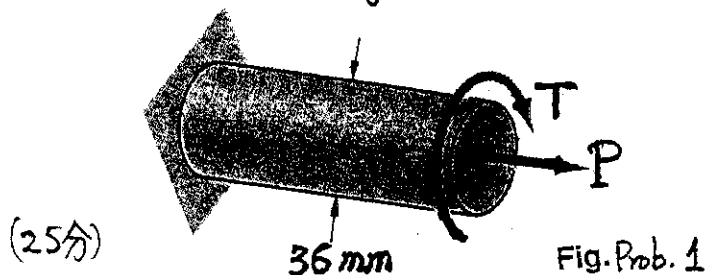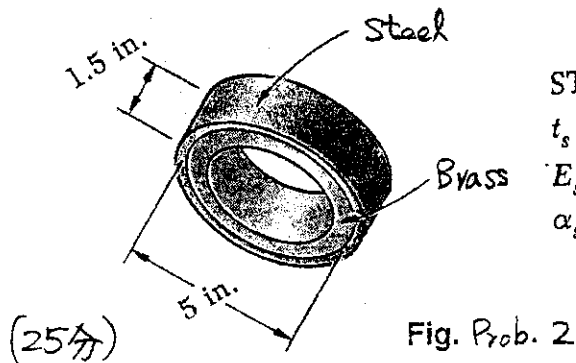本試題是否可以使用計算機： ☑可使用 ， □不可使用 （請命題老師勾選）

Prob. 1 A 36 mm -diameter shaft is made of a grade of steel with a 250 MPa tensile yield strength. (a) Using the maximum-distortion-energy criterion, determine the magnitude of the force P at which yield first occurs when $T = 708 \, N \cdot m$.

(b) Solve Prob. (a) by using the maximum-shearing-stress criterion,

(25分)

36 mm　　Fig. Prob. 1

Prob. 2. A brass ring of 5-in. outer diameter and $\frac{1}{4}$-in. thickness fits exactly inside a steel ring of 5-in. inner diameter and $\frac{1}{8}$-in. thickness when the temperature of both rings is 50°F. Knowing that the temperature of both rings is then raised to 125°F, determine (a) the tensile stress in the steel ring, (b) the corresponding pressure exerted by the brass ring on the steel ring.

STEEL	BRASS
$t_s = \frac{1}{8}$ in.	$t_b = \frac{1}{4}$ in.
$E_s = 29 \times 10^6$ psi	$E_b = 15 \times 10^6$ psi
$\alpha_s = 6.5 \times 10^{-6}/°F$	$\alpha_b = 11.6 \times 10^{-6}/°F$

(25分)　　Fig. Prob. 2

背面仍有題目，請繼續作答

Prob. 3. A cantilever steel bar AB with a 40 × 150-mm rectangular cross section supports a load P at end B. A single strain gage forming an angle of 45° with the horizontal is attached to the surface of the bar at a point C located 400 mm from end B and 50 mm below the bar's upper edge. Knowing that $E = 200$ GPa and $\nu = 0.30$, determine the magnitude of the load P indicated by a gage reading of 240 μ.

(Hint) (1) The Hookes' Law under Biaxial stress state must be used.

(2) The Mohr's circle for 45° strain-gage direction may be used.

(25分)

Fig. Prob.3
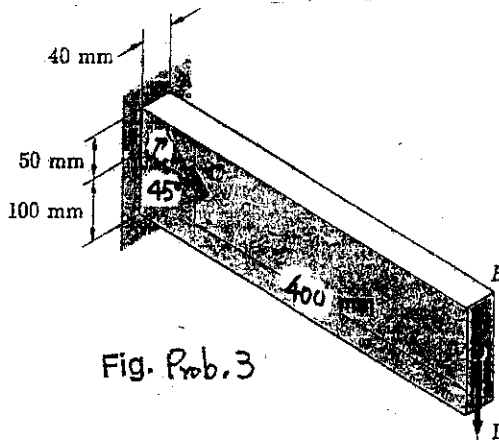
Prob. 4 A 150-lb diver jumps from a height of 25 in. onto end A of a diving board having the uniform cross section shown. Assuming the diver's legs remain rigid and using $E = 1.7 \times 10^6$ psi for the board, determine (a) the maximum deflection of point A, (b) the maximum bending stress in the board, (c) the equivalent static load.

(Hint) The Castigliano's Theorem can be used to determine the deflection of a beam:

$$\delta_j = \frac{\partial U}{\partial P_j} = \int_0^L \frac{M}{EI} \frac{\partial M}{\partial P_j} dx$$

(25分)

Fig. Prob.4.