Using Influence Lines

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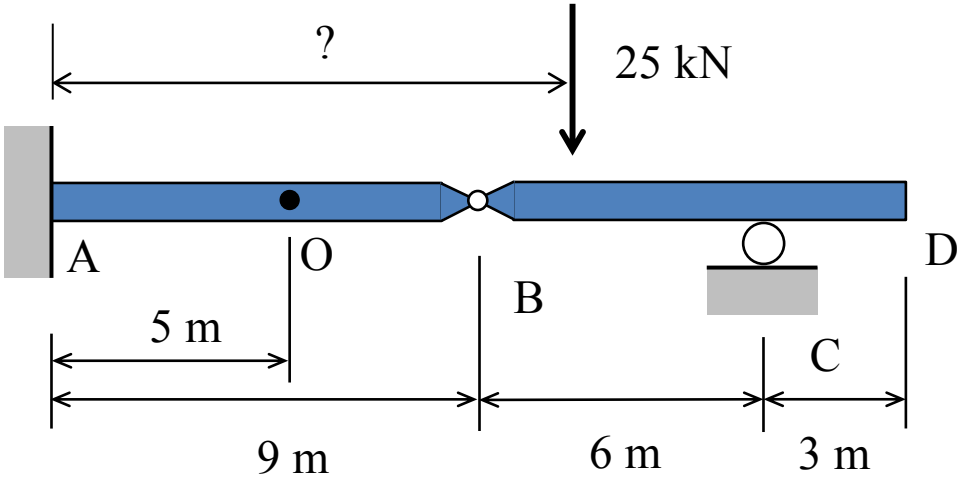
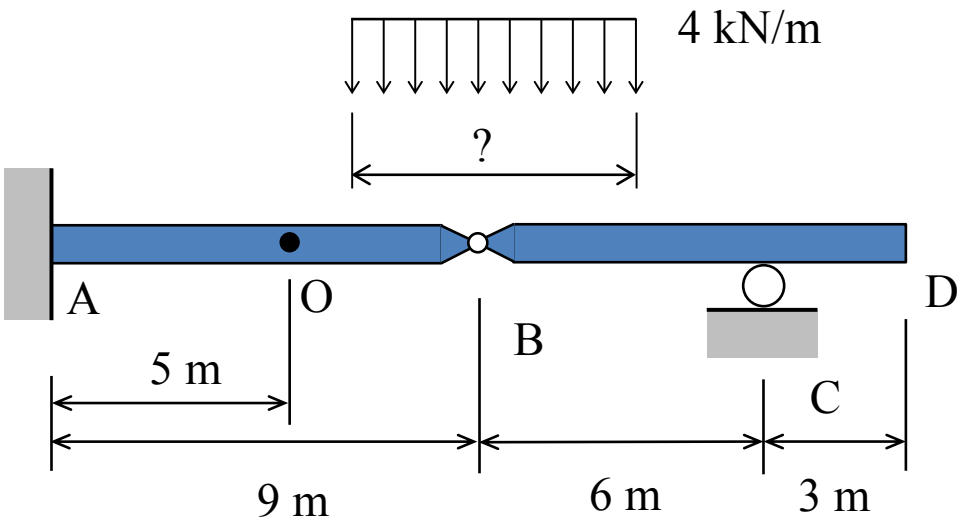
Question 1



Where should we place the 25 kN point load to produce the:

