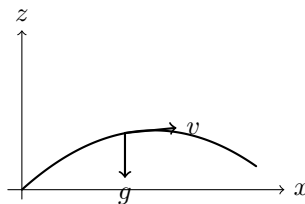


Question 2

A projectile is launched from $\langle 0, 0, 5 \rangle$ with initial velocity $\langle 12, 5, 20 \rangle$ ft/s. With gravity $\vec{a} = \langle 0, 0, -32 \rangle$ ft/s², find its position, time of impact with $z = 0$, and horizontal range vector.

Question 2 – Solution

Strategy Integrate constant acceleration and impose the ground condition on the vertical coordinate.



Position

$$\vec{r}(t) = \langle 12t, 5t, 5 + 20t - 16t^2 \rangle.$$

Impact Solve $5 + 20t - 16t^2 = 0$. The positive root is

$$t_* = \frac{5 + \sqrt{45}}{8} = \frac{5 + 3\sqrt{5}}{8}.$$

Horizontal range At impact,

$$\langle x(t_*), y(t_*) \rangle = \frac{5 + 3\sqrt{5}}{8} \langle 12, 5 \rangle.$$

The horizontal velocity is constant because gravity has no horizontal component.