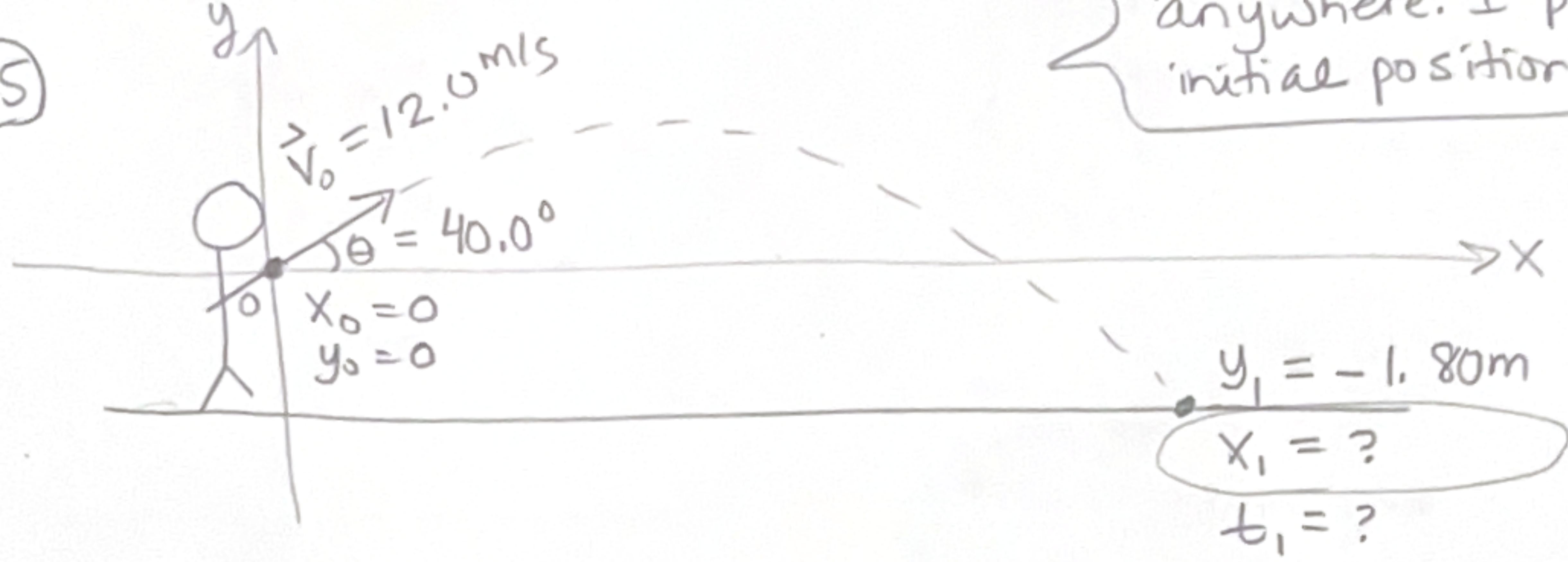
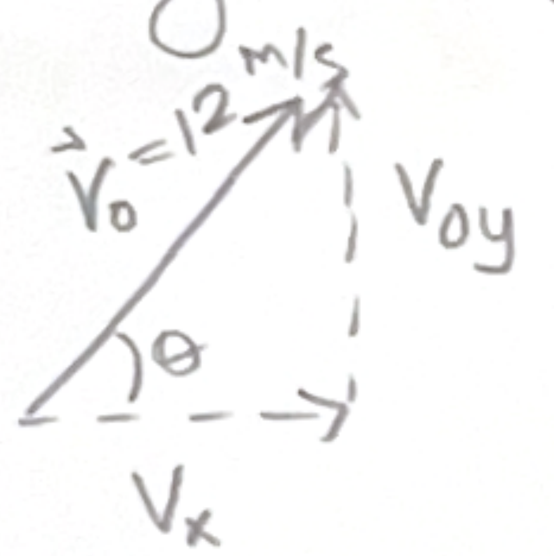
P. 106 #15, #13

> you could set the origin anywhere. I put it at the initial position.

