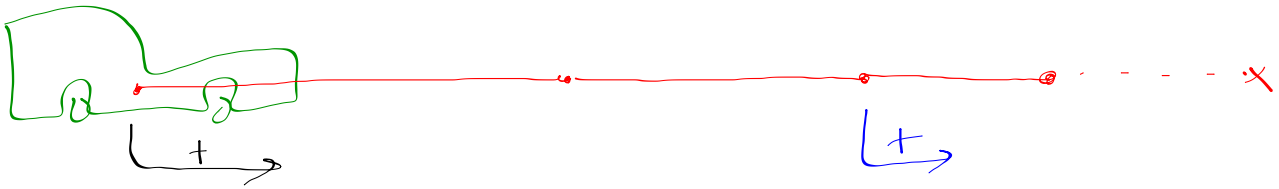
22. A car traveling 80 km/h decelerates at a constant 1.5 m/s^2. Calculate
    a) the distance it goes before it stops. → 22.2 m/s
    b) the time it takes to stop.
    c) the distance it travels DURING the first and third seconds (not between those two times but during the 1st second of travel, and then during the 3rd second of travel).



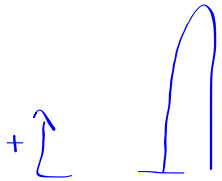
t=0 t=1 t=2 t=3

$x_0 = 0m$
$x =$
$v_0 = 22.2\ m/s$
$v =$ □
$a = -1.5\ m/s^2$
$\Delta t = 2s$

$x_0 = 0m$
$x =$ □
$v_0 =$ □
$v =$
$a = -1.5\ m/s^2$
$\Delta t = 1s$

$\Delta x = x - x_0$

33. A baseball is thrown vertically into the air with a speed of 24.7 m/s.
    a) How high does it go? (at max height, $v=0$)
    b) How long does it take to return to the ground?



$x_0 = 0$

$x = 0$

$v_0 = 24.7\ m/s$

$v =$

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

$t =$

$x = x_0 + v_0 t + \frac{1}{2} a t^2$

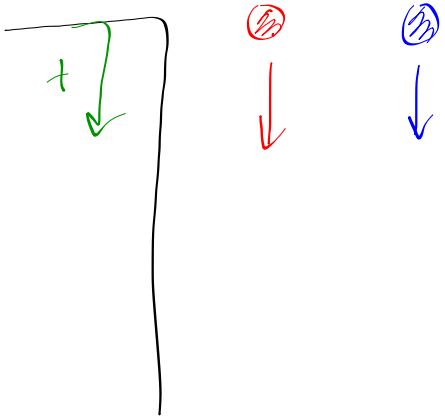
$0 = 0 + 24.7t + \frac{1}{2}(-9.8)t^2$

$-4.9t^2 + 24.7t = 0$

$t(-4.9t + 24.7) = 0$

$t = 0$ $\quad -4.9t + 24.7 = 0$

37. A stone is dropped from the roof of a high building. A second stone is dropped 1.00 s later. How far apart are the stones when the second one has reached a speed of 23.0 m/s?



$x_0 = 0m$
$x =$ ☐
$v_0 = 0 m/s$
$v =$
$a = 9.8 m/s$
$\Delta t = 3.35s$

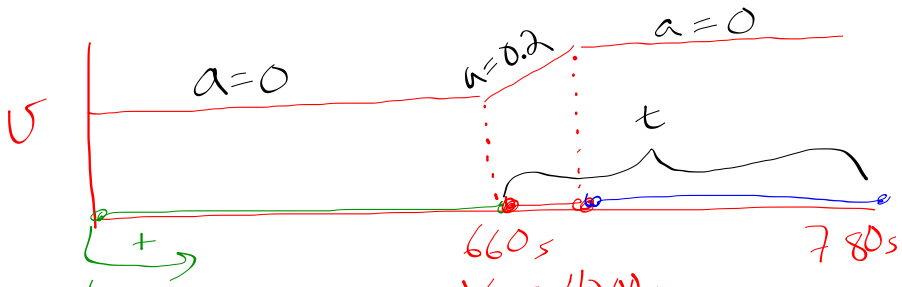
$x_0 = 0m$
$x =$ ☐
$v_0 = 0 m/s$
$v = 23 m/s$
$a = 9.8 m/s$
$\Delta t = 2.35s$

$v = v_0 + at$!

$\Delta t = t - t_0$
$\Delta t = 3.35 - 0$

$\Delta t = t - t_0$
$2.35s = t - 1$
$t = 3.35s$

30. A runner hopes to complete the 5000-m run in less than 13.0 min. After exactly 11.0 min, there are still 800 m to go. The runner must accelerate at 0.20 m/s^2 for how many seconds in order to achieve the desired time?



$X_0 = 0$

$X = 4200\,m$

$v_0 = 6.36\ m/s$

$v = 6.36\ m/s$

$a = 0$

$t = 660\,s$

$X_0 = 4200\,m$

$X = 4200 + 6.36t_1 + \frac{1}{2}(0.2)t_1^2$

$v_0 = 6.36\ m/s$

$v = 6.36 + 0.2t_1$

$a = 0.2\ m/s^2$

$t = t_1$

$t = \boxed{t_1 + t_2 = 120\,s}$

$\ldots\ t_2 = 120 - t_1$

$X_0 = 4200 + 6.36t_1 + \frac{1}{2}(0.2)t_1^2$

$X = 5000\,m$

$v_0 = 6.36 + 0.2t_1$

$v = 6.36 + 0.2t_1$

$a = 0$

$t = t_2 = 120 - t_1$

$X = X_0 + v_0 t + \frac{1}{2}at^2$ ($\frac{1}{2}at^2 \to 0$)

$X_0 = 4200 + 6.36t_1 + \frac{1}{2}(0.2)t_1^2$
$X = 5000m$
$v_0 = 6.36 + 0.2t_1$
$v = 6.36 + 0.2t_1$
$a = 0$
$t = t_2 = 120 - t_1$

$5000 = 4200 + 6.36t_1 + \frac{1}{2}(0.2)t_1^2 + (6.36 + 0.2t_1)(120 - t_1)$

$5000 = 4200 + 6.36t_1 + 0.1t_1^2 + 763.2 + 24t_1 - 6.36t_1 - 0.2t_1^2$

$-0.1t_1^2 + 24t_1 + -36.8 = 0$

Quad. Form. $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$t = 1.54s$ or $t = 238...s$ $\frac{-24 + \sqrt{24^2 - 4(-0.1)(-36.8)}}{2(-0.1)}$