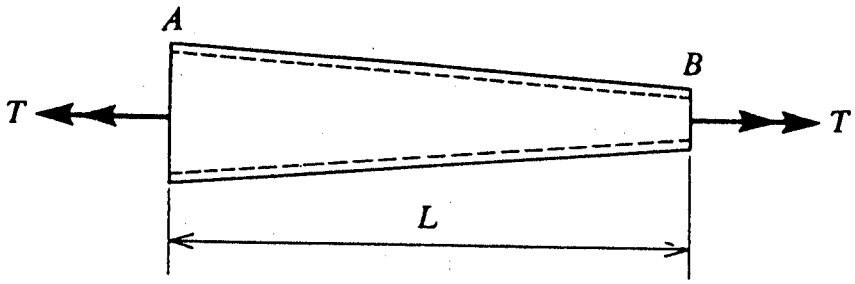
1.A long, thin-walled, tapered tube of circular cross section (see figure) is subjected to a torque T. The tube has constant wall thickness t and length L. The diameters to the middle lines of the cross sections at the ends A and B are $d_a$ and $d_b$, respectively. Derive a formula for the angle of twist $\phi$ of the tube. (25%)



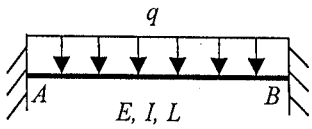

2.Please derive the formula for shear stresses in beam,

$$\tau = \frac{VQ}{Ib}$$

and find the maximum shear for a rectangular cross section with dimension b×h. (25%)

3. A fixed-end beam $AB$ of length $L$ supports a uniform load of intensity $q$.

   Find the maximum bending moment and the maximum deflection of the beam. (25%)




4. The system shown below consists of two bars AB and BC, each of bending stiffness $EI$ and length $L$, elastically hinged together at B by a *torsional* spring of stiffness $K$. (25%)

   (a) Derive an equation for the buckling load of the system.

   (b) Find the lowest buckling loads when (i) $K \to \infty$ and (ii) $EI \to \infty$, respectively.

   (c) Justify the results you obtained in (b).