(15)



① I know I will need the components of $\vec{V}_0$, so I'll do that right away:



$V_x = V_0 \cos\theta$

$V_x = (12\text{ m/s})\cos 40°$

$V_x = 9.19\text{ m/s}$

$V_{oy} = V_0 \sin\theta$

$V_{oy} = (12\text{ m/s})\sin 40°$

$V_{oy} = 7.71\text{ m/s}$

② Find horizontal distance x_1

- Analyze from launch to landing.

HORIZ	VERT
$x_i = 0$	$y_i = 0$
$x_f = 16.5$m	$y_f = -1.80$ m
$V_x = 9.19$ m/s	$V_{iy} = 7.71$ m/s
$\Delta t = 1.8$s	$V_{fy} = -9.8$ m/s
	$a_y = -10$ m/s²
	$\Delta t = 1.8$s

③ There is not enough information yet to use the HORIZ list to find x_1, so I will find Δt using the VERTICAL list:

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

$$-1.80\text{m} = 0 + (7.71\text{ m/s})\Delta t + \frac{1}{2}(-10\text{ m/s}^2)\Delta t^2$$

> OH DEAR! Not the quadratic formula! I will find V_{fy} first to avoid that mess!

$$V_{fy}^2 = V_{iy}^2 + 2a_y\Delta y$$

$$V_{fy}^2 = (7.71\text{ m/s})^2 + 2(-10\text{ m/s}^2)(-1.80\text{ m})$$

$$V_{fy} = \pm 9.8\text{ m/s}$$

$$\therefore V_{fy} = -9.8\text{ m/s}$$

④ Now I will find Δt:

$$V_{fy} = V_{iy} + a_y\Delta t$$

$$\Delta t = \frac{V_{fy} - V_{iy}}{a_y}$$

$$\Delta t = \frac{-9.8\text{ m/s} - 7.71\text{ m/s}}{-10\text{ m/s}^2}$$

$$\Delta t = 1.8\text{s}$$

⑤ Now find x_1!

