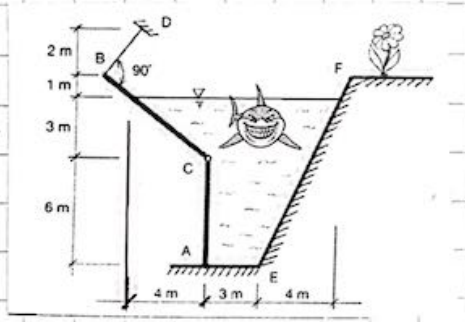
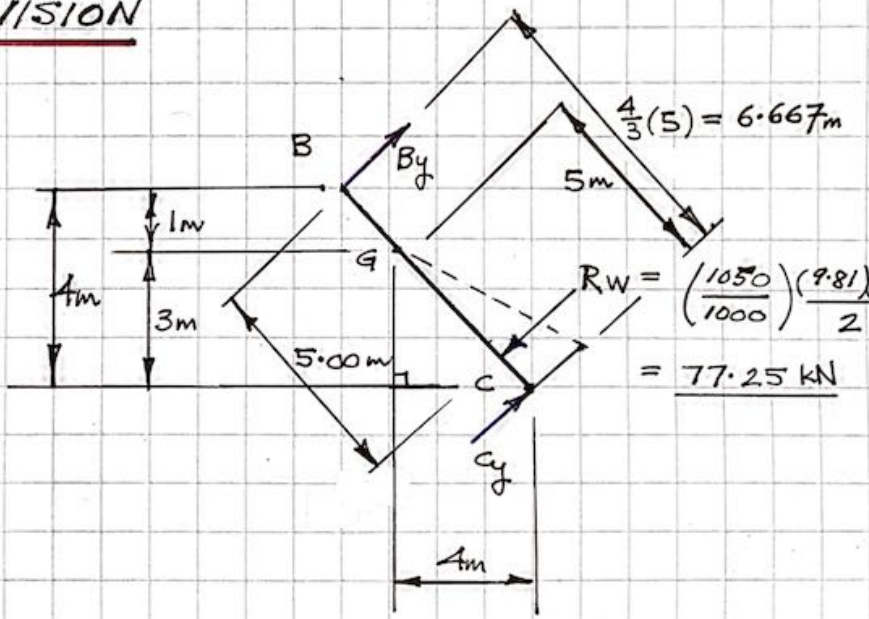
REVISION

