Projectile Practice

A ball rolls horizontally off of a table that is 1.5m high. As the ball moved along the table, it was traveling at 0.56m/s.

a) Draw the data table and input all of the known variables.
b) Why can't you use the horizontal values to find the time that it will take for the ball to hit the floor?
c) Use the vertical values to find the time it will take for the ball to hit the floor.
d) Now use that "time of flight" to calculate how far horizontally from the table the ball will land.
e) How fast will the ball be traveling vertically when it lands?
f) How fast will the ball be traveling horizontally when it lands?
g) Draw a vector diagram showing the vertical final velocity vector and the horizontal final velocity vector drawn head-to-tail and the resultant actual final velocity as the hypotenuse.
h) Solve for the magnitude of the resultant final velocity. This is how fast the ball is actually going.
i) Solve for the number of degrees relative to the horizontal the ball is landing at. (This is the landing angle.)

Answers are on the next page. ☺

(a.)

	V	H
V_0	0	0.56 m/s
V		0.56 m/s
a	−9.81 m/s²	0 m/s²
ΔX	−1.5 m	
t		

(b.) The only formula for objects that aren't accelerating is $V = \frac{\Delta X}{t}$, & there are 2 unknowns.

(c.) $\Delta X = V_0 t + \frac{1}{2} a t^2$

$-1.5\,m = (0\,m/s)t + \frac{1}{2}(-9.81\,m/s^2)t^2$

$t = \sqrt{\frac{2(-1.5\,m)}{-9.81\,m/s^2}} = \boxed{0.55\,s}$

↑ Store the long answer.

(d.) $V = \frac{\Delta X}{t}$

$\Delta X = Vt$

$\Delta X = (0.56\,m/s)(0.55\,s)$

(Use the stored value.)

$\Delta X = \boxed{0.31\,m}$

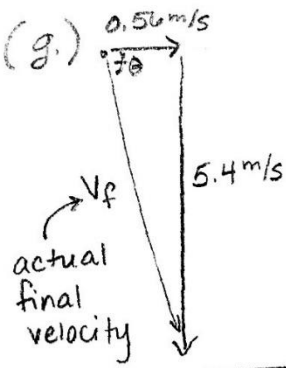
(e.) $V_f^2 = V_0^2 + 2a\Delta X$

$V_f = \sqrt{0^2 + 2(-9.81\,m/s^2)(-1.5\,m)}$

down $V_f = \boxed{5.4\,m/s}$ ← Store the long answer.

(f.) V_x is a constant $\boxed{0.56\,m/s}$ b/c $a_x = 0\,m/s^2$

(g.)



(h.) $V_f = \sqrt{(5.4\,m/s)^2 + (0.56\,m/s)^2}$ ← Use the stored value from (e.)

$V_f = \boxed{5.5\,m/s}$

(i.) $\theta = \tan^{-1}\left(\frac{5.4\,m/s}{0.56\,m/s}\right)$

$\theta = \boxed{84° \text{ below horizontal}}$