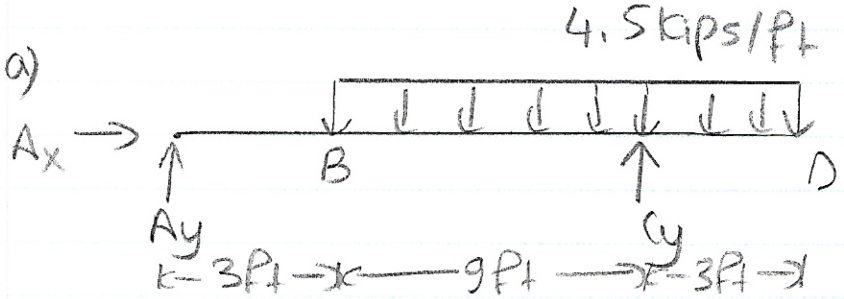
Assignment #1

Part 1:

a)



$\rightarrow \Sigma F_x = 0 \Rightarrow A_x = 0$

$\uparrow \Sigma F_y = 0 \Rightarrow A_y - 4.5 \times 12 + C_y = 0 \Rightarrow A_y + C_y = 54$

$\circlearrowleft \Sigma M_A = 0 \Rightarrow -4.5 \times 12 \times 9 + C_y \times 12 = 0 \Rightarrow C_y = 40.5 \text{ kips}$

$A_y = 13.5 \text{ kips}$

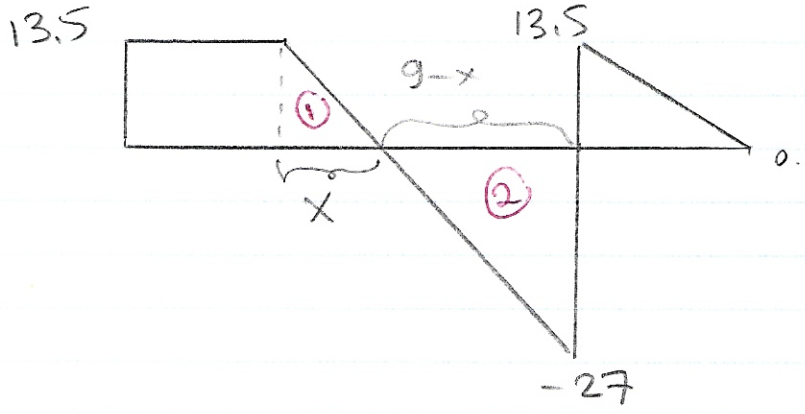
By Similar Δ's (1 and 2)

$$\frac{13.5}{x} = \frac{27}{9-x}$$

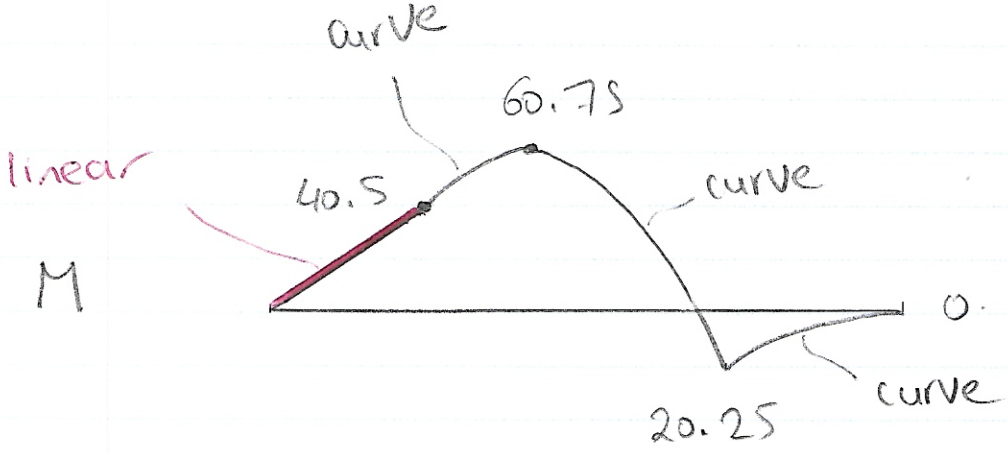
$27x = 121.5 - 13.5x$

$x = 3$

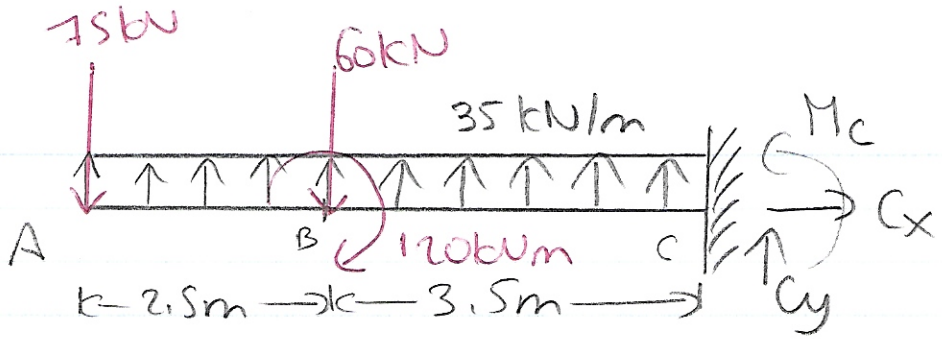
V



M



b)



