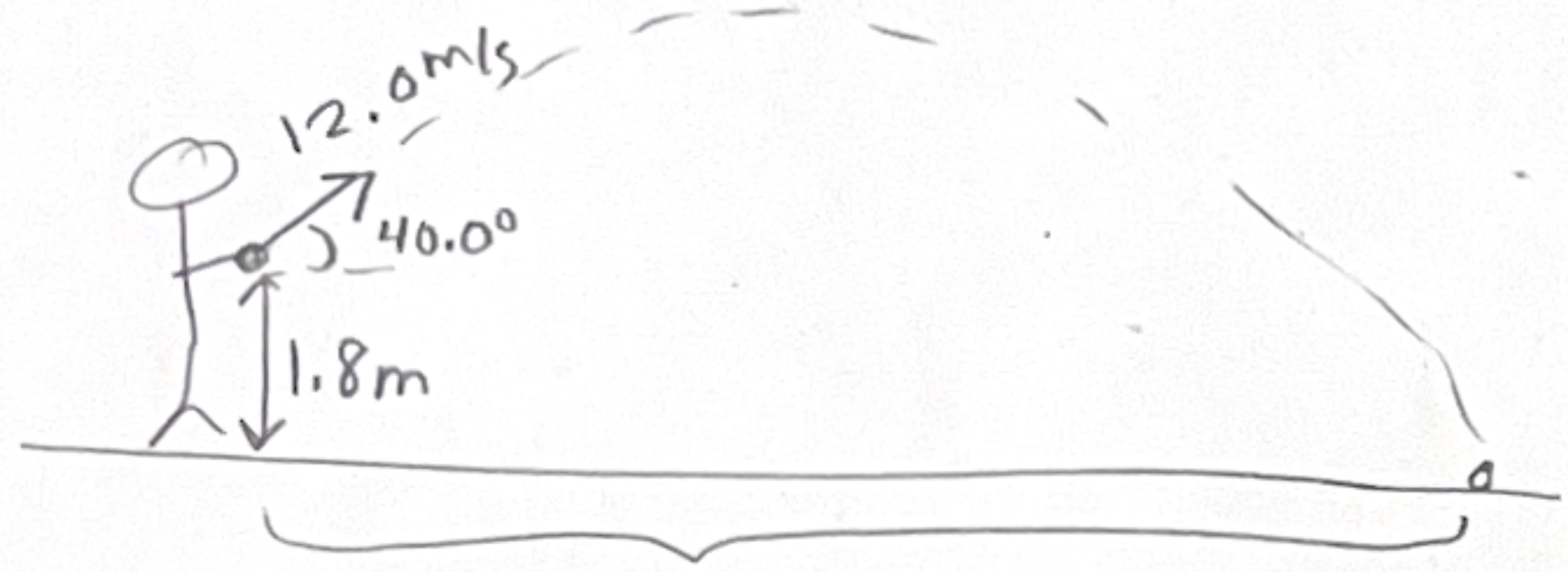
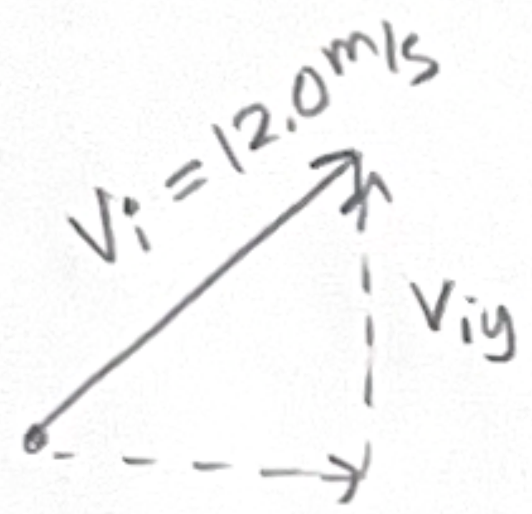
Ch4 p.106 #15, also find velocity before impact



Looking for this distance, Δx



$\cos\theta = \frac{V_{ix}}{V_i}$	$\sin\theta = \frac{V_{iy}}{V_i}$
$V_{ix} = V_i \cos\theta$	$V_{iy} = V_i \sin\theta$
$V_{ix} = (12.0 m/s)\cos 40$	$V_{iy} = (12.0 m/s)\sin 40$
$V_{ix} = 9.19 m/s$	$V_{iy} = 7.71 m/s$

moment: Landing

HORIZ	VERT
$\Delta x = ?$	$\Delta y = -1.8m$
$V_x = 9.19 m/s$	$V_{iy} = 7.71 m/s$
$\Delta t =$	$V_{fy} =$
	$a_y = -9.8 m/s^2$
	$\Delta t =$

Plan: I need to find Δt from the vertical variables. Then I can use it in the horizontal direction to find Δx.

