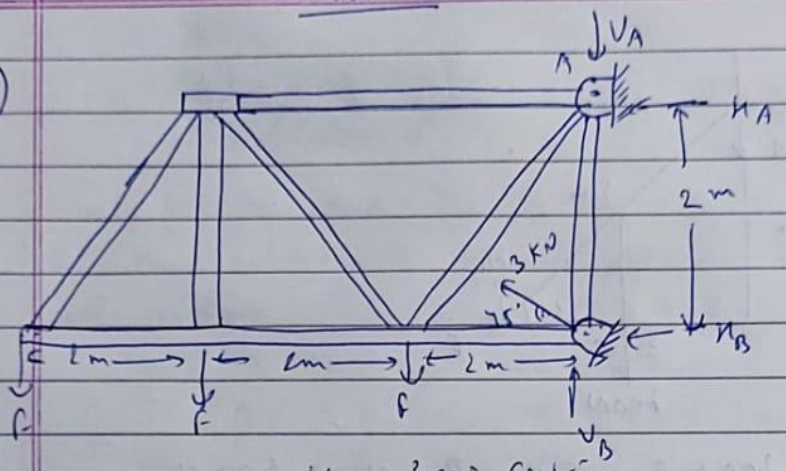
Tutorial - 4

1)



$H_B = 3000 \cos 45° = \frac{3000}{\sqrt{2}} = 2121.320$

$V_B = 3000 \sin 45° = 2121.320$

finding moment of A, $\Sigma M_A = 0$

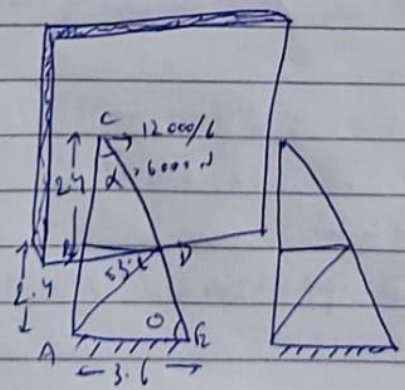
$\Sigma M_A = -2(H_B) + 2(F) + 4(F) + 6F$

$12F = 2H_B$

$F = \frac{H_B}{6} = \frac{3000}{\sqrt{2} \times 6} = 353.55\ N$

$F = 353.55\ N$

2)



Area of $\frac{1}{2}$ = 3 × 4

= 12 m^2

total force = 12 × 1 KN

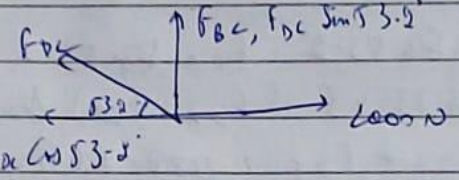
total force = 12000 N

Of High

$\tan\alpha = \frac{3.6}{4.8} \Rightarrow \alpha = \tan^{-1}\left(\frac{3.6}{4.8}\right) = 36.8^\circ$

$\Rightarrow \theta = 53.2^\circ$

FBD at C:



$\Sigma F_x = 0, \quad F_{DC}\cos 53.2^\circ = 2000$

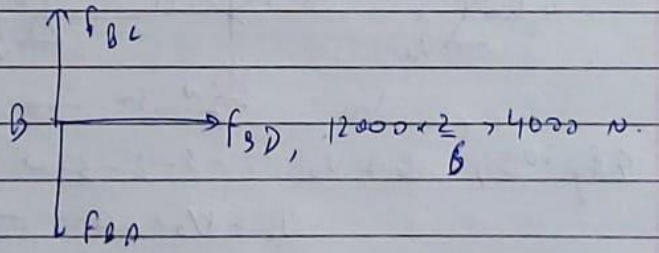
$F_{DC} = \frac{2000}{\cos 53.2^\circ} = 3338.767\ N.$