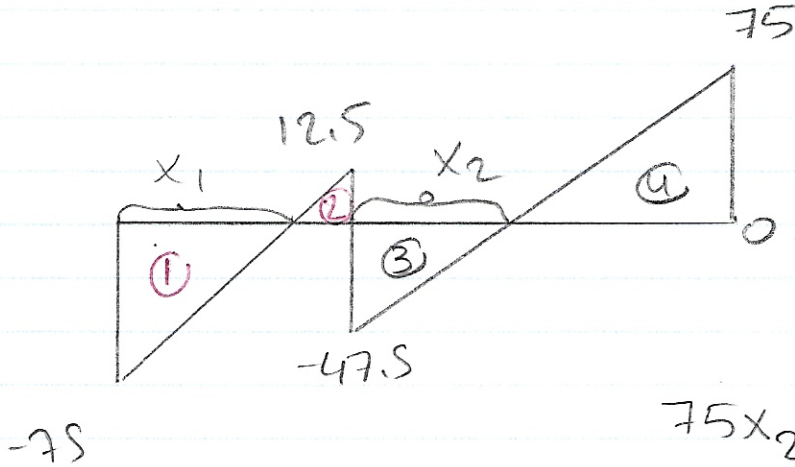
$\rightarrow \Sigma F_x = 0 \Rightarrow C_x = 0$

$\uparrow \Sigma F_y = 0 \Rightarrow -75 + 35 \times 6 - 60 + C_y = 0 \Rightarrow C_y = -75\,kN$

$\circlearrowleft \Sigma M_C = 0 \Rightarrow M_C - 35 \times 6 \times 3 + 60 \times 3.5 + 75 \times 6 - 120 = 0$

$\Rightarrow M_C = 90\,kNm$

V



By similar Δ's (1 and 2)

$\frac{x_1}{75} = \frac{2.5 - x_1}{12.5}$

$12.5 x_1 = 187.5 - 75 x_1$

$x_1 = 2.14$

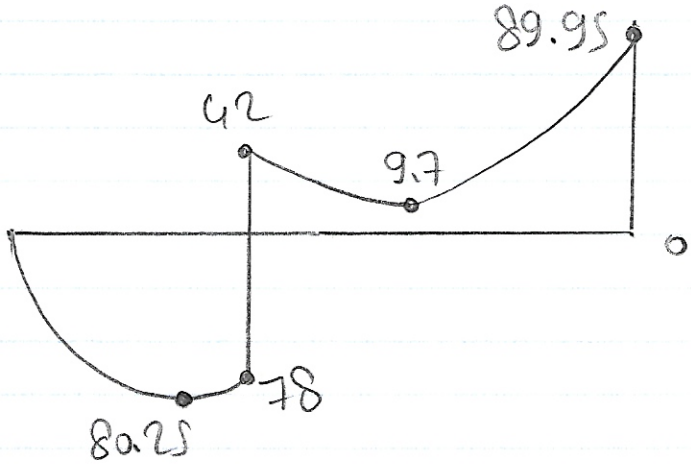
By similar Δ's (3 and 4)

$\frac{x_2}{47.5} = \frac{3.5 - x_2}{75}$

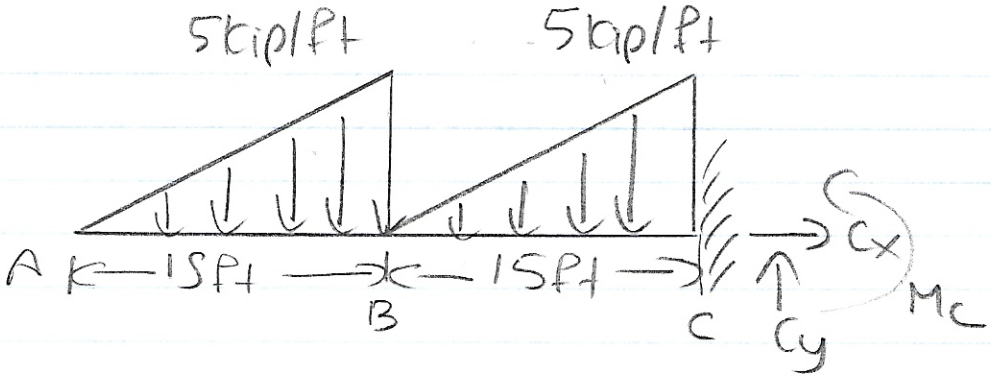
$75 x_2 = 166.25 - 47.5 x_2$

$x_2 = 1.36$

M



c)



