Physics 10154 - Quiz 10A

A 3.50-kg mass is initially at rest against a spring (k_s = 422 N/m) that is compressed 12.0 cm from its equilibrium length. The system is released from rest, and the mass slides across a frictionless, horizontal table, flying off the edge. The tabletop is 41.5 cm above the ground. How far away does the mass land horizontally from the edge of the table? The horizontal distance shown below is not necessarily to scale.
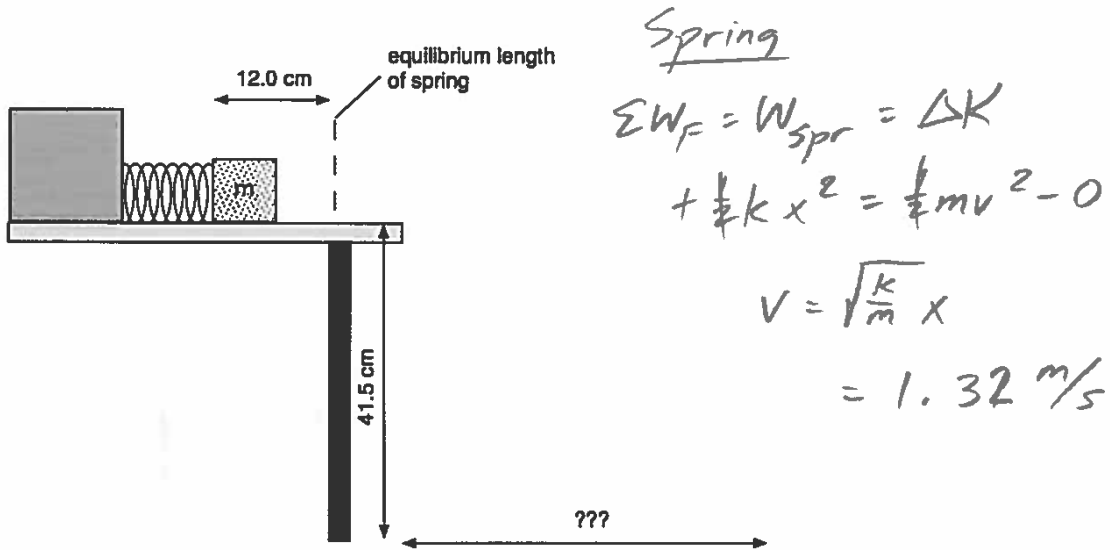
Spring

$$\Sigma W_F = W_{spr} = \Delta K$$
$$+ \tfrac{1}{2}k x^2 = \tfrac{1}{2}mv^2 - 0$$
$$v = \sqrt{\tfrac{k}{m}}\, x$$
$$= 1.32 \text{ m/s}$$

Ballistic motion

$\Delta y = 0.415$
$V_{oy} = 0$
$V_y = ?$
$a_y = 9.8$
$t = ?$

$0.415 = 0t + \tfrac{1}{2}(9.8) t^2$
$0.415 = 4.9 t^2$
$\Rightarrow t = 0.291 s$

$\Delta x = ?$
$V_{ox} = 1.32 \text{ m/s}$
$V_x = 1.32 \text{ m/s}$
$a_x = 0$
$t = 0.291 s$

$\Delta x = v_0 t + \tfrac{1}{2}a_x t^2$
$= (1.32)(0.291)$
$= \boxed{0.384 \text{ m}}$