$\Sigma F_y = 0, \quad F_{BC} + F_{DC}\sin 53.2^\circ = 0$

$F_{BC} = -F_{DC}\sin 53.2^\circ$

$= -2673.45\ N.$

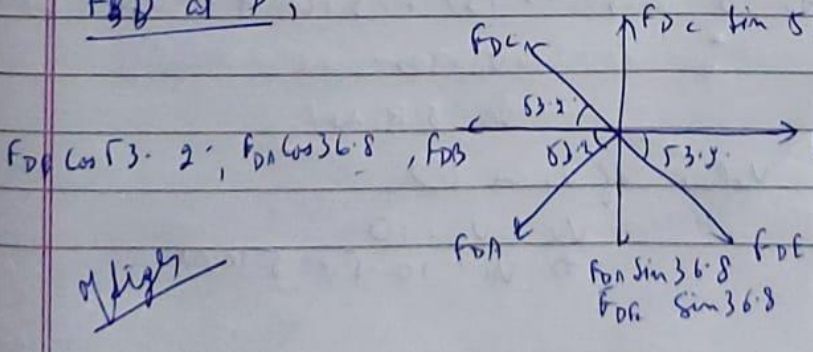
FBD at B.



$\Sigma F_x = 0, \quad F_{BD} = -4000\ N$

$\Sigma F_y = 0, \quad F_{BC} = F_{BA} = -2673.45\ N$

FBD at D,



$\Sigma F_x = 0$,

$F_{DC}\cos 53.2^\circ + F_{DA}\cos 53.2^\circ + F_{DB} = F_{DE}\cos 53.2^\circ$

$2000 + 4000 = F_{DE}\cos 53.2^\circ + F_{DA}\cos 53.2^\circ$

$\Sigma F_y = 0$,

$F_{DC}\sin 53.2^\circ = F_{DA}\sin 53.2^\circ + F_{DE}\sin 53.2^\circ$

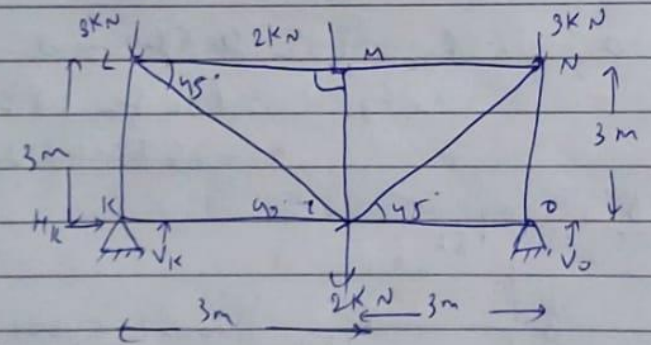
$2673.45 = (F_{DA} + F_{DE})\sin 53.2^\circ$

$F_{DA} + F_{DE} = 3338.767$

$F_{DE} - F_{DA} = 1006.299$

(2) $F_{DA} = -3338.76\,N$ $F_{DE} = 6677.533\,N$

3)



$\Sigma F_y = 0$; $V_K + V_O - 2 - 3 - 2 - 3 = 0$

$V_K + V_O = 10$ — (1)

