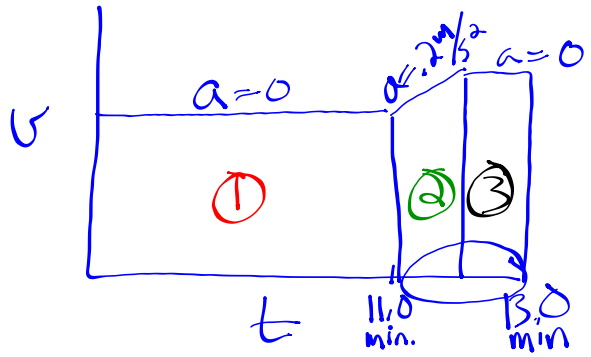
30. A runner hopes to complete the 5000-m run in less than 13.0 min. After exactly 11.0 min, there are still 800 m to go. The runner must accelerate at 0.20 m/s^2 for how many seconds in order to achieve the desired time?



$t_2 + t_3 = 120$

$t_3 = 120 - t_2$

$x_0 = 0\text{ m}$

$x = 4200\text{ m}$

$v_0 = 6.36 \frac{m}{s}$

$v = 6.36 \frac{m}{s}$

$a = 0$

$t = 11\text{ min} = 660\text{ s}$

$x_0 = 4200\text{ m}$

$x = 4200 + 6.36t_2 + 0.1t_2^2$

$v_0 = 6.36 \frac{m}{s}$

$v = 6.36 + 0.2t_2$

$a = 0.2 \frac{m}{s^2}$

$t = t_2 = 1.54\text{ s}$

$x_0 = 4200 + 6.36t_2 + 0.1t_2^2$

$x = 5000\text{ m}$

$v_0 = 6.36 + 0.2t_2$

$v = 6.36 + 0.2t_2$

$a = 0 \frac{m}{s^2}$

$t = t_3 = 120 - t_2$

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

$x = 4200 + 6.36t + \frac{1}{2}(0.2)t^2$

$v = v_0 + at$

$v = 6.36 + 0.2t$

$v^2 = v_0^2 + 2a(x - x_0)$

$v^2 = 6.36^2 + 2(0.2)(x - 4200)$

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

$$5000 = 4200 + 6.36t_2 + 0.1t_2^2 + (6.36 + 0.2t_2)(120 - t_2)$$

$$800 = 6.36t_2 + 0.1t_2^2 + 763.2 - 6.36t_2 + 24t_2 - 0.2t_2^2$$

$$0 = -.1t_2^2 + 24t_2 - 36.8$$

$$t_2 = 1.54\,s \quad \text{or} \quad 238.5\,s$$