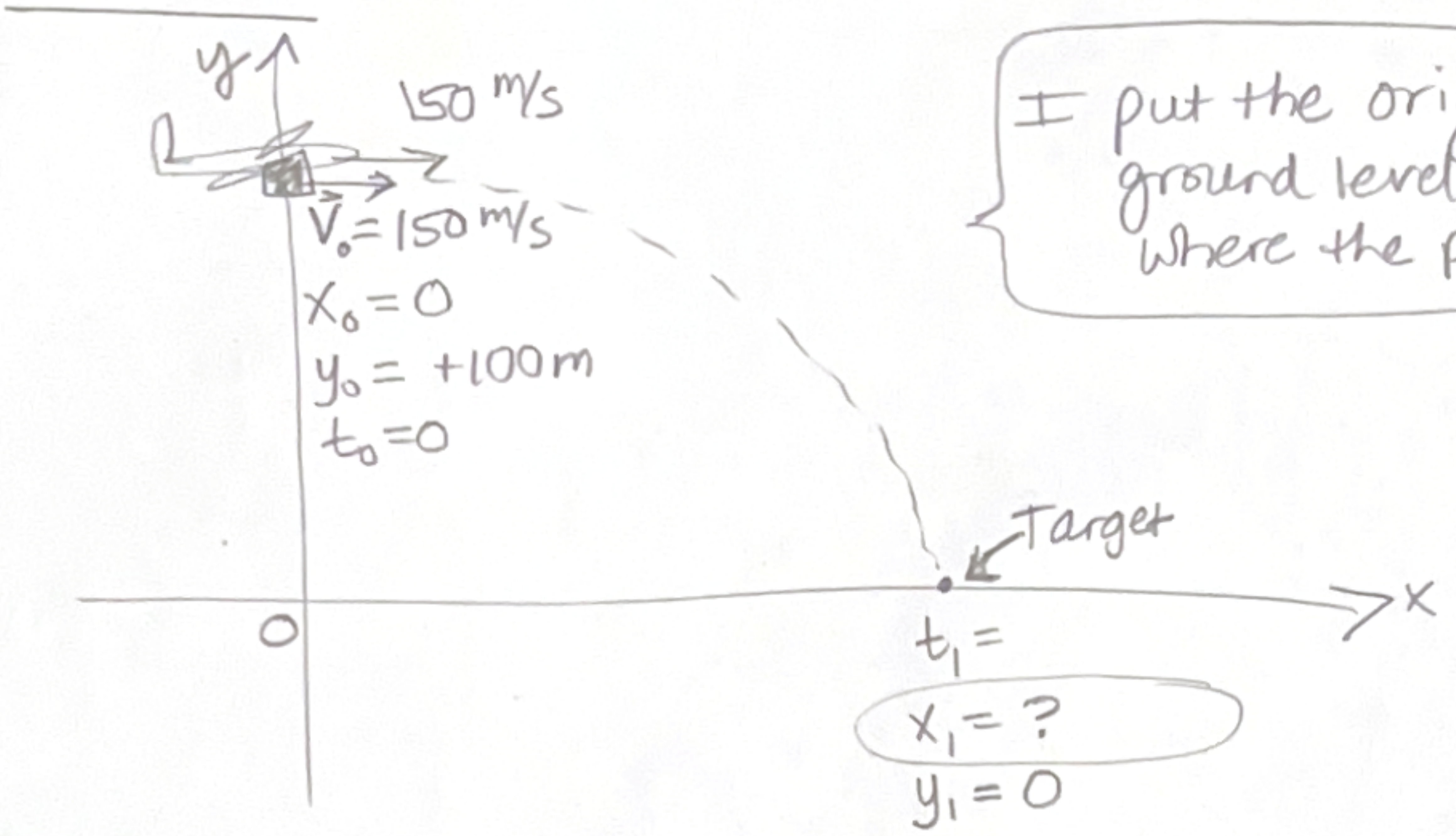
$$x_f = x_i + V_x\Delta t$$

$$x_1 = x_0 + V_x\Delta t$$

$$x_1 = 0 + (9.19\text{ m/s})(1.8\text{s}) = 16.5\text{m}$$

It travels 16.5m

P.106 #13



I put the origin at the ground level, below the point where the package is released

① Components of $\vec{V}_0$? $V_x = +150$ m/s
$V_{0y} = 0$ m/s

② • Find X_1

• Analyze from Launch to Landing (t_0 to t_1)

HORIZ	VERT
$X_i = 0$	$y_i = +100$ m
$X_f = ?$	$y_f = 0$
$V_x = 150$ m/s	$V_{iy} = 0$
$\Delta t =$	$V_{fy} =$
	$a_y = -10$ m/s²
	$\Delta t =$

③ I know Δy, V_{iy}, and a_y, so I can find Δt.

$$y_f = y_i + V_{iy}\Delta t + \tfrac{1}{2} a_y \Delta t^2$$

$$0 = y_0 + 0(\Delta t) + \tfrac{1}{2} a_y \Delta t^2$$

$$\sqrt{\frac{-2y_0}{a_y}} = \Delta t$$

$$\Delta t = \sqrt{\frac{-2(100\text{ m})}{-10\text{ m/s}^2}}$$

$$\Delta t = 4.47\text{s}$$

④ Now I can find X_1 using the HORIZ direction:

$$X_f = X_i + V_x \Delta t$$

$$X_1 = X_0 + V_x \Delta t$$

$$X_1 = 0 + (150\text{ m/s})(4.47\text{s})$$

$$X_1 = 671\text{ m}$$

The package should be dropped 671 m ahead of the target.