$\Sigma F_x = 0$, $H_K = 0$

$\Sigma M_K = 0 \cdot 2(3) + 2(3) + 3(6) + (-V_O)(6) = 0$

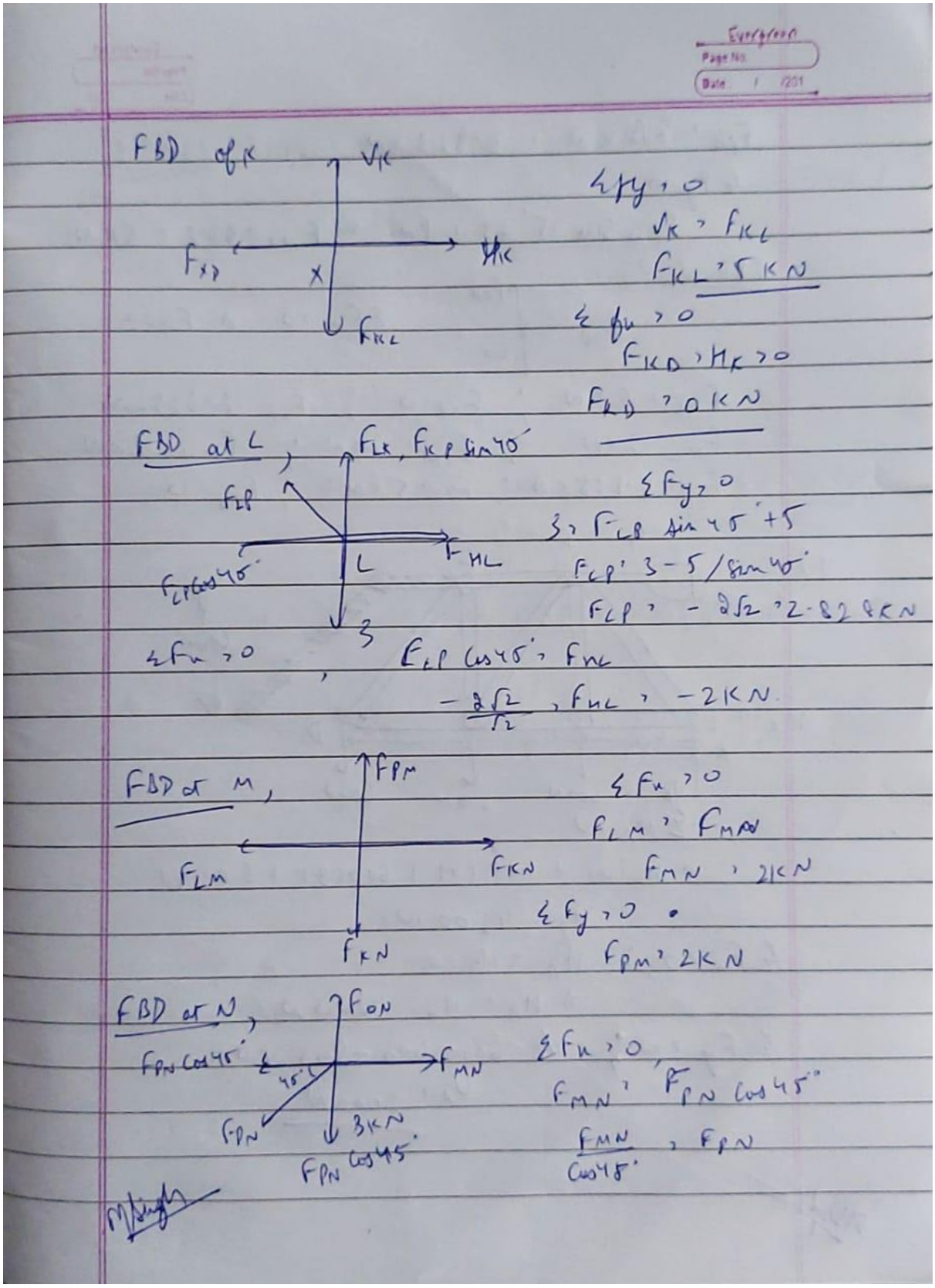
$\rightarrow 6V_O = 30$

$V_O = 5\,KN$

Put value of V_O in (1)

$V_K + V_O = 10$

$\Rightarrow V_K = 10 - 5 = 5\,KN$

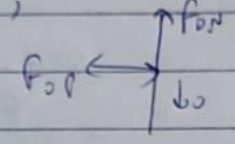

FBD of K
V_K
F_{KD}
H_K
F_{KL}
$\Sigma F_y = 0$
$V_K = F_{KL}$
$F_{KL} = 5\ KN$
$\Sigma F_x = 0$
$F_{KD} - H_K = 0$
$F_{KD} = 0\ KN$
FBD at L,
$F_{LK}, F_{LP}\sin 45°$
F_{LP}
$F_{LP}\cos 45°$
F_{HL}
L
$\Sigma F_y = 0$
$3 - F_{LP}\sin 45° + 5$
$F_{LP} = 3 - 5/\sin 45°$
$F_{LP} = -2\sqrt{2} = 2.82\ KN$
$\Sigma F_x = 0$
$F_{LP}\cos 45° = F_{HL}$
$-\frac{2\sqrt{2}}{\sqrt{2}}, F_{HL} = -2\ KN$
FBD at M,
F_{PM}
F_{LM}
F_{KN}
F_{KN}
$\Sigma F_x = 0$
$F_{LM} = F_{MN}$
$F_{MN} = 2\ KN$
$\Sigma F_y = 0$
$F_{PM} = 2\ KN$
FBD at N,
F_{ON}
$F_{PN}\cos 45°$
45°
F_{MN}
F_{PN}
3KN
$F_{PN}\cos 45°$
$\Sigma F_x = 0$
$F_{MN} = F_{PN}\cos 45°$
$\frac{F_{MN}}{\cos 45°} = F_{PN}$

