1. A bungee cord that behaves linearly elastically has an unstressed length $L_0 = 760\text{mm}$ and a stiffness $k = 140$ N/m.The cord is attached to two pegs, distance $b = 380$ mm apart, and pulled at its midpoint by a force $P = 80\text{N}$ (see figure 1).(20%)
   (a) How much strain energy U is stored in the cord?
   (b) What is the displacement δ_c of the point where the load is applied?
   (c) Compare the strain energy U with quantity $P\delta_c/2$.
   (Note: The elongation of the cord is not small compared to original length.)

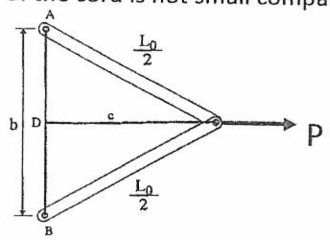

Figure 1

2. A cantilever beam of rectangular cross section (with $b = 25\text{mm}$, height $h = 100\text{mm}$) is loaded by a force P that acts at the midheight of the beam and is inclined at an angle α to the vertical (see figure 2). Two strain gages are placed at point C, which also is at the midheight of the beam. Gage A measures the strain in the horizontal direction and gage B measures the strain at an angle $\beta = 60^o$ to the horizontal. The measured strains are $\epsilon_a = 125\text{x}10^{-6}$ and $\epsilon_b = -375\text{x}10^{-6}$.Determine the force P and the angle α, assuming the material is steel with $E = 200$ Gpa and $\vartheta = 1/3$. (20%)

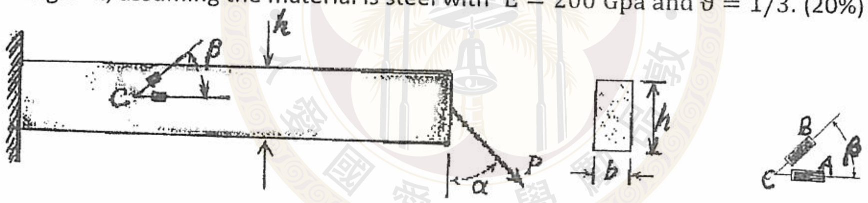

Figure 2

3. (a) A compression member in a bridge truss is fabricated from a wide-flange steel section (see figure 3a). The cross-sectional area A=6640 mm^2 and the axial load P=140kN.(10%)
Determine the normal and shear stresses acting on all faces of stress elements located in the web of the beam and oriented at (i) an angle $\theta=0^o$, (ii) an angle $\theta=22.5^o$ and (iii) an angle $\theta=45^o$. In each case, show the stresses on a sketch of a properly oriented element.

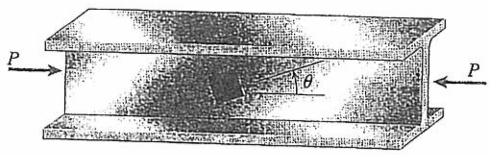

Figure 3a

見背面

3. (b) Two circular shafts (made by the same material) are used to transmit a torque as shown in Fig.3b. If the two shafts have the same cross-sectional area, which one can transmit more torque? Why? (10%)

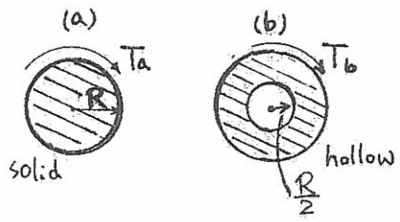

Fig 3b

4. The beam is subjected to the distributed loading shown in Fig. 4. Assume that EI is constant, where E is the Young's modulus and I is the second moment of area of the transverse section with respect to the neutral axis.
   (a) Determine the reactions at A and B. (10%)
   (b) Find the location and value of the maximum deflection of the beam. (10%)

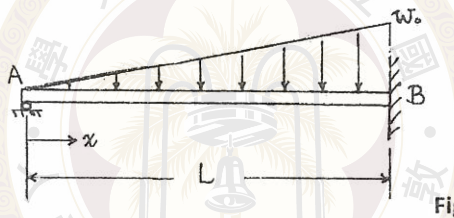

Fig 4

5. A simple beam AB is loaded by two segments of uniform load and two horizontal forces acting at the end of a vertical rigid arm (see Fig. 5a). The cross-section of the beam is shown in Fig. 5b.
   (a) Draw the shear-force and bending-moment diagrams for the beam. (10%)
   (b) Find the distribution of flexural stress at the location $x = 3m$. Also determine the principal stresses at point A . (10%)

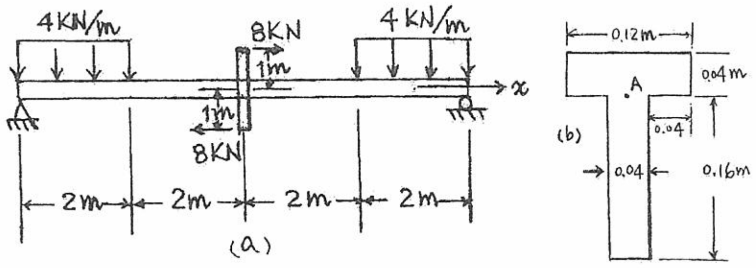

Fig 5