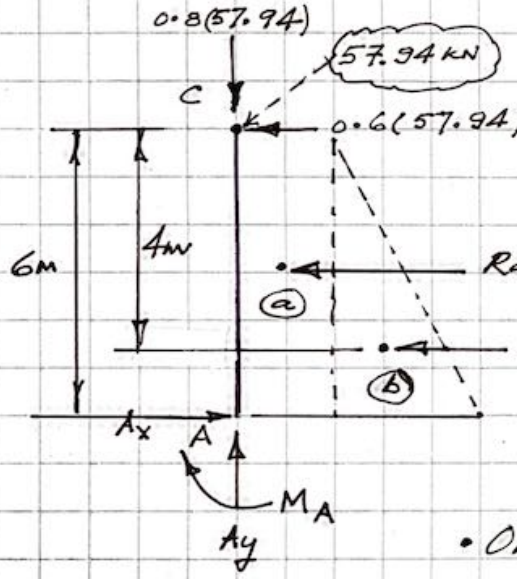
2019 Q1





• On FBD of BC, $\Sigma M_B = 0 \Rightarrow C_y(6.667) - 77.254(5) = 0$

$\therefore C_y = 57.94\ kN$



$R_a = \left(\frac{1050}{1000}\right) 9.81(3)(6)(1) = 185.4\ kN$

$R_b = \left(\frac{1050}{1000}\right)\frac{9.81(6)}{2}(6)(1) = 185.4\ kN$

• On FBD of AC, $\Sigma F_x = 0 \therefore A_x = 34.76 + 2(185.4)$

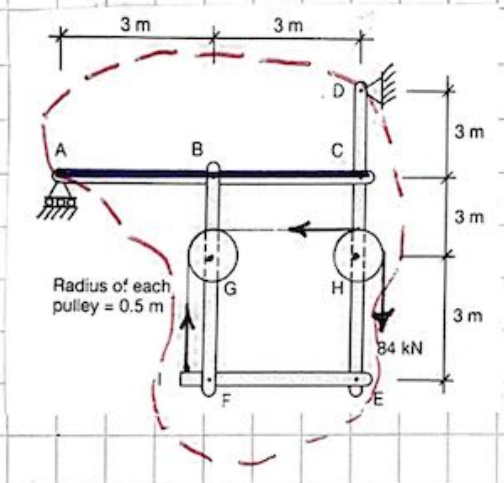
$\therefore A_x = 405\ kN \rightarrow$

$\Sigma F_y = 0 \therefore A_y = 0.8(57.94) = 46.3\ kN \uparrow$

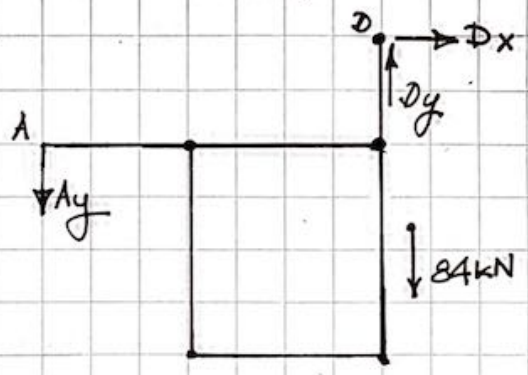
$\circlearrowleft \Sigma M_{@A} = 0 \Rightarrow M_A = 34.76(6) + 185.4(3) + 185.4(2)$

$\therefore M_A = 1135\ kNm \circlearrowright$

2019Q2.



- On a FBD of whole frame,

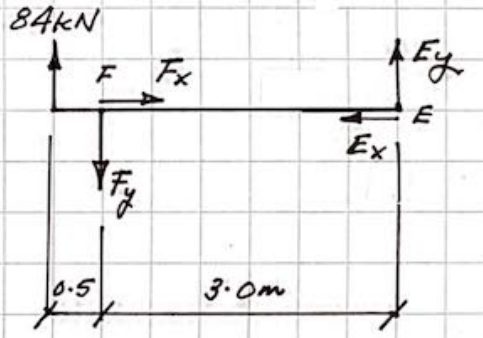


$\Sigma M_D = 0 \Rightarrow A_y(6) - 84(0.5) = 0 \therefore A_y = 7.00\ kN \downarrow$

$\Sigma F_y = 0 \Rightarrow D_y = 7.00 + 84.0\ kN = 91.00\ kN \uparrow$

$\Sigma F_x = 0 \Rightarrow D_x = 0.$

- On a FBD of member FE:



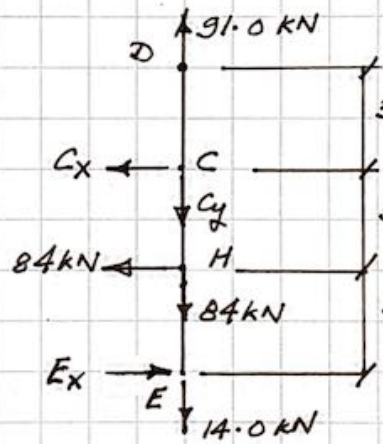
$\Sigma M_E = 0 \therefore F_y(3) - 84(3.5) = 0$

