編號： 96　系所：機械工程學系丁組　　科目：材料力學

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）

1. A steel shaft is to be manufactured as a circular tube (Fig. 2). The shaft is required to transmit a torque of 1500 N • m without exceeding an allowable shear stress of 60 MPa nor an allowing rate of twist of 0.6° / m. (The shear modulus of elasticity of the steel is 78GPa). Determine the required outer diameter d_2 of the hollow shaft if the thickness t of the shaft is specified as one-tenth of the outer diameter. (25%)

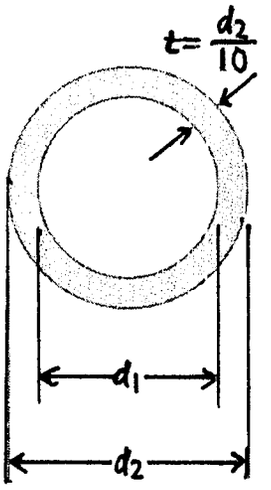

Fig. 1

2. A beam ABC with an overhang supports a uniform load of intensity q= 6 kN/m and a concentrated load P= 28kN (Fig. 3). Calculated the shear force V and bending moment M at a cross section D located 5m from the left-hand support. (25%)

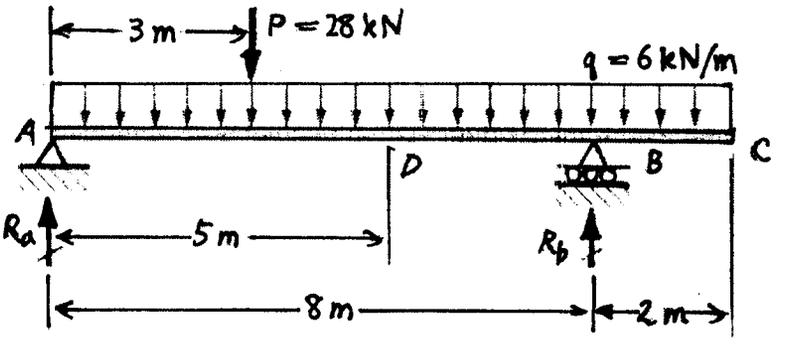

Fig. 2

（背面仍有題目，請繼續作答）

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3. Shown in Fig. 3 (a) is a square element in plane stress. Also shown in Fig. 3(b) is the element's inclined plane (denoted as θ plane) having its normal at the angle θ with the x axis. (a) Determine the total force exerted in A, B, and θ planes and given answers in Table 1, if the area of θ plane is A_θ. (10%). (b) Based on Table 1, write out the equations of equilibrium in terms of σ_x, σ_y, τ_{xy}, τ_{yx}, σ_θ, and τ_θ (10%). (c) Determine the normal and shear stresses(σ_θ and τ_θ) on θ plane.(5%)

	x component force	Y component force
A plane		
B plane		
The inclined plane		

Table 1.

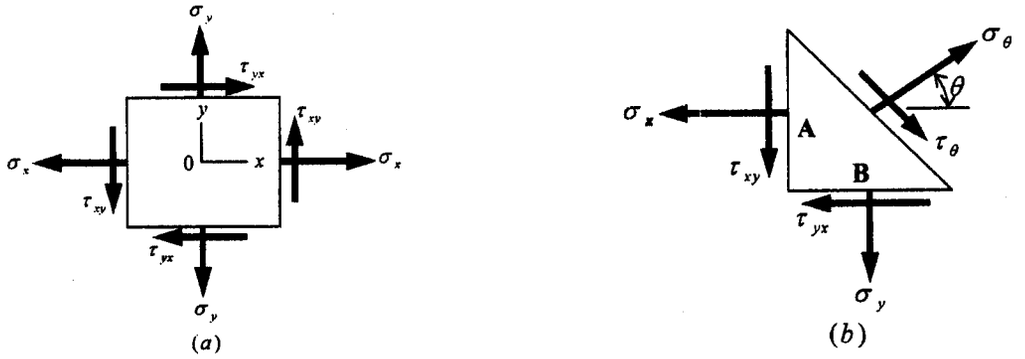

Fig. 3

4. A circular shaft (Fig. 4) with radius r is subjected to pure torsion T. We usually assume that the rate of change $d\phi/dx$ of the angle of twist is constant along the length of the shaft. (1)Derive polar moment of inertia J of the circular cross section (10%). (2) Derive, step by step, the total angle of twist ϕ in terms of torsion T, polar moment of inertia J, length L, and shear modulus of elasticity G. (15%)

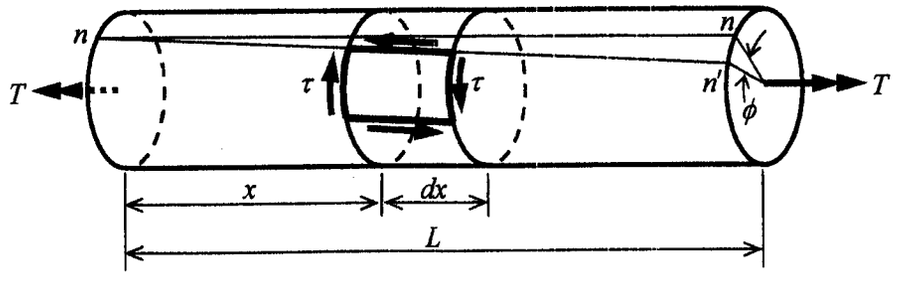

Fig. 4