Chapter 3 Review - Two-Dimensional Motion

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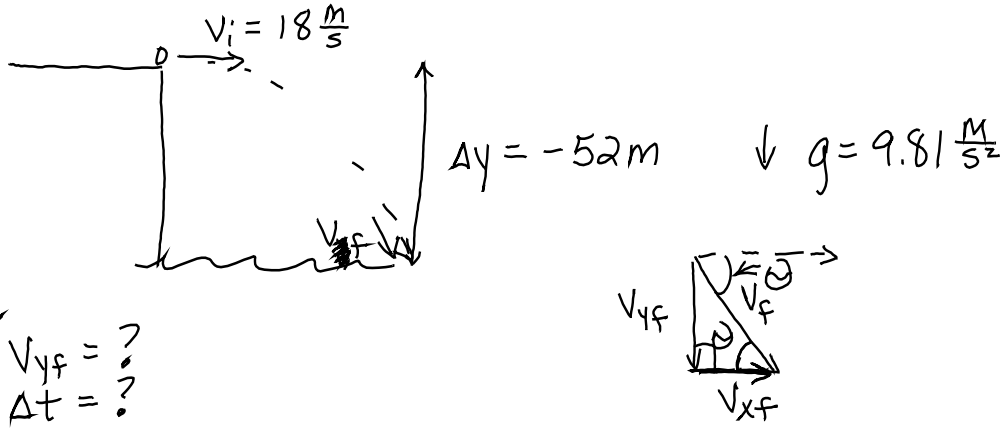
A person standing at the edge of a cliff kicks a stone over the edge with a speed of 18 m/s. The cliff is 52 m above the water's surface. How long does it take the stone to fall to the water? With what speed does it strike the water?

Equations for Projectiles Launched Horizontally

$$\Delta y = -\tfrac{1}{2} g (\Delta t)^2 \qquad \Delta x = v_x \Delta t$$

$$* \; \boxed{v_{yf} = -g \Delta t}$$

$$\boxed{v_{yf}^2 = -2 g \Delta y} \qquad \boxed{v_x = v_{xi} = \text{constant}}$$



✓ $v_{yf} = ?$
$\Delta t = ?$

$$v_{yf} = \sqrt{-2 g \Delta y} = \sqrt{-2(9.81 \tfrac{m}{s^2})(-52 m)} = -31.9 \tfrac{m}{s}$$

$$v_f = \sqrt{v_x^2 + v_{yf}^2} = \sqrt{(18 \tfrac{m}{s})^2 + (-31.9 \tfrac{m}{s})^2} = \boxed{36.6 \tfrac{m}{s}}$$

$$\theta = \tan^{-1}\left(\frac{-31.9 \frac{m}{s}}{18 \frac{m}{s}}\right) = -60.6^\circ$$

$$v_{yf} = -g \Delta t$$

$$\Delta t = -\frac{v_{yf}}{g} = -\frac{(-31.9 \frac{m}{s})}{9.81 \frac{m}{s^2}} = \boxed{3.26 s}$$