Tom the cat is chasing Jerry the mouse across a table surface 1.5 m off the floor. Jerry steps out of the way at the last second, and Tom slides off the edge of the table at a speed of 5.0 m/s. Where will Tom strike the floor, and what speed will Tom have before hitting the floor.

Solution

ΔY is the change in the y direction which is 1.5 m in the problem. We know that the acceleration in the y direction is 9.81 m/s. We also know that Tom goes off the table in the horizontal or x direction so his initial velocity in the y direction has to be 0.

Let's use the kinematics equation:

$$\Delta Y = V_i t + \frac{1}{2} g t^2 = 0 * t + \frac{1}{2} g t^2 = \frac{1}{2} g t^2.$$

$$t = \sqrt{\frac{2\Delta Y}{g}} = \sqrt{\frac{2 * 1.5}{9.81}} = 0.55\ s.$$

Now we need to solve for ΔX, or the change in the x direction. This will tell you how far from the table Tom lands. We use the formula:

$$\Delta X = V_0 t = 5.0 \frac{\text{m}}{\text{s}} * 0.55\ s = 2.75\ m.$$

The speed of Tom before hitting the floor:

$$V_f = \sqrt{V_x^2 + V_y^2}.$$

We know that $V_x = V_0 = 5.0 \frac{\text{m}}{\text{s}}$ and $V_y = gt$. So

$$V_f = \sqrt{V_0^2 + (gt)^2} = \sqrt{5.0^2 + 9.81^2 * 0.55^2} = 7.4 \frac{m}{s}.$$

Answer: $2.75\ m$; $7.4 \frac{m}{s}$.