Division of Engineering
Brown University

ENGN1300: Structural Analysis

Midterm Exam
Thursday, March 25, 2010

NAME: _____

General Instructions

- Exam is open notes and homework.
- You may access the course website and use Maple. No other websites or computational aids are allowed.
- All work must be shown in these pages. You can use Maple for the calculations, but write down your final answers on these pages.
- If you do use Maple, please save your maple file in RTF and email it to me. Use a single Maple file for each problem. Be aware that I don't plan to grade the Maple---I should be able to follow your work by looking at these pages alone.

Sign your name to the statement below:

I affirm that I have executed the examination in accordance with the Academic Honor Code of Brown University.

_____

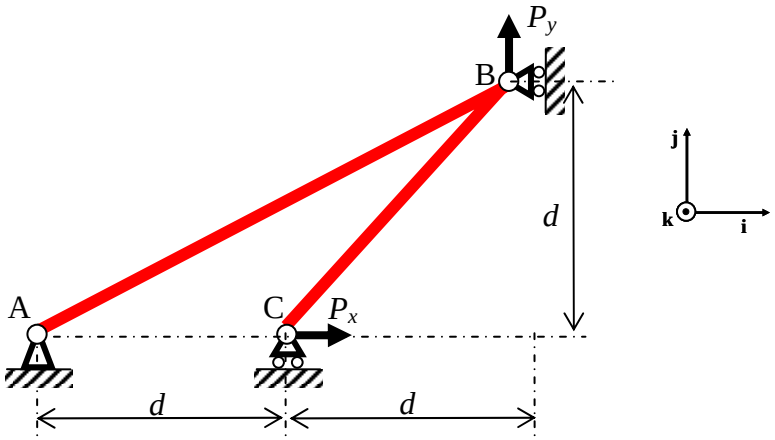
1. (12 points) _____

2. (8 points) _____

3. (5 points) _____

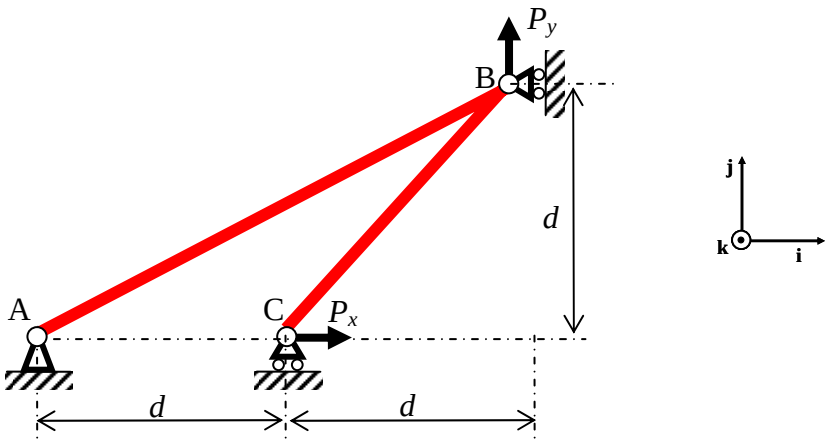
TOTAL (25 points)_____

1. A truss is shown below. Both members have identical values of *E* and *A*. Joint A is pinned and joints A and C are on roller supports. Loads P_x and P_y are applied as shown.



a. Is this truss statically determinate, indeterminate, or a mechanism? Why?

b. As a first step towards determining the member forces and joint displacements, determine expressions for the elongation of each member as functions of the nonzero displacement components of joints B and C. The answer may also involve the dimension *d*. Assume small deflections.

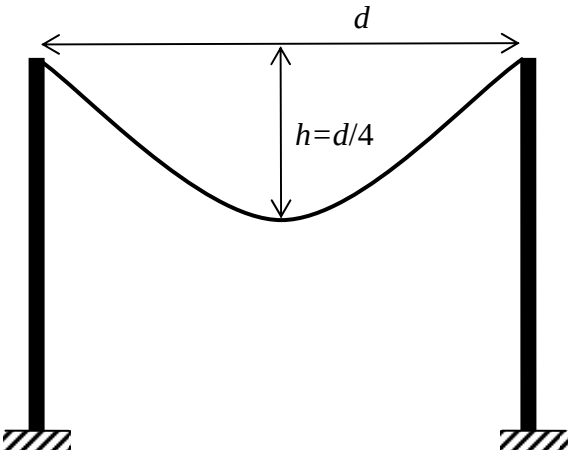


c. Find the potential energy for the structure as a function of the nonzero displacement components of joints B and C, and any of the other parameters of the problem.

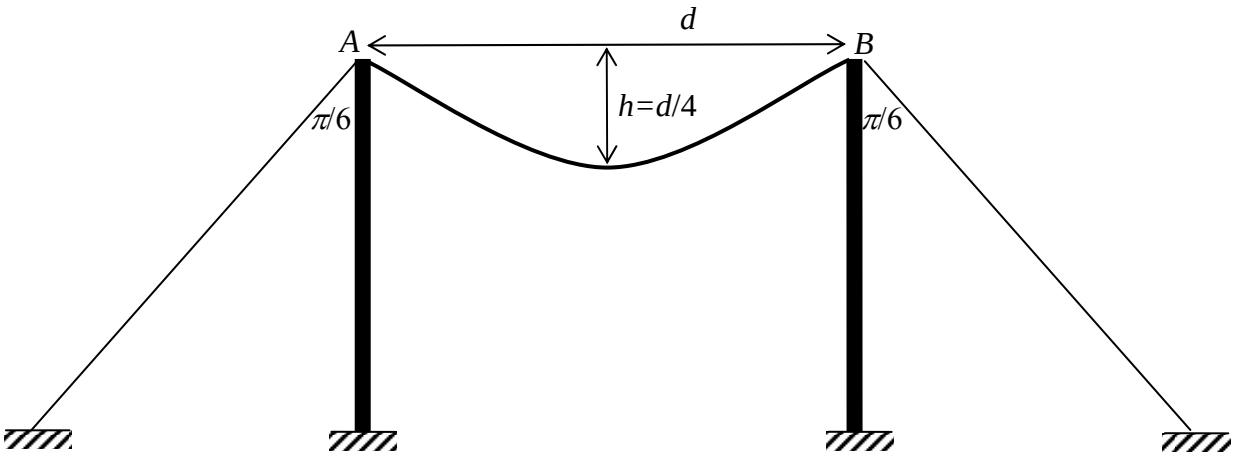
d. Determine the joint displacements and member forces for the case in which P_x=0. The answers may involve P_y, EA, and d.

2. A uniform, inextensible transmission cable hangs under its own weight. Cable weight per unit length is ω. The desired sag is equal to d/4.

a. Find the cable length required, and the maximum tension T_0 in the cable in terms of the given parameters of the problem.



b. To avoid bending in the poles, support cables are added as shown to ensure that **the poles carry only axial load**. Determine the tension T_s of the support cables and the resulting compressive force F in the poles in terms of the given parameters of the problem. To do this, begin with a free body diagram of the point A at the top of the left-hand pole.



3. For the three-hinged arch shown subjected to a load *P* at quarter span, determine the reactions and the forces transmitted through the hinge in terms of the parameters of the problem. No credit will be given if you don't draw free body diagrams!