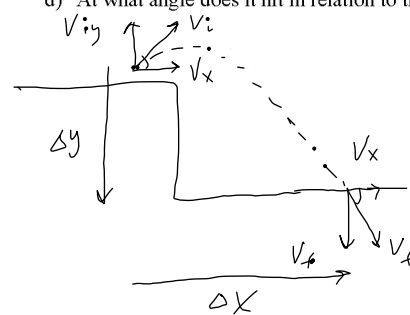Kinematics Quiz 9 – 10-13-05 – Projectile Motion

An armadillo is launched upward at 65 m/s at a 35° angle. It lands in a canyon whose floor is 75 m lower.
(Make a good, labeled diagram and show all important vectors.)
- a) How long does it take to hit?
- b) How far horizontally from the launch location does it land?
- c) What is its final speed?
- d) At what angle does it hit in relation to the ground?

$V_i = 65 \frac{m}{s}$

$\theta_i = 35°$

$\Delta y = -75m$

$t = \underline{\quad} s$

$\Delta X = \underline{\quad} m$

$V_f = \underline{\quad} \frac{m}{s}$

$\theta_f = \underline{\quad}°$

$V_x = V_i \cos\theta$

$\quad = 65\frac{m}{s} \cos 35°$

$\underline{V_x = 53.2 \frac{m}{s}}$

$V_{iy} = V_i \sin\theta$

$\quad = 65\frac{m}{s} \sin 35°$

$\underline{V_{iy} = 37.3 \frac{m}{s}}$

$V_{fy}^2 = V_{iy}^2 + 2a\Delta y$

$V_{fy} = \sqrt{(37.3\frac{m}{s})^2 + 2(-9.8\frac{m}{s^2})(-75m)}$

$V_{fy} = -53.5 \frac{m}{s}$

$V_{fy} = V_{iy} + at$

$t = \frac{V_{fy} - V_{iy}}{a}$

$\quad = \frac{-53.5\frac{m}{s} - 37.3\frac{m}{s}}{-9.8\frac{m}{s^2}}$

a) $\boxed{t = 9.27s}$

$\Delta X = V_x t$

$\quad = 53.2\frac{m}{s}(9.27s)$

b) $\boxed{\Delta X = 493m}$

$$V_f = \sqrt{V_x^2 + V_{fy}^2}$$

$$= \sqrt{\left(53.2\,\tfrac{m}{s}\right) + \left(37.3\,\tfrac{m}{s}\right)^2}$$

c) $\boxed{V_f = 65.0\,\tfrac{m}{s}}$

$$\tan\theta = \frac{V_{fy}}{V_x}$$

$$= \frac{-53.5\,\tfrac{m}{s}}{53.2\,\tfrac{m}{s}}$$

$$\theta = -45.2°$$

d) $\boxed{\theta = 45.2° \text{ below ground}}$