$\Delta y = V_{iy}\Delta t + \frac{1}{2} a \Delta t^2$

$-1.8m = (7.71 m/s)\Delta t + \frac{1}{2}(-9.8 m/s^2)\Delta t^2$

This is a quadratic! Use quadratic formula:

$4.9\Delta t^2 - 7.71\Delta t - 1.8 = 0$

$\Delta t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$\Delta t = \frac{-(-7.71) \pm \sqrt{(-7.71)^2 - 4(4.9)(-1.8)}}{2(4.9)}$

$\Delta t = \frac{7.71 \pm 9.73}{9.8}$

$\Delta t = 1.78s$ and $\Delta t = -0.21s$

The positive is the one we want!

Now, using the horizontal direction:

$\Delta x = V_x \Delta t$

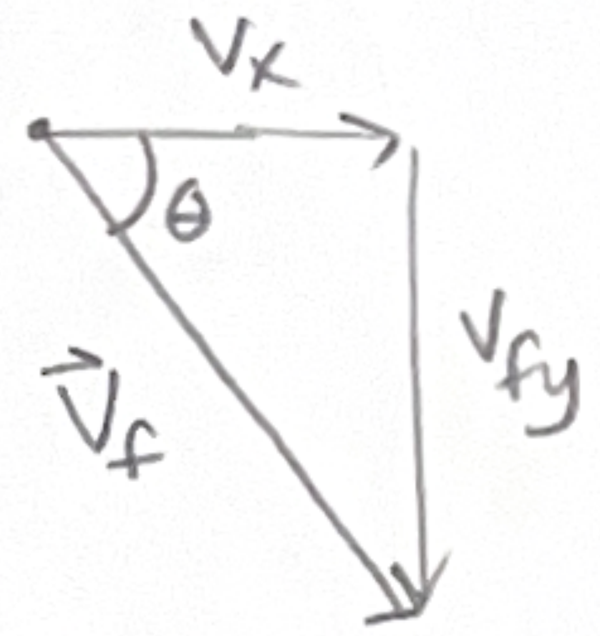
$\Delta x = (9.19 m/s)(1.78s)$

$\Delta x = \boxed{16.4m}$

⇓

#15, continued:

velocity at impact looks like this:



I already know V_x is 9.19 m/s, so if I find V_{fy}, then I can combine them to find the magnitude and direction of $\vec{V}_f$.

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

$V_{fy} = 7.71\,m/s - 9.8\,m/s^2(1.78s)$

$V_{fy} = -9.73\,m/s$

Now use pythagorean theorem to find final speed, V_f:

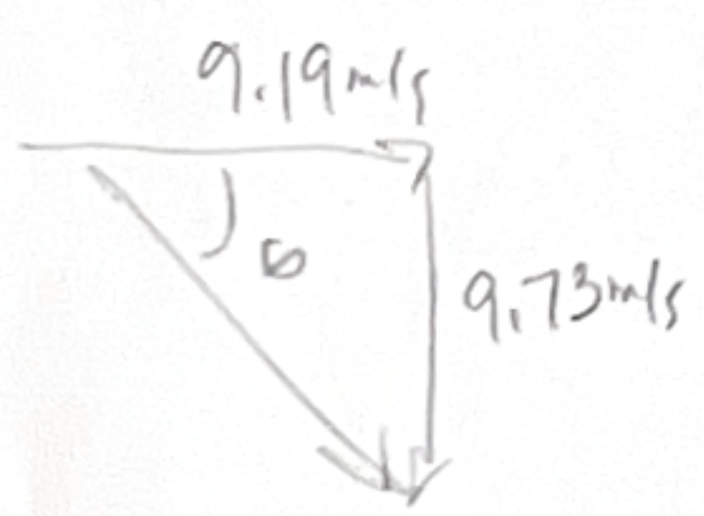
$$V_x^2 + V_{fy}^2 = V_f^2$$

$$(9.19\,m/s)^2 + (-9.73\,m/s)^2 = V_f^2$$

$$\boxed{13.4\,m/s} = V_f$$

Use tangent to find the angle: put in only magnitudes and get the acute angle + look at picture to see where it is.

$$\tan\theta = \frac{V_{fy}}{V_x}$$



$$\tan\theta = \frac{9.73\,m/s}{9.19\,m/s}$$

$$\theta = 47°$$

The velocity at impact is 13.4 m/s at 47° below the horizontal.