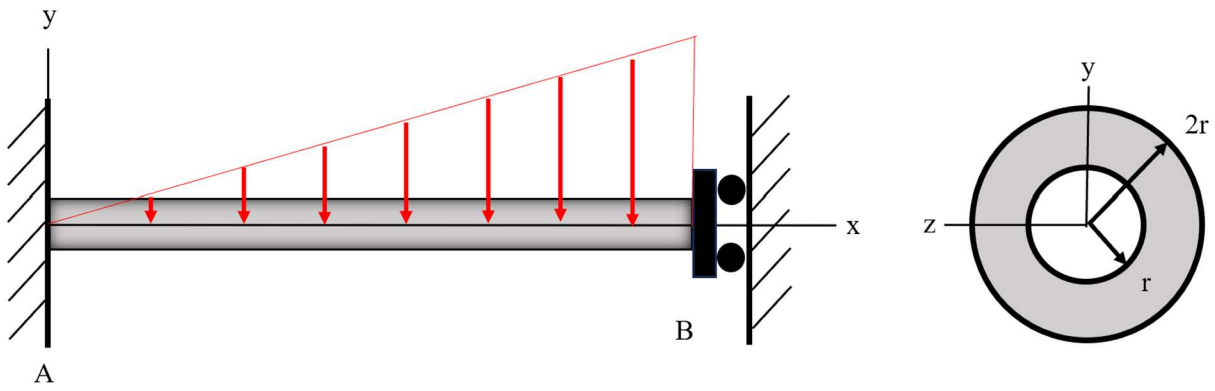
ME 323: Mechanics of Materials **Homework 7**
Fall 2023 **Due: Friday, October 20**

Problem 7.1



A circular beam of length L, Young's modulus E, outer radius 2r, and inner radius r is supported by a fixed end at A and a roller at B. A linearly varying line load $p(x) = -p_o \frac{x}{L}$ acts on the entire length of the beam $\left(p(L) = -p_o \left[\frac{N}{m}\right]\right)$. Solve the following using the 2nd order integration method.

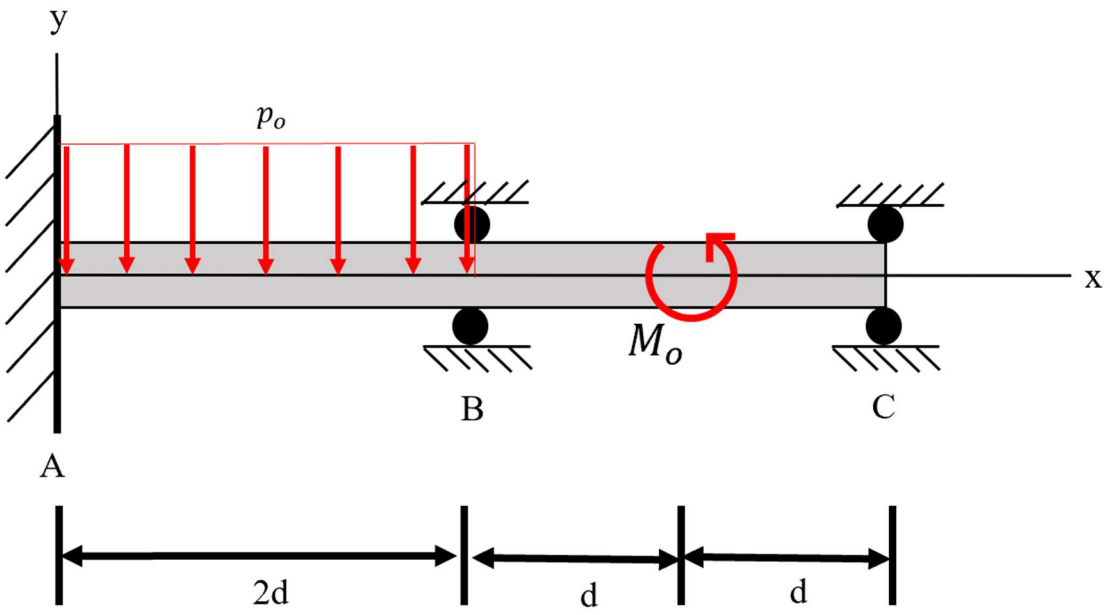
a) Find reactions at A and B.

b) Find the slope and deflection equations $\theta(x)$ and $v(x)$.

c) Find the displacement at B.

