§11-1 Projectile Motion (neglecting air resistance)

Horizontally

- Velocity is constant: $V_h = \frac{\Delta d_h}{\Delta t}$

Vertically

- constant acceleration due to gravity: ($a = -9.81 m/s^2$)

$$V_{v_{ave}} = \frac{\Delta d_v}{\Delta t} \qquad \left(V_{ave} = \frac{V_1 + V_2}{2}\right)$$

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

Maybe useful:

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

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

$$\underline{V_2}^2 = \underline{V_1}^2 + 2\underline{a}\Delta d$$ ← vertical

vertical vertical

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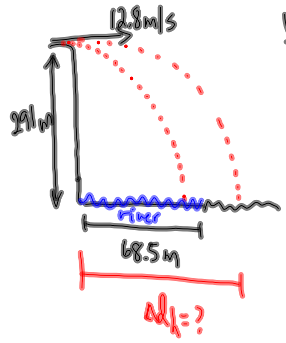


Time for the rock to fall .... look at the vertical motion:

constant acceleration

$a = -9.81 m/s^2$

$\Delta d = -291 m$

$v_1 = 0$

$\Delta t = ?$

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

$\Delta d = \frac{1}{2}a(\Delta t)^2$

$\frac{2\Delta d}{a} = (\Delta t)^2$

$\Delta t = \sqrt{\frac{2(-291m)}{-9.81 m/s^2}}$

$\Delta t = 7.70s$

Horizontally

constant velocity

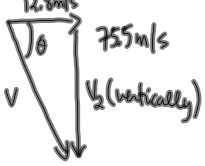
$v = \frac{\Delta d}{\Delta t}$

$\Delta d = (12.8 m/s)(7.70s)$

$\Delta d = 98.6m$

a) Since 98.6m > 68.5m, the rock lands on the other side of the river.

b) velocity at impact?



$a = \frac{\Delta v}{\Delta t}$ ← for vertical velocity

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

$v_2 = \cancel{v_1} + a\Delta t$

$v_2 = (-9.81 m/s^2)(7.70s)$

$v_2 \doteq -75.5 m/s$

$c^2 = a^2 + b^2$

$v^2 = (12.8)^2 + (75.5)^2$

$\boxed{v \doteq 76.6 m/s}$

$\tan\theta = \frac{75.5 m/s}{12.8 m/s}$

$\boxed{\theta \doteq 80.4^\circ}$

The velocity at impact is: 76.6m/s [80.4° below the horizontal]

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