1. Maximum positive moment at point O;
2. Maximum negative moment at point O?

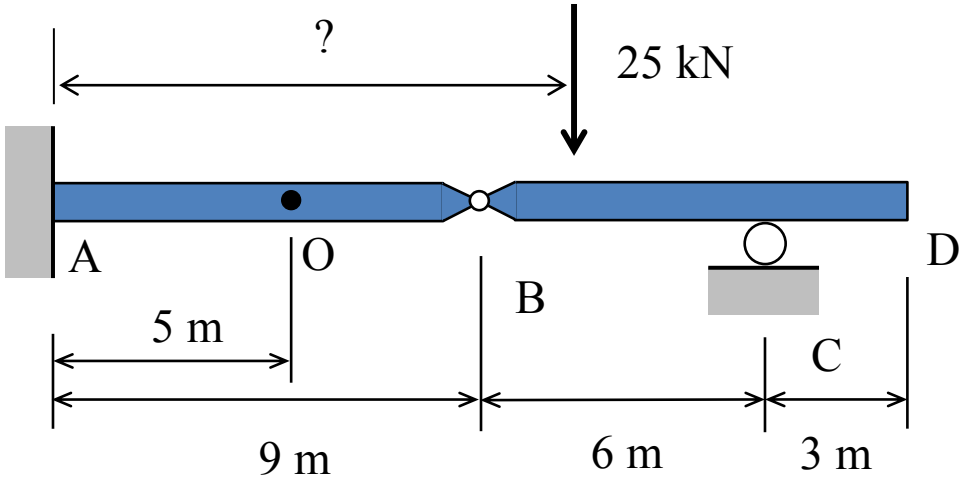
Question 2

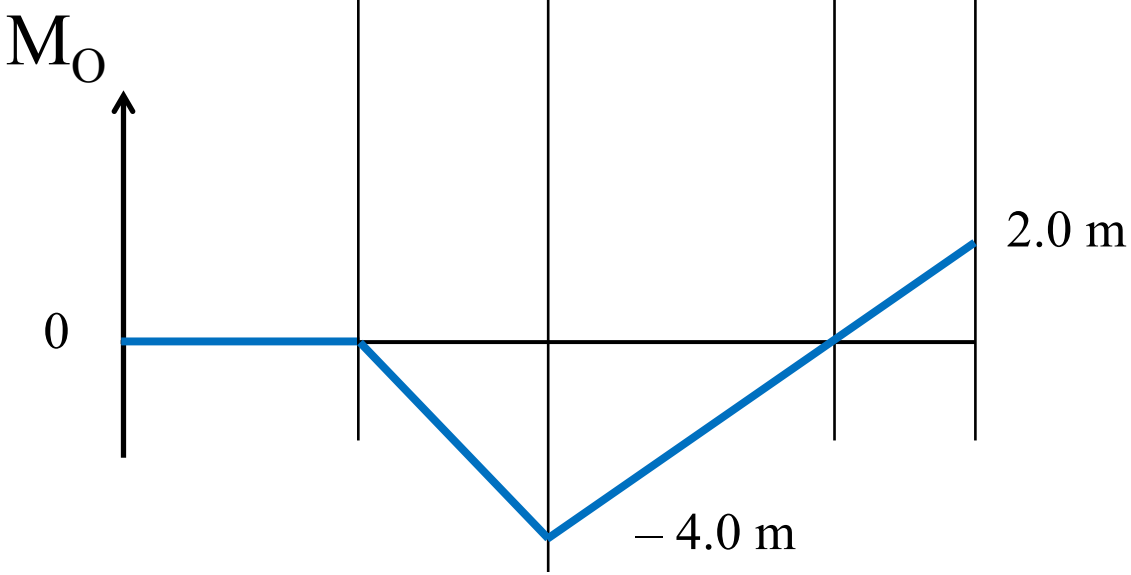


Where should we place the 4 kN/m distributed load to produce the:

1. Maximum positive moment at point O;
2. Maximum negative moment at point O?

With The Influence Line for M_O We can Answer the Questions Easily

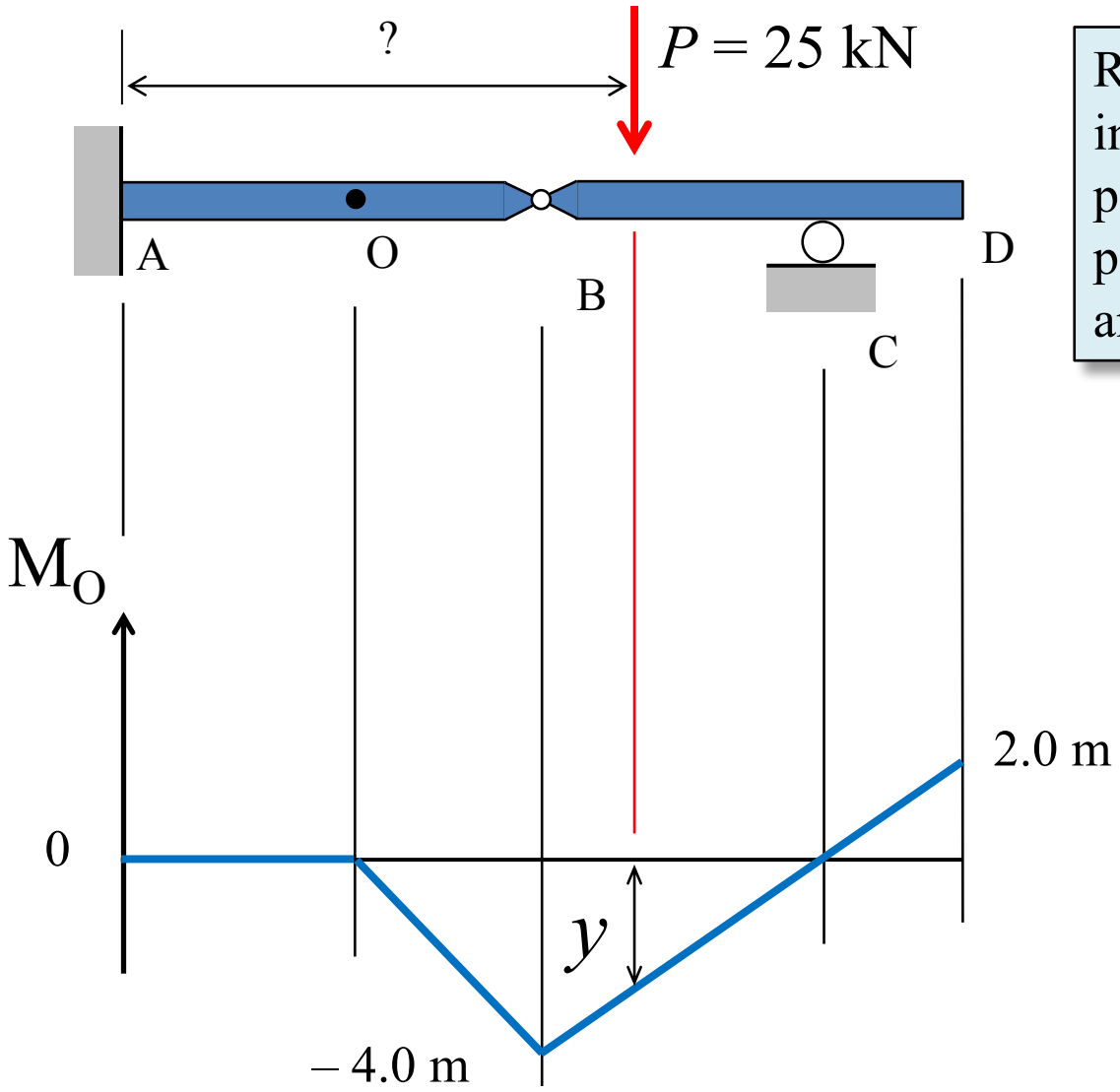




Question 1 involves placing a point load

Recall that we constructed the influence line for M_O by placing a unit, dimensionless point load across the structure and keeping track of M_O.

Influence of a Point Load



Recall that we constructed the influence line for M_O by placing a unit, dimensionless point load across the structure and keeping track of M_O.

Let;