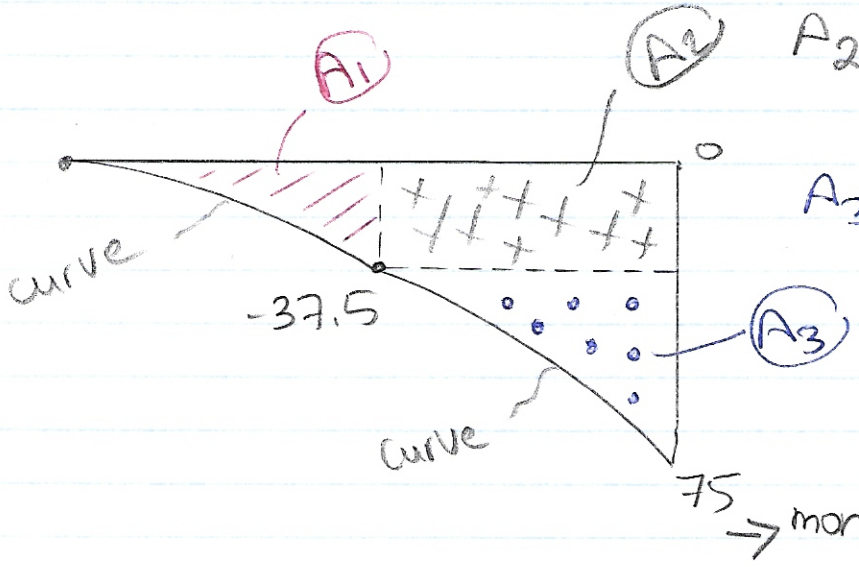
$\rightarrow \sum F_x = 0 \Rightarrow C_x = 0$

$\uparrow \sum F_y = 0 \Rightarrow -\frac{1}{2} \times 15 \times 5 - \frac{1}{2} \times 15 \times 5 + C_y = 0 \Rightarrow C_y = 75 \text{ kip}$

$\circlearrowleft \sum M_C = 0 \Rightarrow M_C + \frac{1}{2} \times 15 \times 5 \times 5 + \frac{1}{2} \times 15 \times 5 \times 20 = 0$