$\therefore F_y = 98.0\ kN \downarrow$

$\Sigma F_y = 0 \therefore E_y + 84 - 98 = 0$

$\therefore E_y = 14.0\ kN \uparrow$

- On a FBD of member DCHE,



$\Sigma M_C = 0$

$\therefore E_x(6) - 84(3) = 0$

$\therefore E_x = 42.0\ kN \rightarrow$

$\Sigma F_x = 0$

$\therefore 42 - 84 - C_x = 0$

$\therefore C_x = -42.0\ kN$

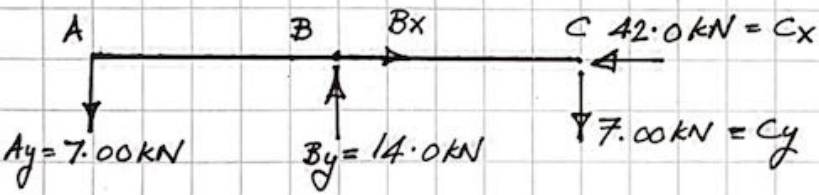
$\therefore C_x = 42.0\ kN \rightarrow$

$\Sigma F_y = 0 \therefore 91 - C_y - 84 - 14 = 0$

$\therefore C_y = -7.00\ kN$

$\therefore C_y = 7.00\ kN \uparrow$

- On a FBD of ABC:



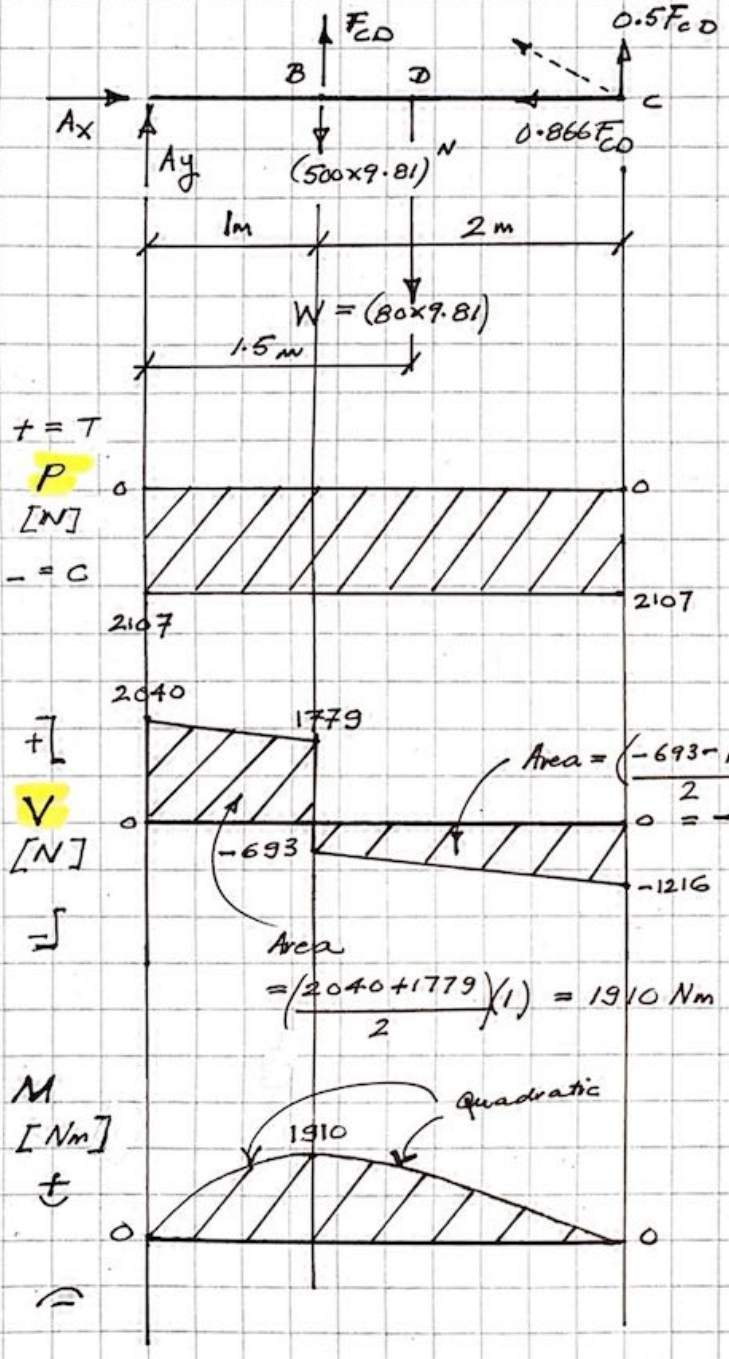
$\Sigma F_y = 0 \therefore B_y - 7.0 - 7.0 = 0$

