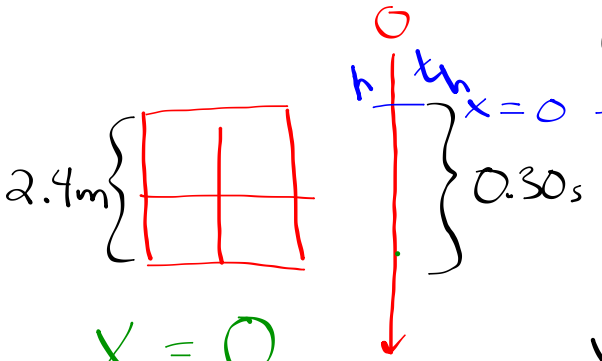
44. A falling stone takes 0.30 s to pass a window 2.4 m high. In other words, as the stone is falling, 0.30 seconds pass AS the stone falls past the window. From what height above the top of the window did the stone fall?



$a = 9.8\ m/s^2$

$X_0 = h = -2.176m$
$X = 0m$
$v_0 = 0\ m/s$
$v = 6.53\ m/s$
$a = 9.8\ m/s^2$
$t = t_h$

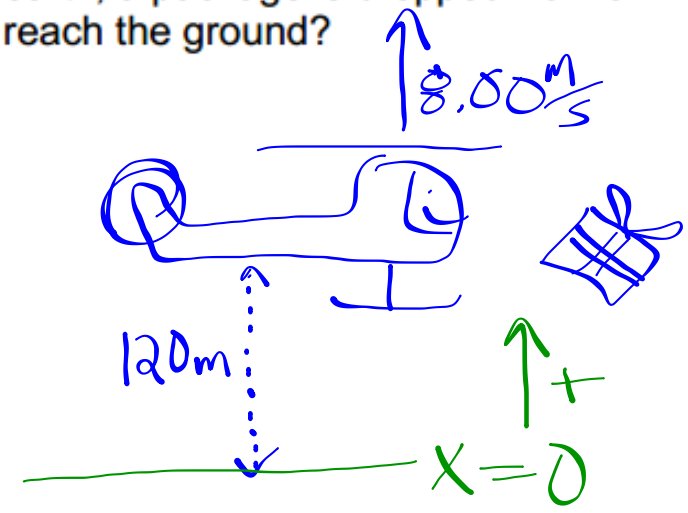
$X_0 = 0$
$X = 2.4m$
$v_0 = 6.53\ m/s$
$v =$
$a = 9.8\ m/s^2$
$t = 0.3\ s$

$$X = X_0 + v_0 t + \frac{1}{2}at^2$$
$$2.4 = v_0(.3) + \frac{1}{2}(9.8)(.3)^2$$
$$v_0 = 6.53\ m/s$$

$$v^2 = v_0^2 + 2a(X - X_0)$$
$$(6.53)^2 = 2(9.8)(-X_0)$$
$$X_0 = -2.176m$$

2.18m

39. A helicopter is ascending vertically with a speed of 8.00 m/s; at a height of 120 m above the earth, a package is dropped from a window. How much time does it take for the package to reach the ground?



$a = 9.8 \frac{m}{s^2}$

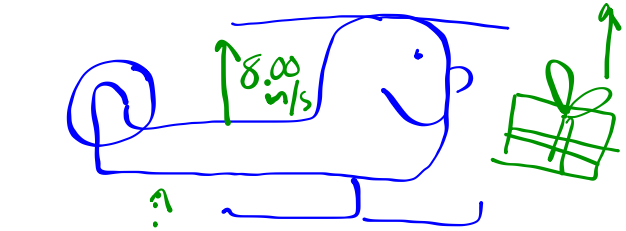
$x_0 = 120\,m$
$x = 0$
$v_0 = 8.00 \frac{m}{s}$
$v = v$
$a = -9.8 \frac{m}{s^2}$
$t = t$

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

$$0 = 120 + 8t + -4.9t^2$$

$t = -4.2$ or $5.83\,s$

39. A helicopter is ascending vertically with a speed of 8.00 m/s; at a height of 120 m above the earth, a package is dropped from a window. How much time does it take for the package to reach the ground?