$M_C = -937.5 \text{ kip ft}$

V

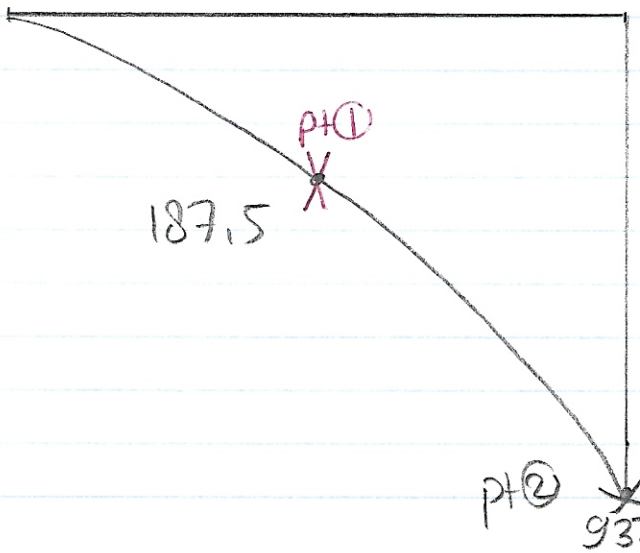


$A_2 = 15 \times (-37.5) = -562.5$

$A_3 = \frac{1}{3}(15)(37.5) = -187.5$

$\Rightarrow$ moment at pt ① =

M



area A1 $= \frac{1}{3}(15)(-37.5)$

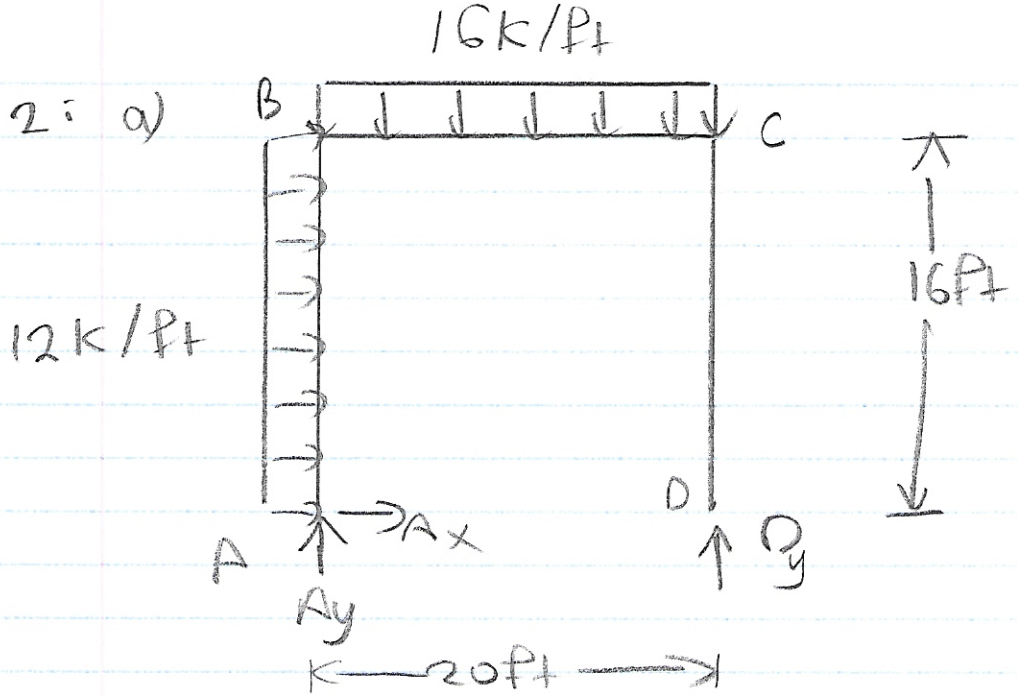
$= -187.5$

$\Rightarrow$ moment at pt ② = moment at pt ① + area A2 + area A3

$= (-187.5) + (-562.5) + (-187.5)$

$= -937.5$

Part 2: a)



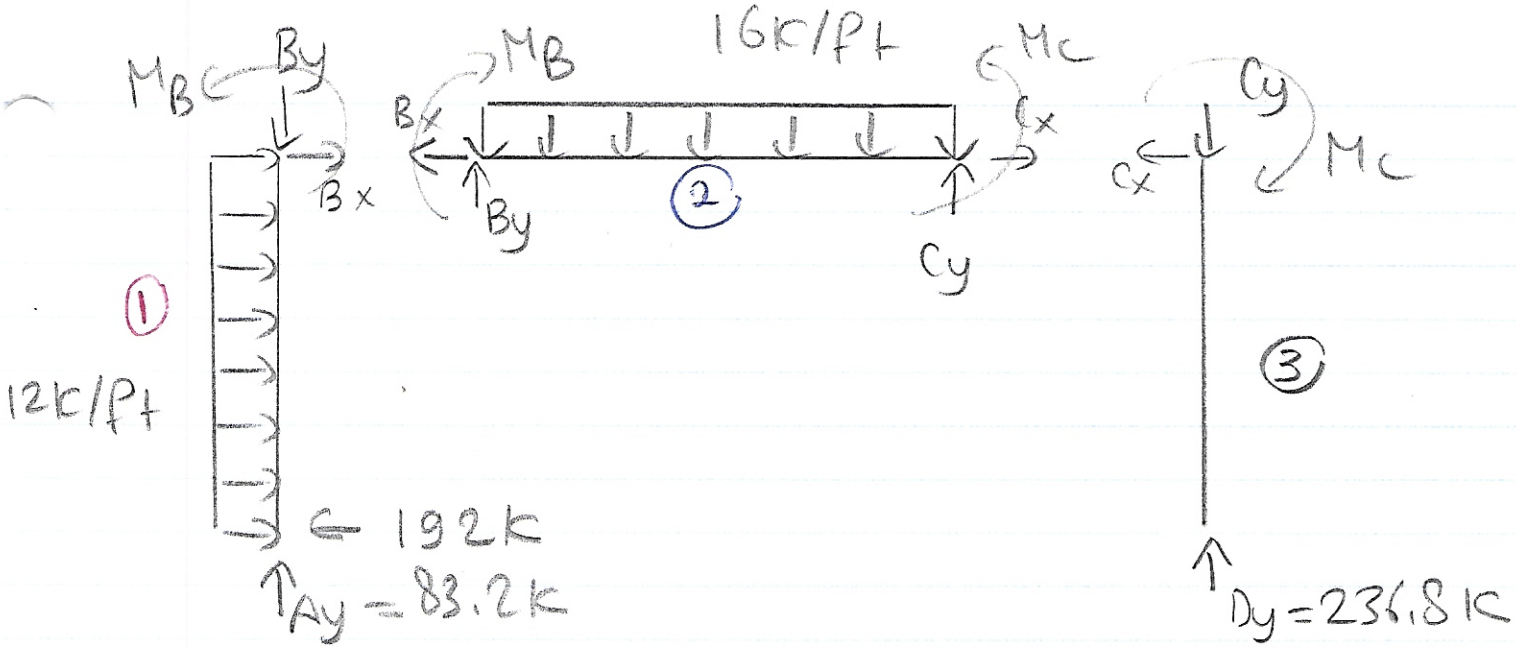
$$\rightarrow \Sigma F_x = 0 \Rightarrow A_x + 12 \times 16 = 0 \Rightarrow A_x = -192K$$

