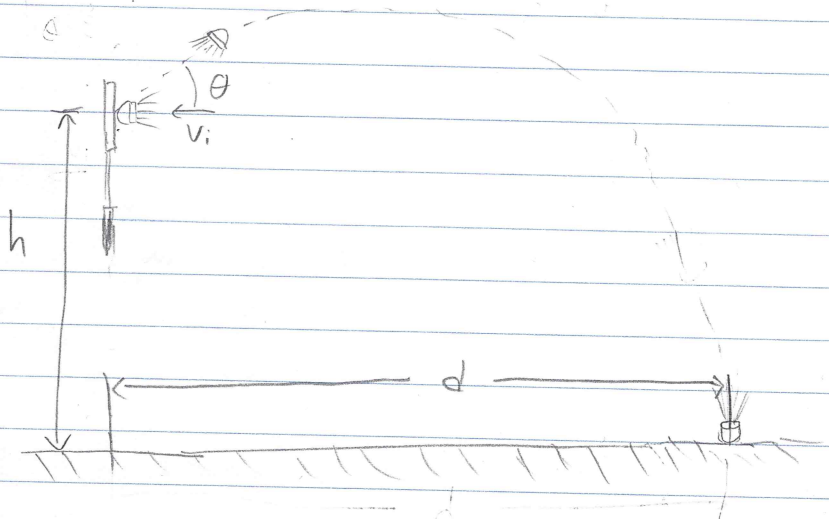
20-P-MOM-DY-46

A birdie is traveling at $v_i = 15\ m/s\ \hat{i}$ before a player hits it with a racket $h = 2.5\ m$ above the ground. The racket applies an average force $F = 50\ N$ which sends the birdie on a trajectory which is $\theta = 75°$ above the horizontal. The birdie lands on the ground $d = 30\ m$ away. Determine the contact time between the racket and the birdie. $m = 0.5\ kg$



Solution:

v_2

$v_2 \sin\theta = v_{2j}$

$v_2 \cos\theta = v_{2i}$

$-h = v_{2j}\, t - \frac{g}{2} t^2$

$d = v_{2i}\, t = v_2 \cos\theta\, t \qquad t = \frac{d}{v_2 \cos\theta} \qquad v_2 = \frac{d}{t \cos\theta}$

$v_2 \sin\theta = \frac{\frac{g}{2} t^2 - h}{t} \Rightarrow \frac{d}{t} \tan\theta = \frac{\frac{g}{2} t^2 - h}{t}$

$d \tan\theta = \frac{g}{2} t^2 - h \qquad t = 4.83\ s \qquad v_2 = 23.99\ m/s$

$m v_1 + \int F\, dt = m v_2$

$Ft = m(v_2 - v_1) \qquad t = 0.0849\ s$