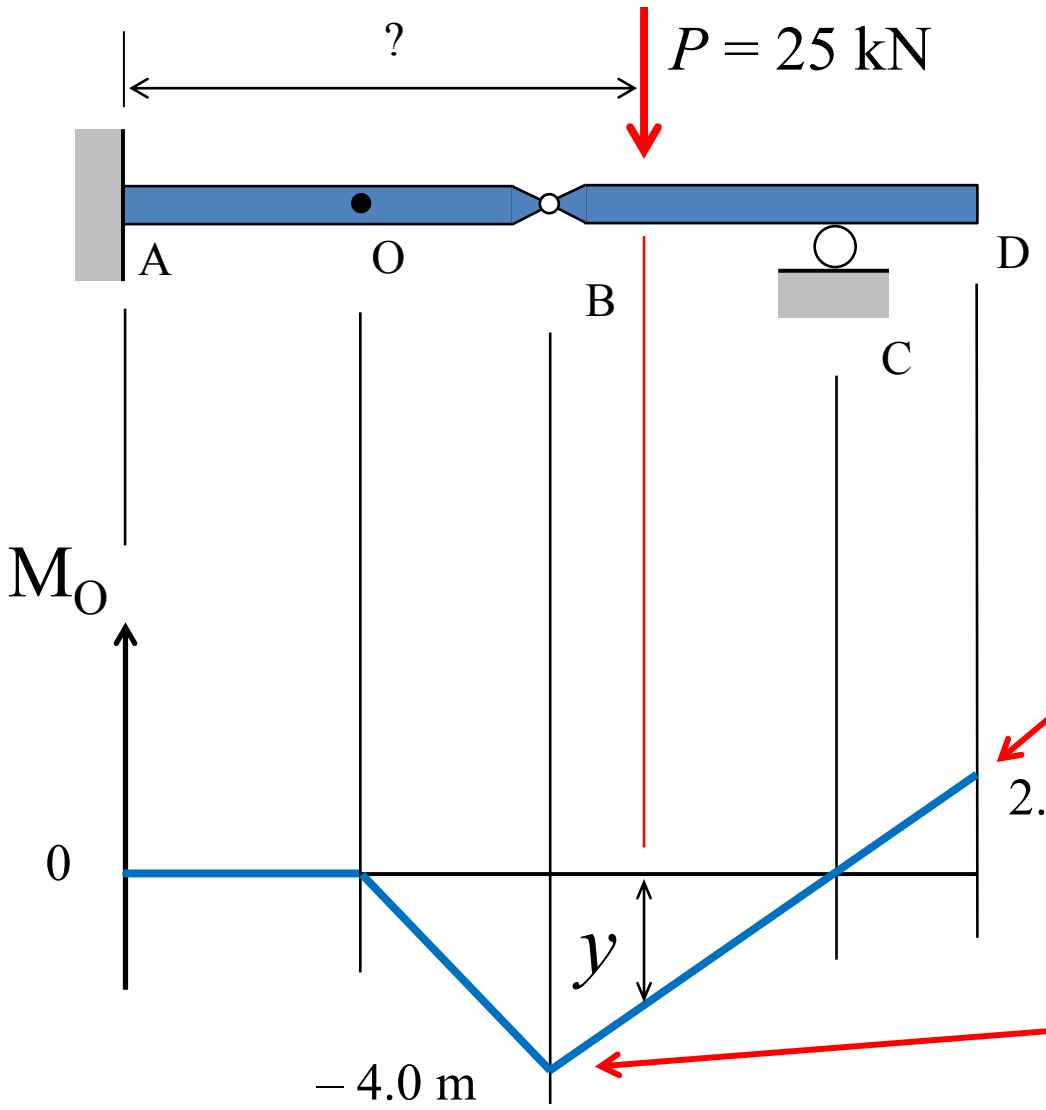
F = response quantity (in this example, M_O)

P = applied point load (in this example, 25 kN)

