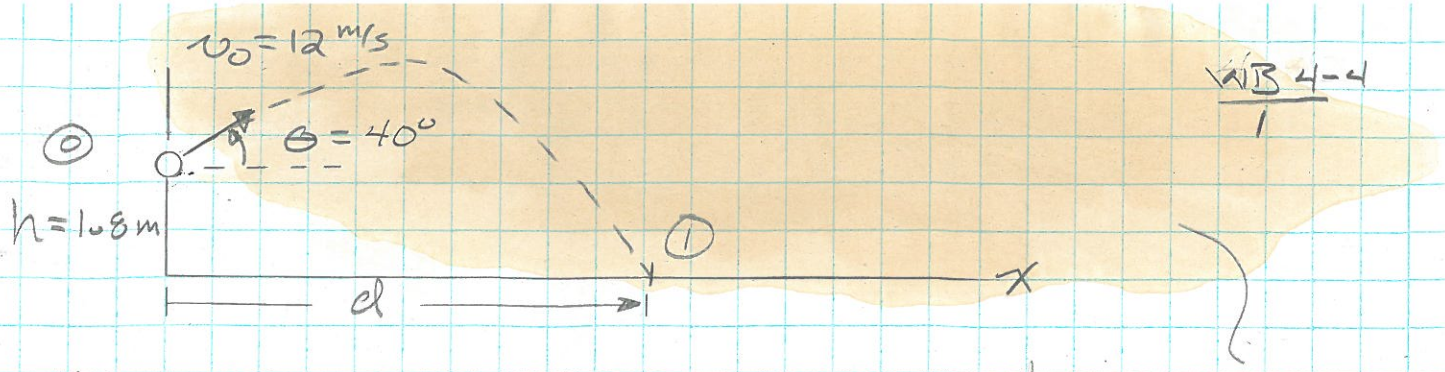

The "Range Equation" won't work here since the y-coordinate of the initial and final points aren't the same. "Coffee stain"

Point 0:
$t_0 = 0$
$(x_0, y_0) = (0, h)$
$(v_{x0}, v_{y0}) = (v_0 \cos\theta, v_0 \sin\theta_0)$

Point 1:
t_1
$(x_1, y_1) = (d, 0)$
(v_{x1}, v_{y1})

Find: Distance d

y-motion: $y_1 = y_0 + v_{y0}\Delta t + \frac{1}{2} a_y \Delta t^2$ $\Delta t = t_1 - t_0$

$$0 = h + v_0 \sin\theta\, t_1 - \frac{1}{2} g t_1^2$$

a quadratic equn for t_1; rewrite:

$$t_1^2 - \frac{2 v_0 \sin\theta}{g} t_1 - \frac{2h}{g} = 0$$

or,

$$t_1^2 - 1.574 t_1 - 0.3673 = 0$$

form: $ax^2 + bx + c = 0 \Rightarrow x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

so:

$$t_1 = \frac{1.574}{2} \pm \frac{1}{2}\sqrt{(-1.574)^2 + 4(.3673)}$$

$$= 0.787 \pm 0.9935$$

$t_1 = 1.7805$ s or -0.2065 unphysical

Now x-motion:

$$x_1 = x_0 + v_{x_0}\Delta t + \frac{1}{2}a_x\Delta t^2 \qquad \Delta t = t_1 - t_0$$

$$d = v_0\cos\theta\, t_1$$

$$\therefore \quad d = 16.37 \text{ m}$$