COP1

Due Date: 1403/01/18

Engineering Mechanics: Dynamics

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Problem 1 :

Imagine a game that the players have to shoot the ball in a way that the ball touches an specific point.At first assume the ball as a particle and analyse it's projectile motion.

A particle P is launched from point A with the initial conditions shown in the figure. If the particle is subjected to aerodynamic drag:

a) Compute the range R of the particle and compare this with the case in which aerodynamic drag is neglected.

b) Plot the trajectories of the particle for both cases.

The acceleration due to aerodynamic drag has the form $a_D = -kv^2\, \boldsymbol{e_t}$, where k is a positive constant, v is the particle speed, and $\boldsymbol{e_t}$ is the unit vector associated with the instantaneous velocity **v** of the particle. The unit vector $\boldsymbol{e_t}$ has the form $\boldsymbol{e_t} = \frac{v_x \boldsymbol{i} + v_y \boldsymbol{j}}{\sqrt{{v_x}^2 + {v_y}^2}}$, where v_x and v_y are the instantaneous x- and y- components of particle velocity, respectively. Use the values $v_0 = 70$ m/s, $\theta = 35$ °, and $k = 4.0 \times 10^{-3}$ m^{-1}.

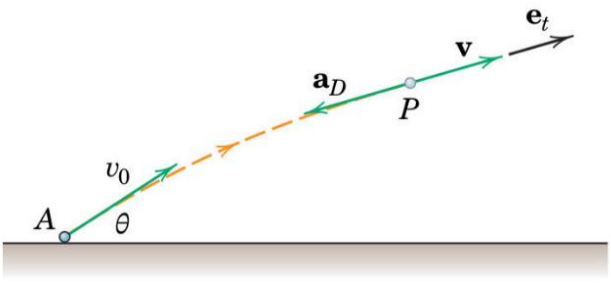

Figure Prob. 1

c) Now imagine that a player is shooting this particle with the mentioned initial velocity. The rules are specified in a way that if the player shoots the ball farther from the point, would get higher score. Be careful to check that the ball doesn't touch the obstacles in the path. Find the best range for angle of projectile motion if the target point is in 20 m from the ground and the position of obstacles with their height is showed in Figure 2.

(With Matlab code of parts a and b, you can have x,y data of the path. For different angles check ball's height to be sure it doesn't hit the obstacles. At last choose the angle with highest distance from the target point.)

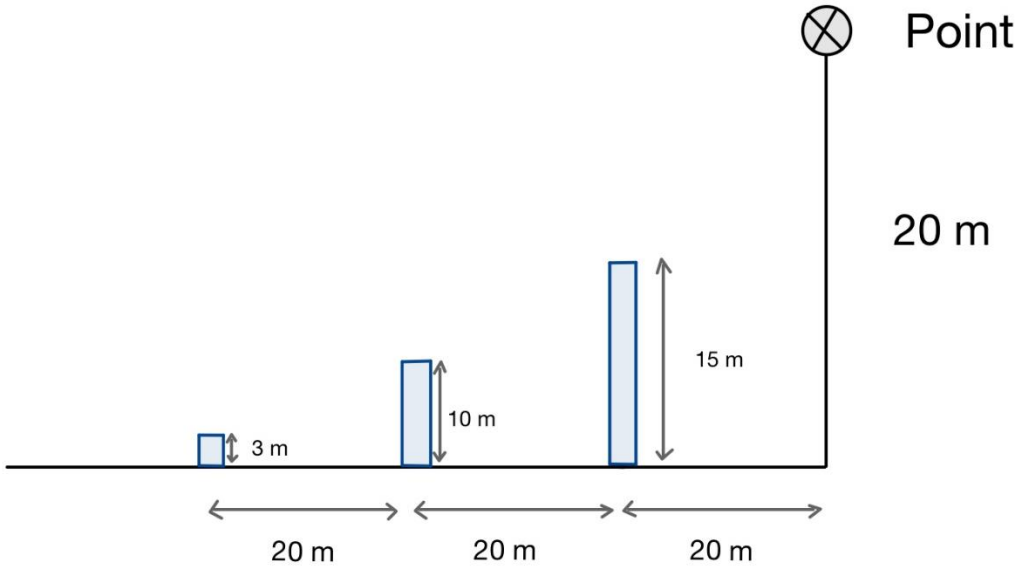

Figure Prob. 2