$$\uparrow \Sigma F_y = 0 \Rightarrow A_y - 16 \times 20 + D_y = 0 \Rightarrow A_y + D_y = 320$$

$$\circlearrowleft \Sigma M_A = 0 \Rightarrow -12 \times 16 \times \frac{16}{2} - 16 \times 20 \times \frac{20}{2} + D_y \times 20 = 0$$

$$D_y = 236.8K$$

$$A_y = 83.2K$$



start with (1):

$\rightarrow \Sigma F_x = 0 \Rightarrow B_x - 192 + 12 \times 16 = 0 \Rightarrow B_x = 0$

$\uparrow \Sigma F_y = 0 \Rightarrow 83.2 - B_y = 0 \Rightarrow B_y = 83.2K$

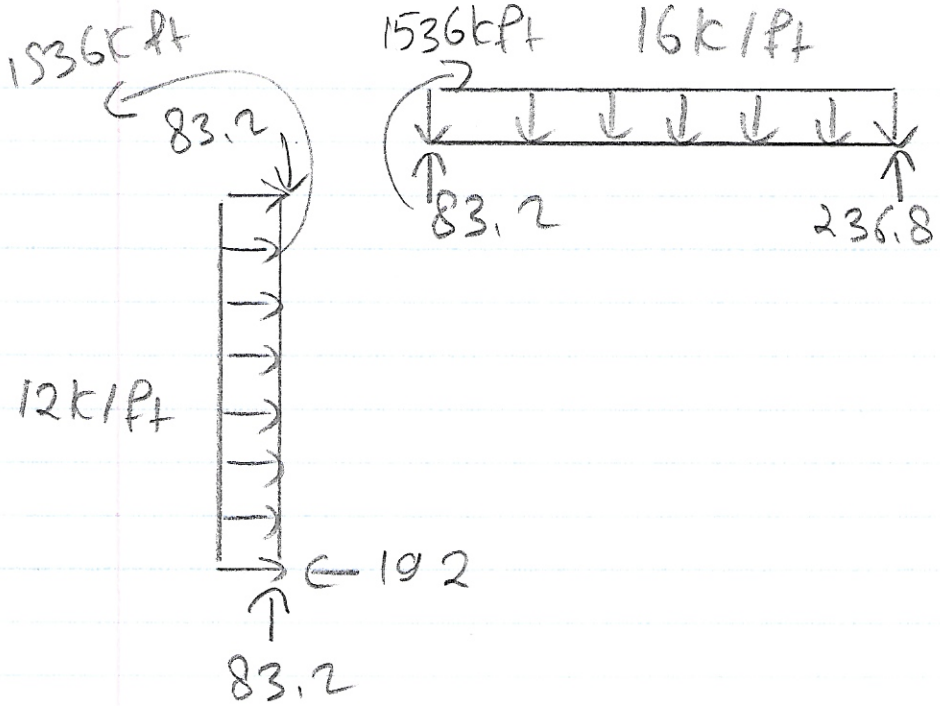
$\circlearrowleft \Sigma M_B = 0 \Rightarrow M_B + 12 \times 16 \times \frac{16}{2} - 192 \times 16 = 0$

