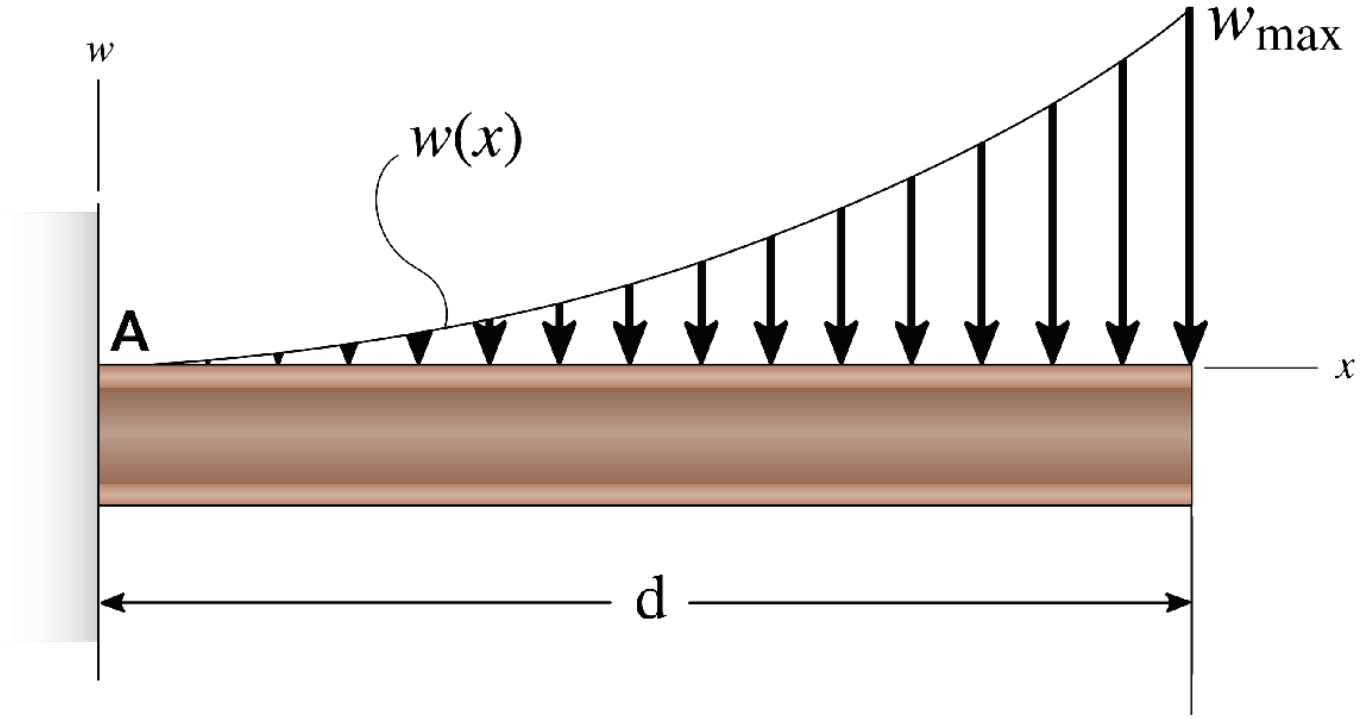

A metal beam is fixed onto a wall and supports a distributed load. If $w(x) = Cx^3$ and has a maximum value of w_{max} at the end of the beam, simplify the distributed load into an equivalent force. Find the magnitude of the equivalent force and the distance along the beam from A, x_E, where the equivalent force acts on.

Find the value for C.

$$w(d) = C \cdot d^3 = w_{max}$$

$$\Rightarrow C = \frac{w_{max}}{d^3}$$

Find the magnitude of the equivalent force, F_E, and the location on the beam where it acts x_E.

$$F_E = \int_0^d w(x)dx = \frac{w_{max}}{d^3}\int_0^d x^3 dx = \frac{w_{max}}{d^3}\left[\frac{x^4}{4}\right]_0^d$$

$$\Rightarrow F_E = \frac{w_{max} \cdot d}{4}$$

$$x_E = \frac{\int_0^d w(x) x dx}{F_E} = \frac{\frac{w_{max}}{d^3}\int_0^d x^4 dx}{F_E} = \frac{\frac{w_{max}}{d^3}\left[\frac{x^5}{5}\right]_0^d}{F_E}$$

$$\rightarrow x_E \frac{\frac{w_{max} \cdot d^2}{5}}{F_E}$$

$$\Rightarrow x_E = \frac{4}{5} d$$