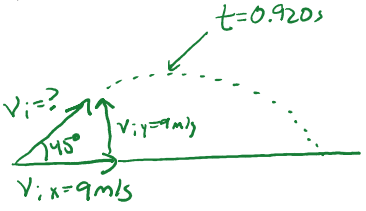
III. Projectiles at an Angle

1. A machine launches a tennis ball at an angle of 45.0 degrees above the horizontal. The ball has an initial vertical velocity of 9.00 m/s and an initial horizontal velocity of 9.00 m/s. The ball reaches its maximum height 0.920 s after its launch. (Neglect air resistance and assume the ball lands at the same height from which it was launched.)

A. Determine the speed of the ball as it leaves the launcher.

$v_{ix} = v_i \cos\theta$

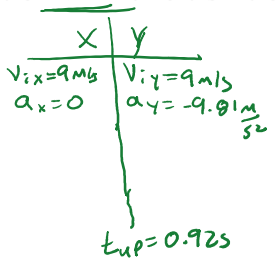
$v_i = \frac{v_{ix}}{\cos\theta} = \frac{9\ m/s}{\cos 45^\circ} = 12.7\ m/s$



B. Determine the horizontal distance traveled by the ball during the ENTIRE time it is in the air.

$d_x = v_{ix} t_{TOTAL} = (9\ m/s)(1.84\ s) = 16.6\ m$

$t_{TOTAL} = 2t_{up} = 2(0.92\ s) = 1.84\ s$



C. Determine the maximum height of the projectile.

$d_y = ?$ (MAX)

$v_{fy} = 0$

$v_{fy}^2 = v_{iy}^2 + 2a_y d_y$

$d_y = \frac{v_{fy}^2 - v_{iy}^2}{2a_y} = \frac{-(9\ m/s)^2}{2(-9.81\ m/s^2)} = 4.13\ m$

D. Compared to the vertical acceleration of the ball at the time of launch, the vertical acceleration of the ball at elapsed time 0.920 s is (A) less, (B) greater, (C) same

ALWAYS $-9.81\ m/s^2$