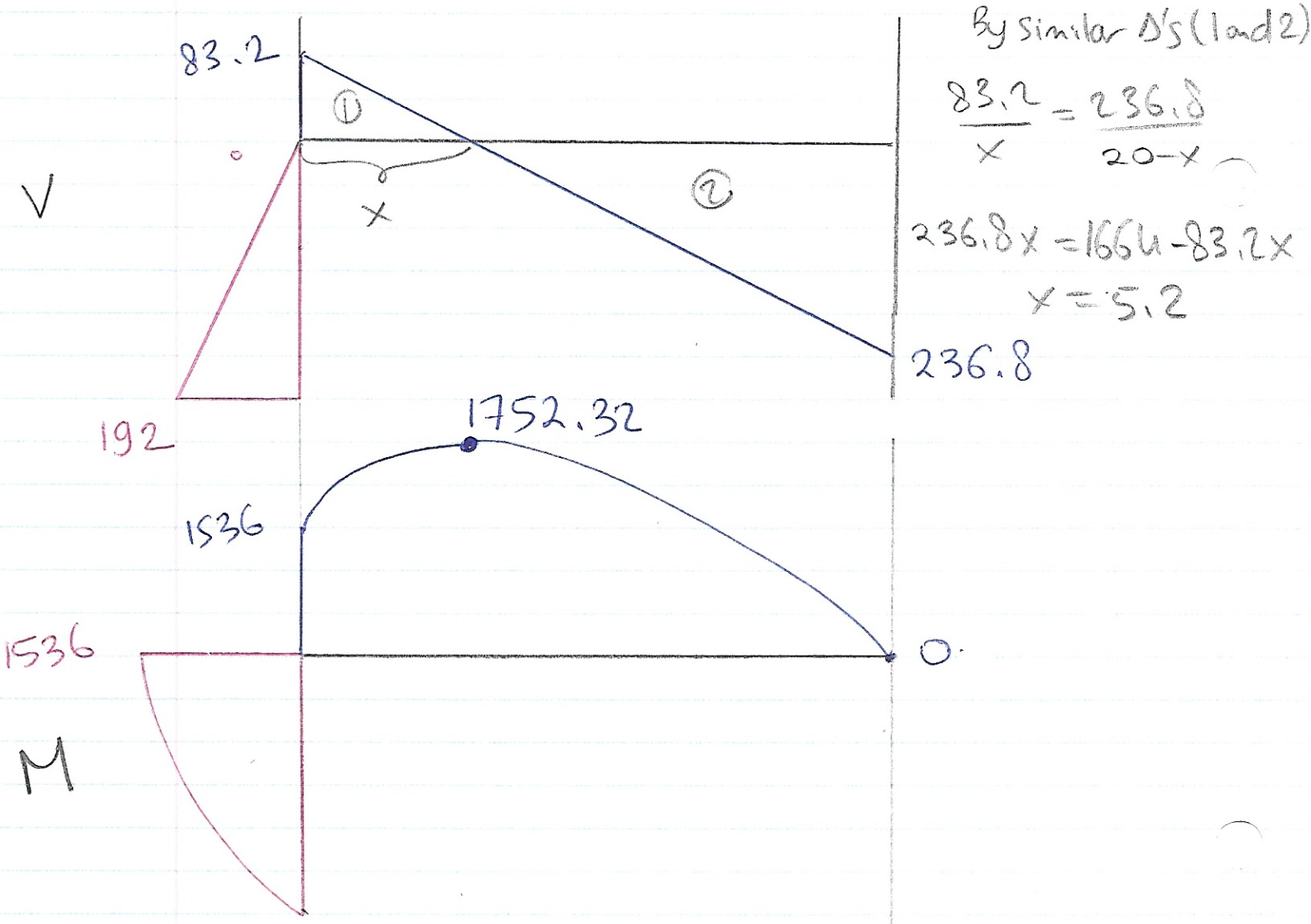
$M_B = 1536 K\text{-}ft$

next (3): $\rightarrow \Sigma F_x = 0 \Rightarrow C_x = 0$

$\uparrow \Sigma F_y = 0 \Rightarrow 236.8 - C_y = 0 \Rightarrow C_y = 236.8K$

$\circlearrowleft \Sigma M_C = 0 \Rightarrow -M_C = 0 \Rightarrow M_C = 0$





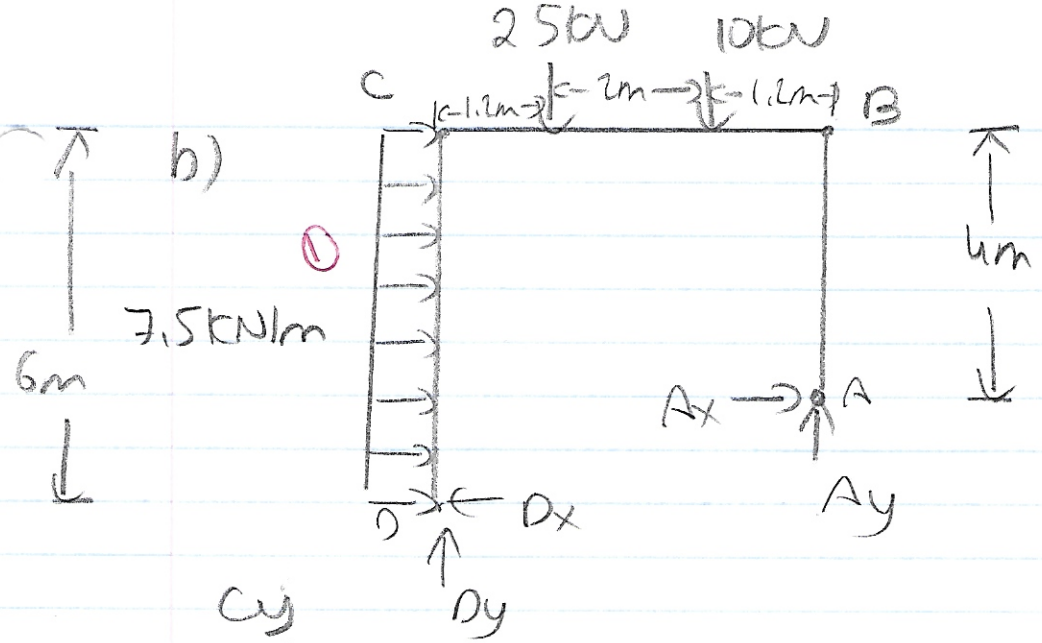
By similar Δ's (1 and 2)