$\therefore B_y = 14.0\ kN \uparrow$

$\Sigma F_x = 0 \therefore B_x - 42.0 = 0$

$\therefore B_x = 42.0\ kN \rightarrow$

2019 Q5. • On a FBD of Beam ABC:



$\Sigma M_A = 0 \therefore 0.5F_{CD}(3) + F_{CD}(1) - 4905(1) - 784.8(0.5) = 0$

$\therefore 2.5F_{CD} = 6082.20 \therefore F_{CD} = 2432.88\ N$

$\Sigma F_y = 0$

$\therefore A_y + 1.5(2432.88) - 580(9.81) = 0$

$\therefore A_y = 2040\ N \uparrow$ (2040.48)

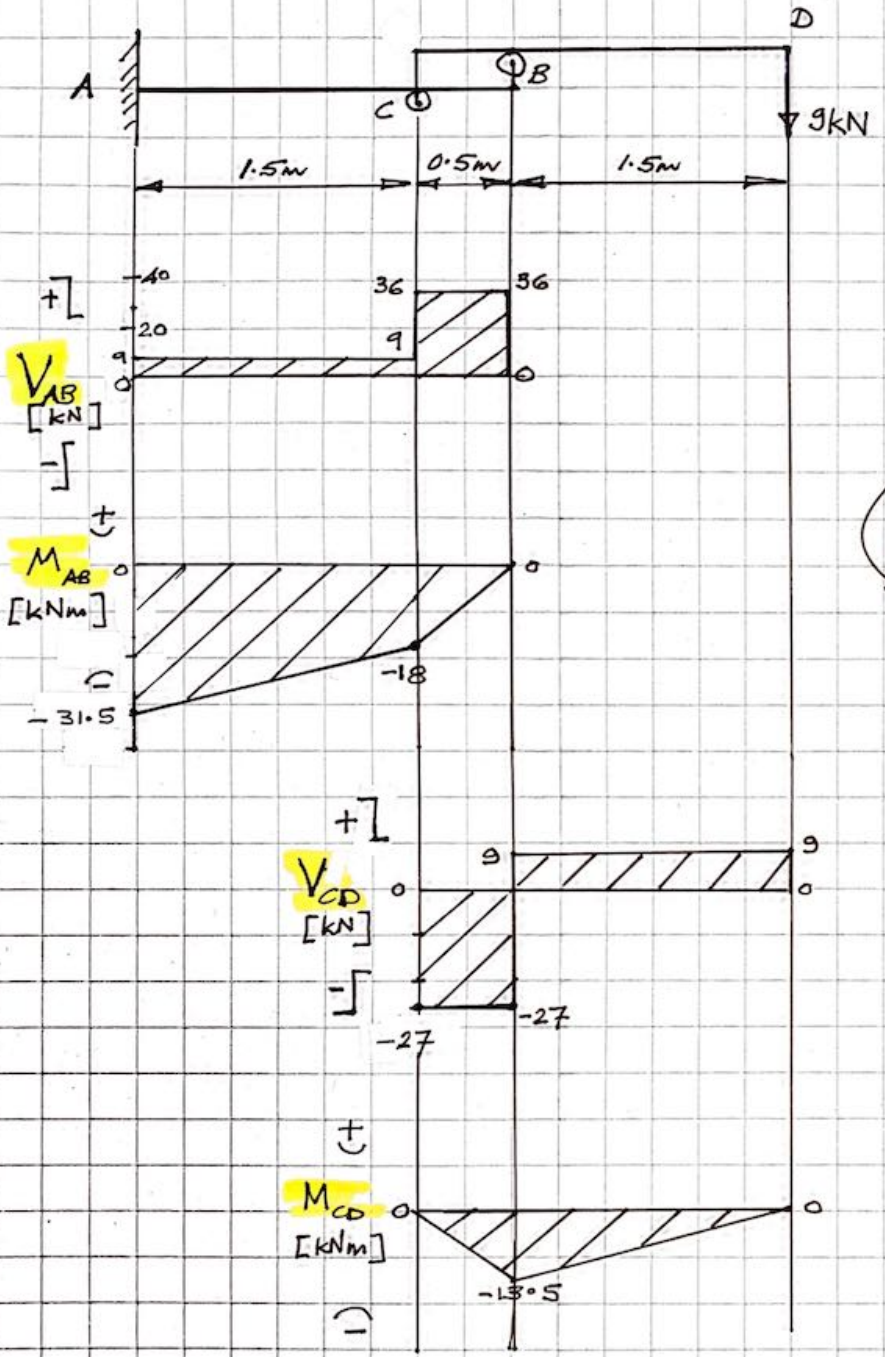
$\Sigma F_x = 0$

$\therefore A_x = 0.866(2432.88) = 2107\ N \rightarrow$

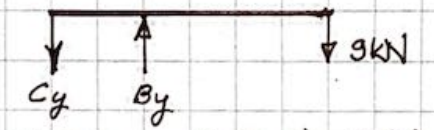
Beam weighs $\frac{(80\times 9.81)}{3}\ N/m = 261.6\ N/m$

