國立中央大學九十一學年度碩士班研究生入學試題卷

所別：機械工程學系　甲組　科目：材料力學　共 2 頁 第 1 頁

1. The assembly shown in **Fig. 1** consists of a steel rod A (modulus of elasticity E_A = 210 GPa, elastic strength S_A = 430 MPa, cross sectional area A_A = 1600 mm^2, and thermal expansion coefficient α_A = 12 x 10^{-6}/°C), a rigid bearing plate C that is securely fastened to bar A, and a bronze bar B (E_B = 100 GPa, S_B = 140 MPa, A_B = 2500 mm^2, and α_B = 17 x 10^{-6}/°C). A clearance of 0.4 mm exists between the bearing plate C and bar B before the assembly is loaded. A load P is applied to the bearing plate and then the temperature of the assembly is slowly raised from 25°C to 50°C. Determine
   (a) The maximum value of P that can be applied to the assembly without causing any plastic deformation during loading and heating. **(20%)**
   (b) The corresponding displacement of plate C. **(5%)**

2. A solid bar of circular cross section is subjected to an axial tensile force T = 26 kN and a bending moment M = 3 kN-m (see **Fig. 2**). Based upon an allowable stress in tension of 120 MPa, what is the required diameter d of the bar? **(25%)**

3. A beam is loaded and supported as shown in **Fig. 3**. Determine
   (a) The deflection midway between the supports. **(13%)**
   (b) The maximum deflection in the interval between the supports. **(12%)**

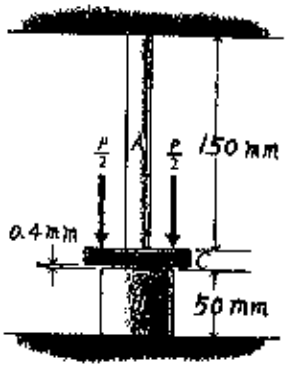

Fig. 1

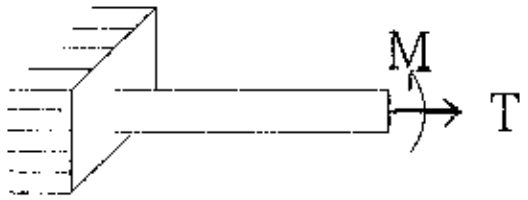

Fig. 2

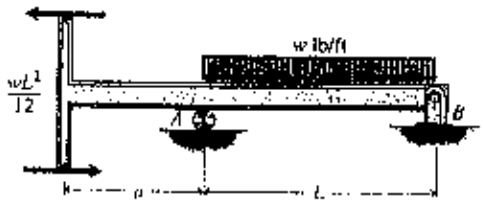

Fig. 3

注意：背面有試題

4. A friction wheel mechanism will transmit power from motor to working machine as shown in **Fig. 4a**. The applied normal force F is 1000 N and the caused torque T without slipping on the output shaft is equal to 60 N-m (on machine side). The point A (see **Fig. 4b**) on the surface of the output shaft is the weakest place.

(a) The bending tensile stress σ_b and torsional shear stress τ_t at the point A can be expressed with the shaft diameter d [mm] at point A:

$$\sigma_b = C_b \cdot \frac{32}{\pi \cdot d^3} \text{ N/mm}^2,$$

$$\tau_t = C_t \cdot \frac{32}{\pi \cdot d^3} \text{ N/mm}^2.$$

Please calculate the factor C_b and C_t. **(7%)**

(b) If the value of the shaft diameter d satisfies the relation $\pi d^3/32 = 2000$ mm^3, please use the stresses σ_b and τ_t calculated above to construct complete **Mohr's Circle** with necessary notation. **(10%)**

(c) Please determine also the principal stresses σ_1, σ_2, the maximum shear stress τ_{max} and the angle of inclination of principal plane φ_σ *with aid of this Mohr's circle*. The angle φ_σ is measured from the positive z-axis of the original stress element to the maximum principal stress σ_1. **(8%)**

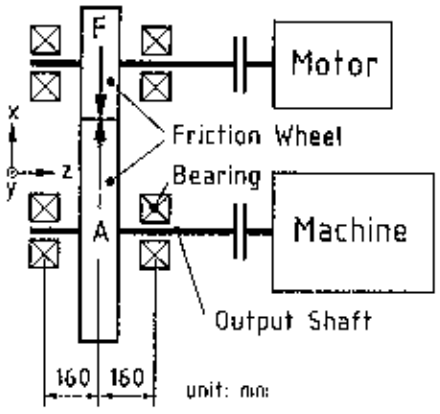

Fig. 4a

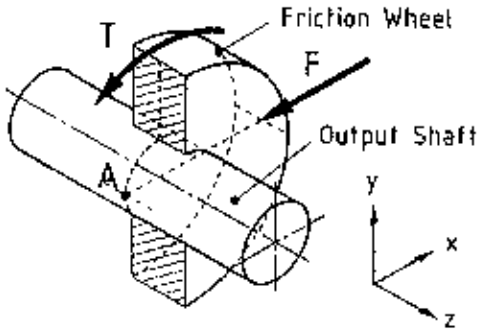

Fig. 4b

參考用