y = ordinate of influence line

$$F = Py$$

Influence of a Point Load



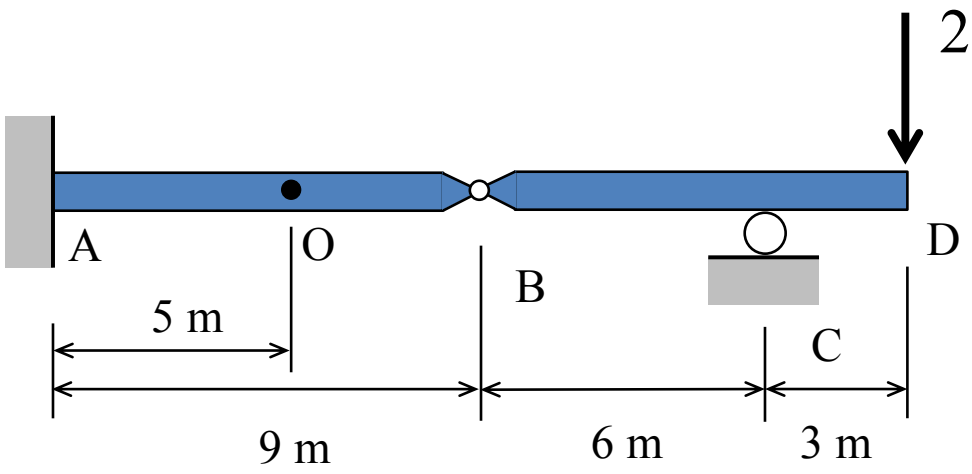
$F = Py$

For this example,
$M_O = (25\ \text{kN})(y)$

Maximum Positive
Ordinate = 2.0 m

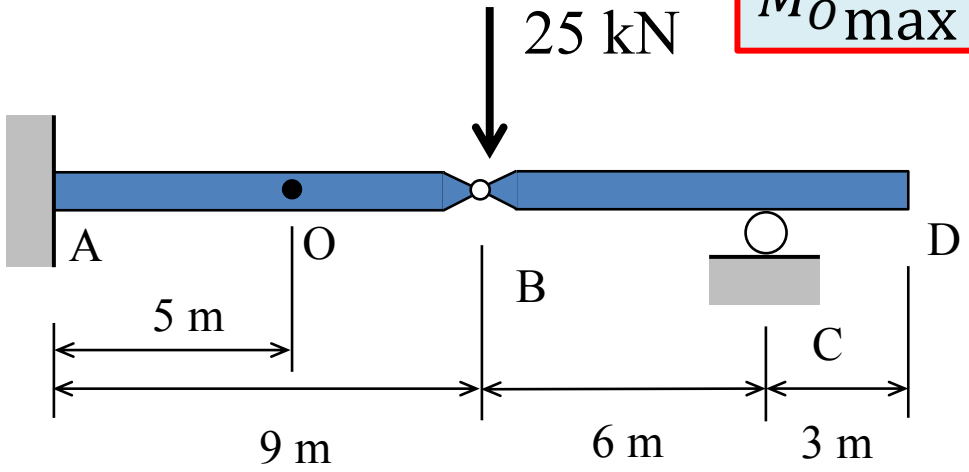
Maximum Negative
Ordinate = – 4.0 m

Answers to Question 1



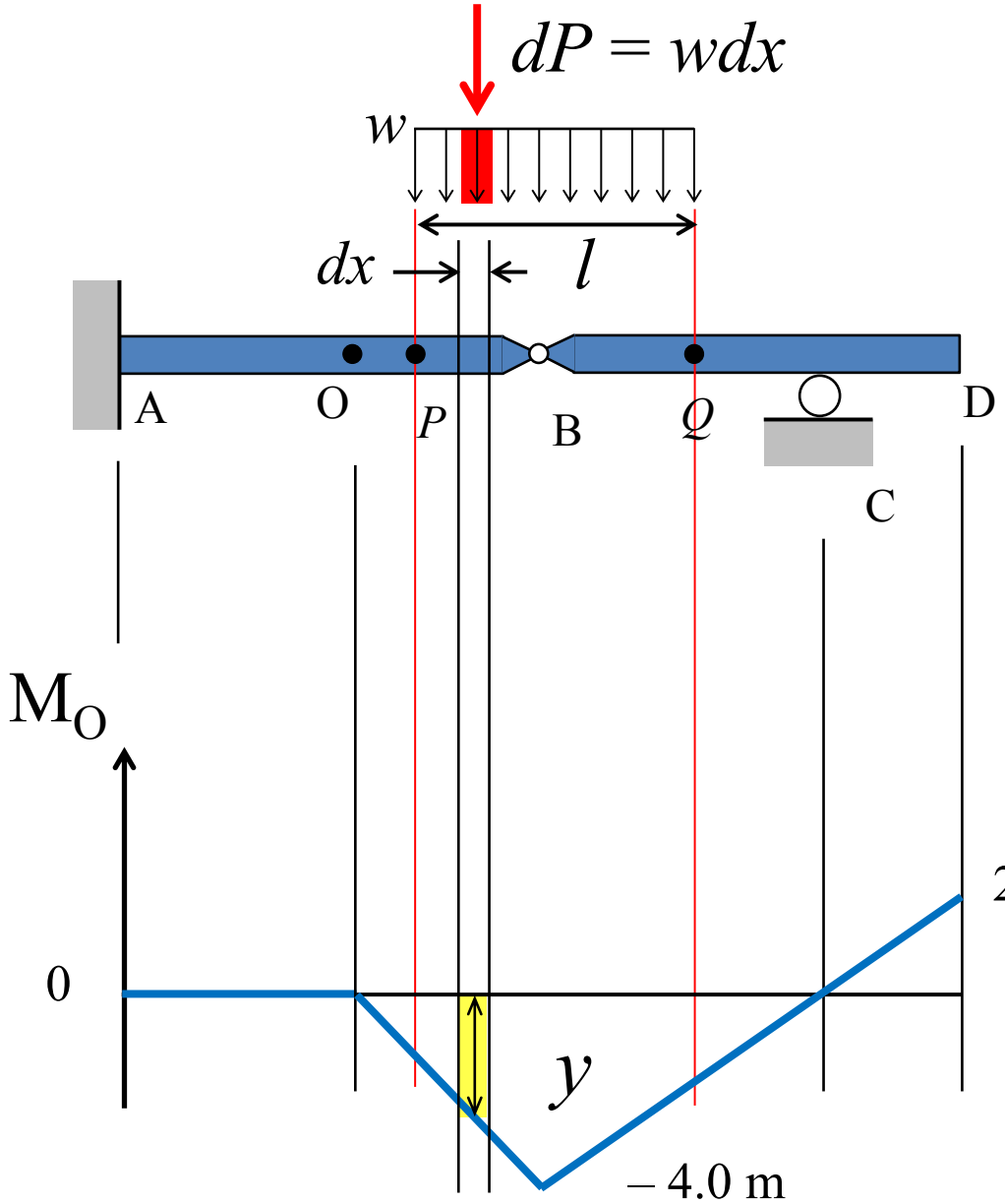
