Projectile Motion

Horizontally - constant velocity

$$v = \frac{\Delta d}{\Delta t}$$

Vertically - constant acceleration (due to gravity)

$a = -9.81\,m/s^2$

$$v_{ave} = \frac{\Delta d}{\Delta t} \quad \left(v_{ave} = \frac{v_1 + v_2}{2} \right)$$

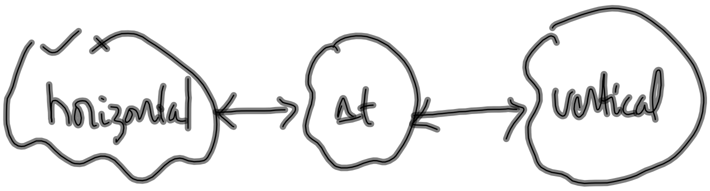
$$a = \frac{\Delta v}{\Delta t} \quad (\Delta v = v_2 - v_1)$$

maybe useful:

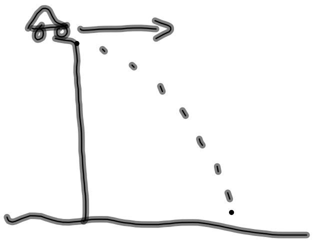
$$\Delta d = v_1 t + \frac{1}{2} a t^2$$

$$\Delta d = v_2 t - \frac{1}{2} a t^2$$

$$v_2^2 = v_1^2 + 2a\Delta d$$



Simplest type of projectile problem:



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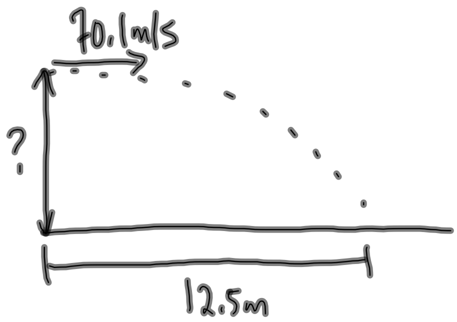
4. $V_h = 70.1 m/s$

$\Delta d_h = 12.5 m$

$\Delta d_v = ?$



Horizontally - velocity is constant

$$V = \frac{\Delta d}{\Delta t}$$

$$\Delta t = \frac{\Delta d}{V}$$

$$\Delta t = \frac{12.5m}{70.1m/s}$$

$$\boxed{\Delta t \doteq 0.178s}$$

Vertically - constant acceleration

$\Delta t = 0.178s$

$a = -9.81 m/s^2$

$V_1 = 0 m/s$

$\Delta d = ?$

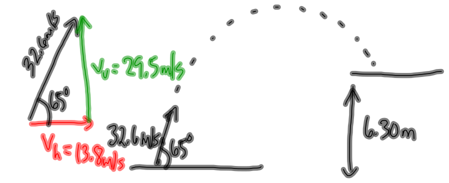
$$\Delta d = \overset{0}{\cancel{V_1 t}} + \frac{1}{2}at^2$$

$$\Delta d = \frac{1}{2}(-9.81 m/s^2)(0.178s)^2$$

$$\boxed{\Delta d \doteq -0.156m}$$

The arrow will hit the target 15.6cm below the point of release.

MP|539 - When the initial vertical velocity is not zero.



a) $\Delta t = ?$

b) $\Delta d_h = ?$

c) $\vec{V}_{impact}$

Vertically - constant acceleration

$\Delta d = 6.30$ m

$v_1 = 29.5$ m/s

$a = -9.81$ m/s^2

$\Delta t = ?$

$$\Delta d = v_1 t + \frac{1}{2} a t^2$$

$$6.30 = (29.5)t - \left(\frac{9.81}{2}\right)t^2$$

$$\left(\frac{9.81}{2}\right)t^2 - (29.5)t + 6.30 = 0$$

$$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$t = \frac{29.5 \pm \sqrt{29.5^2 - 4\left(\frac{9.81}{2}\right)(6.30)}}{9.81}$$

$$t = \frac{29.5 \pm 27.3}{9.81}$$

$t = 0.224$ s or $t = 5.79$ s

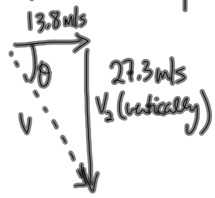
b) horizontally - velocity is constant

$$v = \frac{\Delta d}{\Delta t}$$

$$\Delta d = (13.8 \text{ m/s})(5.79 \text{ s})$$

$$\Delta d \doteq 79.9 \text{ m}$$

c) velocity when landing on green:



vertically:

$v_1 = 29.5$ m/s

$a = -9.81$ m/s^2

$\Delta t = 5.79$ s

$\Delta d = 6.30$ m

$v_2 = ?$

finish......

find v and θ

$$a = \frac{\Delta v}{\Delta t}$$

$$a = \frac{v_2 - v_1}{\Delta t}$$

$$v_2 = v_1 + a\Delta t$$

$$v_2 = 29.5 \text{ m/s} - 9.81 \text{ m/s}^2 (5.79 \text{ s})$$

$$v_2 = -27.3 \text{ m/s}$$

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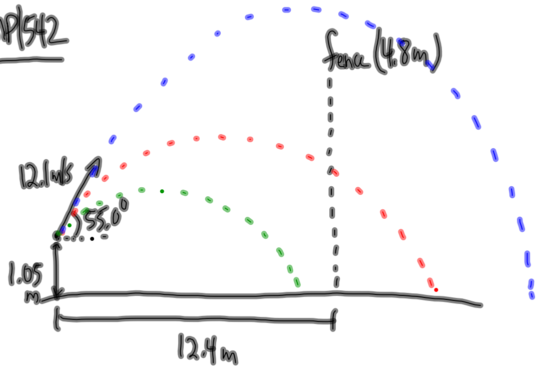


How high is the ball when it has travelled 12.4m horizontally?

$v_h = (12.1\,m/s)\cos 55.0° = 6.94\,m/s$

$v_v = (12.1\,m/s)\sin 55.0° = 9.91\,m/s$

Horizontally (v is constant)

$v = \frac{\Delta d}{\Delta t}$

$\Delta t = \frac{12.4\,m}{6.94\,m/s}$

$\boxed{\Delta t = 1.79\,s}$ ← So how high is the ball at 1.79s?

Vertically (constant acc)

$v_1 = 9.91\,m/s$

$\Delta d = ?$

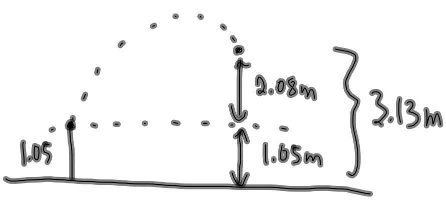
$a = -9.81\,m/s^2$

$\Delta t = 1.79\,s$

$\Delta d = v_1 t + \frac{1}{2}at^2$

$\Delta d = (9.91\,m/s)(1.79\,s) - \left(\frac{9.81\,m/s^2}{2}\right)(1.79\,s)^2$

$\Delta d = 2.08\,m$



Since 3.13m < 4.8m the ball hit the fence.

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