CE 3202 Spring 2011 Exam 3 Name ______________________

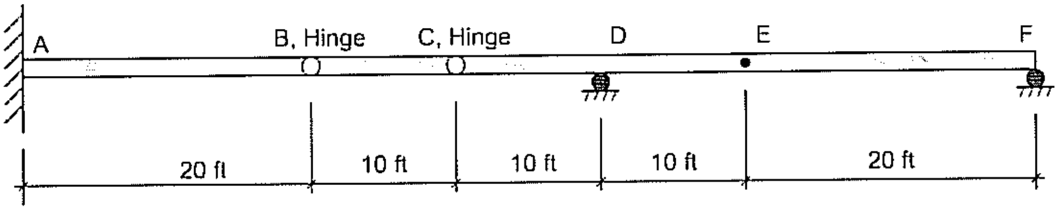
Closed Book; Closed Notes
(3) 3"x5" Note Cards Allowed;
Scientific Calculator Allowed (Graphing Calculators are Banned)
100 points are possible

Answer all questions to the best of your ability. State any assumptions you feel are necessary. Attach extra sheets, if used. Show your work!

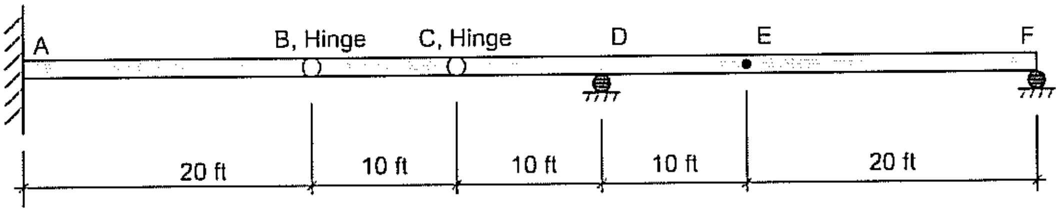
Problem 1. Influence line diagrams.

For the structures show, use the Müller-Breslau Principle to sketch the influence line diagrams for the load effect requested:

