1. Two shafts AB and BC are of the same material but different diameter shown in Fig.1 are welded together at point B. Ends A and C are fastened securely so that the shafts cannot rotate at these points. An external twisting couple M_o is applied to the shafts at point B. Find the twisting couples exerted on the ends of the shafts at A and C. (25%)

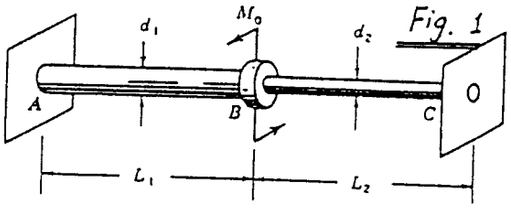

Fig. 1

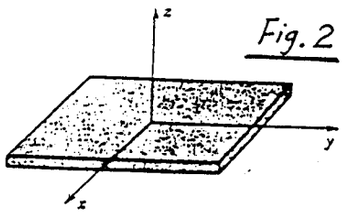

Fig. 2

2. In a flat thin steel plate shown in Fig.2 which is loaded in the xy plane, it is known that:

$$\sigma_x = 145\ \text{MN/m}^2;\ \tau_{xy} = 42\ \text{MN/m}^2;\ \varepsilon_z = -3.6\times10^{-4}$$

The material properties of this steel are: $E = 200\ \text{GN/m}^2$; $\nu = 0.3$.
(a) What are the values of the stress σ_y, and strains $\varepsilon_x, \varepsilon_y, \varepsilon_{xy}$? if the plate is in elastic state. (16%)
(b) Suppose the plate just start to yield under this state of stress, determine the yield stress of the material based on (i) von Mises yield criterion (ii) Tresca yield criterion, respectively. (14%)

3. Determine the horizontal and vertical components of force which the pin at C exerts on member CB of the frame in Fig. 3. (20%)

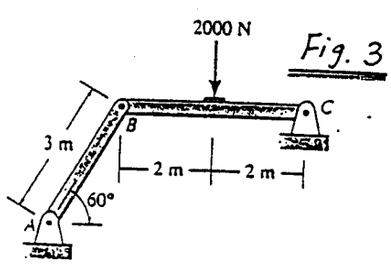

Fig. 3

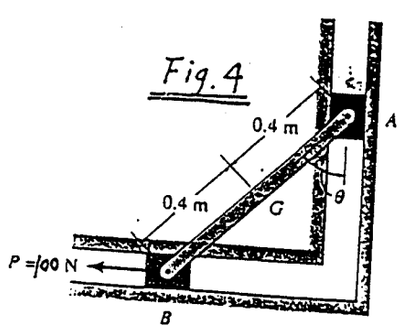

Fig. 4

4. The 10-kg rod shown in Fig.4 is constrained so that its ends move along the grooved slots. The rod is initially at rest when $\theta=0^o$. If the slider block at B is acted upon by a horizontal force P=100 N, determine the angular velocity of the rod at the instant $\theta=45^o$. Neglect the mass of blocks A and B. (25%)