ENCE 353 Final Exam, Open Notes and Open Book

Name : _____

Exam Format and Grading. The exam will be 2 hrs plus five minutes to read the questions. Only attempt four questions. Cross out the question that you did not attempt in the table below. No extra credit will be given for attempting five questions – we will simply grade and count the first four questions.

Partial credit will be given for partially correct answers, so please show all your working.

Question	Points	Score
1	10	
2	10	
3	10	
4	10	
5	10	
Total	40	

Question 1: 10 points

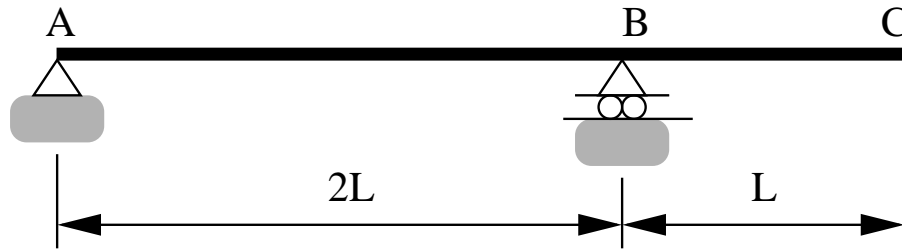Consider the two-span beam structure shown in Figure 1.

Figure 1: Front elevation view of a cantilevered beam structure.

[1a] (5 pts) Use the Muller-Breslau Principle to compute the influence line diagram for the vertical reaction **at A**.

[1b] (5 pts) Now suppose that spans A-B and B-C carry a uniform load of w_o/L N/m. Using your influence line diagram from Part [1a], compute the vertical reaction **at A**.

Question 2: 10 points

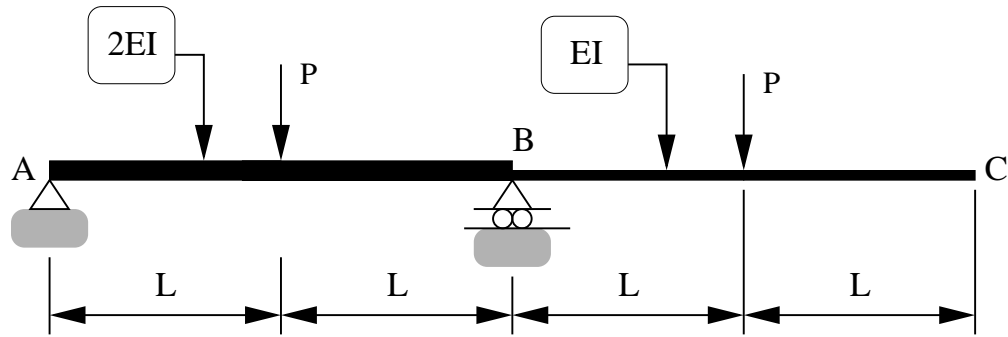Consider the cantilevered beam structure shown in Figure 2.

Figure 2: Front elevation view of a cantilevered beam structure.

Notice that segments A-B and B-C have cross-sectional properties 2EI and EI, respectively.

[**2a**] (4 pts) Use the <u>method of moment-area</u> to compute the rotation at point A.

[2b] (4 pts) Use the <u>method of moment-area</u> to compute the vertical deflection of the beam at point C.

[2c] (2 pts) Draw the deflected shape of the beam.

Question 3: 10 points

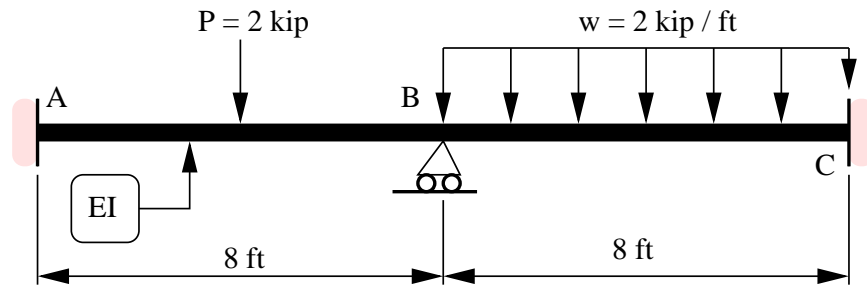Consider the two-span beam structure shown in Figure 3.

Figure 3: Two-span beam structure.

The beam is fully fixed (no rotation) at supports A and C. The moment of inertia and modulus of elasticity are constant along the beam, and are I = 100 in^4 and E = 29,000 ksi, respectively.

[**3a**] (5 pts) Use the method of <u>slope deflection</u> to compute the distribution of bending moments along the beam.

[3b] (2 pts) Compute the support reactions at A, B, and C.

[3c] (3 pts) Draw the shear and bending moment diagrams.

