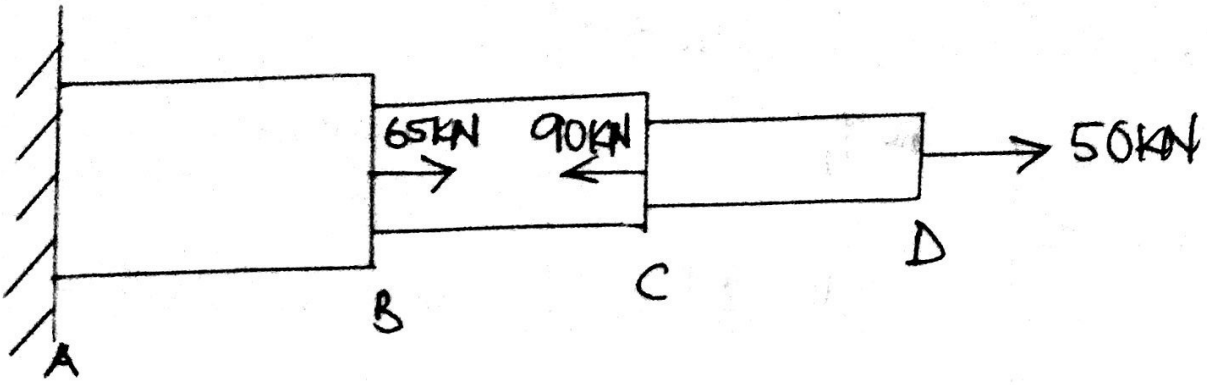
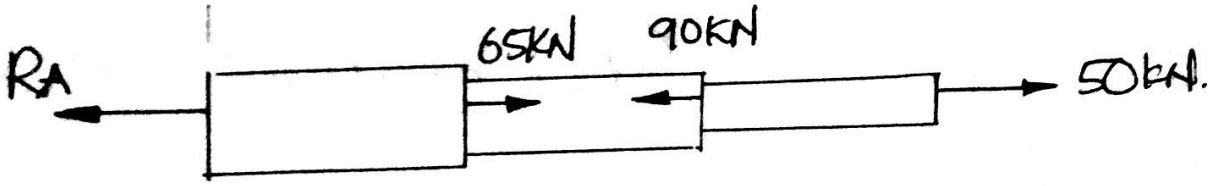
CEE 3211 QUIZ 1 MARKING KEY



(I) Reaction of A.



$\pm \sum F_x = 0$:

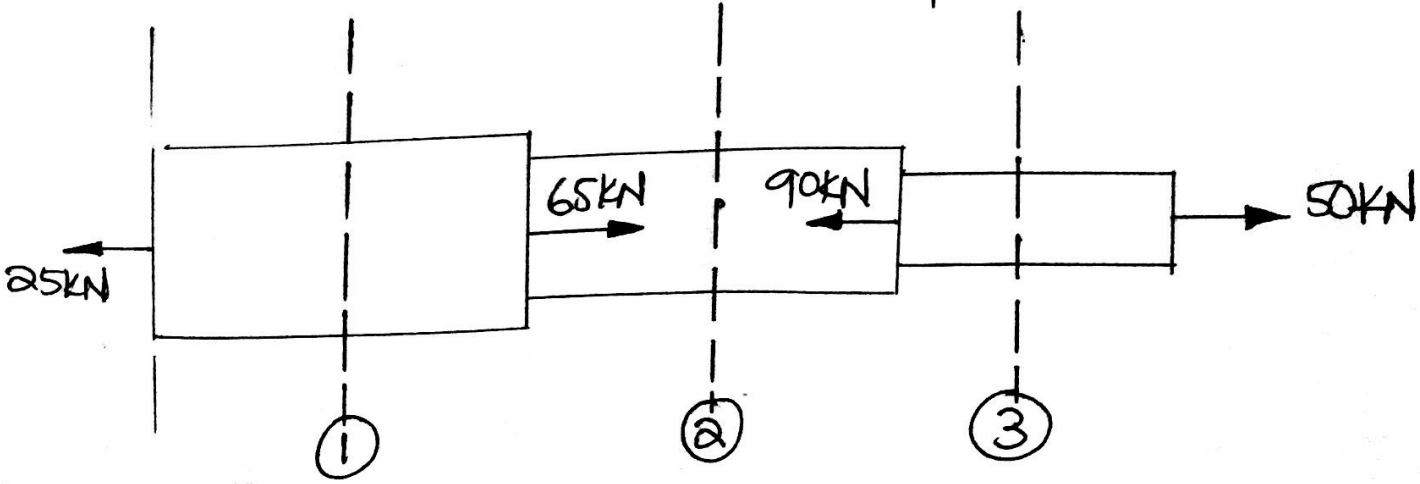
$R_A + 90\,kN = 65\,kN + 50\,kN$

$R_A = (115 - 90)\,kN$

$R_A = \underline{25\,kN}$

(II) GIVEN DATA:

Diameters		Length
AB = 120 mm	E = 200 GPa	30 cm = 300 mm
BC = 90 mm	E = 68.9 GPa	35 cm = 350 mm
CD = 60 mm	E = 101 GPa	45 cm = 450 mm



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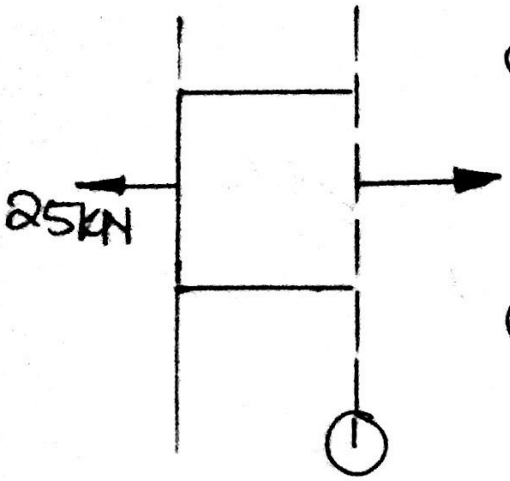
Segment ① : AB



(i) $\pm \sum F_x = 0$.

$P_1 = 25\,KN$.

Member AB is in Tension.

(ii) Normal Stress Induced.

$$\sigma_{AB} = \frac{P_1}{A_{AB}} = \frac{25 \times 10^3 N}{\frac{\pi}{4}(120mm)^2} = \frac{25000\,N}{11309.7\,mm^2}$$

$$\sigma_{AB} = 2.21\,N/mm^2 \quad (MPa)$$

(iii) Elongation.

$$\delta_{AB} = \frac{PL_{AB}}{AE} = \frac{25 \times 10^3 N \times 300mm}{\frac{\pi}{4}(120mm)^2 \times (200 \times 10^3) N/mm^2}$$

$$= \frac{25000 \times 300}{\frac{\pi}{4}(120)^2 \times (200000)}\ mm$$

$$= 0.0033157\,mm$$

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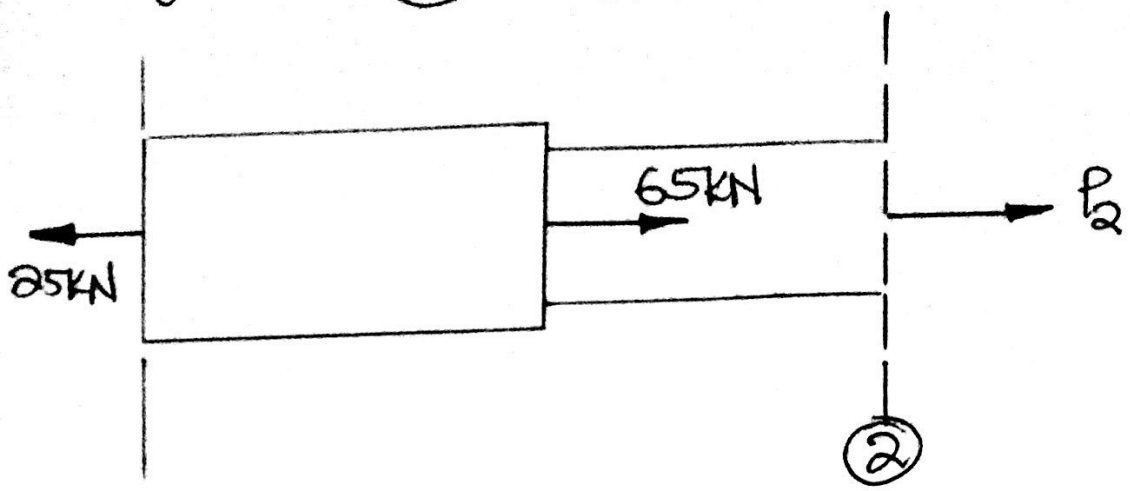
Segment ② : BC



