Rocket problem

Phase 1

$\theta = 49°$ $\quad V_0 = 0$

$t = 6.5s$

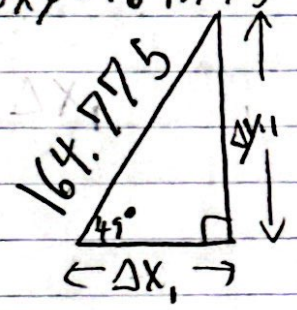
$a = 7.8\ m/s^2$

ΔXY

$\Delta XY = X_0 + \sin\theta t + \frac{1}{2}at^2$

$\Delta XY = 0 + \sin(49)(6.5) + \frac{1}{2}(7.8)(6.5)^2$

$\Delta XY = 164.775$



$\sin 49 = \frac{Y_1}{164.775}$

$124.3572711 = \Delta Y_1$

$\cos 49 = \frac{\Delta X}{164.775}$

$108.102126 5 = \Delta X_1$

Solving for ΔX_1 and ΔY_1

$V_1 = V_0 + at$

$V_1 = 0 + 7.8(6.5)$

$V_1 = 50.7\ , 49°$

$V_{y1} = \sin(49°) \cdot 50.7$

$V_{x1} = \cos(49°) \cdot 50.7$

Solving for vertical and horizontal velocity at End of Phase 1

Phase 2.) freefall → max height

Solving for max height

Y

$v_{y2}^2 - v_{y1}^2 = 2a\Delta y$

$0^2 - (50.7 \cdot \sin 49)^2 = 2(-9.8)(\Delta y)$

$\boxed{74.7 = \Delta y}$

$74.7 = y_2 - y_1$

$74.7 = y_2 - 124$

$74.7 + 124 = y_2$

$\boxed{199\text{m} = y_2}$

Solving for time to max height

$\left(\frac{v_1 + v_2}{2}\right) t = \Delta y$

$\left(\frac{50.7 \sin 49 + 0}{2}\right) t = 74.7$

$\boxed{t = 3.9044...}$

Solving for Δx_2

X

$v_{x1} t = \Delta x_2$

$\cos(49) \cdot 50.7 (3.904) = \Delta x_2$

$\boxed{129.8711\text{ m} = \Delta x_2}$

Phase 3: Max height → Parachute

Solving for time

$\Delta y_3 = v_{y2}t + \frac{1}{2}at^2$

$-60 = 0(t) + \frac{1}{2}(-9.8)(t^2)$

$-60 = -4.9t^2$

$3.5\,s = t$

Given: $\Delta y_3 = -60$

Solving for time in phase 3

$\Delta x_3 = v_{x1}t$

$\Delta x_3 = \cos(49)(50.7)(3.5)$

$\Delta x_3 = 116.3934\,m$

Solving for Δx_3

$\Delta y_4 = \Delta y_2 - \Delta y_3$

$\Delta y_4 = 199 - 60$

$\Delta y_4 = 139$

Solving for Δy_4 height

Phase 4: Parachute → ground

$-\Delta y_4 = v_{y3}t$

$-139 = -6t$

$23.1\bar{6}\,s = t$

$v_{y3} = -6\,m/s$

Solving for time in phase 4

$\Delta x_4 = v_{x2}t$

$\Delta x_4 = -14(23.1\bar{6}) = -324.3\,m$

$v_{x2} = -14\,m/s$

Solving for Δx_4

Solving for total distance

$$\Delta X_{final} = \Delta X_1 + \Delta X_2 + \Delta X_3 + \Delta X_4$$

$$\Delta X_{final} = 108.10 + 129.871 + 116.39 - 324.3$$

$$\boxed{\Delta X_{final} = 29.033 \text{m east}}$$