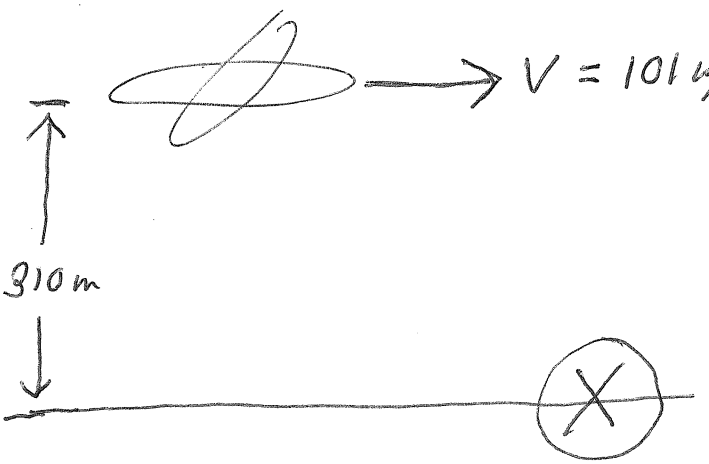
Example

An airplane traveling at a constant $101\ m/s$ is scheduled to drop a bomb on a certain target. If a constant altitude of $310.m$ is maintained, determine the following.

1. How long the bomb is in the air
2. Location of the plane when the bomb detonates on the surface.
3. Where the plane should be located relative to the target when the bomb is released.
4. Determine the impact velocity.

1. y-components



$a = -9.81\ m/s^2$

$\Delta t = ?$

$V_0 = 0\ m/s$

$x_0 = 310\ m$

$x = 0\ m$

$$\cancel{x}^{\,0} = x_0 + \cancel{V_0}^{\,0}\Delta t + \tfrac{1}{2} a \Delta t^2$$

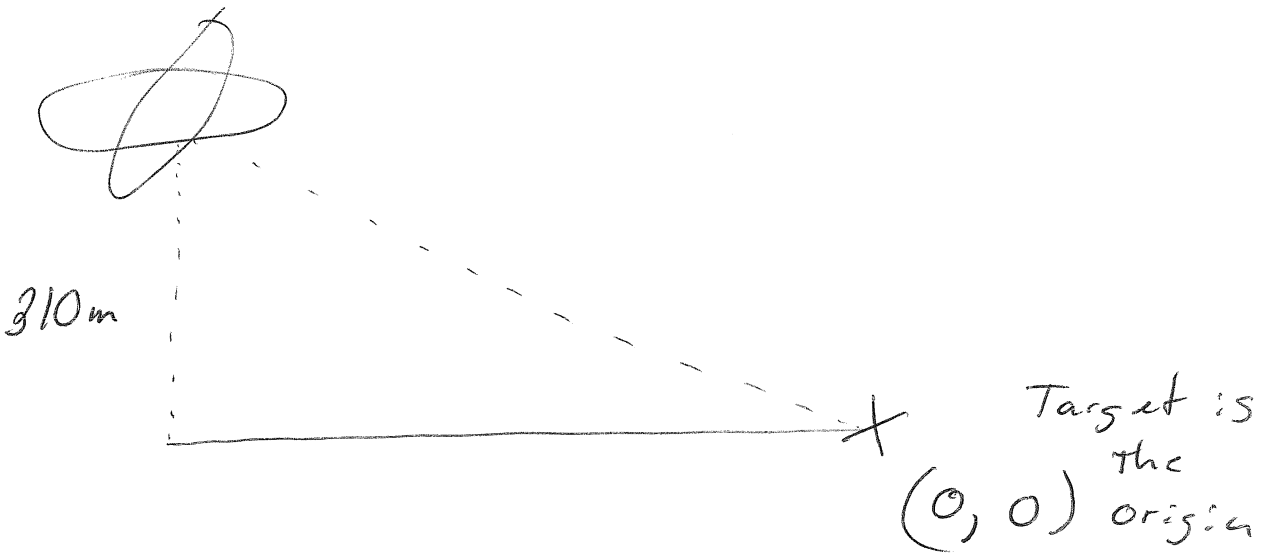
$$0 = 310m + \tfrac{1}{2}\left(-9.81\ m/s^2\right)\Delta t^2$$

$$\Delta t = \sqrt{\frac{-310m}{\tfrac{1}{2}\left(-9.81\ m/s^2\right)}} = 7.9499\ s$$

7.95 s

2. The plane is directly above the blast zone because both plane and bomb have the same velocity in the x-dimension.

3.



$\Delta t_{flight} = 7.9499_s$

x-dimension

$V = 101 m/s$

$x = 0m$

$\cancel{x} = x_0 + V\Delta t$

$0 = x_0 + 101 m/s (7.9499_s)$

$x_0 = -802.9399 m$

$-803 m$

Position

$(-803m, 310m)$

803 meters before the target

4. **x-dimension**

$V = 101\ m/s$

y-dimension

$V_0 = 0\ m/s$

$x_0 = 310\ m$

$x = 0\ m$

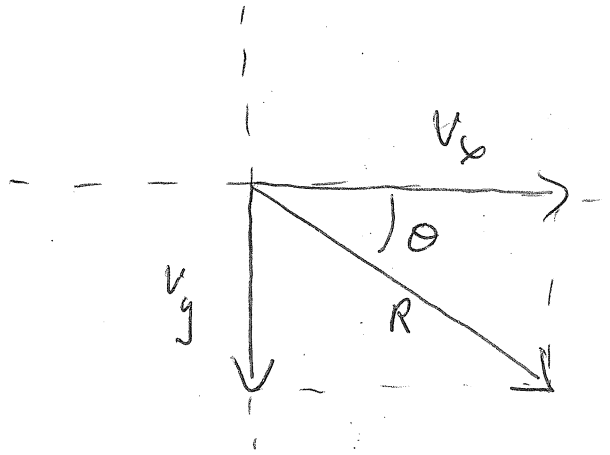
$a = -9.81\ m/s^2$

$V = ?$

$V^2 = V_0^2 + 2a\Delta x$

$V = \sqrt{2(-9.80\ m/s^2)(-310\ m)}$

$= -77.948\ m/s$



$\theta = \tan^{-1}\left(\frac{77.948\ m/s}{101\ m/s}\right) = 37.66^\circ$

$R = \sqrt{(101\ m/s)^2 + (-77.948\ m/s)^2} = 127.58\ m/s$

$128\ m/s$ @ 37.7° below horizontal