$$F = Py$$

$$M_{O_{\max}}^{+} = (25\ \text{kN})(2\ \text{m}) = 50\ \text{kN–m}$$



$$M_{O_{\max}}^{-} = (25\ \text{kN})(-4\ \text{m}) = -100\ \text{kN–m}$$

Influence of a Uniformly Distributed Load

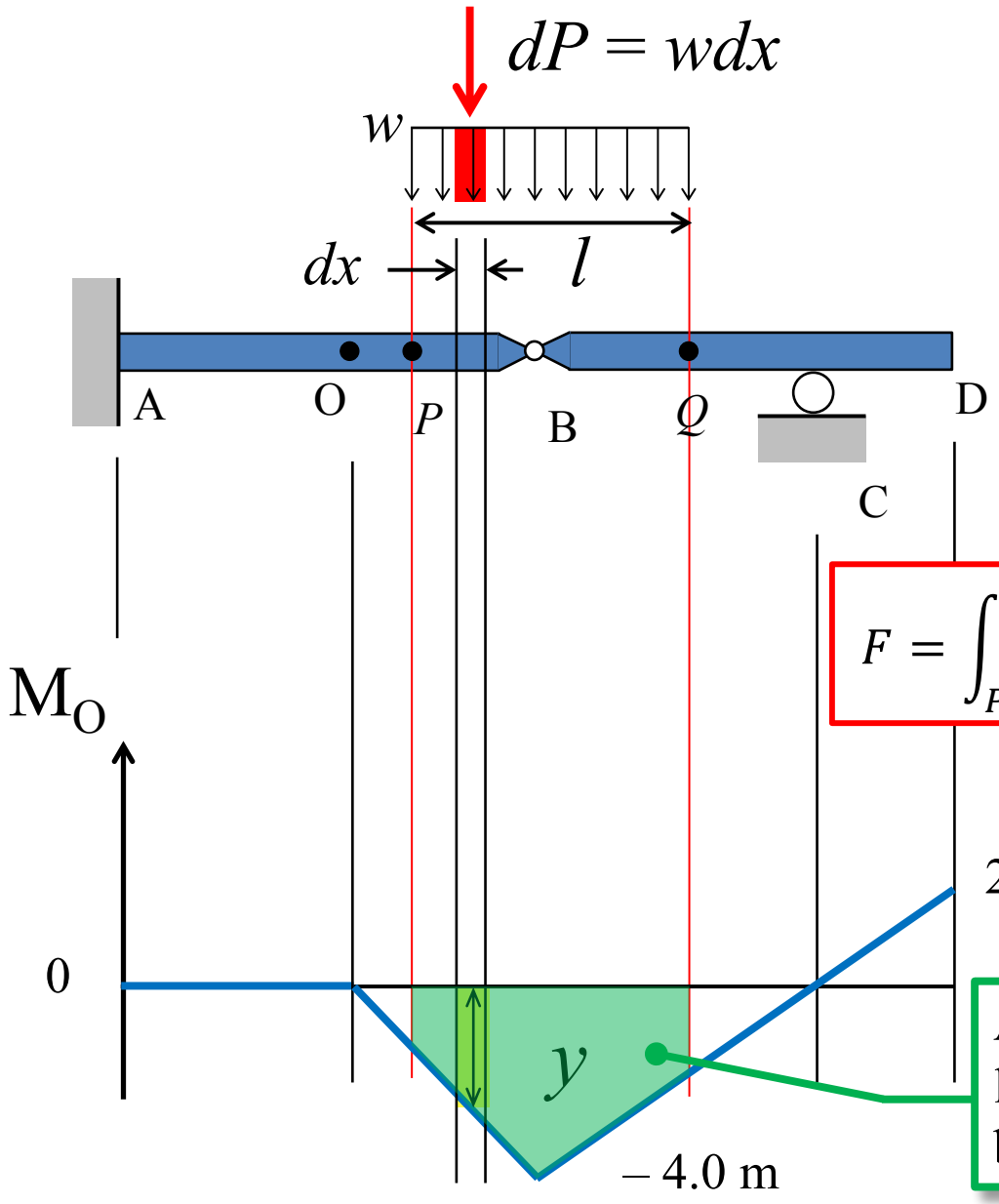


Consider a uniformly distributed load, *w*, acting over a length, *l*, between points *P* and *Q*.

