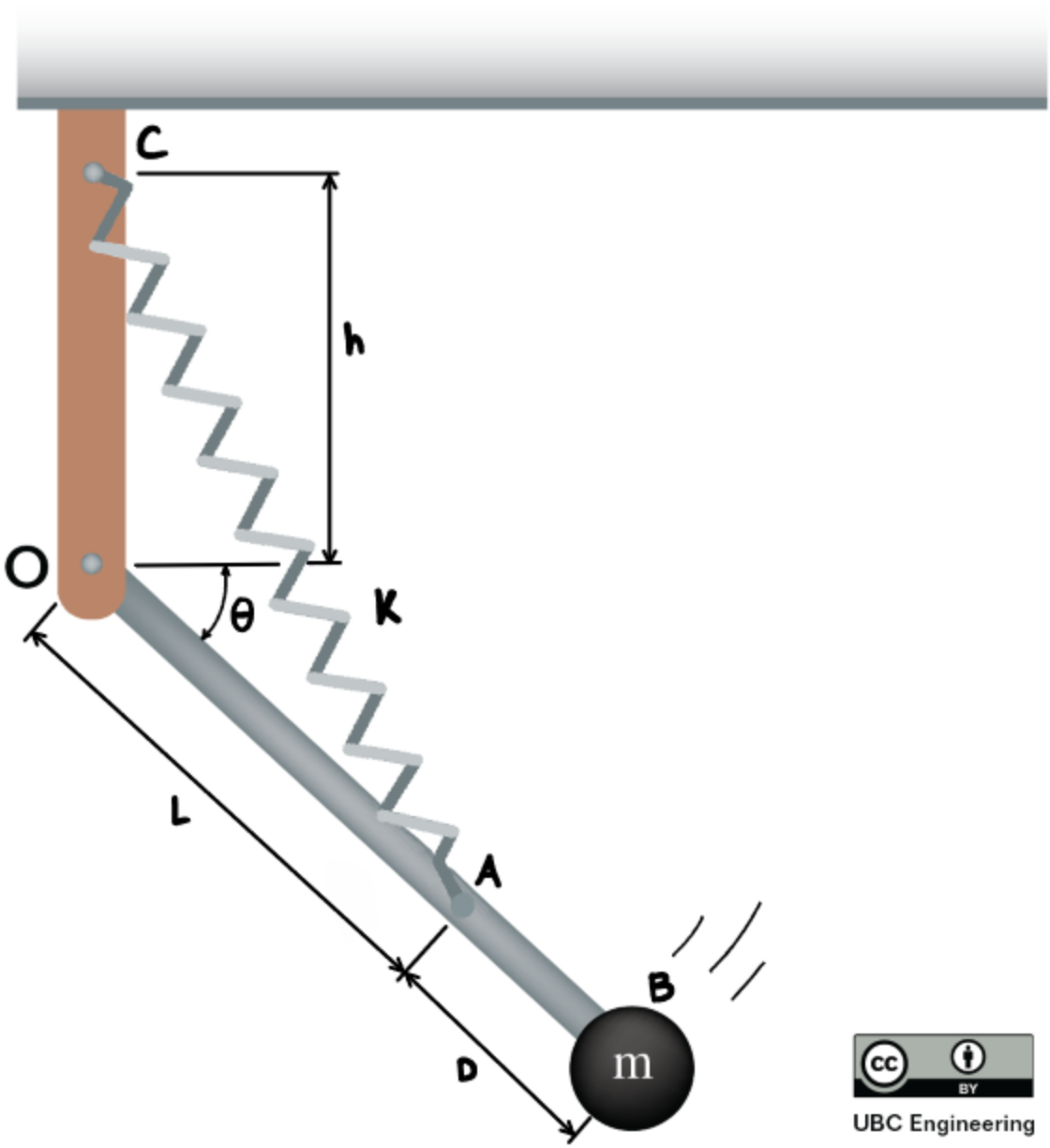
21-P-WE-GD-019



The m kg ball B is dropped with a downward velocity of v_1 m/s when $\theta = 0°$ and the tension in the spring is T_3 N. What is the unstretched length of the spring and how fast is the ball travelling when $\theta = 90°$?