$F_{PN} = 2\sqrt{2}\,kN = 2.828\,kN$

$\Sigma F_y = 0$

$F_{PN}\sin 45° + 3 = F_{NO} \Rightarrow F_{NO} = 3+2 = 5\,kN.$

FBD at O,



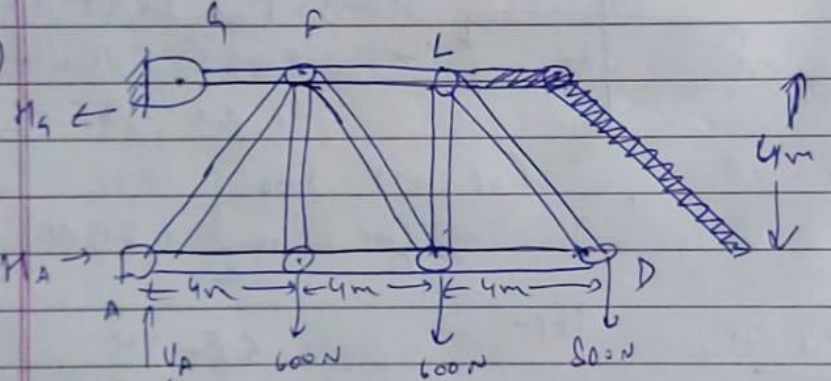
$\Sigma F_x = 0 \Rightarrow F_{OP} = 0$

$F_{KL} = 5\,kN$; $F_{KP} = 0$; $F_{LP} = 2.828\,kN$

$F_{ML} = 2\,kN$; $F_{PM} = 2\,kN$; $F_{MN} = 2\,kN$

$F_{PN} = 2.828\,kN$; $F_{NO} = 5\,kN$; $F_{PO} = 0$

4)



$\Sigma M_A = 0$

$-H_G(4) + 600(4) + 600(8) + 800(12)$

$H_G = 4200\,N.$

$\Sigma F_x = 0$; $H_A - H_G = 0$

$\Rightarrow H_A = H_G = 4200\,N$

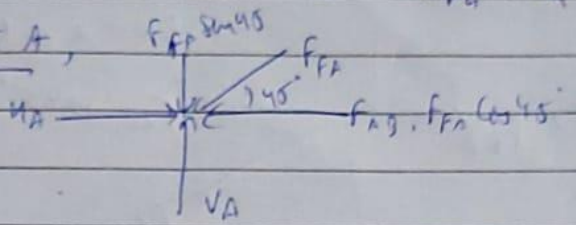
$\Sigma F_y = 0$; $V_A - 600 - 600 - 800 = 0$

$V_A = 2000\,N$

FBD at G, $H_G \leftarrow \quad \rightarrow F_{FG}$ $\quad \Sigma F_x = 0$

$F_{FG} = H_G = 4200\ N$ (Tensile)

FBD at A,



$\Sigma F_y = 0, \quad V_A = F_{FA}\sin 45°$

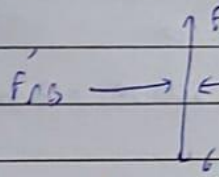
$2000 = F_{FA}\left(\frac{1}{\sqrt{2}}\right) \Rightarrow F_{FA} = 2000\sqrt{2}$

$= 2828.427\ N$ (compressive)

$\Sigma F_x = 0 \quad F_{AB} + F_{FA}\cos 45° = H_A$

$F_{AB} = 4200 - 2000 = 2200\ N$ (compressive)

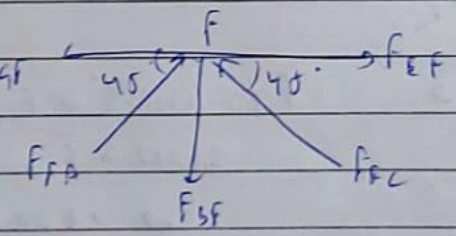
FBD at B,



$\Sigma F_y = 0 \Rightarrow F_{BF} = 600\ N$ (Tensile)