(a) M_E **(5 points).** *Note: Point E is not a hinge.*

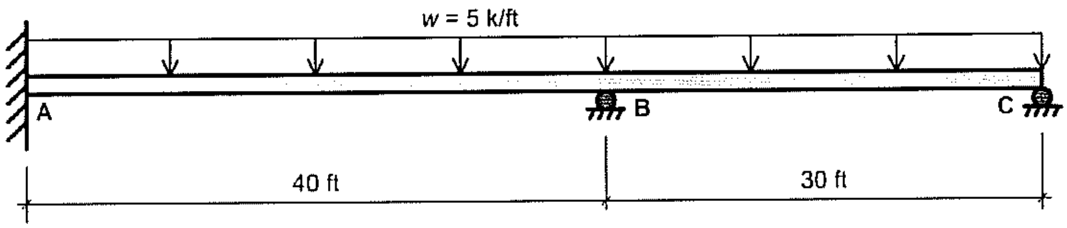


(b) V_E **(5 points).** *Note: Point E is not a hinge.*

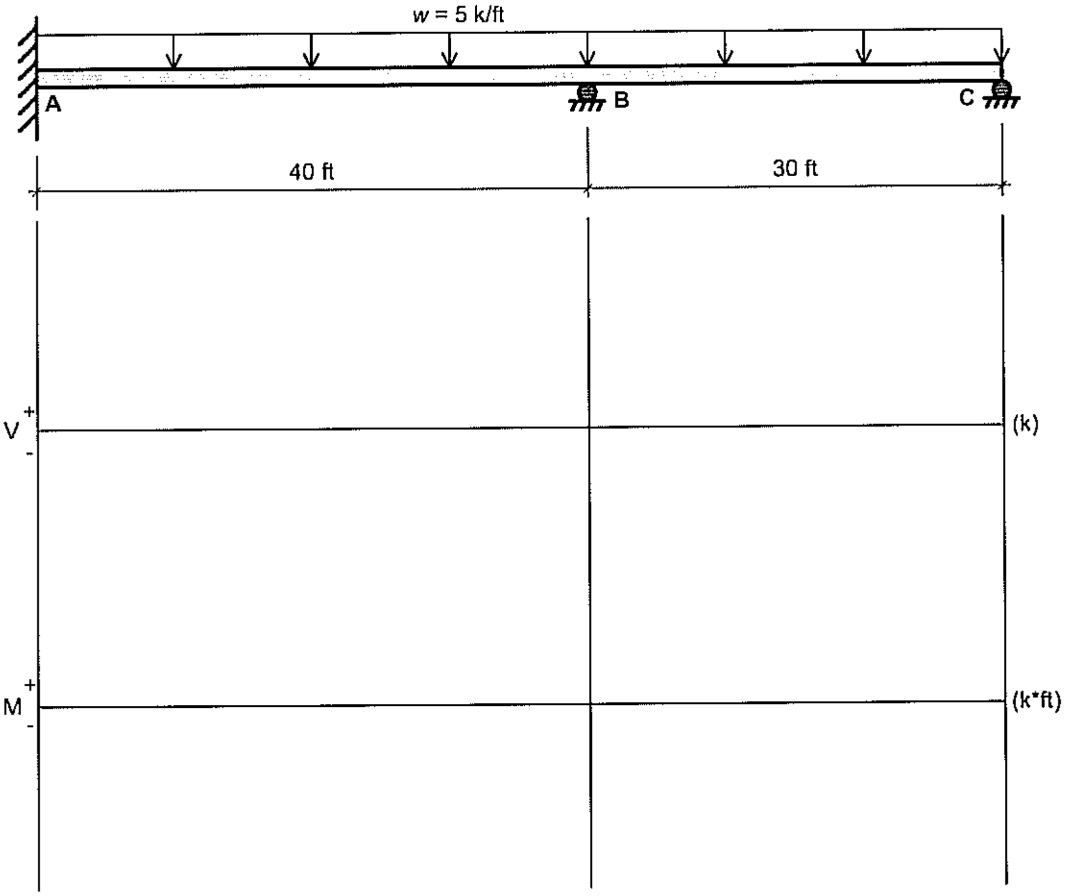


Problem 2. The flexibility method.

(a) For the structure depicted below, find the reactions using the flexibility method and statics. Ignore axial effects. The structure is indeterminate to the second degree. $E = 30{,}000$ ksi; $I = 400$ in^4. The deformation table attached to the back of the exam may be helpful to you. **(40 points).**

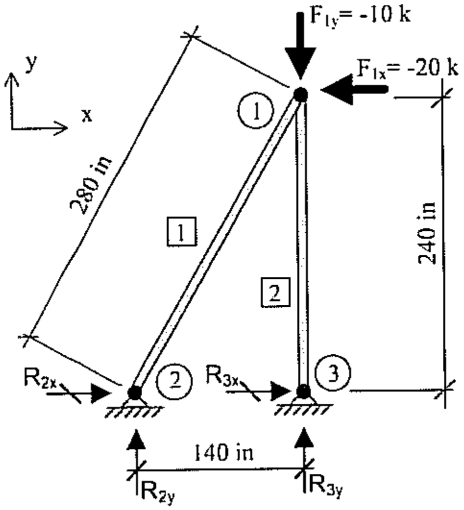


(b) Using your reactions from part (a), draw the shear and moment diagram for this structure. **(10 points).**



Problem 3. Direct-stiffness method for 2D trusses.

(a) For the structure shown below, compute the 4x4 member stiffness matrix and global stiffness matrix for the structure. E = 30,000 kips/in²; A_1 = 4.0 in²; and A_2 = 3.0 in². (15 points). I recommend that you limit your work to 2 significant figures.



$$K_1 = \begin{array}{ccccc} 2x & 2y & 1x & 1y & \\ & & & & 2x \\ & & & & 2y \\ & & & & 1x \\ & & & & 1y \end{array}$$

$$K_2 = \begin{array}{ccccc} 3x & 3y & 1x & 1y & \\ & & & & 3x \\ & & & & 3y \\ & & & & 1x \\ & & & & 1y \end{array}$$

$$K_{global} = \begin{array}{ccccccc} 1x & 1y & 2x & 2y & 3x & 3y & \\ & & & & & & 1x \\ & & & & & & 1y \\ & & & & & & 2x \\ & & & & & & 2y \\ & & & & & & 3x \\ & & & & & & 3y \end{array}$$

(b) Using the global stiffness matrix, from part (a), find the deflection at node ① (both x and y-directions) as well as the x and y reactions at nodes ② and ③. (15 points).

Problem 4. General Knowledge.