$\therefore V_B = 2040.48 - 261.6 = 1778.9\ N$

2018 Q5.



FBD of CBD:



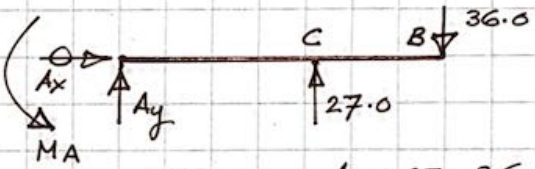
$\Sigma M_C = 0 \therefore By(0.5) - 9(2) = 0$

$\therefore By = 36.0\ kN \uparrow$

$\Sigma F_y = 0 \therefore 36 - 9 - Cy = 0$

$\therefore Cy = 27.0\ kN \downarrow$

FBD of ACB:



$\Sigma F_y = 0 \therefore Ay + 27 - 36 = 0$

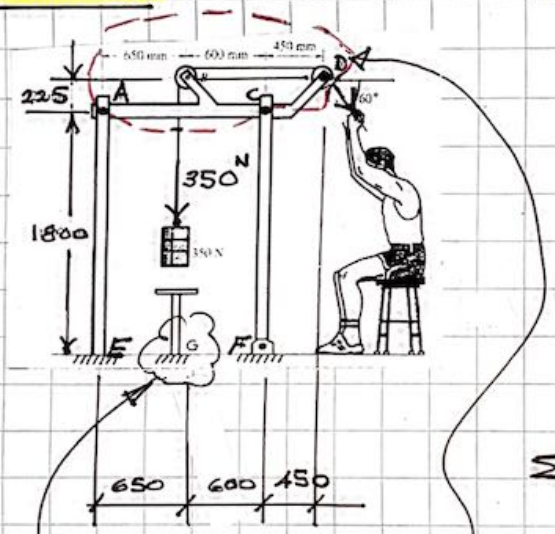
$\therefore Ay = 9.00\ kN \uparrow$

$\Sigma M_{@A} = 0$

$\therefore MA + 27.0(1.5) - 36.0(2) = 0$

$\therefore MA = 31.5\ kNm \circlearrowleft$

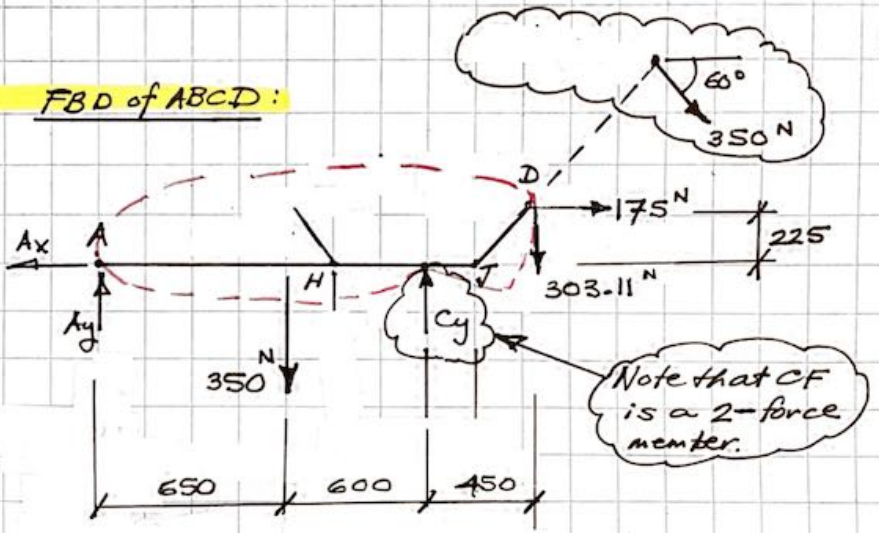
2018 Q3.