$$\frac{83.2}{x} = \frac{236.8}{20-x}$$

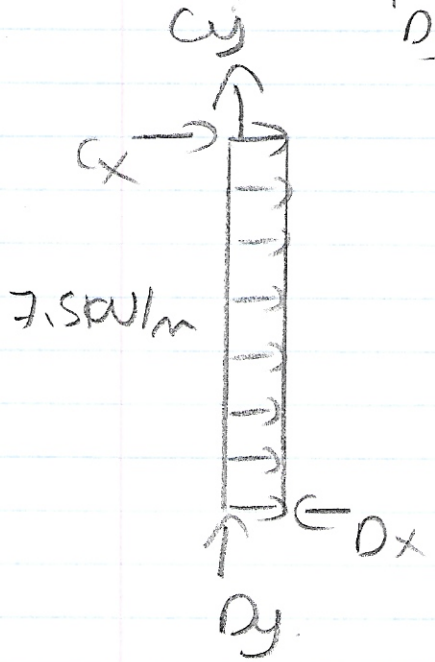
$$236.8x = 1664 - 83.2x$$

$$x = 5.2$$

b)



* 1st analyze ① alone to get Dx



$+\circlearrowleft \Sigma M_C = 0 \Rightarrow -D_x(6) + 7.5(6)\left(\frac{6}{2}\right) = 0$

$D_x = 22.5\,kN$

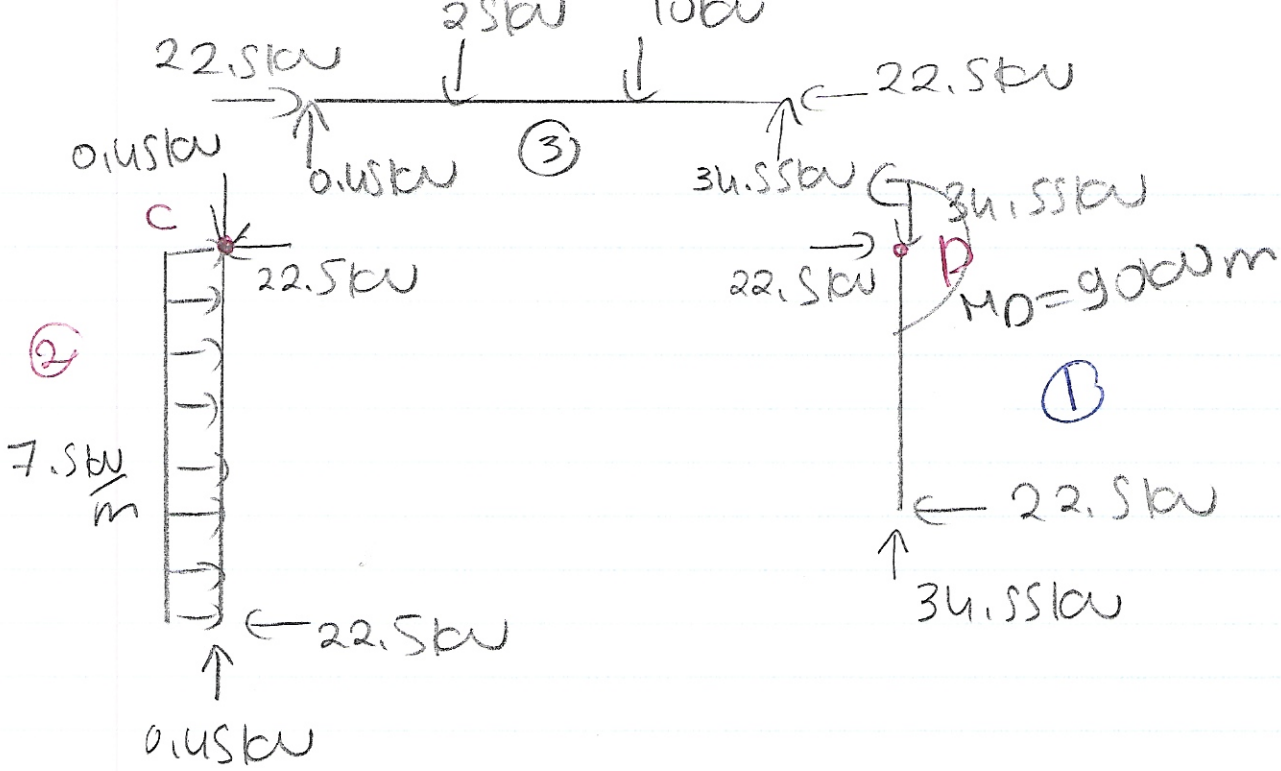
* the analyze the Frame as a whole to get remaining rxns.

