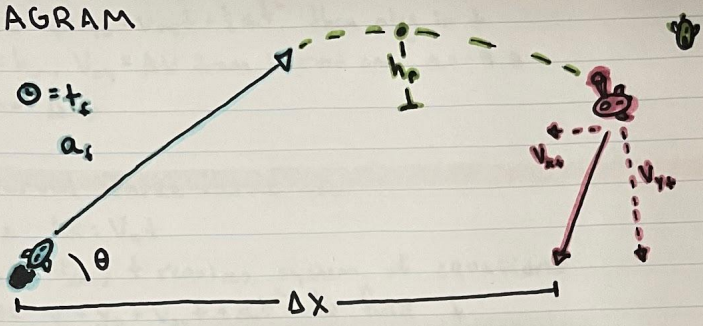
Cecilia Carbonell 9.28.23

DIAGRAM



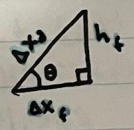

$\theta = 48°$
$t_f = 7.5s$
$a_f = 6.1 m/s^2$
$h_p = 70.m$
$V_{yo} = 9.0 m/s$
$V_{xo} = 15.0 m/s$
$\Delta X = ?$

APPROACH

Break problem into three parts. Find horizontal distance over each interval and add to get final answer.

Interval One: Engine Firing

- Use $\Delta x = v_0 t + \frac{1}{2} a t^2$
- $v_0 = 0$, $t = t_f$, $a = a_f$
- $\Delta x$ is total distance travelled, not horizontal distance




$\cos\theta = \frac{\Delta x_f}{\Delta x_a}$

$\sin\theta = \frac{h_f}{\Delta x_a}$

- Find final velocity with $\Delta v = at$

Interval Two: Projectile Motion

Part One: Find Max Height

- Use $v^2 = v_0^2 + 2a\Delta y$
- $v = 0$, $v_0 = \Delta v$ from interval one, $a = a$, $h_p = \Delta y$
- $h_f + \Delta y$ = max height ($h_m$)

Part Two: Find height of parachute

- $h_m - h_p$ = height of parachute ($h_r$)

Part Three: Horizontal Distance

- Use $\Delta x = v_x t$
- $v_x = \Delta v$ from interval one, solve for $t$ with...

- Use $y = y_0 + v_{oy}t + \frac{1}{2}at^2$ then plug in $t$
- $y = h_r$, $V_{oy} = \Delta V$ from interval one, $a = -9.8$
- Find $\Delta x_p$

## Interval Three: Parachute

- Use $\Delta x = V_x t$
- $V_x = -V_{xt}$, $t$ requires system of equations
- Use $y = y_0 + v_{oy}t + at^2$ to find $t$
- $y = 0$, $y_0 = h_r$, $V_{oy} = -V_{yt}$, $a = 0$
- Use $t$ to find $\Delta x_t$

## Finale: Find Total Distance

- $\Delta x = \Delta x_f + \Delta x_p + \Delta x_t$

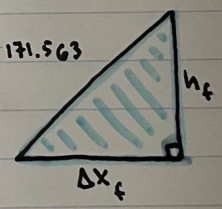
## MY SOLUTION

### ① Engine Firing

$\Delta x_f = v_0 t + \frac{1}{2}at^2$

$\Delta x_f = (0)(7.5) + (\frac{1}{2})(6.1)(7.5)^2$

$\Delta x_f = 171.563$




$\cos 48 = \frac{\Delta x_f}{171.563}$

$171.563 \cos 48 = \Delta x_f$

$\boxed{\Delta x_f = 114.798\,m}$

$\sin 48 = \frac{h_f}{171.563}$

$171.563 \sin 48 = h_f$

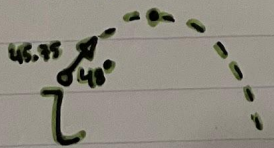
$h_f = 127.496\,m$

$\Delta V = at$

$\Delta V = (6.1)(7.5)$

$\Delta V = 45.75\,m/s$

### ② Projectile Motion




**a** Find Max Height

$v^2 = v_0^2 + 2a\Delta y$

$0 = (45.75)^2 + (2)(-9.8)(\Delta y)$

$\Delta y = \frac{(45.75 \sin 48)^2}{19.6}$

$\Delta y = 58.9757\,m$

Total Height: $186.472\,m$

**b** Height of Chute

$h_r = 186.472 - 70$

$h_r = 116.472\,m$

② Horizontal Distance

$\Delta x = v_x t$

$\Delta x = 45.75 \cos 48 t$

$y = y_0 + v_{0y} t + \frac{1}{2} a t^2$

$116.472 = 127.496 + 45.75 \sin 48 t - 4.9 t^2$

$t = 7.25$

$\Delta x_p = 221.942 m$

③ Parachute

$\Delta x = -15 t$

$y = y_0 + v_{0y} t + a t^2$

$0 = 118.471 - 9t$

$t = 13.1634$

$\Delta x_p = -197.452 m$

④ Final

$\Delta x = \Delta x_f + \Delta x_p + \Delta x_t$

$\Delta x = 114.798 + 221.942 - 197.452$

$\Delta x = 138.838 m\ E$