Cut rope just past the pulley.

No reaction forces @ G because this pedestal is not loaded

1. FBD of ABCD:



$\Sigma M_A = 0 \Rightarrow C_y(1250) - 350(650) - 303.11(1700) - 175(225) = 0$

$\therefore C_y = 625.7\ N \uparrow$

$\therefore F_{CF} = 625.7\ N$ Compression

$\therefore F_y = 626\ N \uparrow$

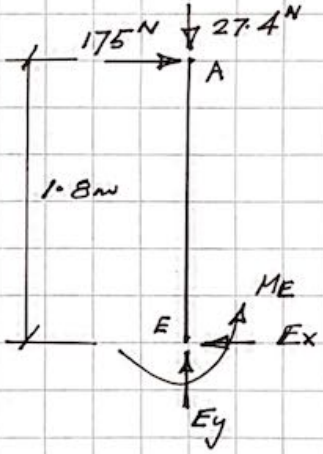
$\not\equiv F_x = 0$ (2-force member)

$\Sigma F_x = 0 \rightarrow A_x = 175^N \leftarrow$

$\Sigma f_y = 0 \rightarrow A_y - 350 + 625.7 - 303.11 = 0$

$\therefore A_y = 27.4^N \uparrow$

2. FBD of AE:



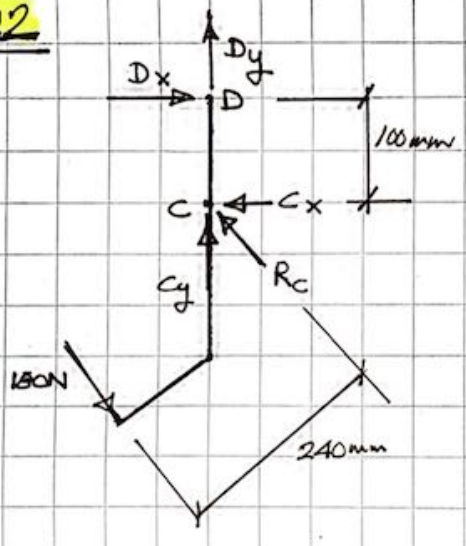
$\Sigma F_x = 0 \Rightarrow E_x = 175\ N \leftarrow$

$\Sigma F_y = 0 \Rightarrow E_y = 27.4N \uparrow$

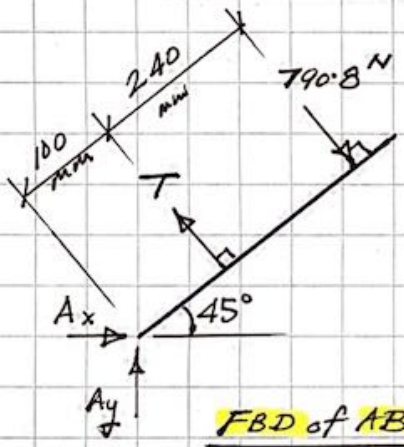
$\Sigma M_{@E} = 0 \Rightarrow M_E = 175(1.8)$

$= 315\ Nm$ ↻

2017 Q2



FBD of Pedal Lever.



