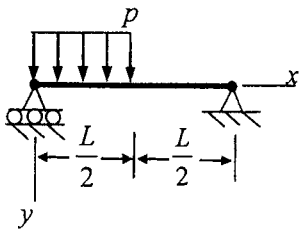
系所組別：航空太空工程學系乙組

考試科目：材料力學

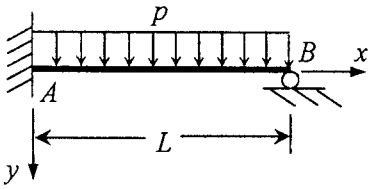
※ 考生請注意：本試題不可使用計算機

1. (25%) A simply supported beam is loaded as shown. The cross section of the beam is square with side h. Find, in terms of p, L, and h, (a) the maximum bending stress; and (b) the maximum shear stress.



2. (25%) A uniform load of intensity p is acting on the beam of flexural rigidity EI as shown. By solving the beam equation, determine (a) the equation of the deflection curve, and (b) the support reactions at A and B for the beam.

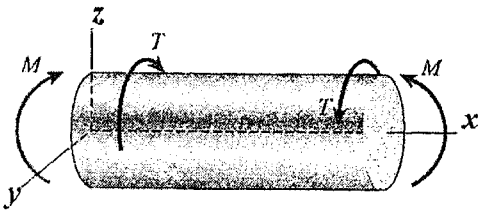
The beam equation is given as $EI\dfrac{d^4y}{dx^4} = p$ or $EI\dfrac{d^2y}{dx^2} = -M$.



3. (25%) A thin-walled cylindrical pressure vessel with flat ends is subjected to a torque $\boldsymbol{T}$, a bending moment $\boldsymbol{M}$ (as shown), and the internal pressure $\boldsymbol{p}$. The outer radius is $\boldsymbol{r_0}$ and the wall thickness is $\boldsymbol{t}$.

(a) Consider a stress element on the **top** of the cylinder. Derive the formulas for calculating the corresponding plane stresses σ_x, σ_y, and τ_{xy}.

(b) How would you find the maximum tensile stress, maximum compressive stress, and the maximum shear stress in the wall of the cylinder?



4. (25%) A composite bar of length L is made of concentric, circular bars bonded together as shown. The shear moduli of elasticity are G_c and G_t respectively for the core and the tube, and the polar moments of inertia for the core and the tube are J_c and J_t, respectively. Consider that the composite bar is acted upon by a total torque $\boldsymbol{T}$.

(a) Find the angle of rotation ϕ of the composite bar.

(b) Find the shear stresses at the common boundary in the core and in the tube, respectively.

(c) Discuss the compatibility of stresses and strains at the common boundary of the two parts.