Write all final answers in terms of at most: p_o, L, E, and r and leave as fractions if necessary. Clearly box in your final answers.

Problem 7.2



A beam of length L=4d, Young's modulus E, and 2nd area moment I is supported by a fixed end at A and rollers at B and C. A line load $p_o\left[\frac{N}{m}\right]$ acts on the beam from A to B, and a moment M_o acts at location 3d. The value $M_o = p_o d^2[Nm]$. Complete the following questions using superposition. Note: you can use the tables in the Appendix of your book as a reference.

a) Determine the reactions on the beam at B and C.

Write all final answers in terms of at most: p_o, d, E, and I and leave as fractions if necessary. Clearly box in your final answers.

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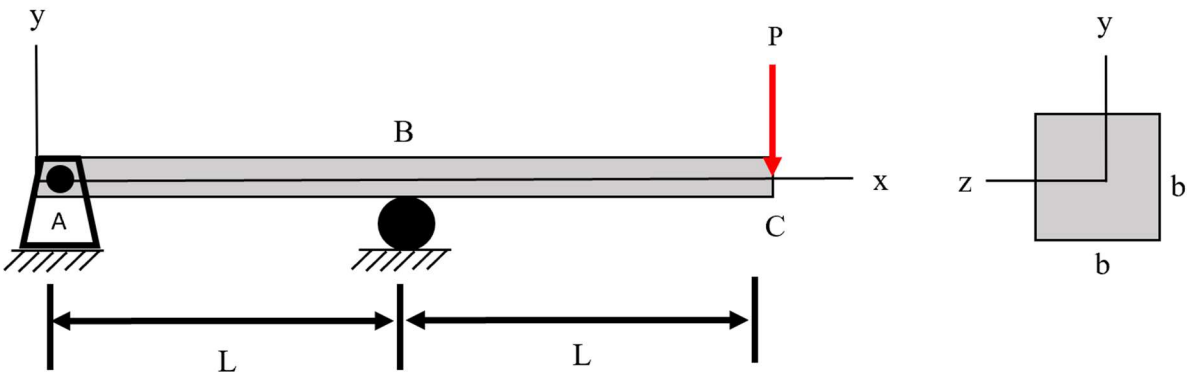
Problem 7.3



The square beam has a width b, Young's modulus E, and 2nd area moment I. It is supported by a pin at A, a roller at B, and has an applied force P at C. L/b = 20 and ν = 0.3

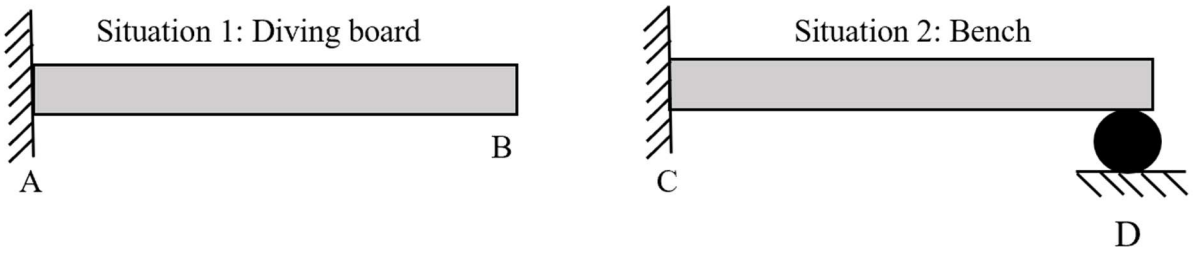
a) Find the deflection of end C using Castigliano's 2nd theorem including shear and bending effects.

b) Repeat part a) without shear effects.

c) Compare your answers in part a) and b) to determine what percent deflection is due to shear effects?

Write all final answers in terms of at most: P, E, and b. Clearly box in your final answers.

Problem 7.4 – submit your answers on Gradescope



Pete is jumping off the highest diving board in the Morgan J. Burke Aquatic Center. After his dive, he sits down on the bench for a rest. Choose true or false for each boundary condition statement below for the diving board (fixed end and free end) and the bench (fixed end and roller). In these statements, v = displacement, Θ = slope, V = shear force, and M = moment.

a) $v(A) = 0$

b) $M(A) = 0$

c) $\Theta(B) = 0$

d) $V(B) = 0$

e) $\Theta(C) = 0$

f) $V(C) = 0$

g) $v(D) = 0$

h) $\Theta(D) = 0$