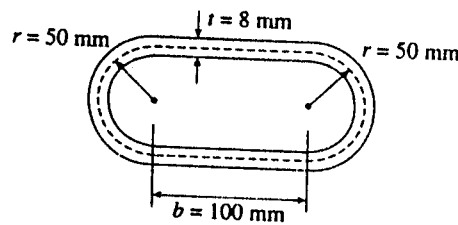1. Please explain the following terminologies
   a. compatibility
   b. stress-strain relation
   c. flexural rigidity
   d. stiffness
   e. buckling

   (20%)

2. Calculate the shear stress $\tau$ and the angle of twist $\phi$ for a steel tube ($G = 76$ GPa) having the cross section shown in the figure. The tube has length $L = 1.0$m and is subjected to a torque $T = 10$ kNm.

   (20%)

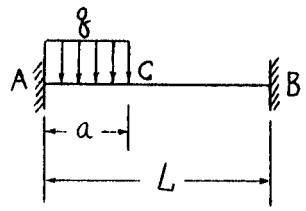

3. Consider the beam structure shown below.
   (a) Draw the diagrams for the distribution of axial force, shear force, and bending moment, respectively, in the beam.
   (b) Find the maximum axial stress and its location in the beam.
   (c) Find the maximum shear stress and its location in the beam.
   (d) What assumptions on the material behavior have been made in obtaining the results above?

   (20%)
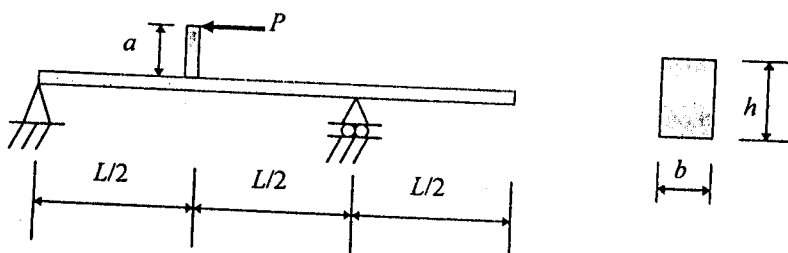
4.  A clamped-clamped beam with flexural rigidity $EI$ is acted upon by a uniformly distributed load of intensity $q$ from $A$ to $C$ (see Figure ).

    (i) Determine the reactions at the supports and the equation of the deflection curve.

    (ii) What are the reactions when $a = L$?   (20%)

5.  (a) A rigid bar hinged at the base is held in a vertical position by two springs: one has a stiffness k and the other, 2k, as shown in the figure. Determine the critical force $P_{cr}$ for this system.

    (b) If the rigidity of the bar is EI instead of being completely rigid, determine the critical force $P_{cr}$.

    (20%)