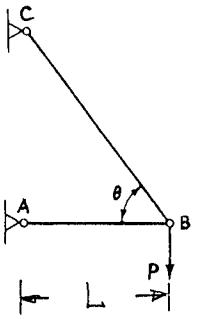
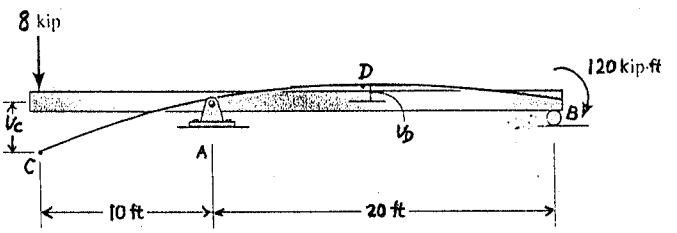
1. Determine the vertical displacement of joint B of the two-bar truss shown in the figure. (A) Calculate the deformation in each bar and use the geometry relationship to calculate the vertical displacement of joint B.(15%) (B) Use energy method the calculate the the vertical displacement of joint B.(15%)

E, A is constant.



2. Determine the elastic curve of the beam in the figure. EI is constant.(20%)



3. The elastic energy stored in an elastic body is expressed as (10%)

$$U = \frac{1}{2}\int_V (\sigma_x \epsilon_x + \sigma_x \epsilon_y + \sigma_z \epsilon_z + \tau_{xy}\gamma_{xy} + \tau_{yz}\gamma_{yz} + \tau_{zx}\gamma_{zx})\,dV$$

Please derive it.

4. If a slender elastic shaft oriented along the axis of x carries a tensile force F(x), a twisting moment Mt(x), and a bending moment Mb(x), please derive the total strain energy in the member is (25%)

$$U = \int_L \frac{F^2}{2AE}dx + \int_L \frac{M_t^2}{2GI_x} + \int_L \frac{M_b^2}{2EI}dx$$

where the integrations are along the length L of the shaft, and where A, Ix, and I are the area, the polar moment of inertia, and the diametral moment of inertial of the shaft cross section, and where E and G are the tension and shear moduli of the shaft material.

5. What is Young's modulus (E)? What is shear modulus (G)? What is Poisson's ratio (ν)? Please derive the following relation between the elastic constants for an isotropic material: (15%)

$$G = \frac{E}{2(1+\nu)}$$