108. (Second problem in **Cluster 2**)

(a) The magnitudes of the components are equal at point A, but in terms of the coordinate system usually employed in projectile motion problems, we have $v_x > 0$ and $v_y = -v_x$. The problem gives v_0 which is related to its components by $v_0^2 = {v_0}_x^2 + {v_0}_y^2$ which suggests that we look at the pair of equations

$$\begin{aligned} v_y^2 &= {v_0}_y^2 - 2g\Delta y \\ v_x^2 &= {v_0}_x^2 \end{aligned}$$

which we can add to obtain $2v_x^2 = v_0^2 - 2g\Delta y$ (this is closely related to the type of reasoning that will be employed in some Chapter 8 problems). Therefore, we find $v_x = -v_y = 6.53$ m/s. Therefore, $\Delta y = v_y t + \frac{1}{2}gt^2$ (Eq. 2-16) can be used to find t.

$$3.00 = (-6.53)t + \frac{1}{2}(9.8)t^2 \implies t = 1.69 \text{ or } -0.36$$

from the quadratic formula or or with a polynomial solver available with some calculators. We choose the positive root: $t = 1.69$ s. Finally, we obtain

$$\Delta x = v_x t = 11.1 \text{ m} \quad .$$

(b) The speed is $v = \sqrt{v_x^2 + v_y^2} = 9.23$ m/s.