Physics 1230 Lecture Supplement #3 Another Example.

Here is another example using the Big Four Eqs. for CONSTANT Acceleration.

EXAMPLE: Suppose that an object is thrown up into the air at an initial speed of 20 m/s and just misses the edge of a bridge before striking the ground 50 m below. (a) Find the time the object is in the air. (See Diagram.)

SOL’N #1 Pick one point where the object is initially Thrown Point #1. The second point could be picked 50 m below where the object is initially Thrown Point #2. Note sign: 

Point #1: 
\[ t = 0 \]
\[ v_0 = +20 \text{ m/s} \]
\[ y_0 = 0 \]

And plug in \( y \): (Let’s use \( y \) since motion is vertical.)

\[ y - y_0 = \frac{1}{2} a t^2 + v_0 t \]
\[ -50 - 0 = \frac{1}{2} (-9.8 \text{ m/s}^2) t^2 + (+20 \text{ m/s}) t \]

Drop UNITS TEMPORARILY

\[ -50 = -4.9 t^2 + 20 t \]
\[ 4.9 t^2 - 20 t - 50 = 0 \]

Here \( t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \)

\[ t = \frac{-(-20) \pm \sqrt{(-20)^2 - 4(4.9)(-50)}}{2(4.9)} \]
\[ t = \frac{20 \pm \sqrt{400 + 980}}{9.8} \]
\[ t = \frac{20 + 37.1}{9.8} = \frac{57.1}{9.8} = 5.8 \text{ s} \]

\[ t = \frac{20 - 37.1}{9.8} = \frac{-17.1}{9.8} = -1.72 \text{ s} \]

(b) Find the time it takes for the object to reach the top of its path. SOL’N Choose Point #1 at beginning but the second point at top. At top, \( v = 0 \). Hence

\[ v = at + v_0 \]
\[ 0 = (-9.8 \text{ m/s}^2) t + (20 \text{ m/s}) \]
\[ t = \frac{20}{9.8} = 2.04 \text{ s} \]