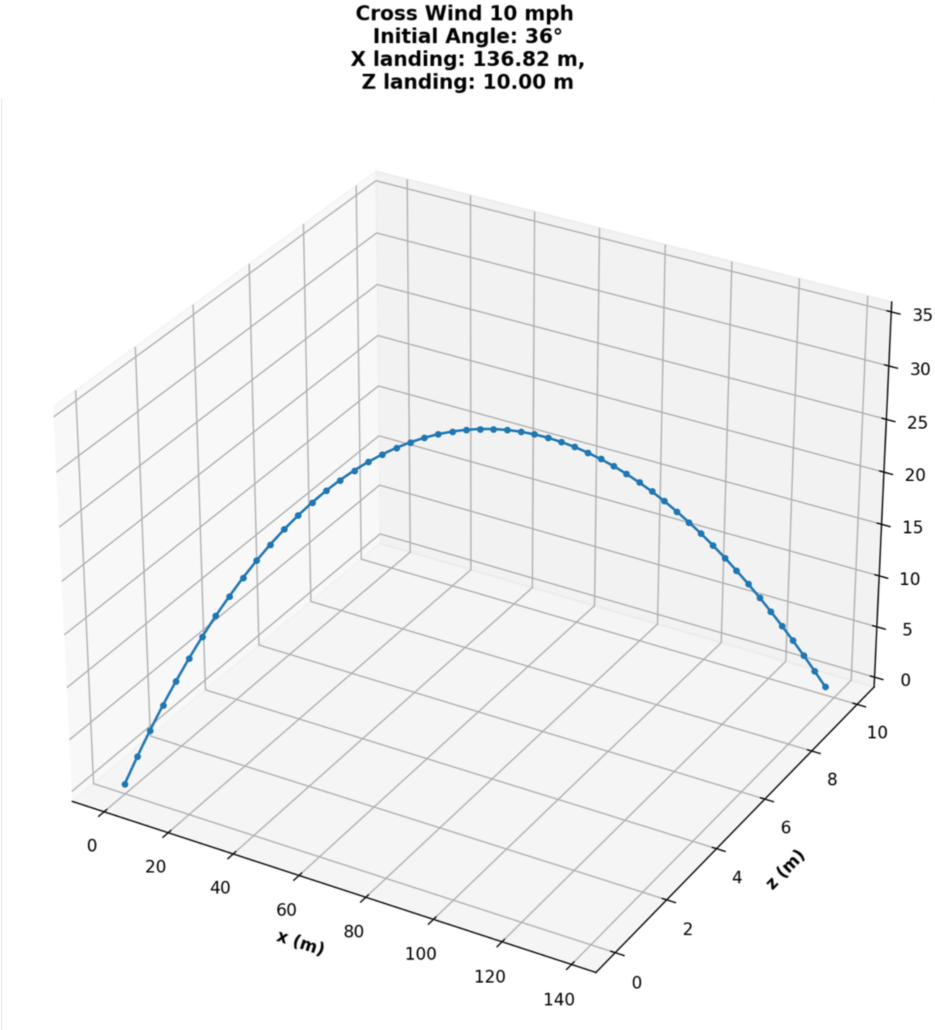
Question 2.13 d)

We get 2 trajectories for which the baseball ball arrives at Homeplate. Since we are referencing "fast ball" we choose the trajectory with initial angle of 2.78°. The speed of this ball when it crosses the Homeplate is 41.09 m/s, or approximately 91.91 mph.





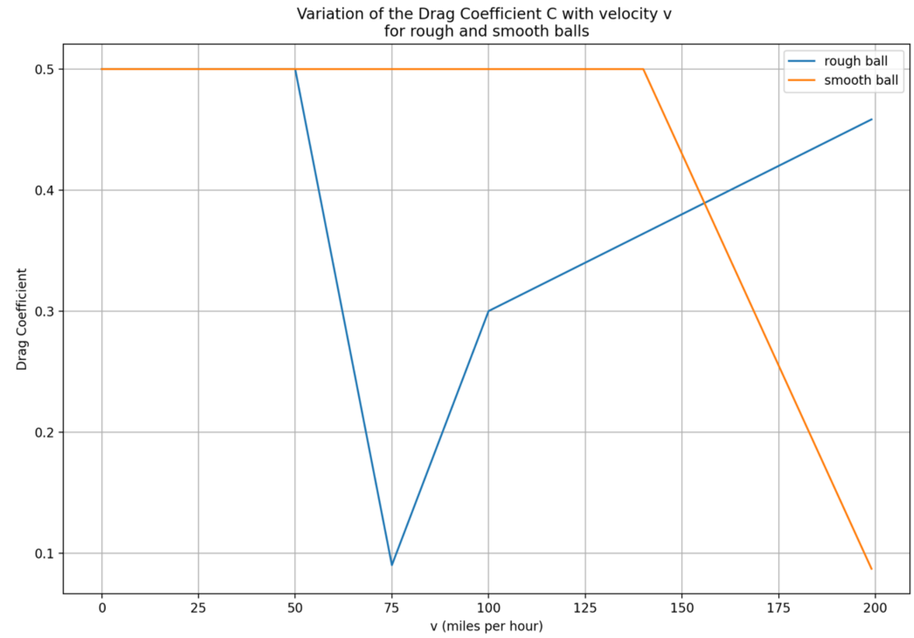
Question 2.14



A cross wind of 10 mph moves the z position by exactly 10.00 meters. It also alters the x landing position (136.82 instead of 136.91 in question 2.13 c))

Question 2.15

We first reproduce the function for drag coefficient based on ball velocity using figure 2.6 in the book (page 33).



We can see on the plot below that a rough ball travels further than a smooth ball. This makes sense since the drag coefficient is lower for rough balls until a speed of 165mph, which is higher than the initial velocity we chose for this example.