

1. What is the definition of shear strain(4%)? According to the definition of shear strain, please use cylindrical coordinate r, θ, z to describe the shear strain in the torsion of circular shaft (4%). Please derive the torsion formula equation $\tau = T \rho / J$ (12%). If you cannot derive the equation, you may explain the terms τ, T, ρ and J to get a partial score(4%).
2. A cylindrical thin-walled pressure vessel with inner radius 30 mm and outer radius 33 mm is subjected simultaneously to an internal pressure 15 Mpa and a torque 2 KN-m. Use (i) maximum distortion energy and (ii) maximum shear stress theory to check if the pressure vessel will yield or not? The yield strength for the vessel is $\sigma_y = 250\text{MPa}$ (30%).

(背面仍有題目,請繼續作答)

3. A beam simply supported at point A and fixed at point B is shown in Figure 3(a). Figure 3(b) shows the cross section of the beam. Assume the modulus of elasticity is E.

- (1) Determine the reactions at points A and B by using:
 - (i) Integration method (10%);
 - (ii) Singularity function method (10%);
 - (iii) Superposition method (5%);
 - (iv) Castigliano's theory (10%);
- (2) Plot the shear force and bending moment diagrams (5%);
- (3) Compute the maximum tensile bending stress in beam (10%).

Note: use the attached table in question (1)-(iii).

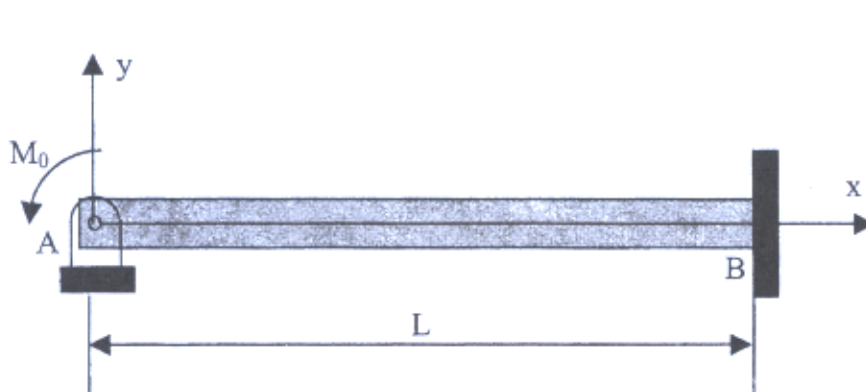


Figure 3(a)

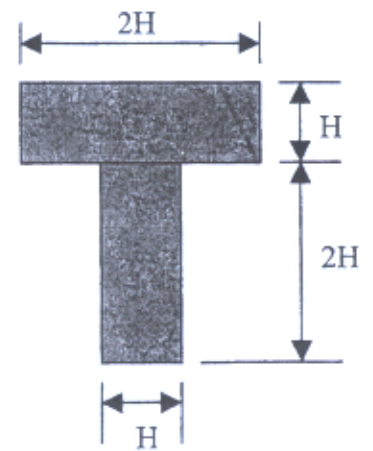


Figure 3(b)

Table.

Beam	Slope	Deflection
	$\theta_{max} = \frac{-PL^2}{2EI}$	$v_{max} = \frac{-PL^3}{3EI}$
	$\theta_{max} = \frac{M_0L}{EI}$	$v_{max} = \frac{M_0L^2}{2EI}$