Quiz No. 4 **Name** SOLUTION

ME 270 – Summer 2024 – Prague

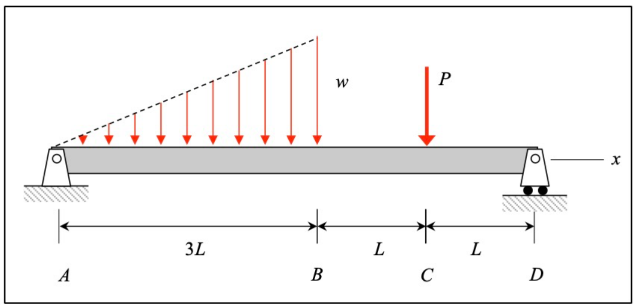
Given: The beam is loaded as shown.

Find: For this problem:

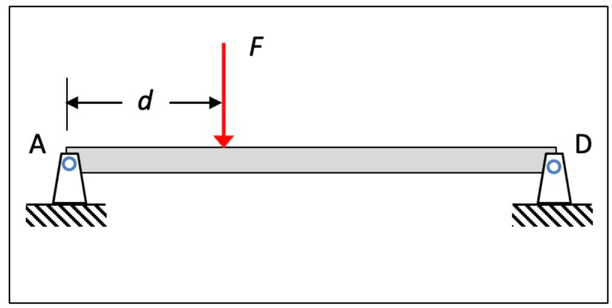
a) Calculate the magnitude and location of the single-force equivalent load; that is, find F and d such that the loading System I is equivalent to loading System II.

b) Determine the reactions acting on the beam at A and D.

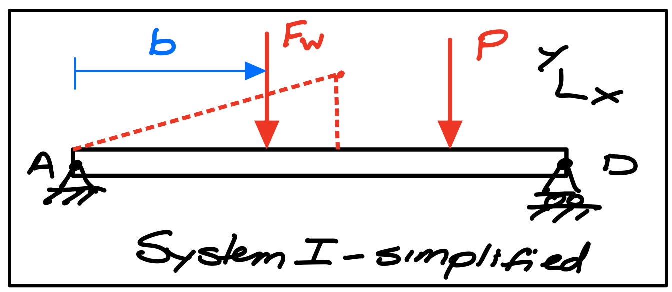
Use the following parameter values for your work: P = 10 kips, w = 2 kips/ft and L = 6 ft.



System I



System II



(a) $F_w = \frac{1}{2}(w)(3L) = \frac{3}{2}wL$

$b = \frac{2}{3}(3L) = 2L$

• $(\Sigma \vec{F})_I = (\Sigma \vec{F})_{II} \Rightarrow$

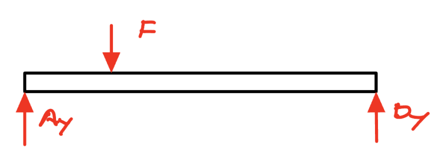
$-F_w - P = -F \Rightarrow F = P + \frac{3}{2}wL = 10 + \frac{3}{2}(2)(6) = 28$ kips ← F

• $(\Sigma M_A)_I = (\Sigma M_A)_{II} \Rightarrow -bF_w - 4LP = -Fd$

$\Rightarrow d = \dfrac{bF_w + 4LP}{F}$

$= \dfrac{(2L)(\frac{3}{2}wL) + 4LP}{\frac{3}{2}wL + P} = \dfrac{3wL^2 + 4PL}{\frac{3}{2}wL + P}$

$= \dfrac{(3)(2)(6)^2 + (4)(10)6}{\frac{3}{2}(2)(6) + 10} = \frac{114}{7}$ ft ← d



(b) $\Sigma M_A = -Fd + 5LD_y = 0$

↳ $D_y = \dfrac{Fd}{5L} = \dfrac{(28)(\frac{114}{7})}{(5)(6)} = \frac{1596}{105}$ kips ← D_y

$\Sigma F_y = A_y + D_y - F = 0$

↳ $A_y = F - D_y = 28 - \frac{1596}{105} = \frac{1344}{105}$ kips ← A_y