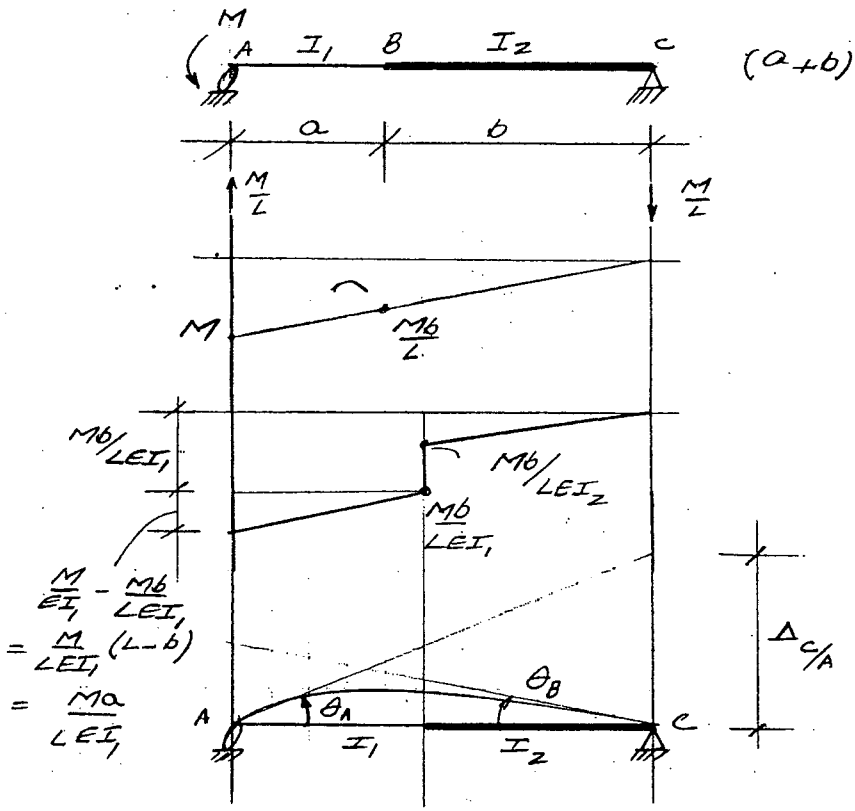
1.



$$\Delta_{C/A} = \frac{Mb}{LEI_2}\cdot\frac{b}{2}\cdot\frac{2b}{3} + \frac{Mb}{LEI_1}\cdot a\cdot\left(b+\frac{a}{2}\right) + \frac{Ma}{LEI_1}\cdot\frac{a}{2}\cdot\left(b+\frac{2}{3}a\right)$$

$$= \frac{M}{EL}\left[\frac{b^3}{3I_2} + \frac{ab^2}{I_1} + \frac{a^2b}{2I_1} + \frac{a^2b}{2I_1} + \frac{1}{3}\frac{a^3}{I_1}\right]$$

$$= \frac{M}{EL}\left[\frac{b^3}{3I_2} + \frac{ab^2}{I_1} + \frac{a^2b}{I_1} + \frac{a^3}{3I_1}\right]$$

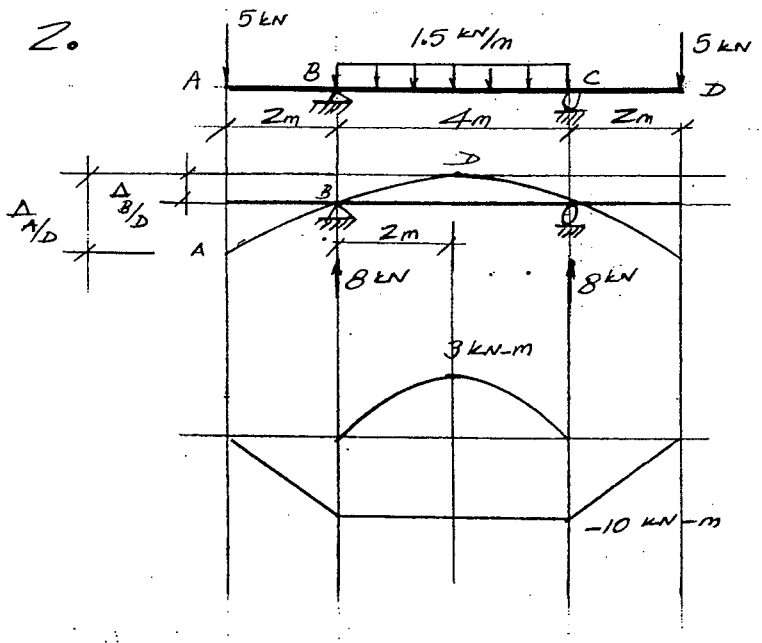
$$= \frac{M}{3EL}\left[\frac{a^3}{I_1} + \frac{b^3}{I_2} + \frac{3ab^2}{I_1} + \frac{3a^2b}{I_1}\right]$$

$$\theta_A = \frac{\Delta_{C/A}}{L} = \frac{M}{3EL^2}\left[\frac{a^3}{I_1} + \frac{b^3}{I_2} + \frac{3ab}{I_1}(a+b)\right]$$

Similarly $\theta_B = \frac{M}{6EL^2}\left[\frac{a^3}{I_1} + \frac{b^3}{I_2} + 3ab\left(\frac{a}{I_1} + \frac{b}{I_2}\right)\right]$

$$= \frac{\Delta_{A/C}}{L}$$

2.



