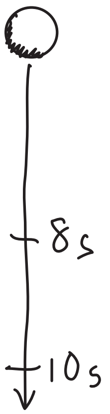
1. How far does an object fall after freefalling from rest for 8 seconds? How about 10 seconds?



$8s: \ d = \frac{1}{2}gt^2 = \frac{1}{2}(9.8\frac{m}{s^2})(8\,s)^2 = \frac{1}{2}(9.8\frac{m}{s^2})(64\,s^2)$

$\boxed{d = 313.6\,m}$

$10s: \ d = \frac{1}{2}(9.8\frac{m}{s^2})(100\,s^2) = \boxed{490\,m}$

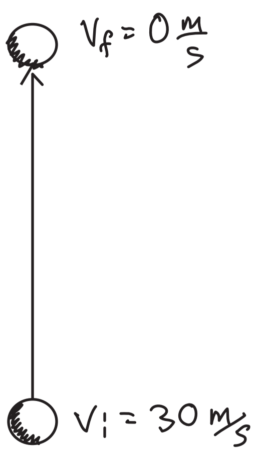
notice that it falls 314 m in the 1st 8 s, and 174 m in just the next 2 s → that's acceleration.

2. One World Trade Center in New York City is 541 m tall. How long would it take an object to fall from the top of the building if air resistance is negligible?

$d = \frac{1}{2}gt^2 \rightarrow t = \sqrt{\frac{2d}{g}} = \sqrt{\frac{2 \cdot 541\,m}{9.8\frac{m}{s^2}}} = \sqrt{110.4\,s^2} = \boxed{10.5\,s}$

division is multiplication by the reciprocal.

3. A baseball is thrown straight upward with an initial velocity of 30 m/s. How far high will the ball go before it begins its downward trip? How long will the upward and downward trips take?



← The acceleration that slows the ball is due to gravity, so $g = \frac{\Delta v}{\Delta t} = \frac{V_f - V_i}{t}$

acceleration in the negative direction (vectors!) → $-9.8\frac{m}{s^2} = \frac{0\frac{m}{s} - 30\frac{m}{s}}{t}$ ← unknown.

$t = \frac{-30\frac{m}{s}}{-9.8\frac{m}{s^2}} = 3.06\,s$

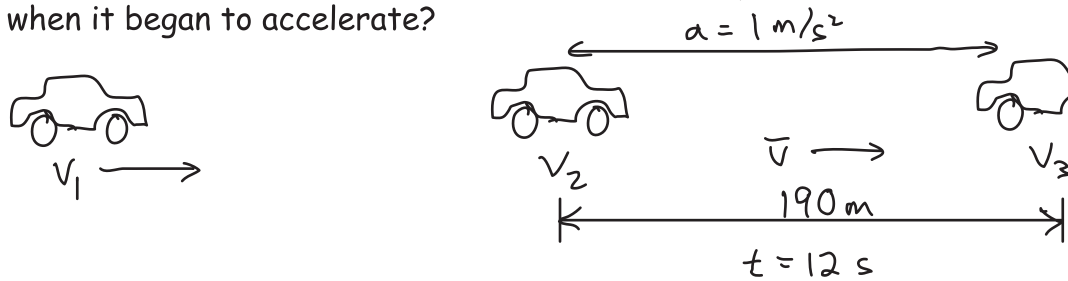
Now $d = \frac{1}{2}gt^2 = \frac{1}{2}(9.8\frac{m}{s^2})(3.06^2)\,s^2$

$\boxed{d = 45.9\,m}$

Time to come back down: $t = \sqrt{\frac{2d}{g}} = \sqrt{\frac{2 \cdot 45.9}{9.8}} = \boxed{3.06\,s}$

* The time to come down is always the same as the time to go up.

4. A car, initially traveling at a constant velocity, accelerates at a rate of 1.0 m·s^{-2} for a period of 12 s. If the car traveled 190 m during this period, what was the velocity of the car when it began to accelerate?



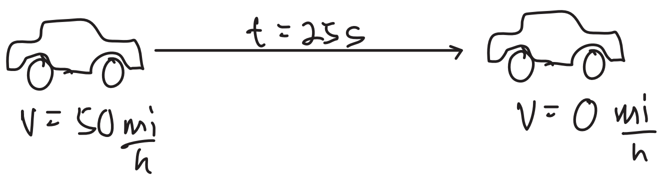
we can just look @ the $v_2 \to v_3$ portion of the problem first, assuming v_1 to be zero (for now)

$$d = \frac{1}{2}at^2 = \frac{1}{2}(1.0\ \frac{m}{s^2})(12\ s)^2 = 72\ m$$ ← Thats the distance accounted for by the acceleration

190 m − 72 m = 118 m traveled in 12 s that is the result of the initial velocity, v_1

$$v = \frac{d}{t} = \frac{118\ m}{12\ s} = \boxed{9.83\ \frac{m}{s}}$$

5. While traveling out in the country at 50 mi./h, your car's engine and brakes stop working any you coast to a stop in 25 seconds. Calculate your average acceleration during the time after the motor shuts off.



$$a = \frac{\Delta v}{\Delta t} = \frac{(0-50)\frac{mi}{h}}{25\ s\left(\frac{1\ h}{3600\ s}\right)} =$$

$$a = -7200\ \frac{mi}{h^2}$$

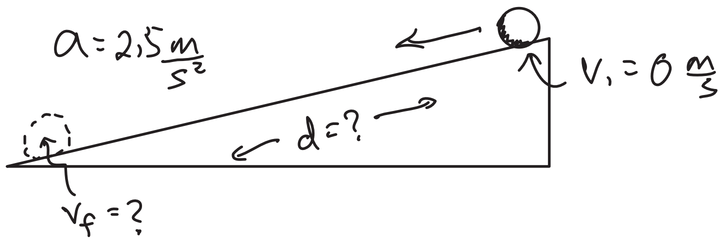
convert to $\frac{m}{s^2}$: $7200\ \frac{mi}{h^2}\left(\frac{1\ h}{3600\ s}\right)^2\left(\frac{1602\ m}{1\ mi}\right) = -0.89\ \frac{m}{s^2}$

Now just for fun, the distance: $d = \frac{1}{2}at^2 = \frac{1}{2}(0.89\ \frac{m}{s^2})\ 25^2 s^2$

$$d = 278.125\ m$$

$$278.125\ m\left(\frac{1\ mi}{1602\ m}\right) = 0.174\ mi.$$

6. A ball rolls down an inclined plane with constant acceleration of 2.5 m·s^{-2}.(a) How fast is the ball rolling after 3s? (b) How far has the ball rolled in this time? (c) How far will the ball have traveled when its velocity reaches 15 m/s?



(a) $a = \frac{\Delta v}{\Delta t}$ (a = 2.5 m/s², $\Delta v = v_f - 0$, Δt = 3.0 s) → $v_f = 2.5 \frac{m}{s^2} \cdot 3.0 s$

$$\boxed{v_f = 7.5 \frac{m}{s}}$$

(b) $d = \frac{1}{2}at^2 = \frac{1}{2}(2.5 \frac{m}{s^2})(3 s)^2 = \boxed{11.25 m}$

(c) First, find the time

$$a = \frac{\Delta v}{\Delta t} \rightarrow \Delta t = \frac{\Delta v}{a} = \frac{15 m/s}{2.5 m/s^2} = 6 s$$

then the distance: $d = \frac{1}{2}at^2 = \frac{1}{2}(2.5 \frac{m}{s^2})(6 s)^2$

$$\boxed{d = 45 m}$$