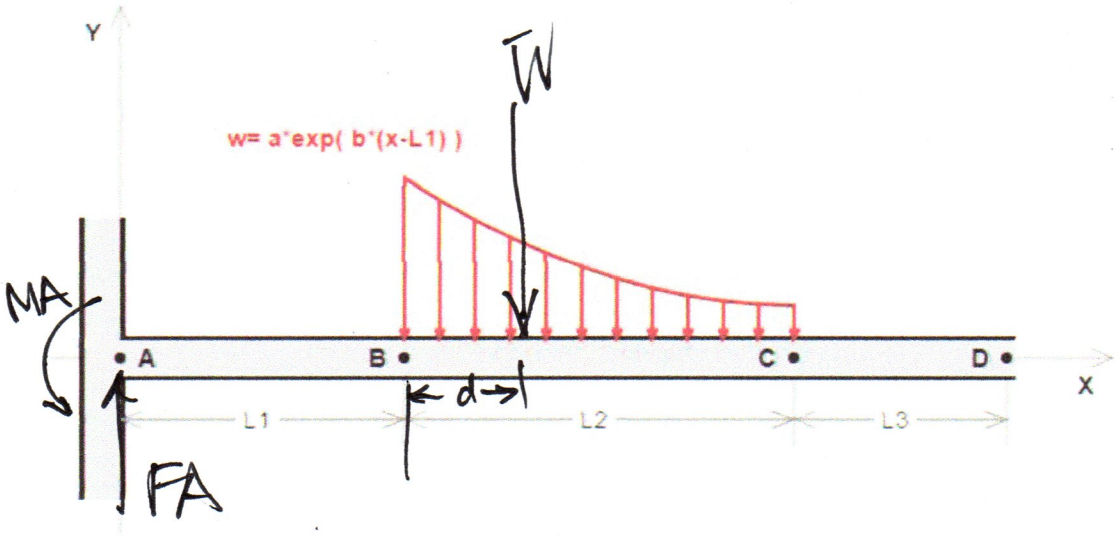
SOLUTION

ip4STATICS Worksheet for U04_P11

A cantilever beam carries exponentially-distributed loading, w lb/ft, in the interval between points B and C. The weight of the uniform beam between A and D is 100 lb.

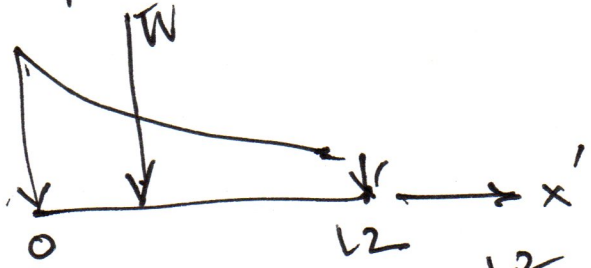
Instance variables: load a lb/ft, b ./ft; lengths L1, L2 and L3 in ft.



(1) What is the reaction force FA at A in equilibrium? ('mag,deg')

(2) What is the reaction moment in equilibrium? (Use ccw:+,cw:-)

First find W and d. Shift x axis to x'.



$$w(x') = a\,e^{bx'}$$

$$W = \int_0^{L2} w(x')\,dx' = \int_0^{L2} a\,e^{bx'}\,dx' = \left(\frac{a}{b}\right)\left(e^{b\cdot L2} - 1\right)$$

$$d\cdot W = \int_0^{L2} x'\,w(x')\,dx' = \int_0^{L2} x'\,a\,e^{bx'}\,dx'$$ integrate by parts

so

$$d\cdot W = \left(\frac{a}{b^2}\right)\left[b\cdot L2\,e^{b\cdot L2} - e^{b\cdot L2} + 1\right]$$

$\therefore\ d = \left(\frac{1}{W}\right)\left(\frac{a}{b^2}\right)\left[k e^k - e^k + 1\right]$, where $k \equiv b \cdot L2$

or $d = \left(\frac{1}{W}\right)\left(\frac{a}{b^2}\right)\left[1 + e^k(k-1)\right]$.

(1) $|FA| = W$

$\angle FA = 90°$

(2) $MA = W(d + L1)$