$E = 200 \times 10^6$ kN/m^2

$I = 10 \times 10^{-6}$ m^4

$$\Delta_{A/D} = \frac{2}{3} \times \frac{3}{EI} \times 2 \times \left(2 + \frac{5}{8} \times 2\right) - \frac{10}{EI} \times \frac{2}{2} \cdot \frac{2}{3}(2)$$

$$- \frac{10}{EI} \times 2 \times \left(2 + \frac{1}{2}(2)\right)$$

$$= -\frac{60.33}{EI}$$

$$\Delta_{B/D} = \frac{2}{3} \times \frac{9}{EI} \times 2 \times \left(\frac{5}{8} \times 2\right) - \frac{10}{EI} \cdot 2 \cdot \frac{2}{2}$$

$$= -\frac{15}{EI}$$

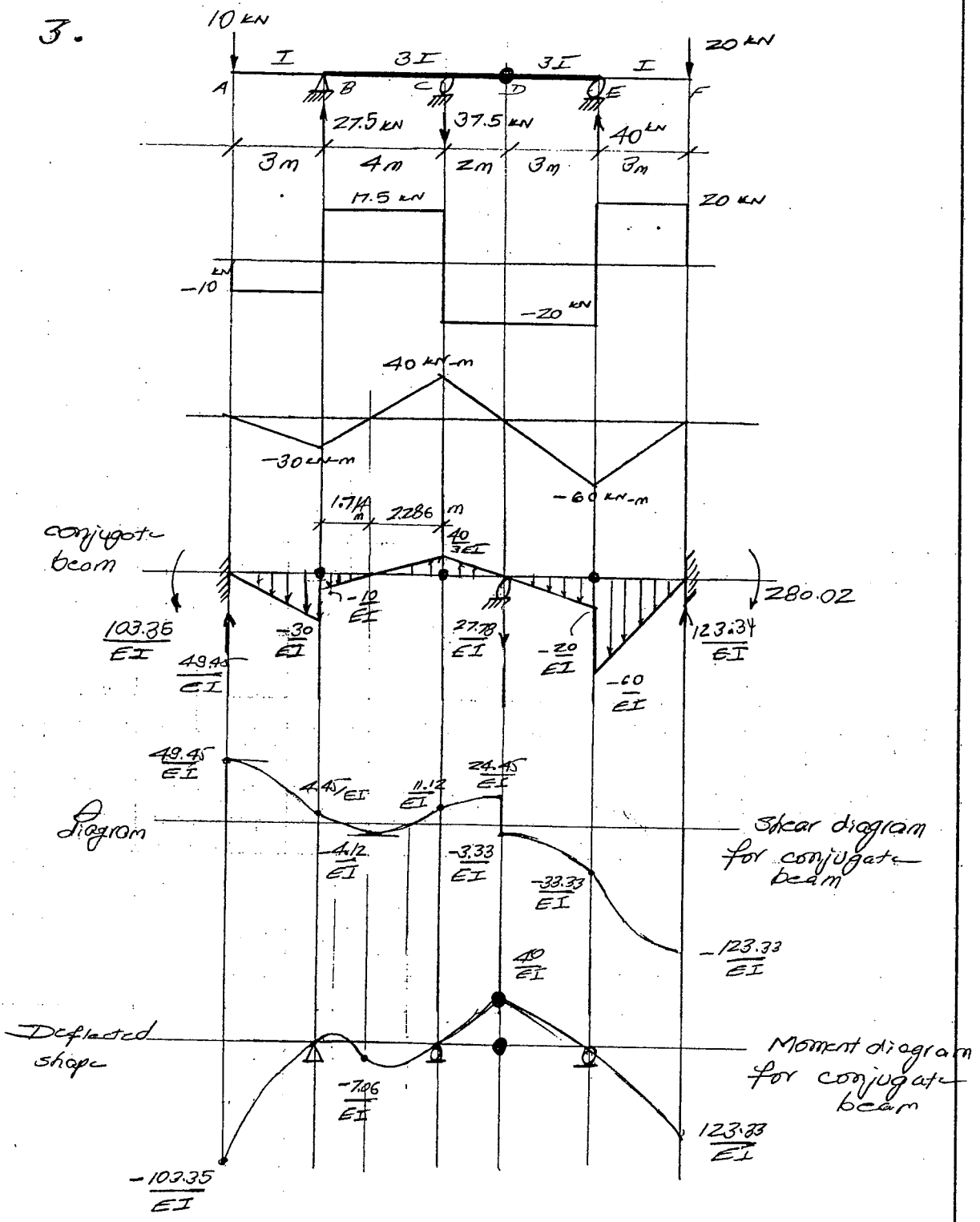
$$\therefore v_A = \Delta_{A/D} - \Delta_{B/D}$$

$$= -\frac{45.33}{EI}$$

$$= -0.02267 \text{ m}$$

or $v_A = 2.267$ cm ↓

3.


10 kN
20 kN
I
3I
3I
I
A
B
C
D
E
F
27.5 kN
37.5 kN
40 kN
3m
4m
2m
3m
3m
17.5 kN
20 kN
-10 kN
-20 kN
40 kN-m
-30 kN-m
-60 kN-m
1.714 m
2.286 m
40/3EI
conjugate beam
280.02
103.35/EI
-30/EI
-10/EI
27.78/EI
-20/EI
123.34/EI
49.45/EI
-60/EI
49.45/EI
4.45/EI
11.12/EI
24.45/EI
Shear diagram for conjugate beam
-4.12/EI
-3.33/EI
-33.33/EI
-123.33/EI
40/EI
Deflected shape
Moment diagram for conjugate beam
-7.96/EI
123.33/EI
-103.35/EI