Question 4: 10 points
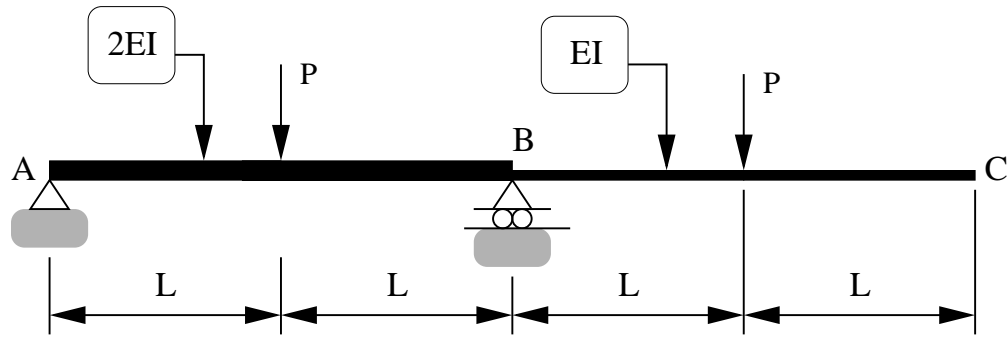
Consider the cantilevered beam structure shown in Figure 4.

Figure 4: Front elevation view of a cantilevered beam structure.

[**4a**] (5 pts) Use the principle of virtual forces to compute the vertical deflection at point C.

[4b] (5 pts) Use the <u>principle of virtual forces</u> to compute the rotation at point C.

Question 5: 10 points

The cable structure shown in Figure 5 carries a triangular load that is zero at the left-hand support and increases to w_o N/m at the right-hand support.
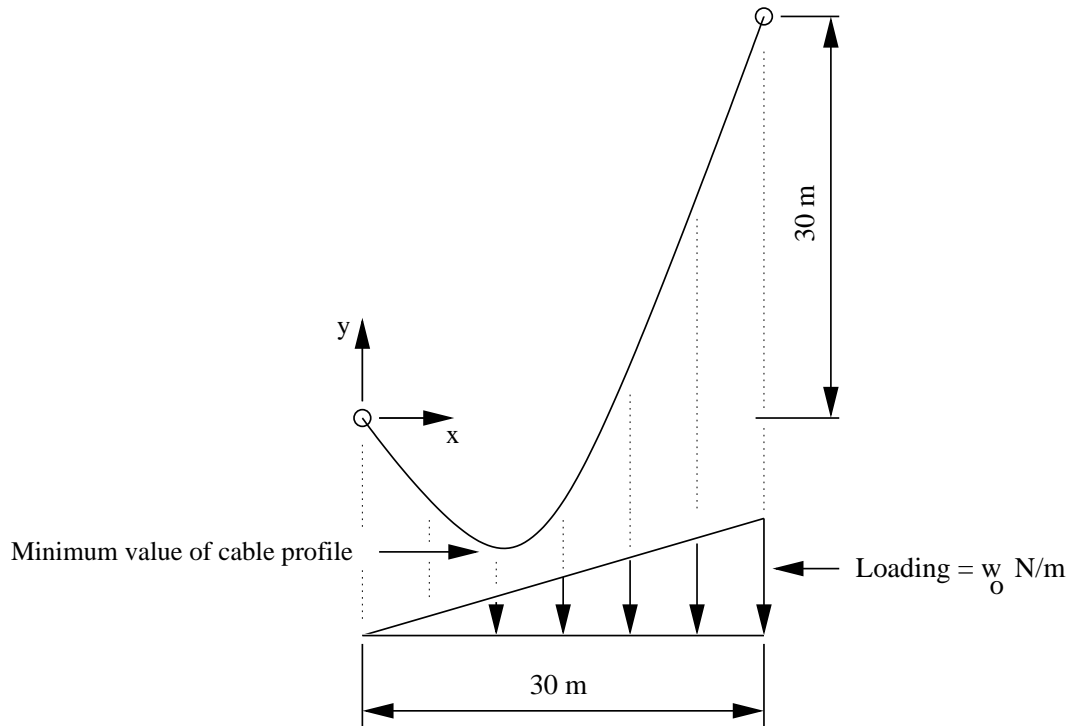

Figure 5: Elevation view of a swing bridge carrying a triangular loading.

[**5a**] (4 pts). Starting from first principles (i.e., the differential equation), show that cable profile is given by the equation

$$y(x) = \frac{w_o x^3}{180H} + \left(1 - \frac{5w_o}{H}\right)x. \tag{1}$$

Now let us assume that the minumum value of the cable profile occurs at x = 10.

[5b] (4 pts). Show that the horizontal cable force is:

$$H = \frac{20w_o}{6}. \tag{2}$$

[5c] (2 pts). Draw and label a diagram showing the horizontal and vertical components of reaction force at the left- and right-hand cable supports.