FBD of ABC

$\Sigma M_C = 0 \quad \therefore 180(240) - D_x(100) = 0$

$\therefore \boxed{D_x = 432\ N \rightarrow}$

$\Sigma F_x = 0 \therefore 180\cos 45^\circ - C_x + 432 = 0$

$\therefore C_x = 559.3\ N \leftarrow$

$\therefore C_y = 559.3\ N \uparrow$

$\& R_C = 790.8\ N \nwarrow$

$\Sigma F_y = 0 \therefore D_y + 559.3 - 180\cos 45^\circ = 0$

$\therefore D_y = -432.0\ N$

$\boxed{\text{i.e. } D_y = 432\ N \downarrow}$

$\Sigma M_A = 0 \therefore T(100) - 790.8(340) = 0$

$\therefore T = 2688.7\ N$

i.e Tension in cable $= 2690\ N$

$\Sigma F_x = 0 \therefore A_x + 790.8\cos 45^\circ - 2688.7\cos 45^\circ = 0$

$\therefore A_x = 1901.2 - 559.2$

i.e $A_x = 1342\ N$

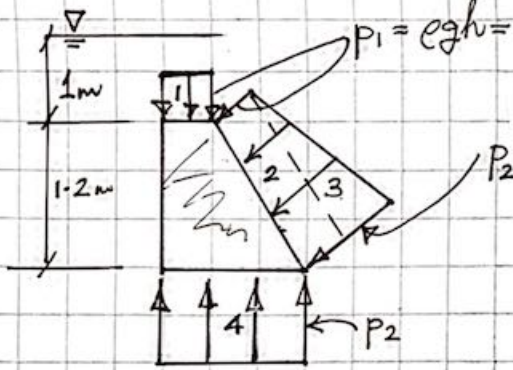
or $A_x = 1340\ N \rightarrow$

$\Sigma F_y = 0 \therefore A_y + 559.2 - 1901.2 = 0$

$\therefore A_y = 1342\ N$

or $A_y = 1340\ N \uparrow$

2017 Q3.

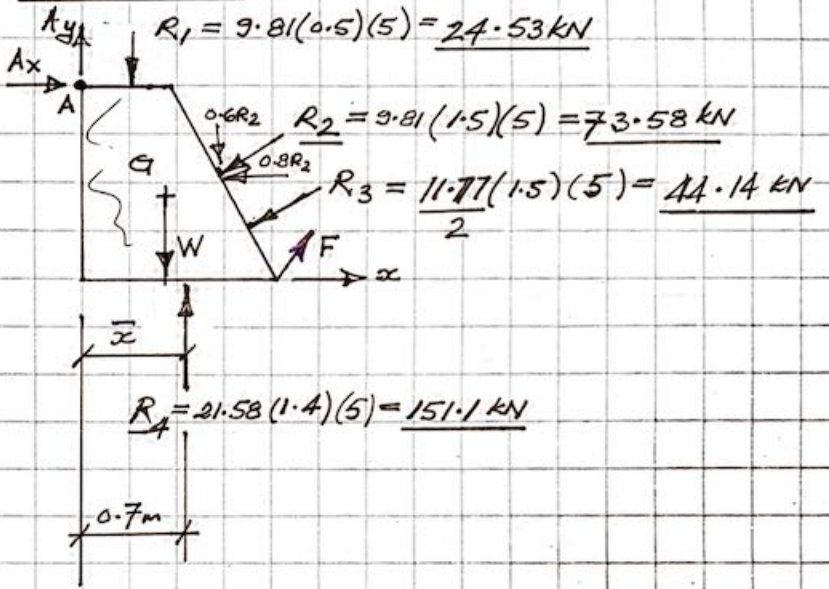


$P_1 = \rho g h = \frac{1000}{1000}(9.81)(1)\ kN/m^2 = 9.81\ kN/m^2$

$P_2\ (total) = \frac{1000}{1000}(9.81)(2.2) = 21.58\ kN/m^2$

Pressure Diagram

FBD of Gate:



- Where is the Mass Centre of the Gate? (Centroid)

$A\bar{x} = A_1\bar{x}_1 + A_2\bar{x}_2$

$\therefore 1.14\bar{x} = \underbrace{(1.2)(0.5)}_{A_1}(0.25) + \underbrace{(1.2)\left(\frac{0.9}{2}\right)}_{A_2}(0.8)$

