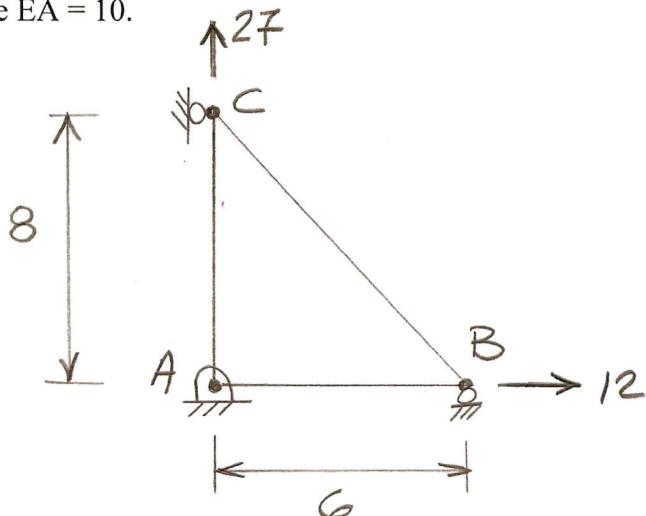


Name: \_\_\_\_\_ ID: \_\_\_\_\_ Date: \_\_\_\_\_

(1)	(2)	(3)	(4)	(5)	Total
<input type="text"/>					
/ 25	/ 25	/ 20	/ 15	/ 15	/ 100

❖ IGNORE shear deformations unless stated otherwise

For the Truss shown in the figure below, determine the Vertical Reaction at B and the Vertical Deflection at C. Use  $EA = 10$ .



### Problem 1 (25 Points)

Solve the above truss problem using the Stiffness method, do not use statics or any other method. The structural model is as follows:

Joints:  Joint 1 is A  Joint 2 is B  Joint 3 is C

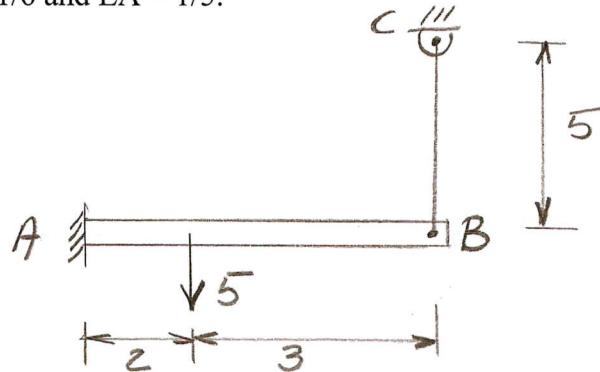
Elements:  Element 1 is AB  Element 2 is AC  Element 3 is BC

### Problem 2 (25 Points)

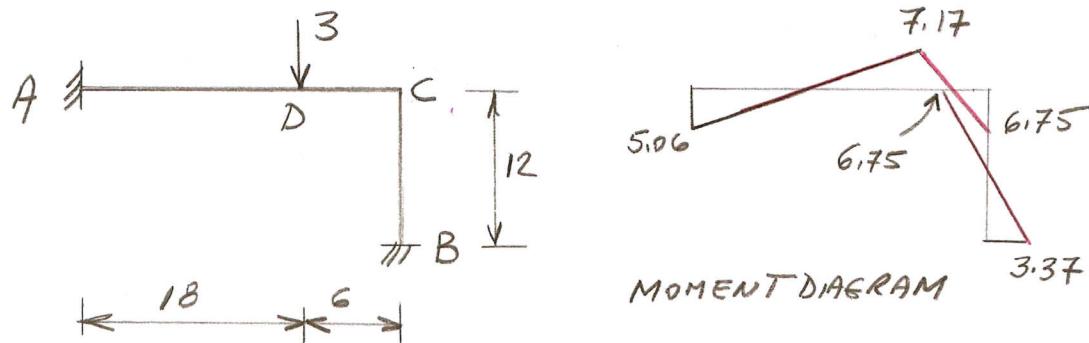
Solve the above truss problem using the Flexibility method with  $Q_1 = \text{Force at C}$ , Virtual Work, and Statics. Do not use any other method or any other redundant.

**Problem 3 (20 Points)**

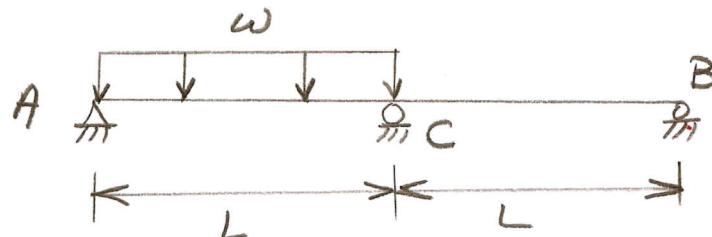
Beam AB is connected to truss BC at B as shown in the figure below. Draw the moment diagram on the compression side for AB. Use the Flexibility method with  $Q_1 = \text{Moment at A}$ , do not use any other redundant. Use  $EI = 1/6$  and  $EA = 1/5$ .

