Free-fall Problems
(Acceleration due to gravity)

Goal: - to be able to solve kinematics problems with gravity

Free fall is the motion of an object, when the only force acting on it is gravity.

For these problems we don't need to be told the acceleration. We know it to be approximately....

$$a_g = 9.8 \text{ m/s}^2$$

acceleration due to gravity

$$g = 9.8 \text{ N/kg}$$

gravitational field strength of Earth

For free fall problems we ignore air resistance unless specifically told otherwise.

An egg is dropped from the top of the school. If the top of the school is 15 metres high, how long will it take the egg to hit the ground?

$\vec{\Delta d} = 15 \text{ m [down]}$

$\vec{a_g} = 9.8 \text{ m/s}^2 \text{ [down]}$

$\vec{v_i} = 0 \text{ (dropped)}$

$\Delta t = ?$

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

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

$\dfrac{2\vec{\Delta d}}{\vec{a}} = \Delta t^2$

$\Delta t = \sqrt{\dfrac{2\vec{\Delta d}}{\vec{a}}} = \sqrt{\dfrac{2(15)}{9.8}}$

$\Delta t = 1.75 \text{ s}$

These problems can only have two directions (up or down).

This means the sign convention is essential.

We can make either direction + or - for any given problem.
What is most important is that you are consistent throughout the problem.

(Most students find it easiest to always think of up as positive and down as negative)

While still on the top of the school (15 m high) a second egg is thrown straight upwards with an initial speed of 8.0 m/s.

a) What is the maximum height reached by the egg?

$\vec{v}_i = 8.0 \text{ m/s } [up]$

$\vec{v}_f = 0$ (stops at max height)

$\vec{a}_g = 9.8 \text{ m/s}^2 [down]$ — always for free fall

$\vec{\Delta d} = ?$

$\vec{v_f}^2 = \vec{v_i}^2 + 2\vec{a}\vec{\Delta d}$

b) How fast is the egg traveling when it strikes the ground?