編號： 80

國立成功大學 107 學年度碩士班招生考試試題

系　　所：機械工程學系

考試科目：材料力學

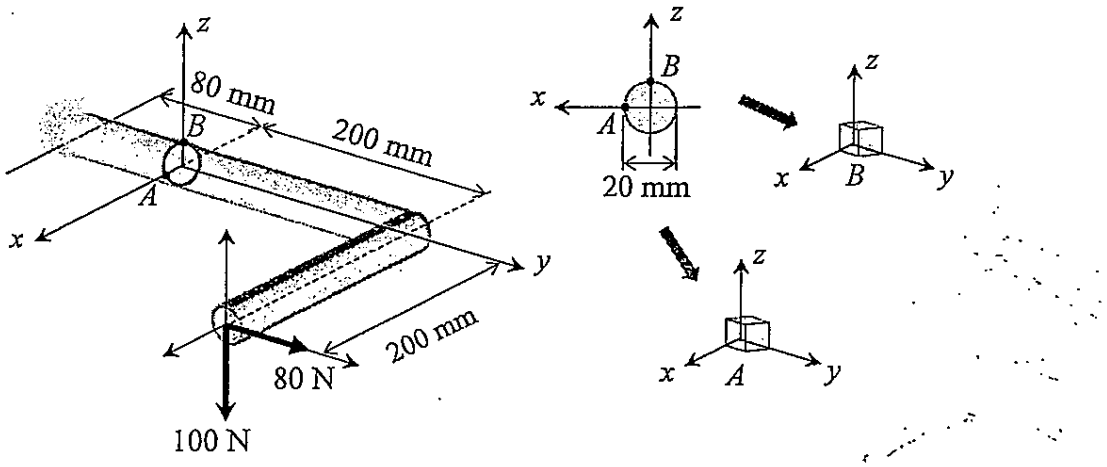
考試日期：0205，節次：1

※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. As shown in the figure, an L-shape bar with a circular cross-section of 20 mm in diameter is fixed on a wall at one end. At the other end, the bar is subjected to a 100 N force in the $-z$ direction and an 80 N force in the $+y$ direction.

   (a) Determine all stress components ($\sigma_{xy}, \sigma_{yz}, \sigma_{zx}, \tau_{xy}, \tau_{yz}, \tau_{zx}$) at point A, and the maximum normal and shear stresses at point A; (12 Points)

   (b) Same as (a) but for point B. (8 Points)

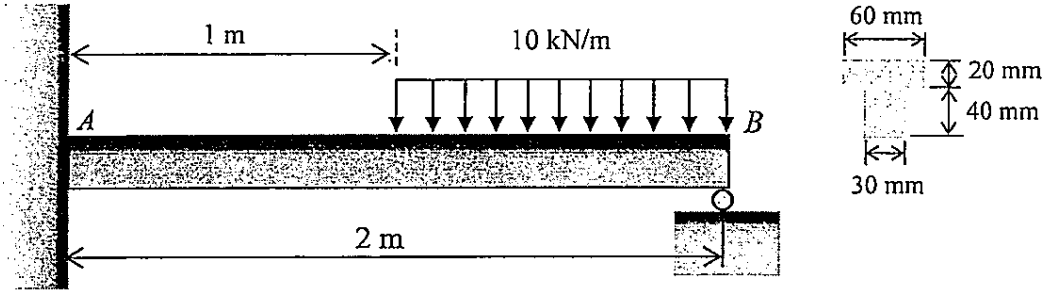


2. As shown in the figure, the beam is supported by a fixed wall at A and a roller at B, and is subjected to a distributed loading of 10 kN/m. The beam has a T-shape cross-section as shown in the figure. The Young's modulus of the beam material is 200 GPa.

   (a) Calculate all reactions at point A and B; (10 Points)

   (b) Plot the moment and shear diagrams of the beam from A to B; (10 Points)

   (c) Determine the maximum deflection of the beam and its location. (10 Points)



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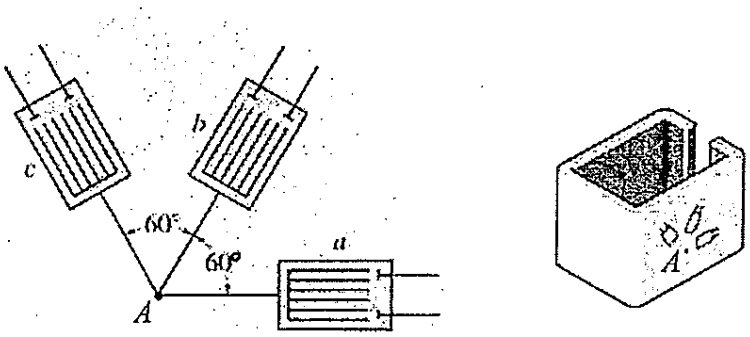
3. The steel bracket as shown is under loads such that the readings of the 60° strain rosette at point A on the external, traction-free surface of the bracket are given by: $\varepsilon_a = 1\times10^{-4}$, $\varepsilon_b = 2\times10^{-4}$ and $\varepsilon_c = 3\times10^{-4}$. The Young's modulus, the yield strength and the Poisson's ratio of the bracket are 200 GPa, 250 MPa and 0.32, respectively. Determine:
   (a) the in-plane principal strains and their directions at point A, (12 Points)
   (b) the three principal stresses at point A, (12 Points)
   (c) the safety factor of the bracket at point A according to the Tresca yield criterion. (6 Points)



4. A keyring as shown is wedged open by a key with a gap $\delta = 1$ mm. The keyring is made of two full ring of steel wire. The overall diameter of the keyring is 20 mm, and the wire diameter is 1 mm. The Young's modulus and Poisson's ratio of the steel wire are 200 GPa and 0.32, respectively. Assuming the contact forces between the keyring and the key are only in the direction normal to the plane of the keyring, determine the compressive forces that the keyring applies on the key by using Castigliano's second theorem (alternative solution approach is not allowed). (20 Points)