1. Fig. 1 shows a fixed-free column of height L with flexural rigidity EI. **Derive** the following:
   (a) Euler's column buckling load P_{cr}. Express P_{cr} in terms of L, EI, n, where n stands for the buckling mode number. (20%)
   (b) Use the result in (a), determine the buckling load P_{cr} for the second buckling mode. (5%)

2. As shown in Fig. 2, beam ACB is subjected to a uniformly distributed load q in segment AC, a concentrated load P at the midpoint of segment AC. Point A is supported with a hinge, and there are roller supports at point C and B. The length of segment AC is L_1, and the length of segment CB is L_2. Beam ACB has a flexural rigidity EI. Determine the reaction at point B.
(Ignore the self-weight of the beam, and express the answer in terms of P, q, L_1 and L_2.)
(25%)

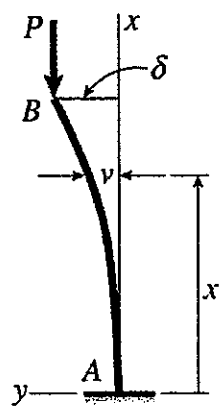

Fig. 1

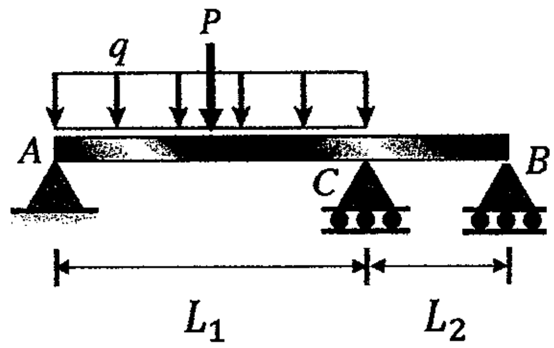

Fig. 2

3. A single strain gauge forming an angle $\beta = 15^\circ$ from a horizontal plane is used to determine the gage pressure in the cylindrical steel tank shown in Figure 3. The cylindrical wall of the tank is 6 mm thick, has a 600-mm inner diameter, and is made of a steel with the modulus of elasticity $E = 200$ GPa and $\nu = 0.3$. Now the strain gage reading is 280×10^{-6}:
   (a) Determine the pressure in the tank.
   (b) Find the maximum "in-plane" shear stress at the point of the strain gauge on the outer surface of the tank.
(25%)

4. The symmetric three-rod truss of Fig. 4 is subjected to a force P at Point C. The three circular rods have the same cross sectional area of 10 cm^2. Rods AC and BC are made of elastic-perfectly plastic steel with a modulus of elasticity of 200 GPa and a yielding stress of 200 MPa. Rod CD is made of an elastic material with a modulus of elasticity of 100 GPa. The length of Rods AC and BC are both 2 meters. The force P is applied to the truss with its magnitude slowly increased from 0 to 800 kN, and then unloaded from 800 kN to 0. Plot the P-Δ curve of this loading and unloading process and mark the X and Y coordinates of each key point of the curve clearly. Use the values of Δ, which is the vertical displacement of Point C, as the X coordinates of the plot and the values of P as the Y coordinates. (25%)

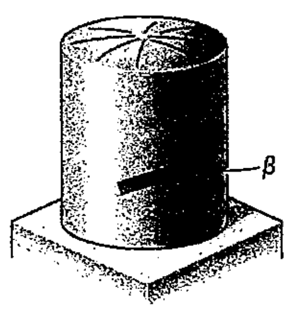

Fig. 3

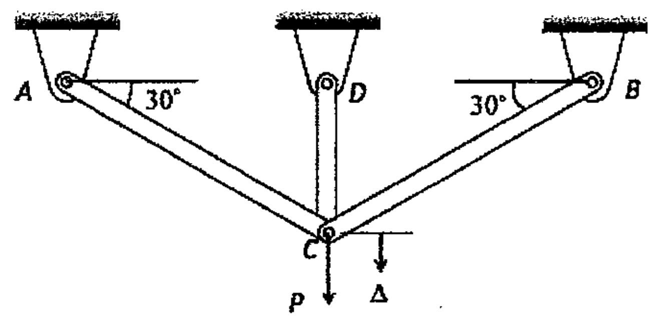

Fig. 4

試題隨卷繳回