（甲組）

1. Each vertical bar in the apparatus shown in the Fig. 1 is made of steel and has cross-sectional area 1200 mm². Find the tensile stress σ in the middle bar if the rigid plate AB weighs 360 kN. (20%)

2. The shear-force diagram for a beam is shown in the Fig. 2. Assuming that no couples act as loads on the beam, draw the bending-moment diagram. (Note that the shear force has units of kilonewtons.) (15%)

3. A thin-walled tube having an elliptical cross section (see Fig. 3) is subjected to a torque T= 6kN·m. Determine the shear stress τ and the angle of twist θ per unit length if G = 80 GPa, t =5 mm, a = 75 mm, and b = 50 mm. (Note: The area of an ellipse is πab, and its circumference is approximately $1.5\pi(a+b)-\pi\sqrt{ab}$.) (15%)

4. Strain gauges oriented in the x and y directions are attached to a thin rectangular steel plate as shown in the Fig. 4. The plate is subjected to uniform normal stresses σ_x and σ_y. The strain gauges give readings $\varepsilon_x = 500\times10^{-6}$ and $\varepsilon_y = 100\times10^{-6}$. Assuming that $E = 200$GPa and $\nu = 0.30$, calculate the stresses σ_x and σ_y. (20%)

5. Determine the displacements of a beam (see Fig. 5) by Castigliano's second theorem. (15%)

6. Explain the following mechanical terms : (15%)
   1) The core of a cross section
   2) The critical load of a column
   3) Moment-Area Method for determining the deflection of a beam.

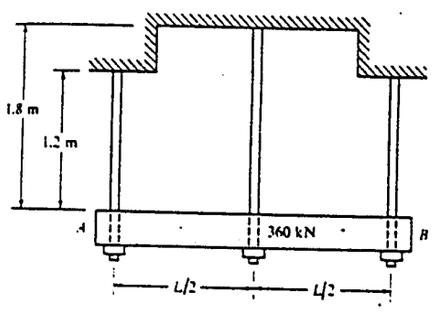

Fig. 1.

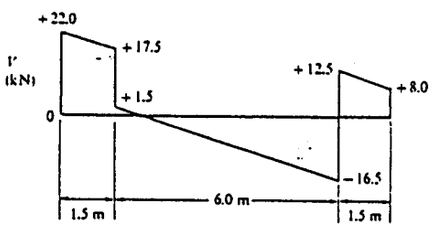

Fig. 2

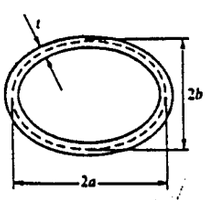

Fig. 3

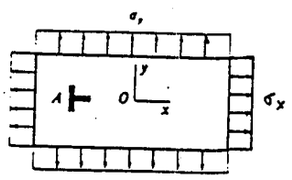

Fig. 4

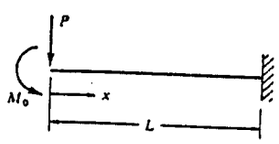

Fig. 5.