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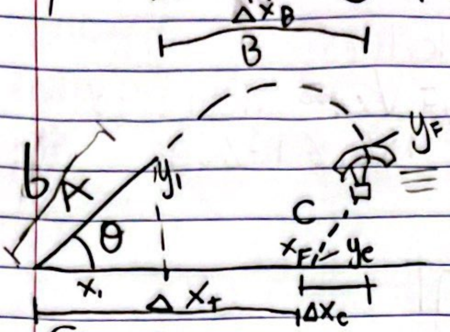
Multi-Step Rocket Problem



overall displacement: ΔX_T

Given:

$\theta = 57°$

$t_A = 9.0s$

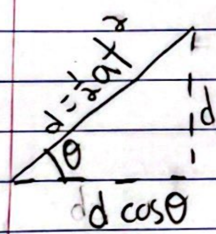
$a_A = 5.5 m/s^2$

y_P = Δy from max height of when parachute opens: 83 m

$V_{Cy} = 8.0 m/s$

$V_{Cx} = 17 m/s$

Solving part A



$d = \frac{1}{2}at^2$

$d = \frac{1}{2} \cdot 5.5 \cdot 9^2$

$d = 222.75$

variables found
$y_1 = 186.813869 m$
$x_1 = 121.318345 m$
$V_1 = 49.5 m/s$
$V_{yA} = 41.51419311 m/s$
$V_{xA} = 26.95963223 m/s$

$x_1 = d \cos\theta$

$= 222.75 \cos 57°$

$= 121.318345$

$t = 9.0s$

$a = 5.5 m/s^2$

$\theta = 57°$

$y_1 = d \sin\theta$

$= 222.75 \sin 57°$

$= 186.813869$

V_1 = velocity at (x_1, y_1)

$= a \cdot t$

$V_1 = at$

$= 5.5 \cdot 9$

$= 49.5 m/s$

$V_{yA} = V_1 \sin\theta$

$V_{yA} = 49.5 \cdot \sin 57°$

$V_{yA} = 41.51419311$

$V_{xA} = V_1 \cos\theta$

$V_{xA} =$

$V_{xA} = 26.95963223$

Answer range = - 656 - 55 m

Part B

Given/Known:
$a = -9.8$

calculated
$V_{oy} = V_{xA} = 41.51419311$
$y_1 = 186.813869$

Finding max height

y_m = max height
t_m = time to max height
$V = 0$
needed:
$t_m = 4.236142154$
$y_m =$

$V_{oy} =$

$V = V_o + at$

$0 = 41.51419311 + -9.8t$

$\frac{-41.51419311}{-9.8} \quad \frac{-9.8t}{-9.8}$

$4.236142154 = t$

$y_m = y_1 + V_{oy}t + \frac{1}{2}at^2$

$= y_m = 186.813869 + 41.51419311 \cdot 4.236142154 + \frac{1}{2} \cdot -9.8 \cdot 4.236142154^2$

$\boxed{y_m = 274.7438807}$

Finding ΔX_B and y_F

$y_F = y_m - y_p = 274.7438807 - 83m$

$= \boxed{y_F = 191.7438807\ m}$

$V_{oxB} = V_{xA} = 26.95963223$
t_B = needs to be calculated*
$y_1 = 186.813869$
$V_{oyB} = V_{yA} = 41.51419311$

$\boxed{\Delta X_B = 225.1619019}$

$y_F = y_1 + V_{oyB} t_B + \frac{1}{2} a t_B^2$

$191.7438807 = 186.813869 + 41.51419311 t_B + \frac{1}{2} \cdot -9.8 t_B^2$

subtract y_F from both sides and put in correct form

$0 = -4.9t_B^2 + 41.51419311 t_B + 4.9300117$

use quadratic formula calculator

* $\boxed{t_B = 8.351816523\ s}$

$\Delta X_B = V_{oxB} \cdot t_B$
$\Delta X_B = 26.95963223 \cdot 8.351816523$
$\Delta X_B = 225.1619019$

Scanned with CamScanner

Part C

variables:

$y_F = 191.7438807 m$

$y_e = 0$

$V_{oyc} = V_{yc} = -8.0 m/s$

$a = 0$

t_c = needs to be calculated:

$$y_f = y_e + V_{oy}t_c + \frac{1}{2}at_c^2$$

$$= 191.7438807 + -8.0t + 0$$

$$\frac{-191.7438807}{8} = \frac{-8.0t}{8}$$

$$\boxed{t_c = 23.96798509 s}$$

$V_{oxc} = V_{xc} = -17 m/s$

$$\Delta x_c = V_{oxc} \cdot t_c$$

$$\Delta x_c = -17 \cdot 23.96798509$$

$$\boxed{\Delta x_c = -407.4557465 m}$$

$$\Delta x_t = x_1 + \Delta x_B + \Delta x_c$$

$$\Delta x_t = 121.318345 + 225.1619019 + -407.4557465$$

$$\Delta x_t = 60.98 \text{ m to the West}$$