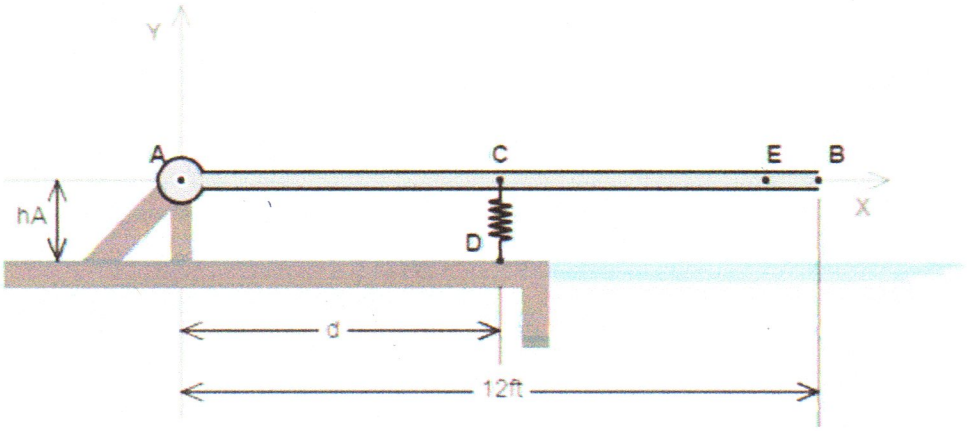
SOLUTION

ip4STATICS Worksheet for U04_P06

A diving board is designed to sit horizontally under its own weight, Wb. Assume the board is uniform in geometry and density. The spring stiffness is k lbs/ft.

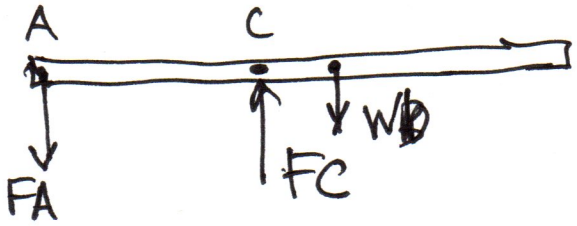
Instance variables: force Wb in lbs; lengths d and hA in ft; stiffness k in lb/ft; and force Wd in lbs (see part (2)).



(1) What is the spring free length, Lf, that positions the board horizontally at equilibrium under its own weight?

(2) A diver of weight Wd lbs now stand 1 ft in from the free end of the board (at E). Using the free length Lf from part (1), what is the height hB *above the water surface* at point B?

(1) FBD:



$\Sigma F_y = 0$: $F_A + W_b = F_C$

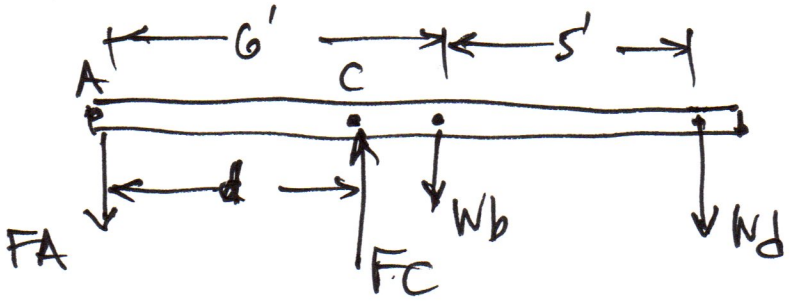
$\Sigma M_A = 0$: $d \cdot F_C = 6 \cdot W_b \rightarrow F_C = \left(\frac{6}{d}\right) W_b$

and $F_A = W_b\left(\frac{6}{d} - 1\right)$

Spring: $F_C = k(L_f - h_A)$

or $\boxed{L_f = h_A + F_C/k}$

(2) FBD



strategy: Find new spring length and the deflection at end.

$\Sigma F_y = 0$: $F_A = F_C - W_b - W_d$.

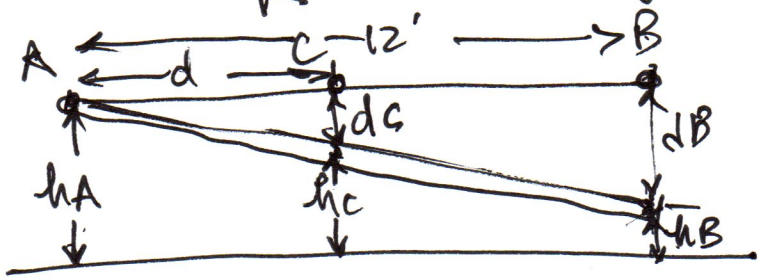
$\Sigma M_A = 0$: $d \cdot F_C = 6 \cdot W_b + 11 \cdot W_d$

so $F_C = \left(\frac{6}{d}\right) W_b + \left(\frac{11}{d}\right) W_d$. (*)

Spring: $F_C = k(L_f - h_c)$, where h_c is ht of pt C.

so $h_c = L_f - \frac{F_C}{k}$, where (*) gives F_C.

Geometry:



Small angles

$\frac{dC}{d} = \frac{dB}{12}$, where $dC = h_A - h_C$ and $dB = h_A - h_B$.

Then $\boxed{h_B = h_A\left(1 - \frac{12}{d}\right) + h_C\left(\frac{12}{d}\right)}$