2.22a) The position is given by

$$x = 2 + 3t - 4t^2$$

The derivative of position with respect to time. The derivative of a polynomial can be found according to

$$\frac{d}{dt}\left(at^n\right) = nat^{n-1}$$

See page 43 & example 2.3

$$v = \frac{dx}{dt} = \frac{d}{dt}\left(2 + 3t - 4t^2\right) = 3 - 8t$$

$v = 3 - 8t$ the object changes direction when $v = 0$

$v = 3 - 8t = 0$ $\therefore$ $t = 3/8\,s$ this is time at which it changes direction i.e. The peak.

What is the position at $t = 3/8\,s = .375\,s$

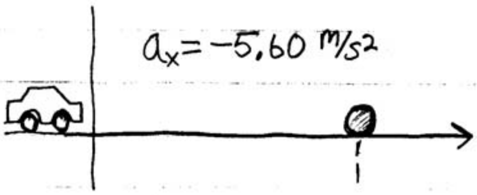
$$x = 2 + 3(.375\,s) - 4(.375\,s)^2 = 2.56\ m$$

b) At $t = 0$ $x = 2$ when else does $x = 2$

$$2 = 2 + 3t - 4t^2$$
$$0 = (3 - 4t)t \qquad t = 0,\ 3/4\,s$$

$$v = 3 - 8\,(3/4\,s) = -3\ m/s$$

2.23)



$x_i = 0\,m$ $\qquad$ $x_f = 62.4\,m$

$v_{xi} = ?$ $\qquad$ $v_{xf} = ?$ speed moving when it hits the tree

$t = 4.20\,s$

$$x_f = x_i + v_{xi}t + \frac{1}{2}a_x t^2$$

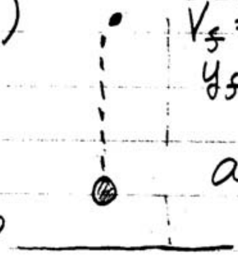
$$v_{xi} = \frac{x_f - x_i - \frac{1}{2}a_x t^2}{t} = \frac{62.4\,m - \frac{1}{2}(-5.6\,m/s^2)(4.20\,s)^2}{4.2\,s}$$

$$v_{xi} = 26.6\ m/s$$

$$v_{xf} = v_{xi} + a_x t$$

$$v_{xf} = 26.6\ m/s + (-5.60\ m/s^2)(4.20\,s) = 3.1\,m/s$$

2.29)



$t = 3s$
$V_f = 0$ } at the peak
$y_f = ?$

$V_i = ?$
$y_i = 0$

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

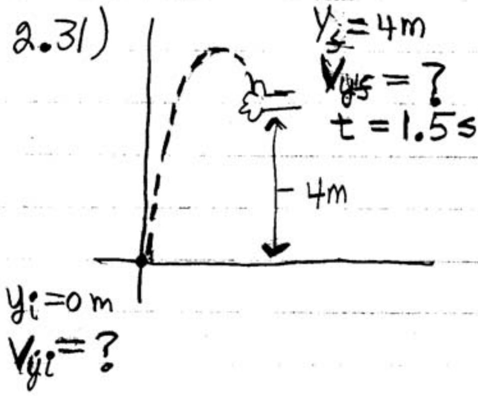
$$V_{yf} = V_{yi} + a_y t$$

$$V_{yi} = V_{yf} - a_y t = -a_y t = 9.8\,\frac{m}{s^2}(3s) = 29.4\, m/s$$

$$y_f = y_i + \frac{1}{2}(V_i + V_f)\,t$$

$$y_f = \frac{V_i}{2} t = \frac{29.4\,\frac{m}{s}}{2}(3s) = 44.1\, m$$

2.31)



$a_y = -9.8\,m/s^2$

we do not know V_{yi} or V_{yf} and thus there is only one equation we can use.

$$y_f = y_i + V_{yi}t + \frac{1}{2}a_y t^2$$

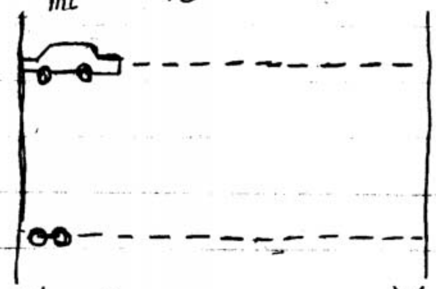
$$V_{yi} = \frac{y_f - y_i - \frac{1}{2}a_y t^2}{t} = \frac{4m - \frac{1}{2}(-9.8\frac{m}{s^2})(1.5s)^2}{1.5s}$$

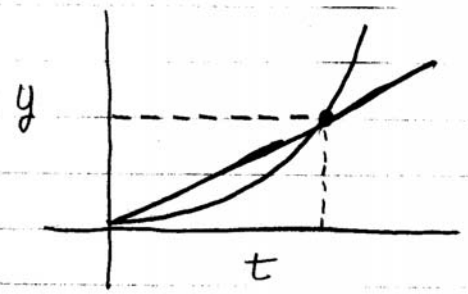
$$V_{yi} = 10.0\ m/s$$

$$V_{yf} = V_{yi} + a_y t = 10\,m/s + (-9.8\,m/s^2)(1.5s)$$

$$V_{yf} = -4.7\ m/s$$

2.40) $V_{mi} = 15\,m/s$ $\qquad$ $V_{mf} = 15\ m/s$





$V_{oi} = 0$ $\qquad$ $V_{of} = ?$

$y_i = 0 \quad a_y = 2.00\,m/s^2$ $\qquad$ $Y_f = ?$

$t = ?$

$$y_f = \cancel{y_i}^{0} + V_{mi}t = \cancel{y_i}^{0} + \cancel{V_{oi}t}^{0} + \frac{1}{2}a_y t^2$$

$$V_{mi}t - \frac{1}{2}a_y t^2 = 0$$

$$\left(V_{mi} - \frac{1}{2}a_y t\right)t = 0$$

$$t = 0 \quad \text{or} \quad t = \frac{2V_{mi}}{a_y} = \frac{2(15\,m/s)}{2\,m/s^2} = 15\,s$$

$$y = V_{mi}t = 15\,m/s\,(15\,s) = 225\,m$$