Department of Civil and Environmental Engineering, Fall Semester, 2016

ENCE 353 Midterm 2, Open Notes and Open Book

Name : _____

Exam Format and Grading. Attempt both questions 1 and 2. Partial credit will be given for partially correct answers, so please show all your working.

Question	Points	Score
1	20	
2	20	
Total	40	

Question 1: 20 points

Moment-Area and Deflections. Consider the cantilevered beam structure shown in Figure 1.

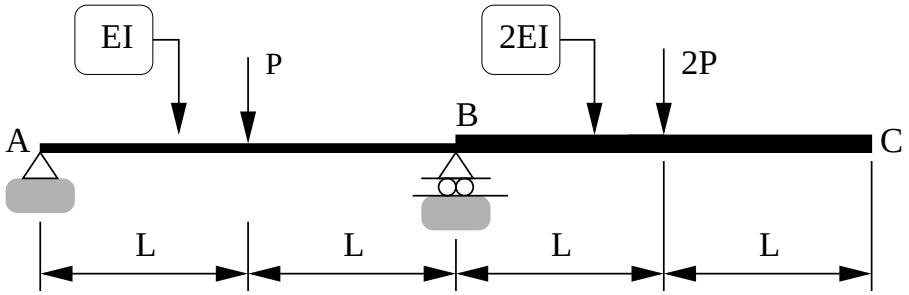

Figure 1: Front elevation view of a cantilevered beam structure.

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

[1a] (4 pts) Compute and draw the M(x)/EI diagram for the complete beam A-B-C.

[1b] (4 pts) Draw and label a diagram of the deflected shape. Clearly indicate on your diagram regions of the beam having zero curvature.

[1c] (6 pts) Draw and label a diagram showing how the rotation at A is related to the beam deflections at points B and C.

[1d] (6 pts) Use the method of moment-area to compute the vertical deflection of the beam at point C.

Question 2: 20 points

Virtual Forces. Figure 2 is a front elevation view of a simple two-bar truss. A vertical load P is applied at node B.

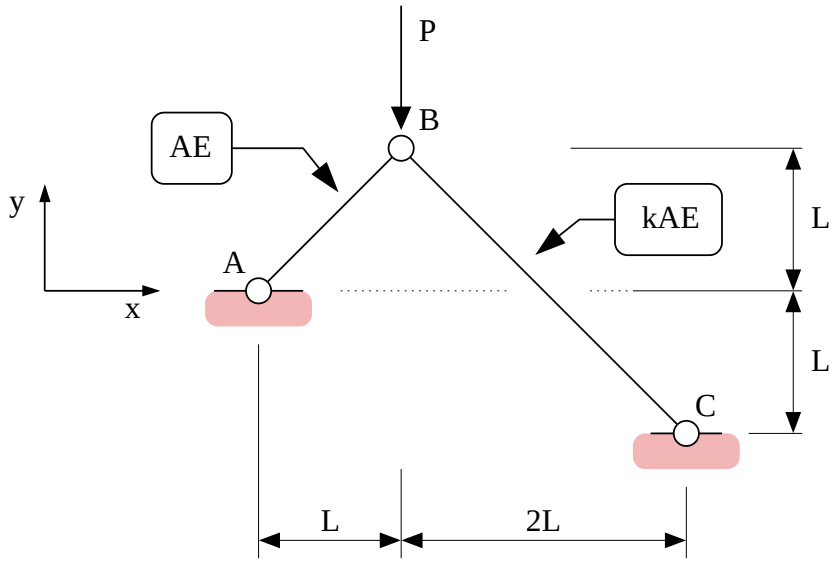

Figure 2: Front elevation view of a simple two-bar truss.

Notice that the left-hand bar has cross section properties AE, and the right-hand bar has cross section properties kAE, where k is a positive constant.

[2a] (6 pts) Use the method of virtual forces to show that the vertical displacement at node B is:

$$\triangle_y = \left[\frac{\sqrt{2}}{k} + \frac{1}{\sqrt{2}}\right]\frac{PL}{AE}. \tag{1}$$

[2b] (6 pts) Show that the horizontal displacement at node B is:

$$\triangle_x = \left[\frac{\sqrt{2}}{k} - \frac{1}{\sqrt{2}}\right]\frac{PL}{AE}. \tag{2}$$

[2c] (4 pts) Hence, show that:

$$\text{Total displacement at node B} = \sqrt{\left[\frac{4}{k^2} + 1\right]} \cdot \frac{PL}{AE}. \tag{3}$$

[2d] (4 pts) Determine the value of k that will cause node B to move downwards with zero horizontal displacement. This is a one-line computation.