系所組別： 生物醫學工程學系甲組

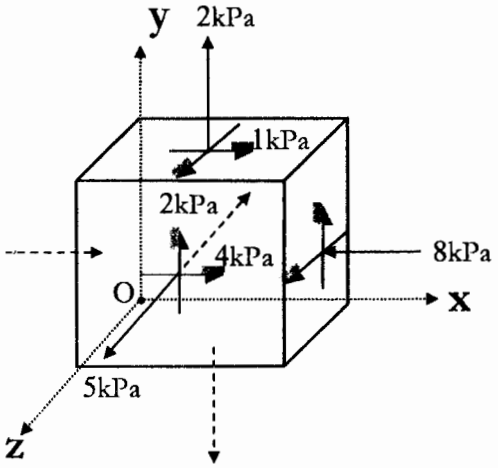
考試科目： 材料力學

考試日期：0223，節次：2

※ 考生請注意：本試題不可使用計算機

1. Define the following terms:
   (a) Poisson's ratio. (5%)
   (b) Shear modulus (5%)
   (c) True stress (5%)
   (d) Shear stress (5%)
   (e) Strain-energy density (5%)
   (f) Draw a typical stress-strain diagram of a **ductile** material and mark yield strength, ultimate strength, and fracture point in the diagram. (5%)

2. The stress state for a linear elastic isotropic material is shown to the right (E=45 kPa and ν=0.35). (a) What is the magnitude and direction of the largest normal strain? (5%) (b) What is the magnitude of the largest shear strain? What plane does it take place in? (5%)



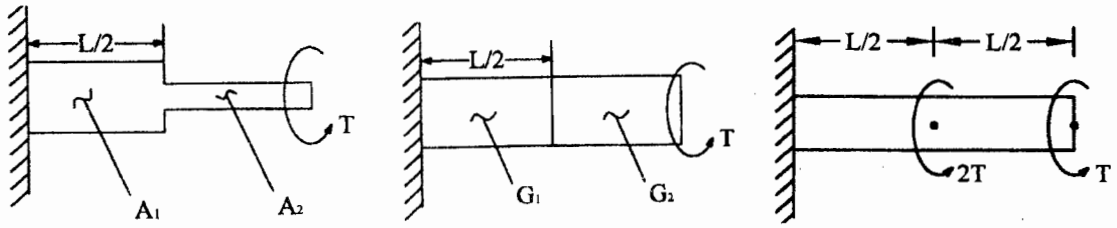
3. Like stress, strain can have different components at each point depending on the coordinate system to which it is referred. Show that strain can be transformed in the following fashion (15%):

$$\varepsilon_{xx}' = \varepsilon_{xx}\cos^2\alpha + \varepsilon_{yy}\sin^2\alpha + \gamma_{xy}\sin\alpha\cos\alpha\,,$$

$$\varepsilon_{yy}' = \varepsilon_{xx}\sin^2\alpha + \varepsilon_{yy}\cos^2\alpha - \gamma_{xy}\sin\alpha\cos\alpha\,,$$

$$\frac{\gamma_{xy}'}{2} = (\varepsilon_{yy} - \varepsilon_{xx})\sin\alpha\cos\alpha + (\cos^2\alpha - \sin^2\alpha)\frac{\gamma_{xy}}{2}\,.$$

4. Consider members subjected to the torques(s) as shown below. Find the angle of twist at the end of the cylinder for each case (15%).



(背面仍有題目,請繼續作答)

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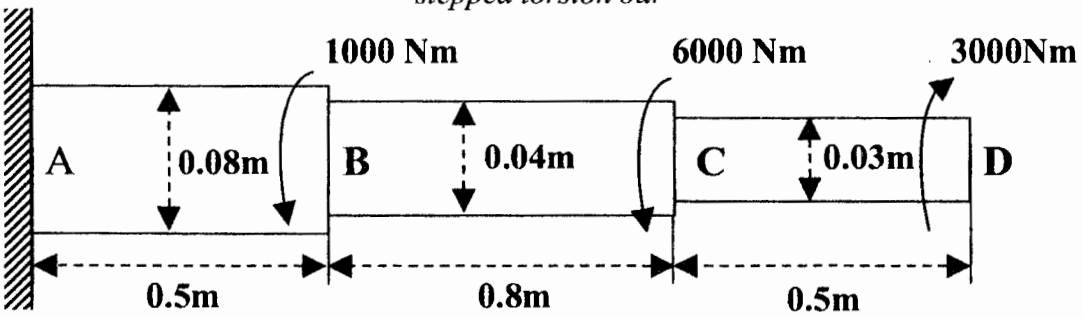
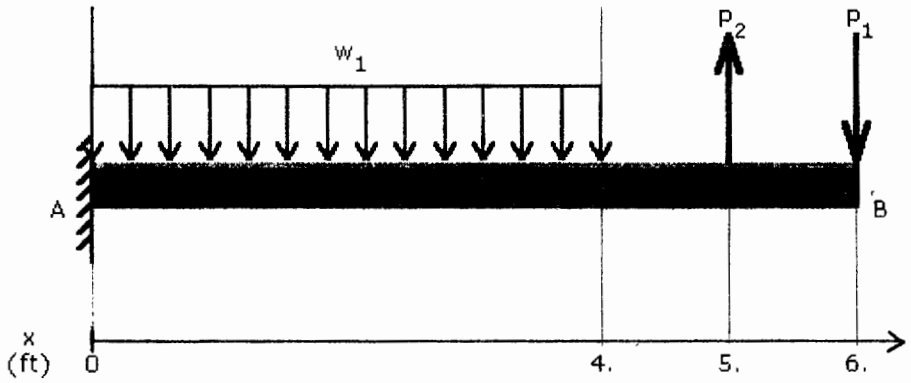
5. A stepped steel (G=80 GPa) torsion bar ABCD consisting of solid circular cross-sections is subjected to three external torques, in the directions shown below. Calculate the maximum shear stress in the bar, τ_{max} (MPa) (10%).

stepped torsion bar



6. A cantilever beam is used to support a uniformly distributed load of intensity w_1 = 25 lb/ft and two concentrated loads $P_1 = P_2$ = 50 lbs, as shown below. (a) Draw the shear force diagram and label the location (along x-axis) and magnitude of the maximum shear force (5%). (b) Draw the bending moment diagram and label the location (along x-axis) and magnitude of the maximum bending moment (5%).



7. Consider the 2-D state of stress shown to the right. Find the values of stress α'_{xx}, α'_{yy}, α'_{xy} for $\alpha = 45^{\circ}$, the principal stresses, and the maximum shearing stress (10%).