$= 0.582$

$\therefore \bar{x} = 0.511\ m$

- On FBD of Gate, $\Sigma M_A = 0$

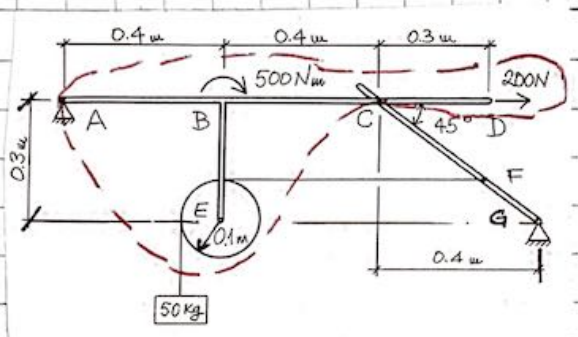
$\therefore +24.53(0.25) + 0.6(73.58)(0.95) + 0.8(73.58)(0.6) + 0.6(44.14)(1.1) + 0.8(44.14)(0.8)$

$+ \left(\frac{6300}{1000}\right)(9.81)(0.511) - 151.1(0.7) - \frac{1}{\sqrt{5}}F(1.2) - \frac{2}{\sqrt{5}}F(1.4) = 0$

$\therefore 66.58 = 1.789F$

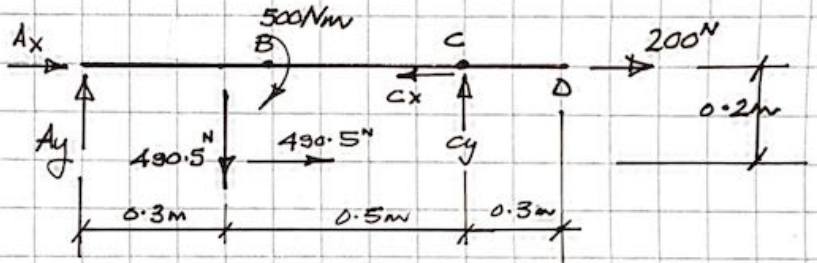
$\therefore F = 37.2\ kN\ (T)$

2015 Q5.



$= 490.5\ N$

• On a FBD as indicated, of ABCD:



$\Sigma M_A = 0$

$\therefore -490.5(0.3) - 500 + 490.5(0.2) + C_y(0.8) = 0$

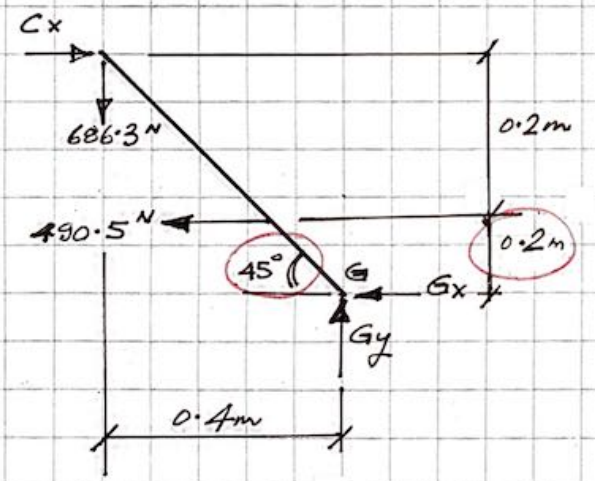
$\therefore \underline{C_y = 686.3\ N} \uparrow$

$\Sigma F_y = 0$

$\therefore A_y - 490.5 + 686.3 = 0 \quad \therefore A_y = -195.8\ N$

i.e. $\underline{A_y = 195.8\ N} \downarrow$

• On a FBD of CFG:



$\Sigma M_G = 0 \Rightarrow 490.5(0.2) + 686.3(0.4) - C_x(0.4) = 0$

$\therefore \underline{C_x = 931.6\ N} \rightarrow$

$\Sigma F_x = 0 \quad \therefore 931.6 - 490.5 - G_x = 0$

$\therefore \underline{G_x = 441\ N} \leftarrow$

$\Sigma F_y = 0 \quad \therefore \underline{G_y = 686\ N} \uparrow$

Reverting back to FBD of ABCD:

$\Sigma F_x = 0 \Rightarrow A_x + 490.5 - 931.6 + 200 = 0$

$\therefore A_x = 241\ N \rightarrow$

$\& \quad A_y = 196\ N \downarrow$