Physics Name Sam Wheatley

Multi-Step Rocket Problem

A rocket is launched over level ground, from rest, at a specified angle above the East horizontal. The rocket engine is designed to burn for specified time while producing a constant net acceleration for the rocket. Assume the rocket travels in a straight-line path while the engine burns. After the engine stops the rocket continues in projectile motion. A parachute opens after the rocket falls a specified distance from its maximum height. When the parachute opens the rocket instantly changes speed and descends at a constant vertical speed. A horizontal wind blows the rocket, with parachute, from the East to West at the constant speed of the wind. Assume the wind affects the rocket only during the parachute stage.

Givens for your individualized problem:

Launch angle	39	deg
Engine burn time	6.1	sec
Net acceleration of rocket while engine burns	7.4	m/s^2
Vertical distance rocket falls from max height before parachute opens	80	m
Rocket with parachute constant vertical speed	9	m/s
Wind and rocket with parachute constant horizontal speed	17	m/s

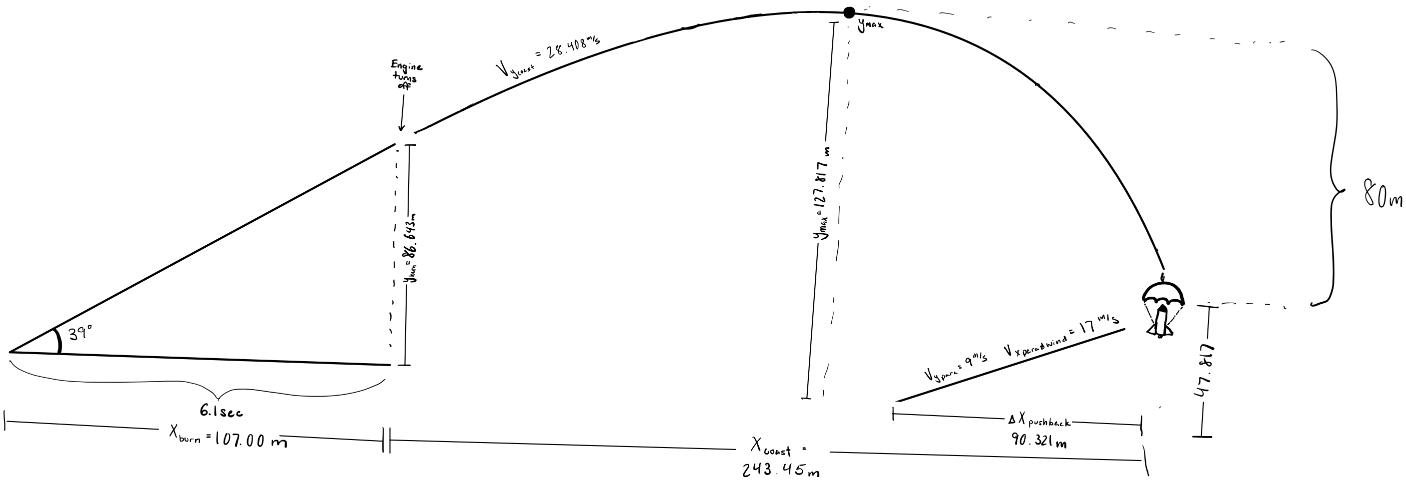
Calculate the x-displacement of where the rocket lands relative to the initial x-position.

Your written work, which may be hand-written, must include:

- Your given values including units, and the variable names you've assigned them
- A clear diagram with each **variable** labeled (no values). Note that there are likely multiple y and v values that you will use for the different stages. You should subscript your variables to help tell them apart. The intent of the diagram is to help indicate the meaning of each variable.
- Your work shown for each part of the solution including:
  - the equations before any substitutions
  - a clear substitution step
  - the work shown to get a numerical solution
- Your circled final answer to 4 sig figs with units. Include the magnitude and direction of the displacement.

The assignment is worth 8 points. It will be graded for correctness and work shown.

Sam Wheatley 2D Rocket Problem



Engine burn

given:
- engine burn time (t) = 6.1s
- net acceleration = 7.4 m/s²
- launch angle = 39°

$y = y_0 + V_{0y}t - \frac{1}{2}at^2$

$y_{burn} = 0 + 0 - \frac{1}{2}(7.4\sin(39°))(6.1)^2$

$y_{burn} = 86.643m$

$X = X_0 + V_{0y} - \frac{1}{2}at^2$

$X_{burn} = \frac{1}{2}(7.4\cos(39°))(6.1)^2$

$X_{burn} = 107.00m$

Coast Period

given:
- engine burn time (t) = 6.1s
- net acceleration = 7.4 m/s²
- launch angle = 39°
- height from max → parachute open: 80m

finding the max height:

$V_{y_{coast}} = at$

$V_{y_{coast}} = 7.4\sin(39°) \cdot 6.1 = 28.408 \ m/s$

$y = y_0 + V_{0y}t - \frac{1}{2}gt^2$

$y_{coast} = 86.643 + 28.408t - 4.9t^2$

* I plugged this equation into my calculator & found the maximum height that way

$y_{max} = 127.817m$

finding when the parachute opens:

$127.817 - 80 = 47.817m$ (distance from max that the parachute opens)

↳ the parachute opens at 47.817m above the ground

finding the distance of the coast period:

$47.817 = 86.643 + 28.40t - 4.9t^2$

* I used the previous equation but went to find the time it took to get to the parachute opening (47.817m)

$t = 6.940$ sec (found on graphing calculator)

$V_{x_{coast}} = at$

$V_{x_{coast}} = 7.4\cos(39°) \cdot 6.1 = 35.08 \ m/s$

$v = \frac{d}{t}$

$35.08 \ m/s = \frac{X_{coast}}{6.94}$

$X_{coast} = 243.455m$

Pushback → landing

given:
- rocket w/ para constant verticle speed: 9 m/s
- wind & rocket w/ para constant horizontal speed: 17 m/s

$\frac{47.817m}{9 \ m/s} = 5.313s$

$\Delta X_{pushback} = V_{0x}t$

$= -17 \ m/s \cdot 5.313s$

$= -90.321m$

Total Displacement

$\Delta X_{displacement} = 107.00 + 243.45 + (-90.321)$

$= \boxed{260.134m}$