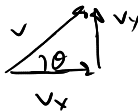A ball is thrown at an unknown speed and angle off a building 20.0m high.
Someone observes the ball to be traveling at a speed of 30.0 m/s and in a direction
50.0 degrees below the horizontal just before striking the ground.

a) What is the initial velocity of the ball (magnitude and direction)?

b) How much time did it spend in the air?

c) How far horizontally did it travel?

a) $V_{yf}^2 = V_{yo}^2 + 2a_y \Delta y \rightarrow$ $V_{yo} = \sqrt{V_{fy}^2 - 2a_y \Delta y} = \sqrt{(30\frac{m}{s}\sin(50)) - 2(-9.81\frac{m}{s^2})(-20m)}$
$= 11.56 \, m/s$

$V_{ox} = V_{fx} = 30\frac{m}{s}\cos(50) = 19.28\frac{m}{s}$
(no acceleration in x-direction)

$V = \sqrt{(11.56\frac{m}{s})^2 + (19.28\frac{m}{s})^2} = \boxed{22.48\frac{m}{s}}$

$\theta = \tan^{-1}\left(\frac{11.56\frac{m}{s}}{19.28\frac{m}{s}}\right) = \boxed{30.94°}$

b) $V_{fy} = V_{oy} + at \rightarrow t = \frac{V_{fy} - V_{oy}}{a_y} = \frac{-30\frac{m}{s}\sin(50) - 11.56\frac{m}{s}}{-9.81\frac{m}{s^2}} = \boxed{4.23 s}$

Could've also solved as
a quadratic with
$\Delta y = V_{oy}t + \frac{1}{2}at^2$

c) $\Delta x = Vt = (19.28\frac{m}{s})(4.23 s) = \boxed{81.55m}$