**Problem 4 (15 Points)**

The moment diagram (drawn on the compression side) is shown in the figure below for a one-bay frame. Determine the vertical deflection at D and the rotation at C. Use  $EI = 1$ .

**Problem 5 (15 Points)**

For the beam shown in the figure below, determine the reaction at B in terms of  $w$  and  $L$ . Use the Flexibility method with  $Q_1 = \text{Moment at C}$ , do not use any other redundant. Use  $EI = \text{constant}$ .



	1	2	3	4		1	2	5	6		3	4	5	6
$1 \textcircled{1} 2$	1	0	-	1	$1 \textcircled{2} 3$	0	0	-	1	$2 \textcircled{3} 3$	0.36	-0.48	-	3
$\begin{matrix} k = 10 \\ n = 6 \end{matrix}$	0	0	-	2	$\begin{matrix} k = 10 \\ n = 8 \end{matrix}$	0	1	-	2	$\begin{matrix} k = 10 \\ 10 \end{matrix}$	-0.48	0.64	-	4
$c=1, s=0$	-	+	3	4	$c=0, s=1$	-	+	5	6	$c=-0.6$	-	+	5	6

$$\begin{array}{c}
 \begin{array}{ccccc}
 & 3 & 6 & & \\
 \left[ \begin{array}{cc|c} +10/6 & 0.48 & d_3 & = & 12 \\ 0.36 & & & & \\ \hline 0.48 & +10/8 & d_6 & = & 27 \\ & 0.64 & & & \end{array} \right] & & & & \\
 \begin{array}{l} d_3 = 2.7 \\ d_6 = 13.6 \end{array} & & & & \\
 \Delta_c = 13.6 \uparrow & & & & \\
 B = 10 \downarrow & & & & \\
 K_{43}d_3 + K_{46}d_6 = R_4, \quad R_4 = -10 & & & & \\
 \begin{array}{l} \uparrow \\ -0.48 \end{array} \quad \begin{array}{l} \downarrow \\ -0.64 \end{array} & & & & 
 \end{array}
 \end{array}$$

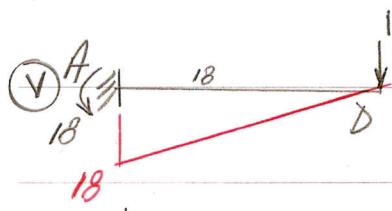
(1)  $\Delta_C = \frac{(1)(17)}{10} (8) = 13.6$ ,  $\Delta_C = 13.6 \uparrow$

$D_{KL} = 2(2 \times 0.6 \times 6 + 1 \times 6) + 3(2 \times 0.6 \times 6)$

$+ \frac{(15)(2)}{15}(5) = 53$

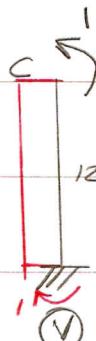
$F_{II} = 5(2 \times 1 \times 1) + \frac{(15)(15)}{15}(5) = 11$

The diagram shows a horizontal beam supported by a spring at the left end and a fixed support at the right end. A downward triangular load is applied over the entire length of the beam. The peak of the triangle is labeled 2.836. The total length of the beam is divided into three segments, each labeled 1, 2, and 3 from left to right. At the left end, there is a reaction force of 5.273 downwards and a reaction moment of 4.055 clockwise. At the right end, there is a reaction force of 0.9454 upwards.



$$(1) \Delta_D = \frac{18}{6} (2 \times 18 \times 5.06 - 18 \times 7.17)$$

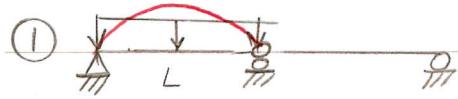
$$\Delta_D = 159.3 \downarrow$$



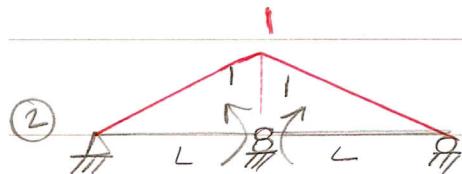
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$$B (1) \theta_C = \frac{12}{6} (2 \times 1 \times 6.75 - 2 \times 1 \times 3.37 + 1 \times 6.75 - 1 \times 3.37)$$

$$\theta_C = 20.285$$



$$1/2 Q_{PL} = \frac{L}{3EI} \left( 1 \times \frac{\omega L^2}{8} \right) = \frac{\omega L^3}{24EI}$$



$$2/2 F_H = \frac{L}{6EI} (2 \times 1 \times 1) \times 2 = \frac{2}{3} \frac{L}{EI}$$

$$0 = \frac{\omega L^3}{24EI} + \frac{2}{3} Q_1 \rightarrow Q_1 = - \frac{\omega L^2}{16}$$

$$) \sum M = 0 : B(L) + \frac{\omega L^2}{16} = 0, B = \frac{\omega L}{16}$$

