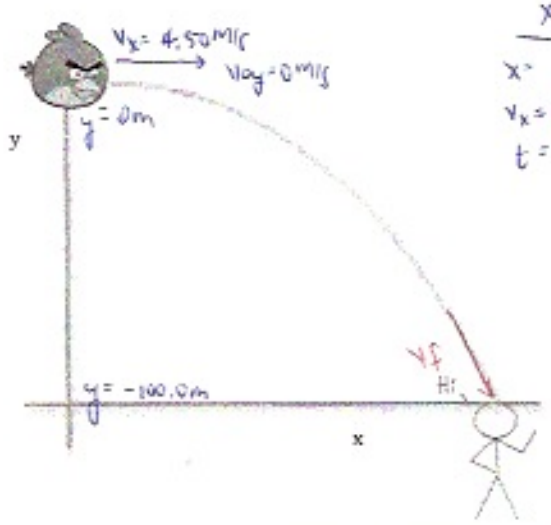
Physics: Kinematics in Two-Dimensions
Class Examples

1/2 Projectile:

Example 4:
Let's say that you are a cunning bird, and you are 'target-practicing.' You're flying 4.50 m/s horizontally (initially no velocity in the y-direction) and are 100.0 m above the top of an unsuspecting 'target.' Find the following:

A. The time to impact
B. The velocity in the x-direction and the velocity in the y-direction of the 'package' on impact.
C. The **magnitude** of the final velocity of the package (v_f).

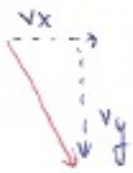


x
$x =$
$v_x = 4.50$ m/s
$t =$

y
$y = 0$ m (at the top)
$= -100$ m (at the bottom)
$v_{0y} = 0$ m/s
$v_y =$
$a_y = -9.8$ m/s²
$t =$

A) $t = ?$
$v_{0y} = 0$ m/s
$a_y = -9.8$ m/s²
$y = -100$ m

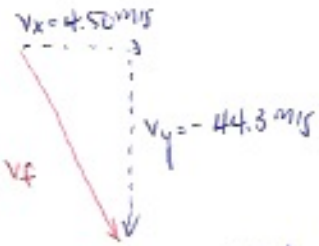
$y = v_{0y}t + \frac{1}{2}a_y t^2$
$-100 = (0)t + \frac{1}{2}(-9.8)t^2$
$-100 = 0 - 4.9t^2$
$-100 = -4.9t^2$
$\frac{-100}{-4.9} = t^2$
$t^2 = 20.4$
$t = 4.52$ s

B.)


V_x = constant = 4.50 m/s

$v_y = ?$
$v_{0y} = 0$ m/s
$a_y = -9.8$ m/s²
$t = 4.52$ s

$v_y = v_{0y} + at$
$v_y = 0 + (-9.8)(4.52)$
$v_y = -44.3$ m/s

C.)


$v_f^2 = (4.50)^2 + (-44.3)^2$
$v_f^2 = 20.25 + 1962.49$
$v_f^2 = 1982.74$
$v_f = 44.5$ m/s

$\theta = \tan^{-1}\left(\frac{o}{a}\right) = \tan^{-1}\left(\frac{y}{x}\right)$
$\theta = \tan^{-1}\left(\frac{-44.3}{4.50}\right)$
$\theta = -84.2°$