Answer the following questions

(a) True or False: $\int f(x) + g(x)dx = \int f(x)dx + \int g(x)dx$? **(2 points).**

(b) True or False: $\int f(x)g(x)dx = \int f(x)dx \int g(x)dx$? **(2 points).**

(c) You need to use an indefinite integral to find deflections using the double-integral method; you use a definite integral to find deflections using both the moment-area and virtual work methods. Fill in the following table that summarized what concepts are required (or not required) to solve definite and indefinite integrals (use "yes" and "no" as your entries in the table). **(4 points).**

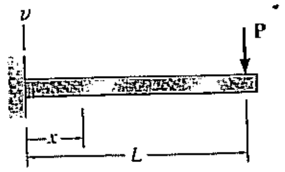
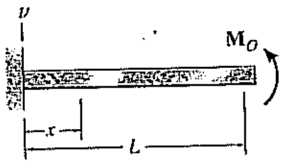
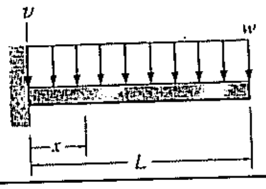
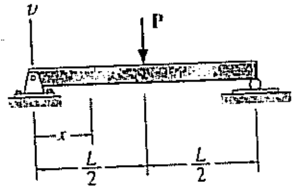
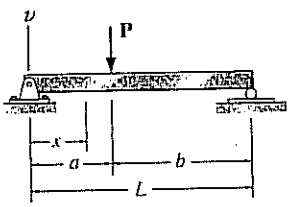
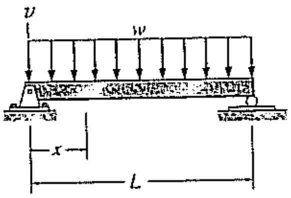
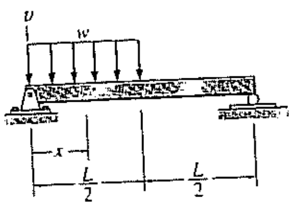
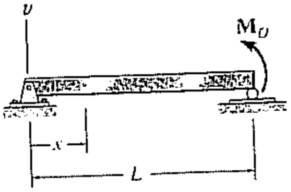
	Limits of Integration	Constants of Integration
Definite Integral		
Indefinite Integral		

(d) What can you say about the inverse of matrix *A*? **(2 points).**

$$A = \begin{bmatrix} 1 & 2 \\ -6 & -12 \end{bmatrix}$$

Beam Deflections and Slopes

HIBBELER, R.C. (2011) "STRUCTURAL ANALYSIS"

Loading	v + ↑	θ + ↺	Equation + ↑ + ↺
	$v_{\max} = -\frac{PL^3}{3EI}$ at $x = L$	$\theta_{\max} = -\frac{PL^2}{2EI}$ at $x = L$	$v = \frac{P}{6EI}(x^3 - 3Lx^2)$
	$v_{\max} = \frac{M_O L^2}{2EI}$ at $x = L$	$\theta_{\max} = \frac{M_O L}{EI}$ at $x = L$	$v = \frac{M_O}{2EI}x^2$
	$v_{\max} = -\frac{wL^4}{8EI}$ at $x = L$	$\theta_{\max} = -\frac{wL^3}{6EI}$ at $x = L$	$v = -\frac{w}{24EI}(x^4 - 4Lx^3 + 6L^2x^2)$
	$v_{\max} = -\frac{PL^3}{48EI}$ at $x = L/2$	$\theta_{\max} = \pm\frac{PL^2}{16EI}$ at $x = 0$ or $x = L$	$v = \frac{P}{48EI}(4x^3 - 3L^2x)$, $0 \le x \le L/2$
		$\theta_L = -\frac{Pab(L+b)}{6LEI}$ $\theta_R = \frac{Pab(L+a)}{6LEI}$	$v = -\frac{Pbx}{6LEI}(L^2 - b^2 - x^2)$ $0 \le x \le a$
	$v_{\max} = -\frac{5wL^4}{384EI}$ at $x = \frac{L}{2}$	$\theta_{\max} = \pm\frac{wL^3}{24EI}$	$v = -\frac{wx}{24EI}(x^3 - 2Lx^2 + L^3)$
		$\theta_L = -\frac{3wL^3}{128EI}$ $\theta_R = \frac{7wL^3}{384EI}$	$v = -\frac{wx}{384EI}(16x^3 - 24Lx^2 + 9L^3)$ $0 \le x \le L/2$ $v = -\frac{wL}{384EI}(8x^3 - 24Lx^2 + 17L^2x - L^3)$ $L/2 \le x \le L$
	$v_{\max} = -\frac{M_O L^2}{9\sqrt{3}EI}$	$\theta_L = -\frac{M_O L}{6EI}$ $\theta_R = \frac{M_O L}{3EI}$	$v = -\frac{M_O x}{6EIL}(L^2 - x^2)$