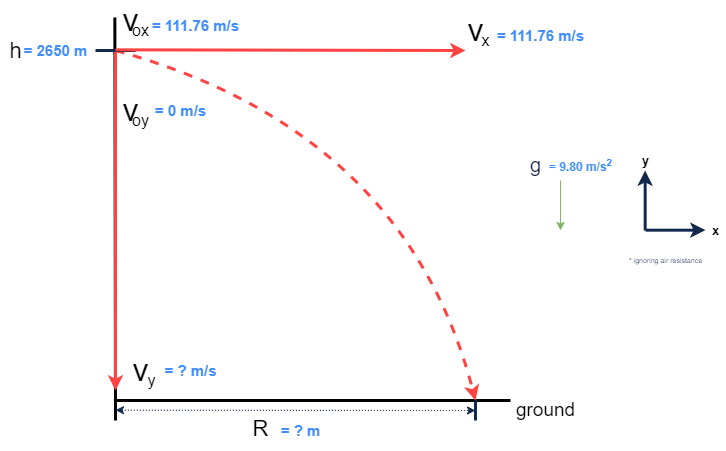
**A&L Engineering**

**Supply Drop Plan**

# DIAGRAM



# INITIAL CALCULATIONS

# Converting to S.I. units:

=

# Final Horizontal Velocity: (Constant horizontal velocity, ignoring air resistance):

# Time in Air:

## 

# Final Vertical Velocity:

# Final Total Velocity:

# Horizontal Drop Distance:

## Description

**v** *= final total velocity*

**a** *= acceleration = g = 9.80*

**t** *= time payload is in the air once dropped (s)*

**h** *= height to drop payload (m)*

**R** *= horizontal distance from target (m)*

In Kinematics, horizontal and vertical motion are independent of each other, but they do have a relationship via time. In projectile motion of a free-falling object, the greater the amount of time in the air, the greater the final vertical velocity. With no air resistance, the horizontal velocity is constant.

**The total (final) velocity can be found with the Pythagorean Theorem:**

# MODIFIED SCENARIO ONE

## Diagram

## 

## Source: National Oceanic and Atmospheric Administration.

## “[National Weather Service](National%20Weather%20Service)”.*7/22/2022, https://www.weather.gov*

## Description

# Converting to S.I. units:

= -

**Head wind only affects horizontal motion, so:**

**Adjusted horizontal velocity:**

=

**Horizontal distance should be less at a slower horizontal velocity:**

The 18 mph (or 8.0 m/s) headwind caused the horizontal velocity to decrease; however, no change occurred to the vertical motion. The decreased horizontal velocity requires a smaller horizontal distance from 2599.0 m in the original plan to 2411.8 m in this scenario.

# MODIFIED SCENARIO TWO

## Diagram

Chart

Description automatically generated with medium confidence

## Description

**Final vertical velocity:**

**Final horizontal velocity (ignoring air resistance):**

**Air-Time:**

**Vertical height:**

H =

* 54 m > 50 m, so the payload will reach (and pass) the target site

Changing the starting velocity or angle of the catapult would alter the distance needed to reach the target site. A lower velocity or a steeper (larger) angle (relative to the horizontal plane) would be more precise, in this case.