

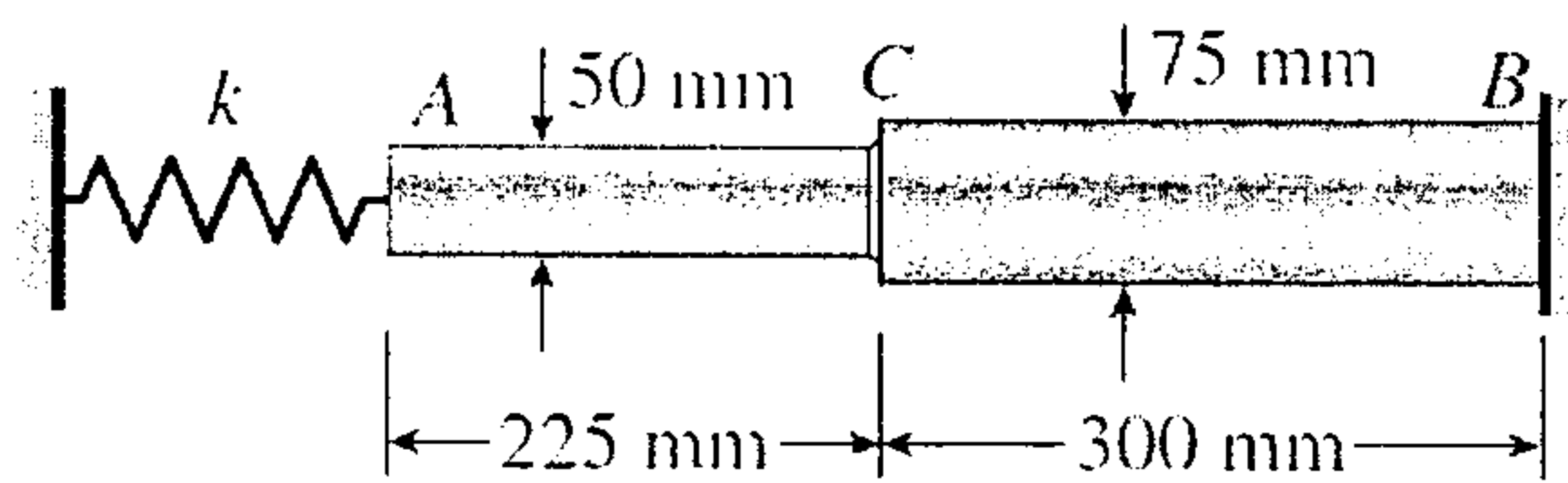
國立清華大學 103 學年度碩士班考試入學試題

系所班組別：動力機械工程學系 丙組(固體與奈微米力學組)

