Flying

x	y
$\Delta x = v_{0x} t$	$y = y_0 + v_0 t - \frac{1}{2} g t^2$
$\Delta x = v_0 \cos\theta t$	$0 = 0 + v_0 \sin\theta t - \frac{1}{2} g t^2$
$\Delta x = v_0 \cos\theta \left(\frac{2v_0 \sin\theta}{g}\right)$	$0 = t\left(v_0 \sin\theta - \frac{1}{2} g t\right)$
$\Delta x = \frac{2 \sin\theta \cos\theta v_0^2}{g}$	$v_0 \sin\theta = \frac{1}{2} g t$
$\Delta x = \frac{\sin(2\theta) v_0^2}{g}$	$t = \frac{2 v_0 \sin\theta}{g}$

maximum when $2\theta = 90°$, so $\theta = 45°$ when maxed

$\sin\theta = \cos(90 - \theta)$ and vice versa $\sin(2\theta) = 2\sin\theta\cos\theta$

$\sin 20° = \cos 70°$

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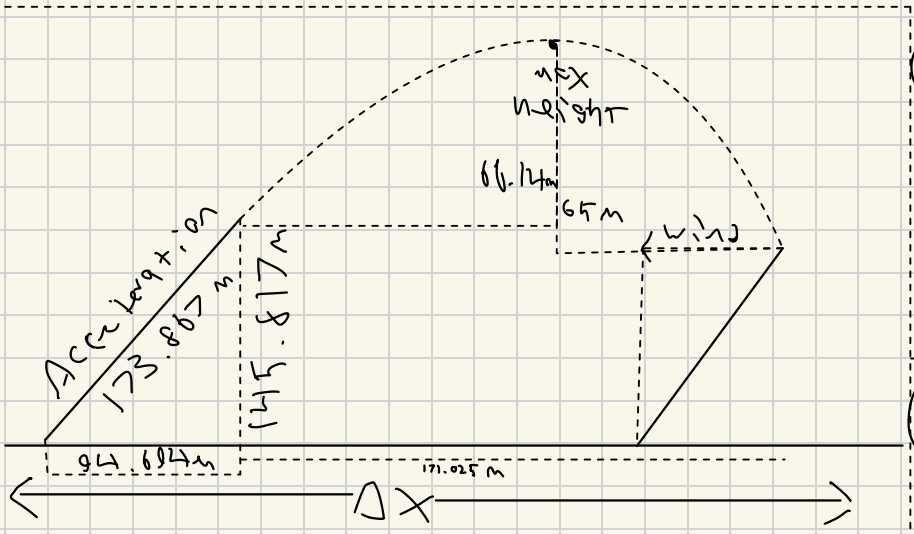
Launch angle	57°	deg
Engine burn time	8.1	sec
Net acceleration of rocket while engine burns	5.3	m/s²
Vertical distance rocket falls from max height before parachute opens	65	m
Rocket with parachute constant vertical speed	10.0	m/s
Wind and rocket with parachute constant horizontal speed	15	m/s



1. Attempting to find the distance traveled during first stage.

$x = x_0 + v_0 t + \frac{1}{2} a t^2$

$x = 0 + 0(8.1) + \frac{1}{2}(5.3)(8.1)^2$

$x = 173.867$ m 57° north of east

2. Break vector into x and y components

$\sin\theta = \frac{y}{h}$ $\cos\theta = \frac{x}{h}$

$\sin 57° = \frac{y}{173.867}$ $\cos 57° = \frac{x}{173.867}$

$173.867 \sin 57° = y$ $173.867 \cos 57° = x$

$y = 145.817$m $x = 94.694$ m

3. find velocities at end of 1st phase.

$v = v_0 + at$

$v = 0 + (5.3)(8.1)$

$v = 42.93$

$\sin\theta = \frac{v_y}{v}$ $\cos\theta = \frac{v_x}{v}$

$\sin 57° = \frac{v_y}{42.93}$ $\cos 57° = \frac{v_x}{42.93}$

$42.93 \sin 57° = v_y$ $42.93 = \cos 57° = v_x$

$v_y = 36.00$m/s $v_x = 23.38$ m/s

4. find max height of phase 2

$v_y = v_{0y}$

Phase 1 Phase 2

$v_y^2 = v_{0y}^2 + 2g\Delta y$

$0 = 1296.30 + 2(-9.8)\Delta y$

$\Delta y = 66.14$m above end of phase 1

5. find Δx over phase 2

$y = y_0 + v_0 t - \frac{1}{2} g t^2$

$146.955 = 145.817 + 36t - 4.9t^2$

$t = 2.315$ s

$\Delta x = vt$

$\Delta x = v_x t$

$\Delta x = (23.38)(2.315)$

$\Delta x = 171.025$

6. find distance for phase 3

$\Delta t = vt$

$65 = (10)t$

$t = 6.5$ s

$\Delta x = vt$

$\Delta x = (-13)(6.5)$

$\Delta x = -84.5$m

7. add all Δx's from ground steps

$94.694 + 171.025 - 84.5 = 181.2187$m east