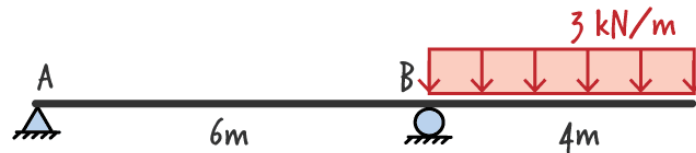# Statics– ST10 (Solution for Exercise A)
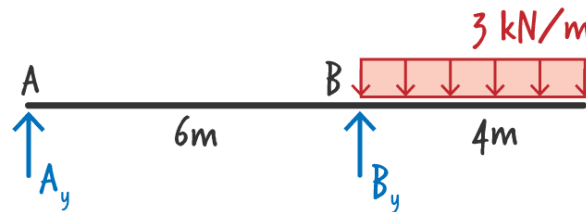## Shear and Moment Equations for Statically Determinate Beams

Write the shear and moment equations for the statically determinate beam shown below.

Solution

Draw the beam's free-body diagram.

The beam has two non-zero unknown reaction forces. Write the necessary equilibrium equations for determining the support reactions.
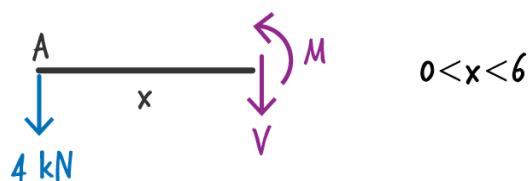
$$\sum F_y = A_y + B_y - 4(3) = 0$$
$$\sum M_{a B} = (3)(4)(4/2) + 6A_y = 0$$

Solving the above equations for the reaction forces, we get the following:

$$A_y = -4 \ kN$$
$$B_y = 16 \ kN$$

We need two sets of shear and moment equations - one for the left segment and one for the right segment of the beam. For the left segment, the free-body diagram can be drawn as shown below:

The equilibrium equations for the above free-body diagram are as follows:
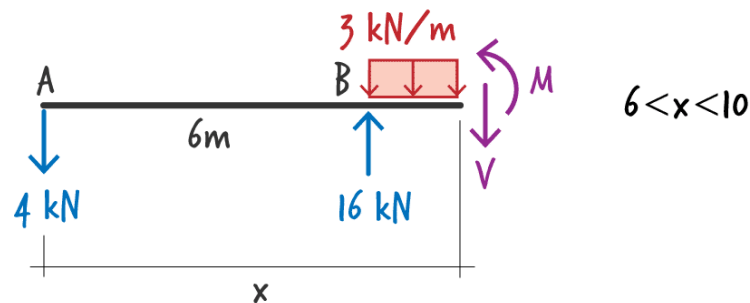
$$\sum F_y = -4 - V = 0$$

$$\sum M_{@A} = (x)(V) - M = 0$$

Solving these equations for V and M, we get the shear and moment equations for the left segment of the beam in terms of x where x is between 0 and 6.

$$V(x) = -4 \ kN$$

$$M(x) = -4x \ kN.m$$

For the right segment of the beam, we cut the segment at an arbitrary point and draw the needed free-body diagram as shown below:

The equilibrium equations for the above diagram can be written as follows:

$$\sum F_y = -4 + 16 - 3(x-6) - V = 0$$

$$\sum M_{@B} = (3)(x-6)\frac{x-6}{2} + (x-6)(V) - M - 6(4) = 0$$

Solving these equations for shear and moment, we get the following:

$$V(x) = 30 - 3x \ kN$$

$$M(x) = -\frac{3}{2}(x-10)^2 \ kN.m$$

Here is the summary of the results:

$$V(x)=\begin{cases} -4 \text{ kN} & 0<x<6 \\ 30-3x \text{ kN} & 6<x<10 \end{cases}$$

$$M(x)=\begin{cases} -4x \text{ kN.m} & 0\leq x\leq 6 \\ -\dfrac{3}{2}(x-10)^2 \text{ kN.m} & 6\leq x\leq 10 \end{cases}$$