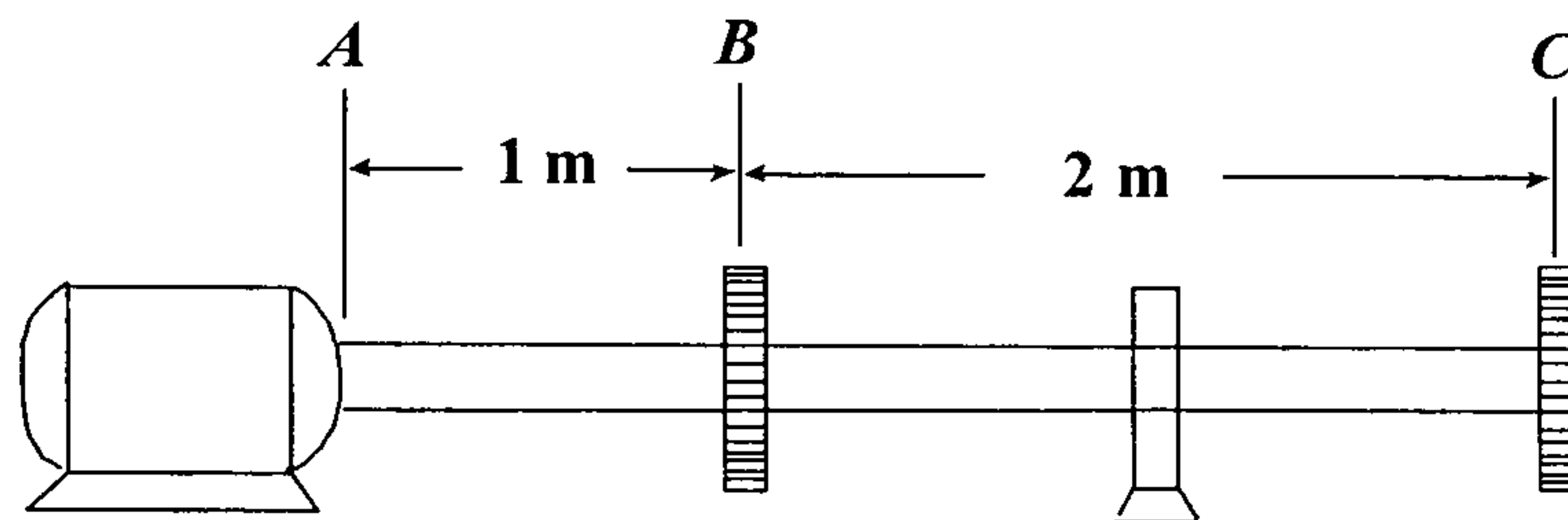
考試科目 (代碼)：材料力學 (1301)

共 3 頁，第 1 頁 *請在【答案卷、卡】作答

1. A plastic bar ACB having two different solid circular cross sections is held between an elastic support at A and a rigid support at B as shown in the figure. The elastic support at A has spring constant $k = 50 \text{ MN/m}$. The diameters in the left- and right-hand parts are 50 mm and 75 mm, respectively. The corresponding lengths are 225 mm and 300 mm. Also, the modulus of elasticity E is 6.0 GPa, and the coefficient of thermal expansion α is $100 \times 10^{-6}/^\circ\text{C}$. Only the bar ACB is subjected to a uniform temperature increase of 40°C . Calculate the following quantities:
- (1) the compressive force N in the bar;
 - (2) the maximum compressive stress σ_c ; and
 - (3) the displacement δ_c of point C . (20%)



2. A motor delivers 100 kW at 10 Hz to a solid shaft of 60 mm diameter, which has a shear modulus $G = 200 \text{ GPa}$. The gears at B and C drive machinery requiring power equal to 40 kW and 60 kW, respectively. Find (a) the maximum shear stress in the shaft and (b) the angle of twist between the motor at A and the gear at C . (20%)



