

Falling Objects Calculations

$$\vec{g} = -9.81 \text{ m/s}^2$$

the acceleration due to gravity

Note that \vec{g} can be used in place of \vec{a} in any kinematics equation.

ex) LD drops a rock on a Science 20 student to get them to work harder! **LD drops the rock from rest** and it takes **3.5 s** to hit the ground. How high was the rock dropped from?

$$\vec{v}_i = 0 \text{ m/s}$$

$$t = 3.5 \text{ s}$$

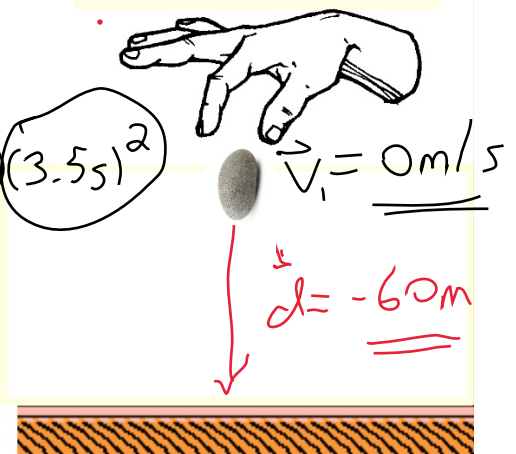
$$d = ?$$

$$\vec{a} = -9.81 \text{ m/s}^2$$

$$\vec{d} = \vec{v}_i t + \frac{1}{2} \vec{a} t^2$$

$$\vec{d} = (0 \text{ m/s})(3.5 \text{ s}) + \frac{1}{2} (-9.81 \frac{\text{m}}{\text{s}^2})(3.5 \text{ s})^2$$

$$\vec{d} = \underline{\underline{-60 \text{ m}}}$$



ex) A cannon ball is dropped from 150 m in the air. How long does it take to hit the ground?

$$\vec{v}_i = 0 \text{ m/s}$$

$$\vec{d} = -150 \text{ m}$$

$$t = ?$$

$$\vec{a} = -9.81 \text{ m/s}^2$$

$$\vec{d} = \vec{v}_i t + \frac{1}{2} \vec{a} t^2$$

cancel 1/2

$$-150 \text{ m} = (0 \text{ m/s}) t + \frac{1}{2} (-9.81 \text{ m/s}^2) t^2$$

$$-150 = \frac{1}{2} (-9.81) t^2$$

$$-150 = -4.905 t^2$$

$$\frac{-150}{-4.905} = \frac{-4.905 t^2}{-4.905}$$

$$\sqrt{30.58} = \sqrt{t^2}$$

$$5.535 = t$$

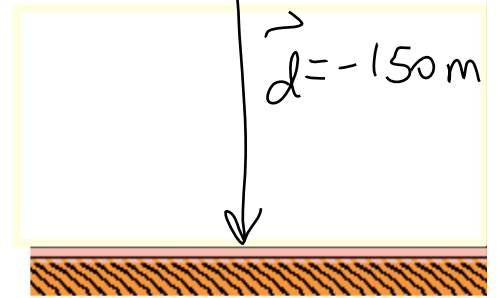
5.535



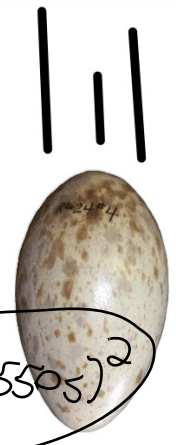
$$\vec{v}_i = 0 \text{ m/s}$$



$$\vec{d} = -150 \text{ m}$$



ex) An egg is thrown downward out of a window. If the window is 11.2 m above the ground, and it took the egg 0.550 s to hit the ground, what was the initial velocity of the egg?



$$\begin{aligned} \vec{d} &= -11.2 \text{ m} \\ t &= 0.550 \text{ s} \\ \vec{v}_i &= ? \\ \vec{a} &= -9.81 \text{ m/s}^2 \end{aligned}$$

$$\vec{d} = \vec{v}_i t + \frac{1}{2} \vec{a} t^2$$

$$-11.2 \text{ m} = \vec{v}_i (0.550 \text{ s}) + \frac{1}{2} (-9.81 \text{ m/s}^2) (0.550 \text{ s})^2$$

$$-11.2 = 0.55 \vec{v}_i - 1.4838$$

$$\frac{-9.7162}{0.55} = \frac{0.55 \vec{v}_i}{0.55}$$

$$\vec{v}_i = \underline{\underline{-17.7 \text{ m/s}}}$$

Practice:
Physics UA pt B