11.1 Projectile Motion

- Gravity is the only force influencing ideal projectile motion. (Neglect air friction.)
- Gravity affects only the vertical motion, so equations for uniformly accelerated motion apply.
- No forces affect horizontal motion, so equations for uniform motion apply.
- The horizontal and vertical motions are taking place during the same time interval, thus providing a link between the motion in these dimensions.

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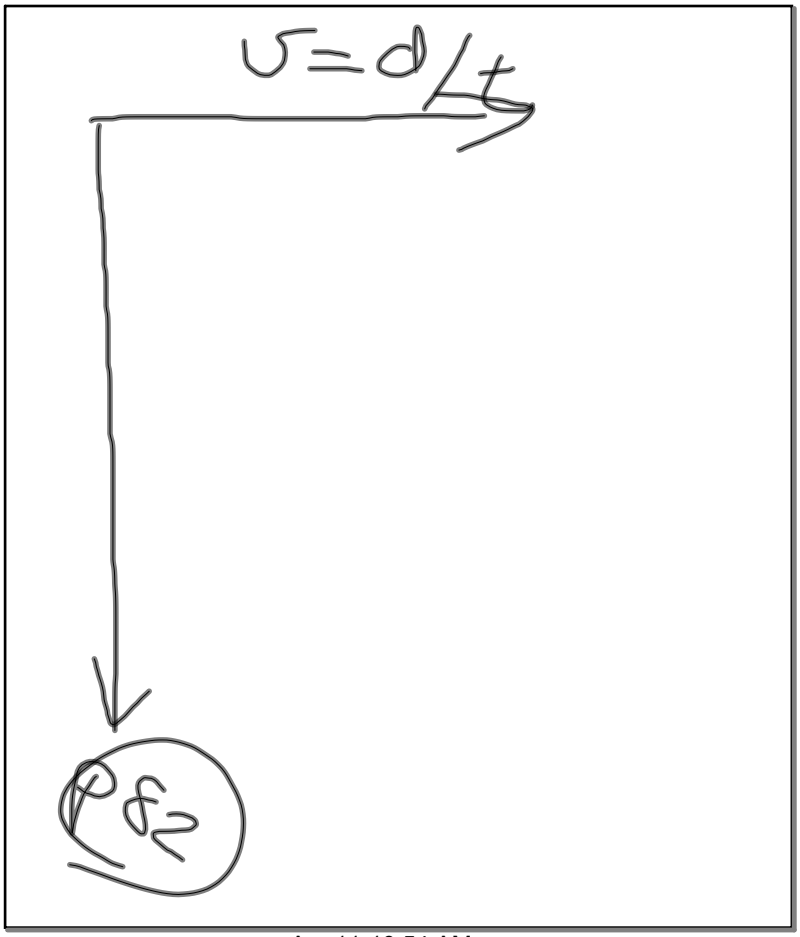

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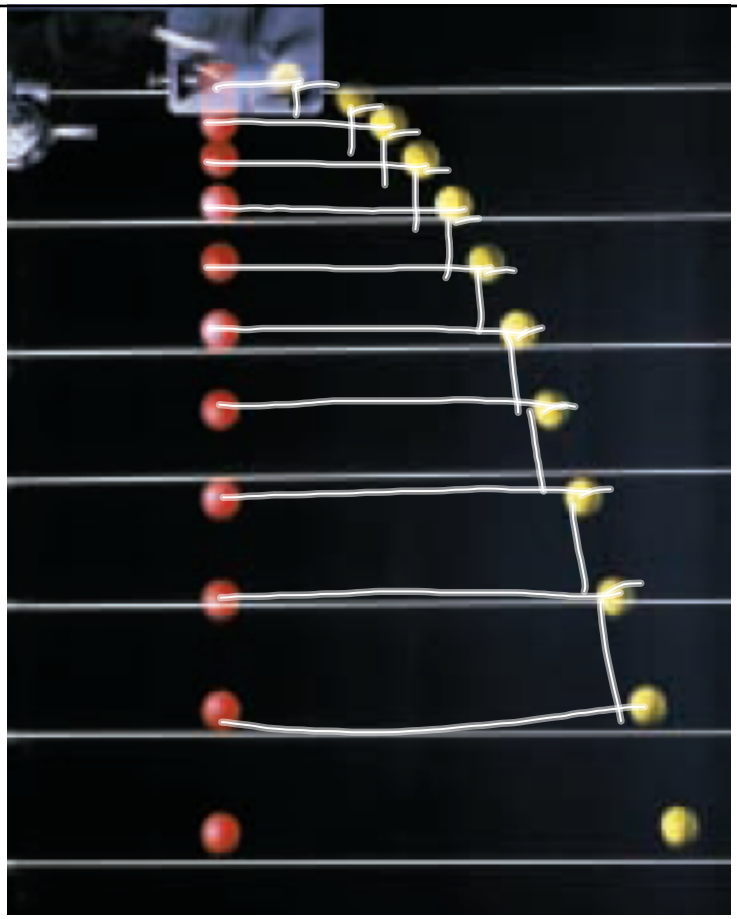

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Analyzing a Horizontal Projectile

While hiking in the wilderness, you come to a cliff overlooking a river. A topographical map shows that the cliff is 291 m high and the river is 68.5 m wide at that point. You throw a rock directly forward from the top of the cliff, giving the rock a horizontal velocity of 12.8 m/s.

(a) Did the rock make it across the river?

(b) With what velocity did the rock hit the ground or water?

Variables and Constants

Known		Implied	Unknown
$\Delta y = -291$ m	river width = 68.5 m	$a_y = -9.81 \frac{\text{m}}{\text{s}^2}$	Δx
$v_x = 12.8 \frac{\text{m}}{\text{s}}$		$v_{iy} = 0.0 \frac{\text{m}}{\text{s}}$	$\vec{v}_f$

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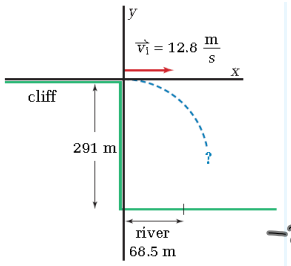
Calculations:



$t = ?$

$d = 291\,m$

$v_{i,y} = 0$

$a = -9.8\,m/s^2$

$d = \frac{at^2}{2} + v_i t$

$-291\,m = \frac{-9.8t^2}{2}$

$-291 = -4.9t^2$

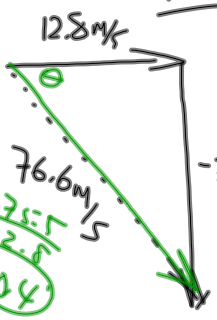
$\sqrt{\frac{-291}{-4.9}} = t = 7.7\,s$

$v = \frac{d}{t} \Rightarrow d = v \cdot t$

$= (12.8)(7.7)$

$= 98.56\,m$

$v =$



$v_f = v_i + at$

$= 0 + (-9.8)(7.7)$

$= -75.5\,m/s$

$\tan\theta = \frac{-75.5}{12.8}$

$\theta = 80.4°$

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