$+\circlearrowleft \Sigma M_A = 0 \Rightarrow +10(1.2) + 25(1.2+2) - D_y(1.2+2+1.2) - D_x(6-4) - 7.5(4)\left(\frac{4}{2}\right) + 7.5(2)\left(\frac{2}{2}\right) = 0$

$D_y = 0.45\,kN$

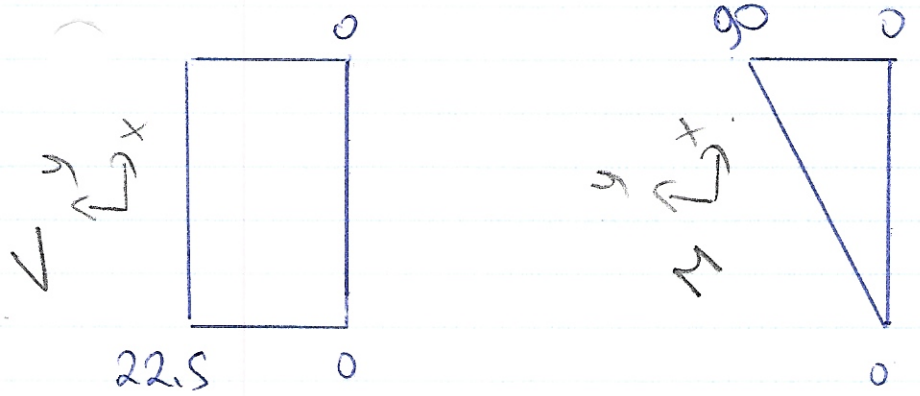
$\rightarrow \Sigma F_x = 0 \Rightarrow A_x + 7.5(6) - 22.5 = 0 \Rightarrow A_x = -22.5\,kN$

$\uparrow \Sigma F_y = 0 \Rightarrow A_y - 25 - 10 + 0.45 = 0 \Rightarrow A_y = 34.55\,kN$

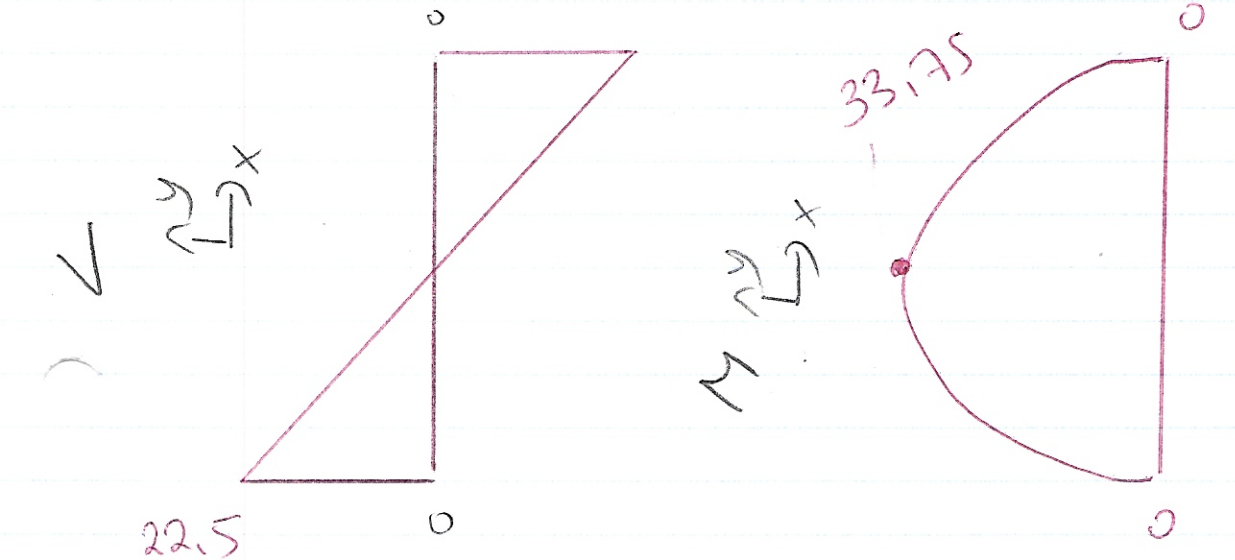


$\circlearrowright \Sigma M_D = 0 \Rightarrow -22.5(4) + M_D = 0 \Rightarrow M_D = 90\,kNm$

for ①



for ②



for ③