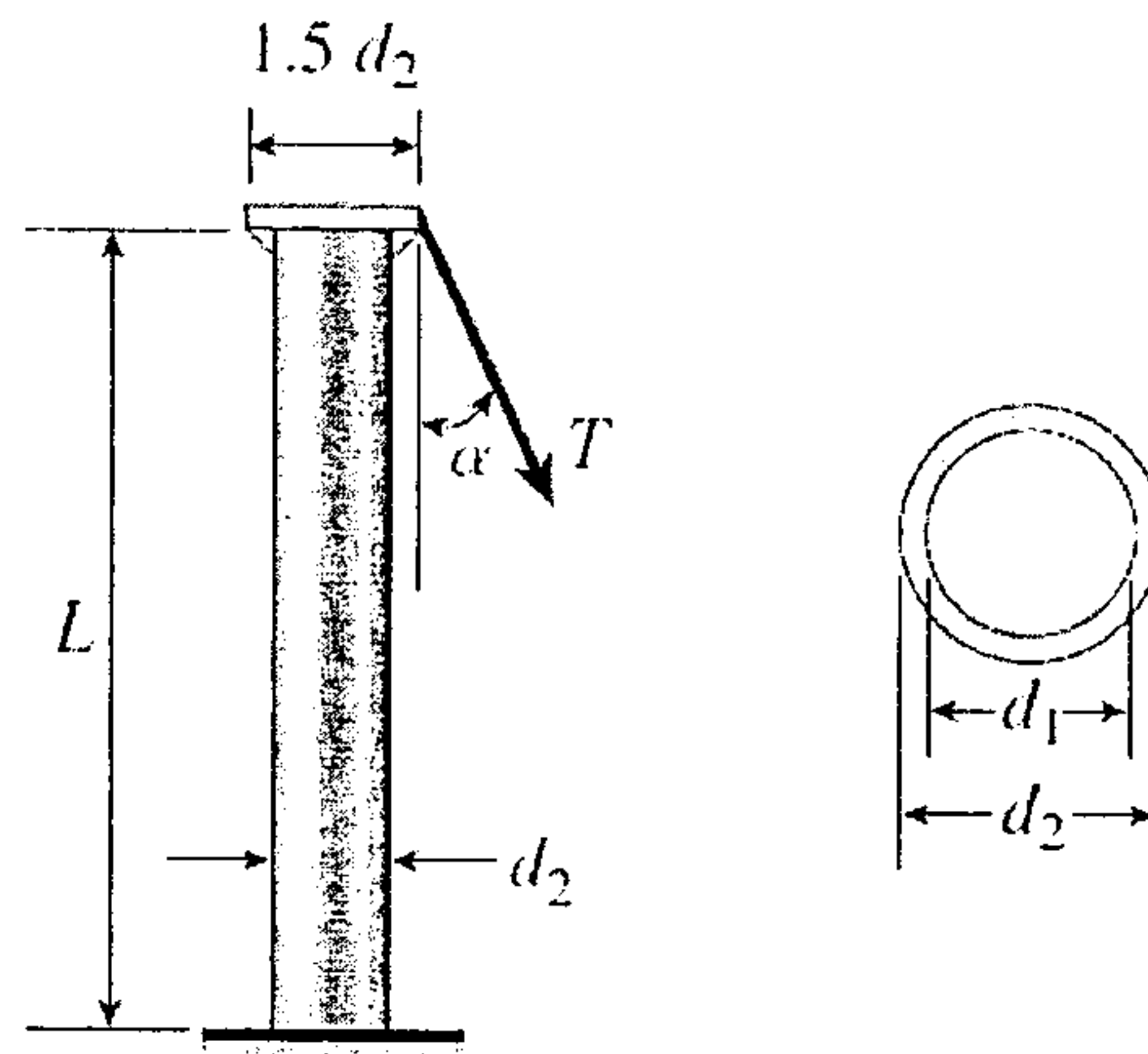
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