$v = 8.00\ m/s$ $a_g = 9.8\ m/s^2$

120m

+

x=0

$x_0 = 120\ m$
$x = 0\ m$
$v_0 = 8.00\ m/s$
$v = v$
$a = -9.8\ m/s^2$
$t = t$

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

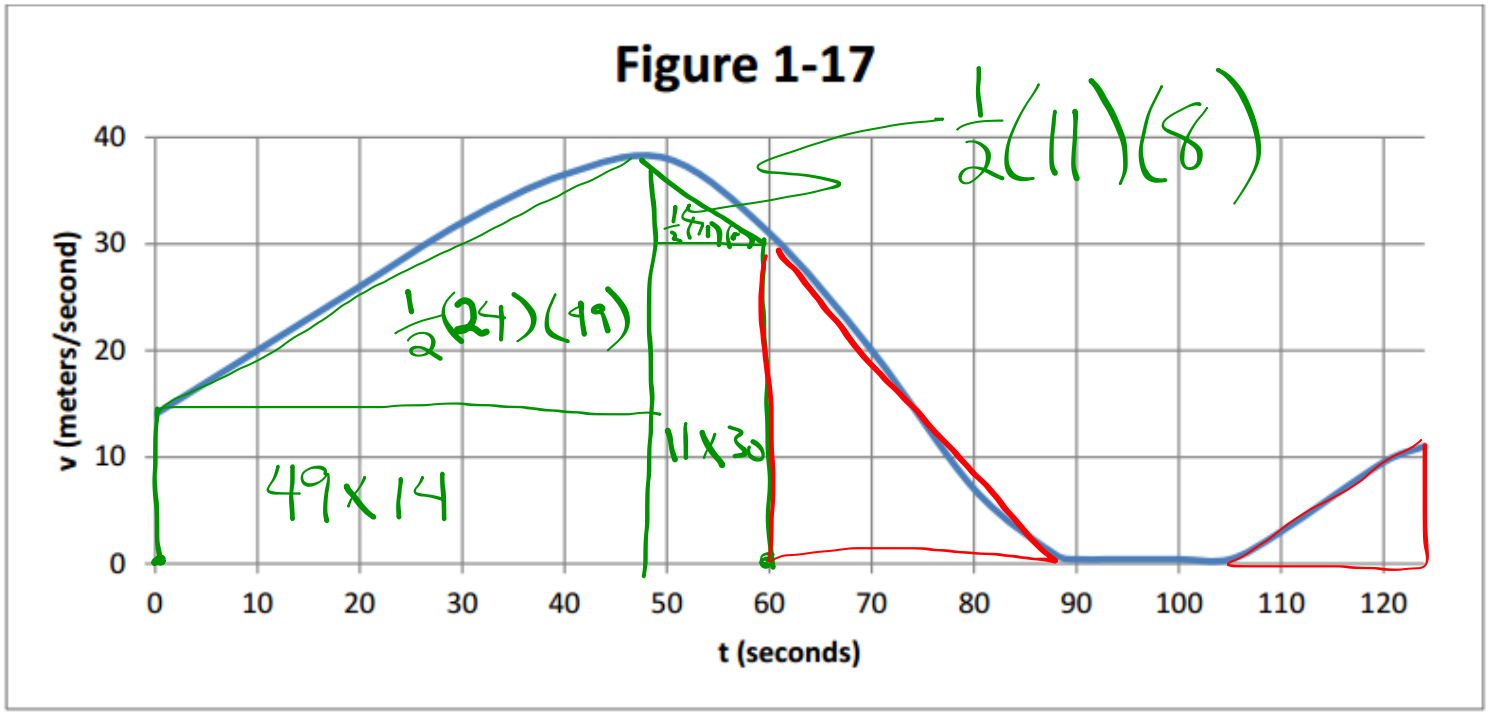
$0 = 120 + 8t + -4.9t^2$

Use quadratic formula!

$t = -4.2$ or

$t = 5.8s$

52. In Figure 1-17, estimate the distance the train traveled during
    a) the first minute.
    b) the second minute.



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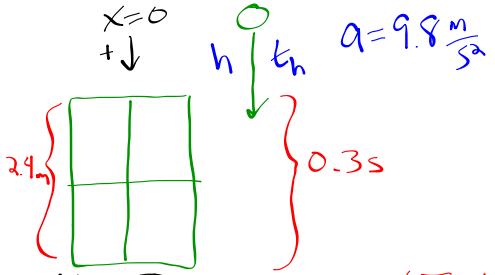


$x_0 = 0m$
$x = h+2.4m$
$v_0 = 0\frac{m}{s}$
$v = v$
$a = 9.8\frac{m}{s^2}$
$t = t_h + 0.3s$
0.67s

$v = v_0 + at$
$= (9.8)(t_h + 0.3)$
$= 9.8t_h + 2.94$

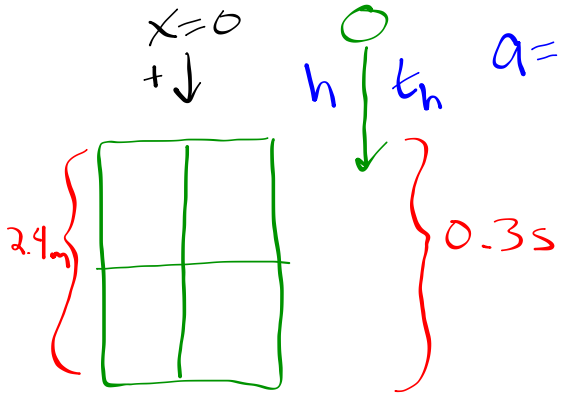
$9.8t_h + 2.94 = 9.47\ m/s$ (from next page)

$x = x_0 + v_0 t + \frac{1}{2}at^2$
$h+2.4 = \frac{1}{2}(9.8)(t_h+0.3)^2$
$h = 4.9(t_h+0.3)^2 - 2.4$
$h = 4.9(t_h^2 + 0.6t_h + 0.09) - 2.4$

$9.8t_h + 2.94 = 9.47$
$t_h = 0.67s$

$h = 4.9(0.67^2 + 0.6(.67) + 0.09) - 2.4$
$= 4.9(.45 + .40 + 0.09) - 2.4$
$= 2.2\ m$ holy cow

Continued...