(Assume $g = 9.81$ m/s^2, $K = K$ N/m, $L = L$ m, $D = D$ m and $h = h$ m)

given

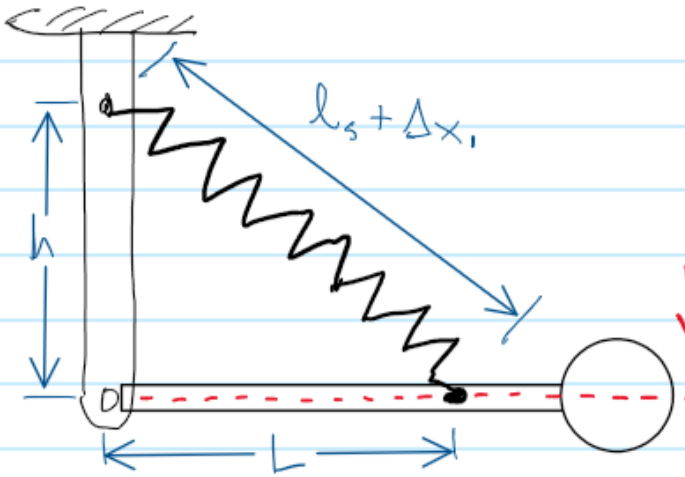
$m, v_1, \theta_1, T_s, \theta_2, g, K, L, D, h$

find

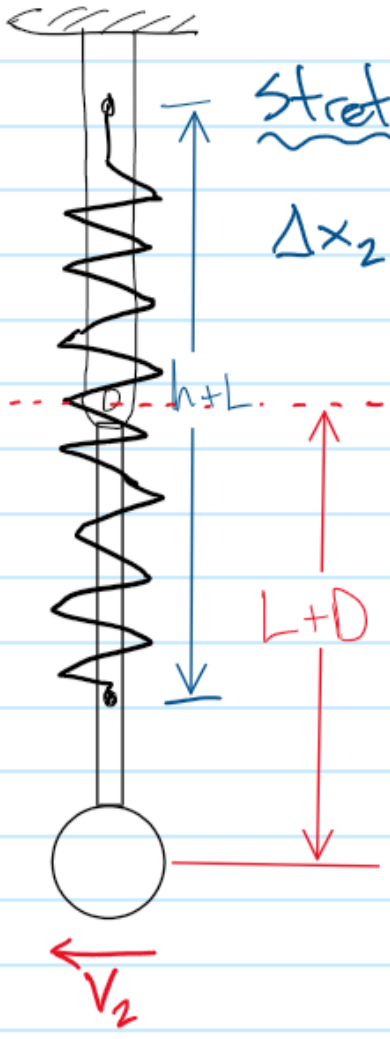
v_2

FBD

state1



state2



Stretch at state2

$\Delta x_2 = (h+L) - l_s$

stretch at state 1

$T_s = 100 = K \Delta x_1$

$\Delta x_1 = T_s / K$

$l_s + \Delta x_1 = \sqrt{h^2 + L^2}$

$l_s = \sqrt{h^2 + L^2} - \Delta x_1$

Conservation of energy

$$T_1 + V_1 = T_2 + V_2$$

no gravitational pot. at state 1
because of datum → neg. grav. pot. at state 2

$$\frac{1}{2}mv_1^2 + \frac{1}{2}K\Delta x_1^2 = \frac{1}{2}mv_2^2 + \frac{1}{2}K\Delta x_2^2 - mg(L+D)$$

$$v_2 = \sqrt{\frac{mv_1^2 + K\Delta x_1^2 + 2mg(L+D) - K\Delta x_2^2}{m}}$$