#10)

$d_{fx} = 35\,m$

$d_{fy} = 0$

$d_{oy} = 0$

$g = -9.81$

$\theta = 45°$

$v = ?$

x-dir

$$v_x = \frac{d_{fx}}{t}$$

$$v\cos 45 = \frac{35}{t} \quad (1)$$

y-dir

$$d_{fy} = d_{oy} + v_{oy}t + \frac{1}{2}a_y t^2$$

($v_{oy} = v\sin 45$)

$$0 = 0 + (v\sin 45)t - 4.9t^2 \quad (2)$$

Solve (1) for t sub in (2)

$$v\cos 45 = \frac{35}{t}$$

$$(v\cos 45)t = 35$$

$$t = \frac{35}{v\cos 45} \quad \text{sub (2)}$$

(2) →

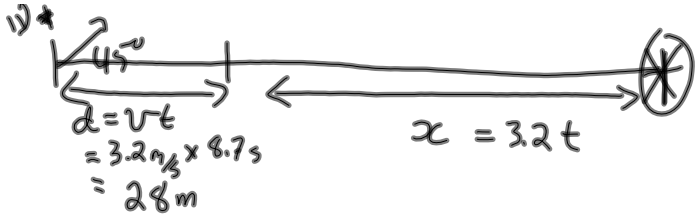
$$0 = (v\sin 45)\left(\frac{35}{v\cos 45}\right) - 4.9\left(\frac{35}{v\cos 45}\right)^2$$

$$0 = 35 - \frac{1200.5}{v^2}$$

$$-35 = -\frac{1200.5}{v^2} \Rightarrow -35v^2 = -1200.5$$

$$v^2 = 343$$

$$\boxed{v = 18.5\ m/s}$$



$$d_{fx} = 28 + 3.2t$$

$$v_x = v\cos\theta \quad (45^\circ) = \frac{28 + 3.2t}{t} \quad (1)$$

y-dir

$$d_{fy} = d_{oy} + v_{oy}t + \tfrac{1}{2}at^2$$

$d_{fy} = 0$, $d_{oy} = 0$, $v_{oy} = v\sin\theta$

$$0 = (v\sin 45)t - 4.9t^2 \quad (2)$$

in (1) solve for v and sub in (2)

(1) $\rightarrow$ $v = \dfrac{28 + 3.2t}{t\cos 45}$

(2) $\rightarrow$ $0 = \left[\dfrac{(28+3.2t)}{t\cos 45}\right](\sin 45)t - 4.9t^2$

$$0 = 28 + 3.2t - 4.9t^2$$

$$4.9t^2 - 3.2t - 28 = 0$$

$$t = \frac{-(-3.2) \pm \sqrt{(-3.2)^2 - 4(4.9)(-28)}}{2(4.9)}$$

$$= \frac{3.2 \pm 23.6}{9.8}$$

$t = 2.73\text{ s}$ or -2.08 s ← reject neg tm

sub t in (1) find v

$$v = \frac{28 + 3.2(2.73)}{(2.73)\cos 45}$$

$v = 19$ m/s

Home Run Question

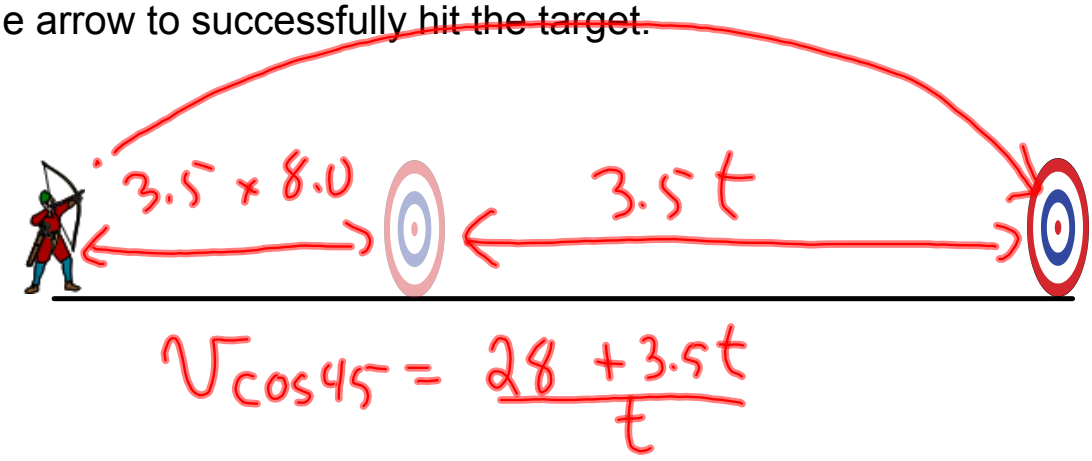
Suppose the left-centre field wall is 3 m high off the ground and located 105 m from home plate. A batter connects the ball 1.0 m above the ground at an angle of 55° and the ball has a speed of 32 m/s. Will this be a home run?

(i.e when the ball has travelled 105 m horizontally is it higher than 2 m above the initial point of contact?)

- Break up the initial velocity into its components.
- Determine the time it takes to travel 105 m horizontally.
- Determine the height above the point of contact using the found time.
- If y > 2 m then it is a home run.

Hitting a Moving Target

In an archery skills competition an archer stands next to her target. A bell rings and the target begins to move away from the archer at 3.5 m/s but the archer must wait a certain amount of time before shooting. This archer releases the arrow 8.0 s after the bell has rung in an attempt to hit the moving target. Assuming the launch angle is 45° and the arrow is launched at the same height as the target, determine the initial speed of the arrow to successfully hit the target.



$$V\cos 45 = \frac{28 + 3.5t}{t}$$

- Find an expression for the horizontal distance covered by the arrow.
- Write the expression for V_x using d_{fx}/t and remember that $V_x = V\cos 45^o$.
- Combine the above to have a formula for V.
- Write $V_{oy} = V\sin 45^o$.
- Write the formula for vertical displacement, d_{fy}
- In the above substitute $V\sin 45$ for V_{oy}.
- Now substitute the formula for V into the vertical displacement expression.
- Solve for t, then find V.