(I) $\overset{+}{\rightarrow} \Sigma F_x = 0$:

$$P_2 + 65\,KN = 25\,KN.$$

$$P_2 = (25 - 65)\,KN = -40\,KN$$

$$\underline{P_2 = 40\,KN} \leftarrow$$ Member BC is in compression

(II) Normal Stress induced.

$$\sigma_{BC} = \frac{P_2}{A_{BC}} = \frac{40 \times 10^3\,N}{\frac{\pi}{4}(90\,mm)^2} = \frac{40000\,N}{6361.7\,mm^2} = 6.29\,N/mm^2$$

$$\sigma_{BC} = \underline{6.29\,N/mm^2} \quad (MPa)$$

(III) Elongation

$$\delta_{BC} = \frac{PL_{BC}}{AE} = \frac{-40 \times 10^3\,N \times 350\,mm}{\frac{\pi}{4}(90\,mm)^2 \times (68.9 \times 10^3)\,N/mm^2}$$

$$= \frac{-40000 \times 350}{\frac{\pi}{4}(90)^2 \times (68900)}\,mm = -0.0319399\,mm$$

$$= \underline{-0.0319399\,mm}$$

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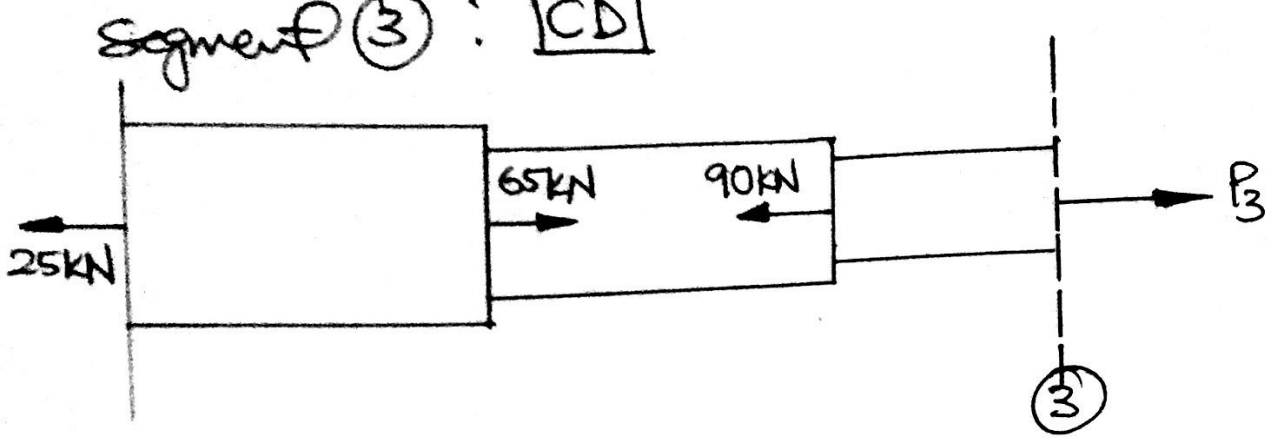
Segment ③ : CD



① $\Sigma F_x = 0$

$P_3 + 65\,kN = 25\,kN + 90\,kN$

$P_3 = (25+90-65)\,kN = \underline{50\,kN}$

Member CD is in Tension.

(ii) Normal Stress induced.

$$\sigma_{CD} = \frac{P_3}{A_{CD}} = \frac{50\times10^3\,N}{\frac{\pi}{4}(60\,mm)^2} = \frac{50\,000\,N}{2827.4\,mm^2} = 17.68\,(MPa)$$

$$= \underline{\underline{17.68\,N/mm^2}}\ (MPa)$$

(iii) Elongation.

$$\delta_{CD} = \frac{PL_{CD}}{AE} = \frac{50\times10^3\,N \times 450\,mm}{\frac{\pi}{4}(60\,mm)^2 \times (101\times10^3)\,N/mm^2}$$

$$= \frac{50\,000 \times 450}{\frac{\pi}{4}(60)^2 \times (101\,000)}\,mm$$

$$= \underline{0.0787896\,mm}$$

$\therefore$ Total Elongation : $\delta_T = \delta_{AB} + \delta_{BC} + \delta_{CD}$

$\Rightarrow \delta_T = [0.0033157]\,mm + [-0.0319399]\,mm + [0.0787896]\,mm$

$= \underline{\underline{0.0502\,mm}}$

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