Homework 7:

1. Calculate the rotation at point B: [Use Castigliano's theorem]

2. Calculate the rotations at point D and E: (neglect axial deformations) [Use Castigliano's 1st theorem]

3. Calculate the deflection at point O: [the structure is planar] [Use Castigliano's 1st theorem].

[Hint: the structure is symmetric and the spring adds an energy term equal to \( \frac{1}{2} k_5 \Delta^2 \)]
4) Calculate the deflection at point B using Castigliano's 2nd theorem. [neglect shear]

5) Calculate the rotation at point D using 2nd Castigliano's theorem. [neglect shear]

6) Calculate the deflection at point B using 2nd Castigliano's theorem. [neglect shear]
   
   [Hint: the energy in spring is]
   
   \[
   \frac{1}{2} K_s \Delta^2 = \frac{1}{2} \frac{P^2}{K_s}
   \]

7) Using 2nd Castigliano's theorem, calculate the deflection at point B. [neglect shear]

   [Hint: the energy in rotational spring is:
   
   \[
   \frac{1}{2} K_r \theta^2 = \frac{1}{2} \frac{M_s^2}{K_r}
   \]