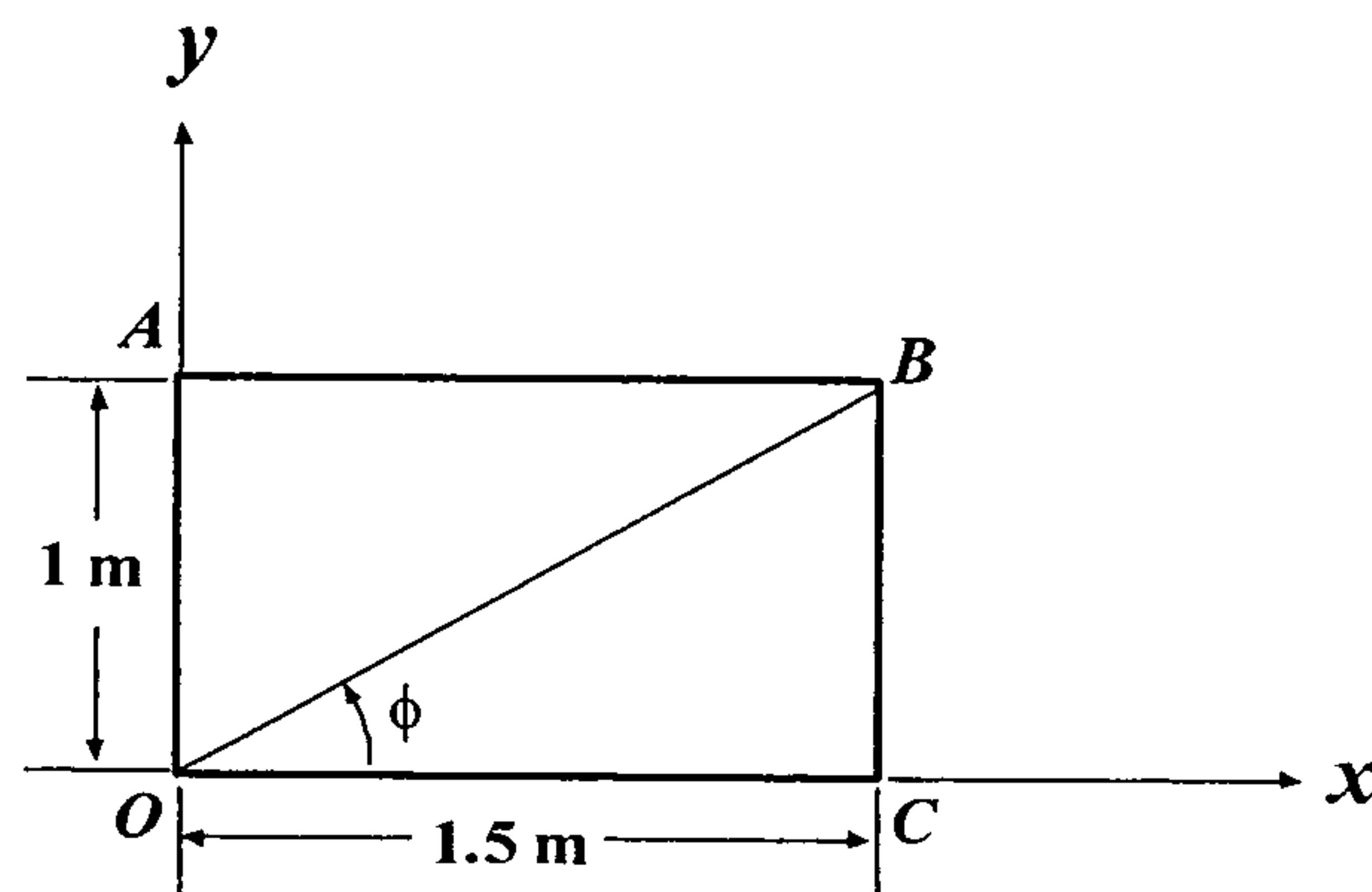
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共 3 頁，第 2 頁 *請在【答案卷、卡】作答

