

# ES120 Spring 2018 – Section 7 Notes

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## Problem 1:

For the beam and loading shown, (a) draw the shear and bending-moment diagrams, (b) determine the equations of the shear and bending-moment curves.

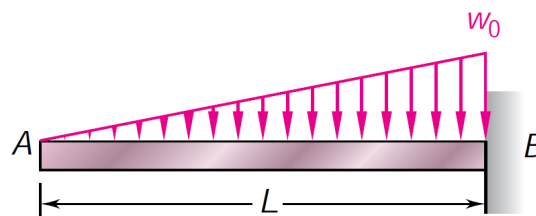


Figure 1

### Solution 1

To do this problem we must begin by drawing the free body diagram for an arbitrary distance  $x$  from edge  $A$  to point  $J$ .

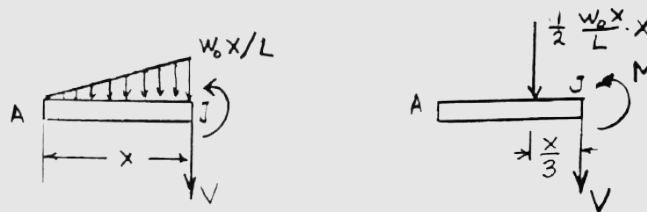


Figure 2

Using this figure, we can compute the force balance in the  $y$  direction such that

$$-\frac{1}{2} \frac{w_o x}{L} x - V = 0 \quad (1)$$

$$V = -\frac{w_o x^2}{2L} \quad (2)$$

Now to obtain the equation for the bending moment, we simply integrate  $V$  with respect to  $x$ , namely:

$$M = -\frac{w_o x^3}{6L} \quad (3)$$

Now, to obtain the maximum value of both, we evaluate the above equations at point B, where  $x = L$

$$V(L) = -\frac{w_o L}{2} \quad (4)$$

$$M(L) = -\frac{w_o L^2}{6} \quad (5)$$

Using this, we can draw the shear and bending moment diagrams as

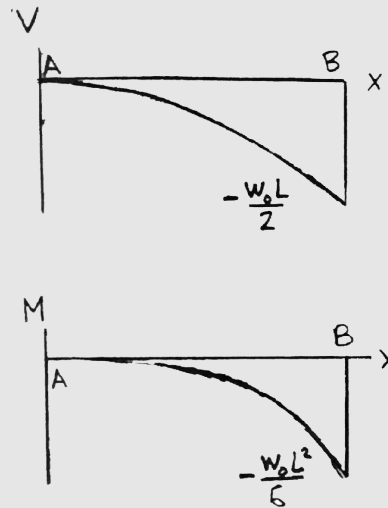
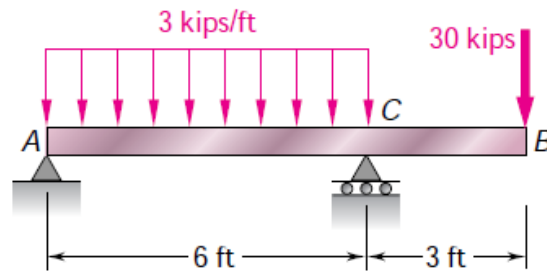


Figure 3

**Problem 2:**

Draw the shear and bending-moment diagrams for the beam and loading shown, and determine the maximum absolute value (a) of the shear, (b) of the bending moment.

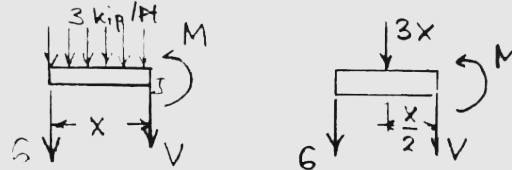
**Figure 4****Solution 2**

This problem is a bit more complex than the previous one. First, we need to begin finding the unknown reaction forces along the bottom of the beam. To do this, let's use sum of moments about points  $C$  and  $A$ , respectively (we know that the distributed load can be approximated as a point load at the center between  $A$  and  $C$  and of the total amount  $3 \times 6 = 18$  kips):

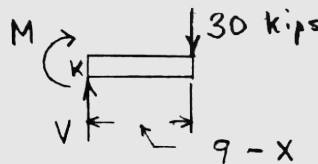
$$\Sigma M_C = 0 : -6R_A + (3)(18) - (3)(30) = 0 \Rightarrow R_A = -6 \text{ kips} \quad (6)$$

$$\Sigma M_A = 0 : 6R_C - (3)(18) - (9)(30) = 0 \Rightarrow R_C = -54 \text{ kips} \quad (7)$$

Using this information, we can separate this problem into two parts, namely  $A$  to  $C$  and  $C$  to  $B$ . So let's begin by solely analyzing  $A$  to  $C$ .

**Figure 5**

Now let's analyze  $C$  to  $B$

**Figure 6**

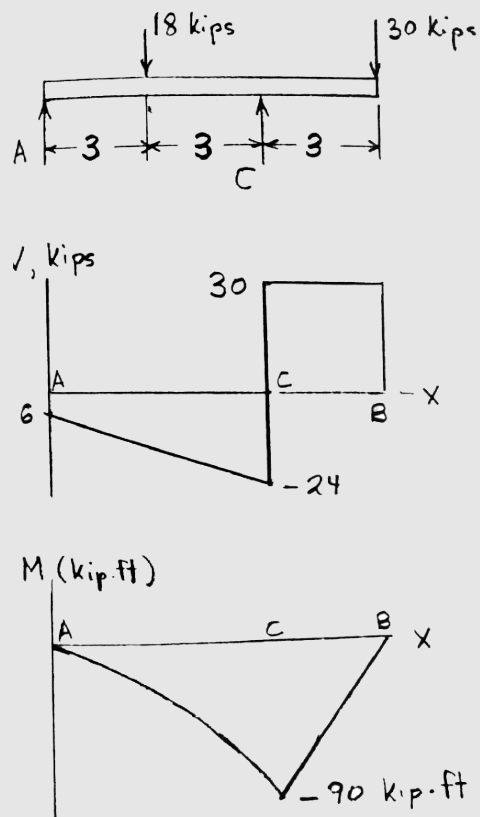
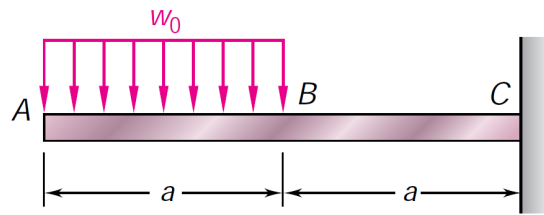
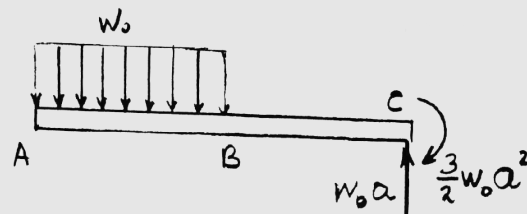


Figure 7

**Problem 3:**

(a) Using singularity functions, write the equations defining the shear and bending moment for the beam and loading shown. (b) Use the equation obtained for  $M$  to determine the bending moment at point  $C$  and check your answer by drawing the free-body diagram of the entire beam.

**Figure 8****Solution 3****Figure 9**