$a = 9.8 \frac{m}{s^2}$

Velocity at the top of the window:

$X = X_0 + v_0 t + \frac{1}{2} a t^2$

$\cancel{h} + 2.4m = \cancel{h} + v_0(.3) + \frac{1}{2}(9.8)(.3)^2$

$v_0 = \frac{2.4 - \frac{1}{2}(9.8)(.3)^2}{.3}$

$= \boxed{6.53 \frac{m}{s}}$

$X_0 = h$
$X = h + 2.4m$
$v_0 = v_0$
$v = v$
$a = 9.8 \frac{m}{s^2}$
$t = 0.3 s$

$(t_0 = t_h, t_1 = t_h + .3, \Delta t = 0.3s)$

velocity at the bottom of the window

$v = v_0 + a \cdot t$

$= 6.53 + (9.8)(.3)$

$= \boxed{9.47 \frac{m}{s}}$ → to previous page...

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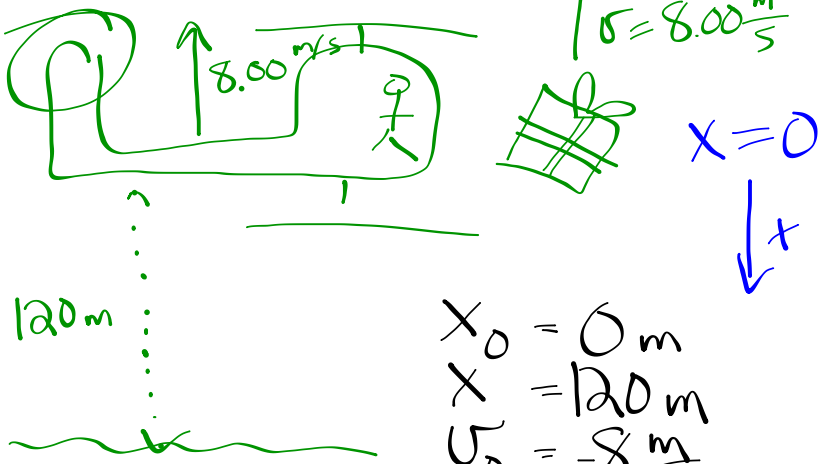
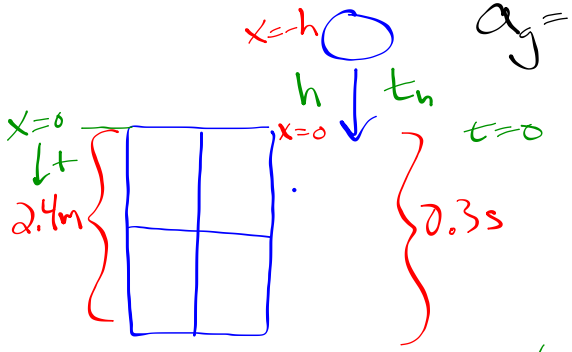


$v = 8.00 \frac{m}{s}$ $a_g = 9.8 \frac{m}{s^2}$

$x_0 = 0\,m$
$x = 120\,m$
$v_0 = -8 \frac{m}{s}$
$v = v$
$a = 9.8 \frac{m}{s^2}$
$t = t$

$$x = x_0 + v_0 t + \frac{1}{2} a t^2$$
$$120 = (-8)t + 4.9t^2$$
$$-4.9t^2 + 8t + 120 = 0$$
$$t = -4.2 \text{ or } \boxed{t = 5.8\,s}$$

44. A falling stone takes 0.30 s to pass a window 2.4 m high. In other words, as the stone is falling, 0.30 seconds pass AS the stone falls past the window. From what height above the top of the window did the stone fall?



$a_y = 9.8 \frac{m}{s^2}$

$x_0 = -h$
$x = 0$
$v_0 = 0 \frac{m}{s}$
$v = 6.53 \frac{m}{s}$
$a = 9.8 \frac{m}{s^2}$
$t = t_h$

$x_0 = 0m$
$x = 2.4m$
$v_0 = v_0 = 6.53 \frac{m}{s}$
$v = v$
$a = 9.8 \frac{m}{s^2}$
$t = 0.3s$

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

$2.4 = v_0 (.3) + (4.9)(.3)^2$

$v_0 = 6.53 \frac{m}{s}$

$x_0 = -h$
$x = 0$
$v_0 = 0 \frac{m}{s}$
$v = 6.53 \frac{m}{s}$
$a = 9.8 \frac{m}{s^2}$
$t = t_h$

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

$(6.53)^2 = 2(9.8)(h)$

$h = 2.18m$