3. A vertical pole of aluminum is fixed at the base and pulled at the top by a cable having a tensile force T (see figure). The cable is attached at the outer edge of a stiffened cover plate on top of the pole and makes an angle $\alpha = 20^\circ$ at the point of attachment. The pole has length $L = 2.5$ m and a hollow circular cross section with outer diameter $d_2 = 280$ mm and inner diameter $d_1 = 220$ mm. The circular cover plate has diameter $1.5d_2$. Determine the allowable tensile force T_{allow} in the cable if the allowable compressive stress in the aluminum pole is 70 MPa. (20%)



4. A rectangular plate $OABC$ as shown below is known to have uniform strain components: $\varepsilon_x = 520 \times 10^{-6}$, $\varepsilon_y = 250 \times 10^{-6}$ and $\gamma_{xy} = 400 \times 10^{-6}$. Determine (a) the principal strains and the corresponding directions, (b) the change in the length of diagonal OB and (c) the change in the angle ϕ between diagonal OB and the x axis. (20%)



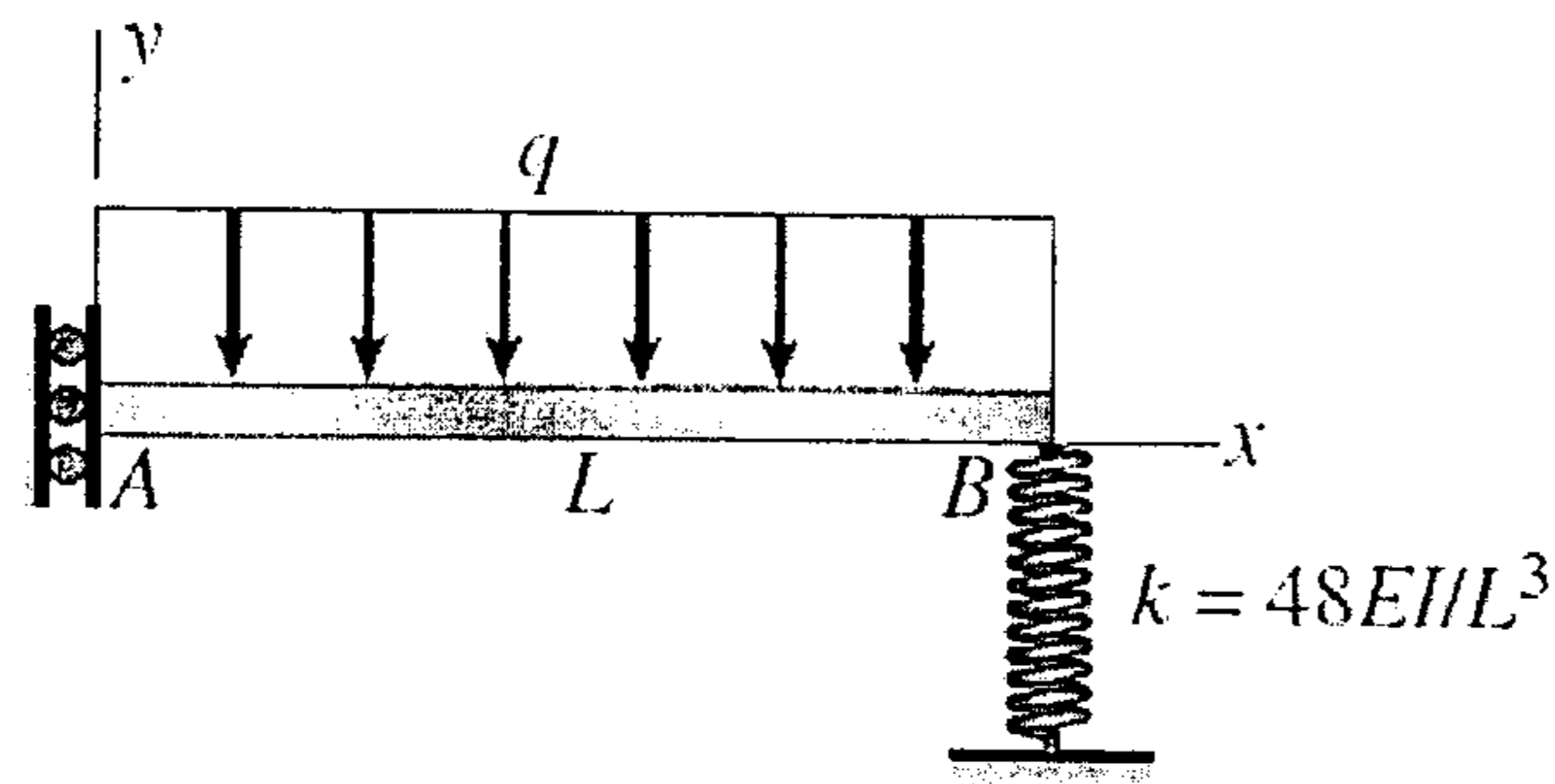
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共 3 頁，第 3 頁 *請在【答案卷、卡】作答

5. The beam shown in the figure has a guided support at A and a spring support at B . The guided support permits vertical movement but no rotation. Derive the equation of the deflection curve and determine the deflection δ_B at end B due to the uniform load of intensity q . (Note: Use the second-order differential equation of the deflection curve.) (10%)



6. Answer the following questions
- (a) When uniform temperature changes in the members of a statically determinate structure, there will be no stress induced in the members. Is this statement true or false? Give your arguments as complete as possible. (5%)
- (b) Why do we need the material properties to find the reaction forces in a statically indeterminate structure? (5%)