Think of the uniformly distributed load as a series of point loads, $dP = wdx$

$$dF = dPy$$

Influence of a Uniformly Distributed Load



$$dF = dPy$$

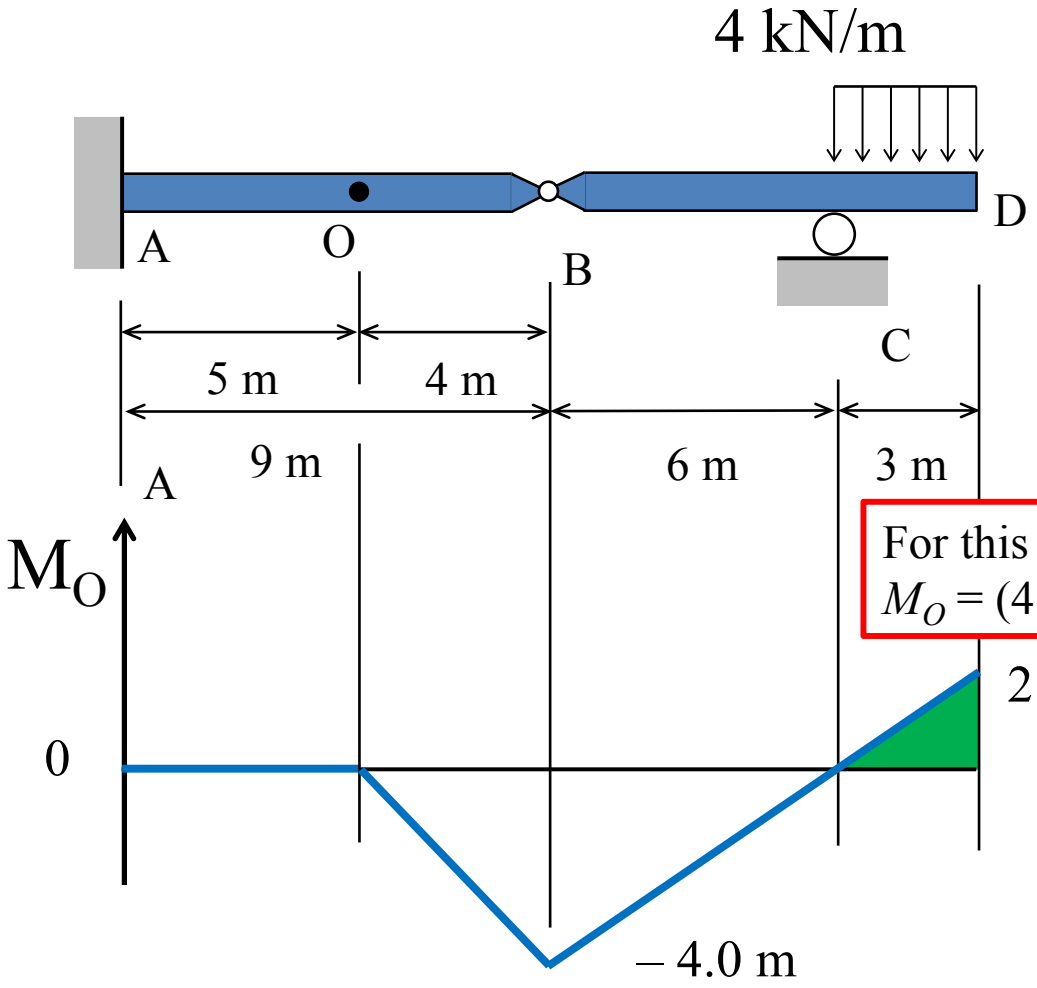
Add the influence of all of the infinitesimal point loads, dF, over the length l.

$$F = \int_P^Q dF = \int_P^Q ydP = \int_P^Q ywdx$$

$$F = w\left[\int_P^Q ydx\right]$$

Area of the influence line over length, l, between points P and Q

Answers to Question 2



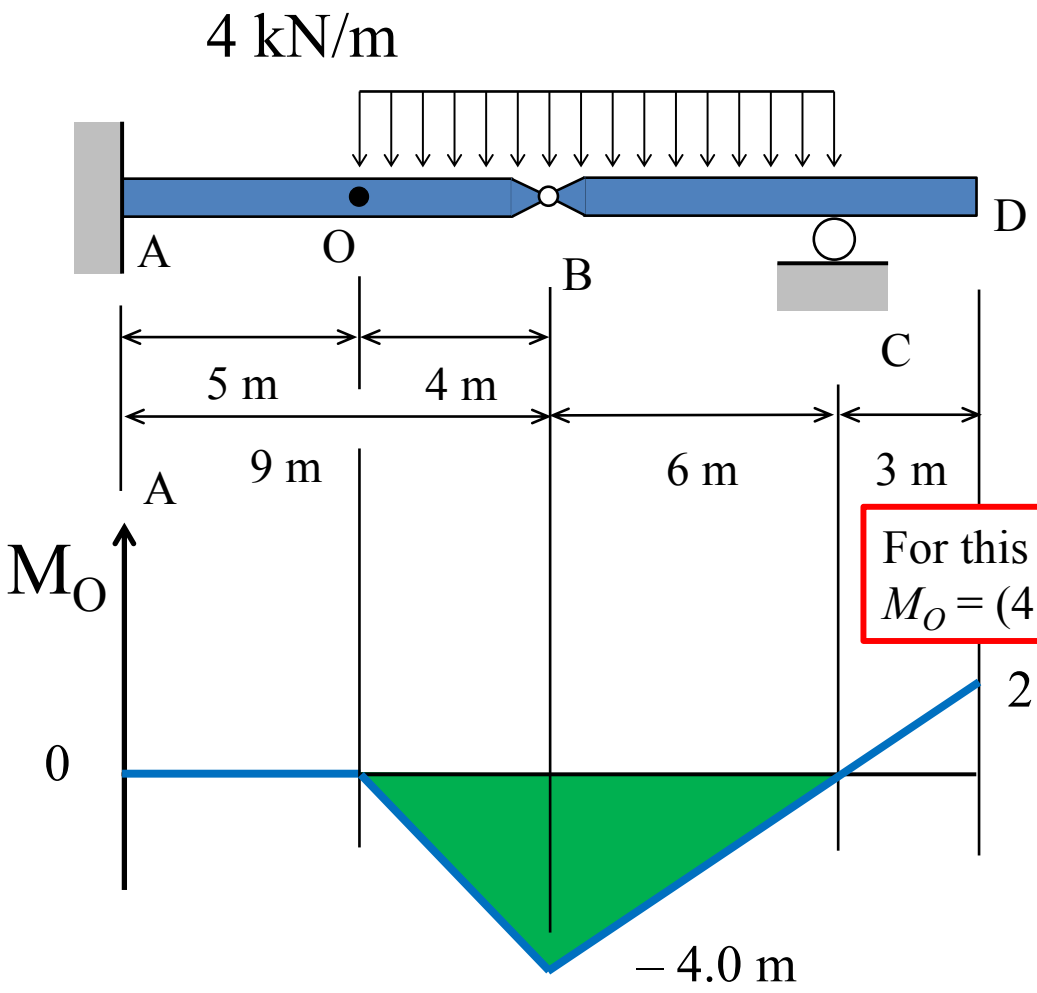
$$F = w\left[\int_P^Q y dx\right]$$

For this example,
M_O = (4 kN/m)(Area under the distributed load)

Place the distributed load over all of the positive area of the M_O influence line to find $M_{O\,\max}^{+}$

$$M_{O\,\max}^{+} = (4\ \text{kN/m})\left[\frac{1}{2}(3\ \text{m})(2\ \text{m})\right] = 12\ \text{kN–m}$$

Answers to Question 2



$$F = w\left[\int_P^Q y dx\right]$$

For this example,
M_O = (4 kN/m)(Area under the distributed load)

Place the distributed load over all of the negative area of the M_O influence line to find $M_{O_{\max}}^{-}$

$$M_{O_{\max}}^{-} = (4\ \text{kN/m})\left[\frac{1}{2}(10\ \text{m})(-4\ \text{m})\right] = -80\ \text{kN–m}$$