$\Sigma F_x = 0, \quad F_{AB} = F_{BC} = 2200\ N$ (compressive)

FBD at F,



$\Sigma F_y = 0$

$F_{BF} = F_{FA}\sin 45° + F_{FC}\sin 45°$

$600 - 2000 = F_{FC}\sin 45°$

$F_{FC} = -1400\sqrt{2} = -1979\ N$

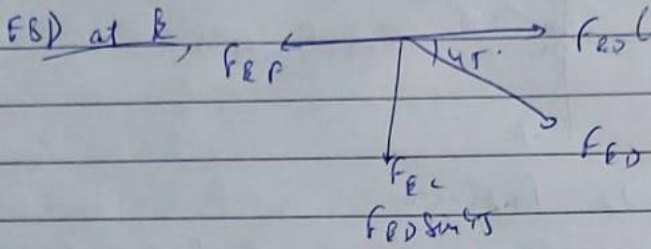
$= 1979\ N$ (Tensile)

$\Sigma F_x = 0$; $F_{FA}\cos 45^\circ + F_{EF} = F_{GF} + F_{FC}\cos 45^\circ$

$F_{EF} = 4200 - 1400 - 2000$

$= 800\,kN$ (Tensile)

FBD at E,



$\Sigma F_x = 0$; $F_{EF} = F_{ED}\cos 45^\circ$

$800\sqrt{2} = F_{ED}$

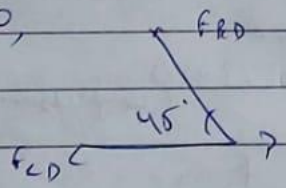
$F_{ED} = 800\sqrt{2}\,N = 1131.37\,N$ (Tensile)

$\Sigma F_y = 0$; $F_{EC} + F_{ED}\sin 45^\circ = 0$

$F_{EC} + 800 = 0$

$F_{EC} = -800\,N = 800\,N$ (compressive)

FBD at D,



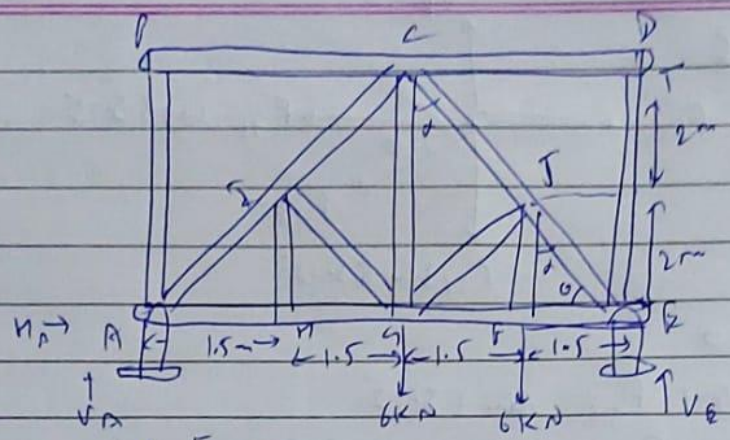
$\Sigma F_x = 0$; $F_{ED}\cos 45^\circ = F_{CD}$

$800\,N = F_{CD}$

$F_{CD} = 800\,N$ (compressive)

Evergreen
Page No.
Date : / /201

(5)



$\tan\theta = \frac{2}{1.5}$

$\theta = 53.13°$

$\alpha = 36.87°$

$\Sigma F_x = 0$

$H_A = 0$

$\Sigma F_y = 0 \Rightarrow V_A + V_E = 12$

$\Sigma M_A = 0$

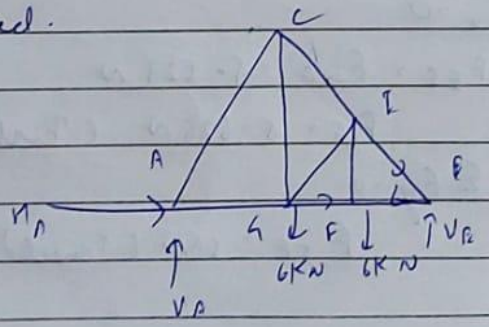
$6 \times 3 + 6 \times 4.5 - V_E \times 6 = 0$

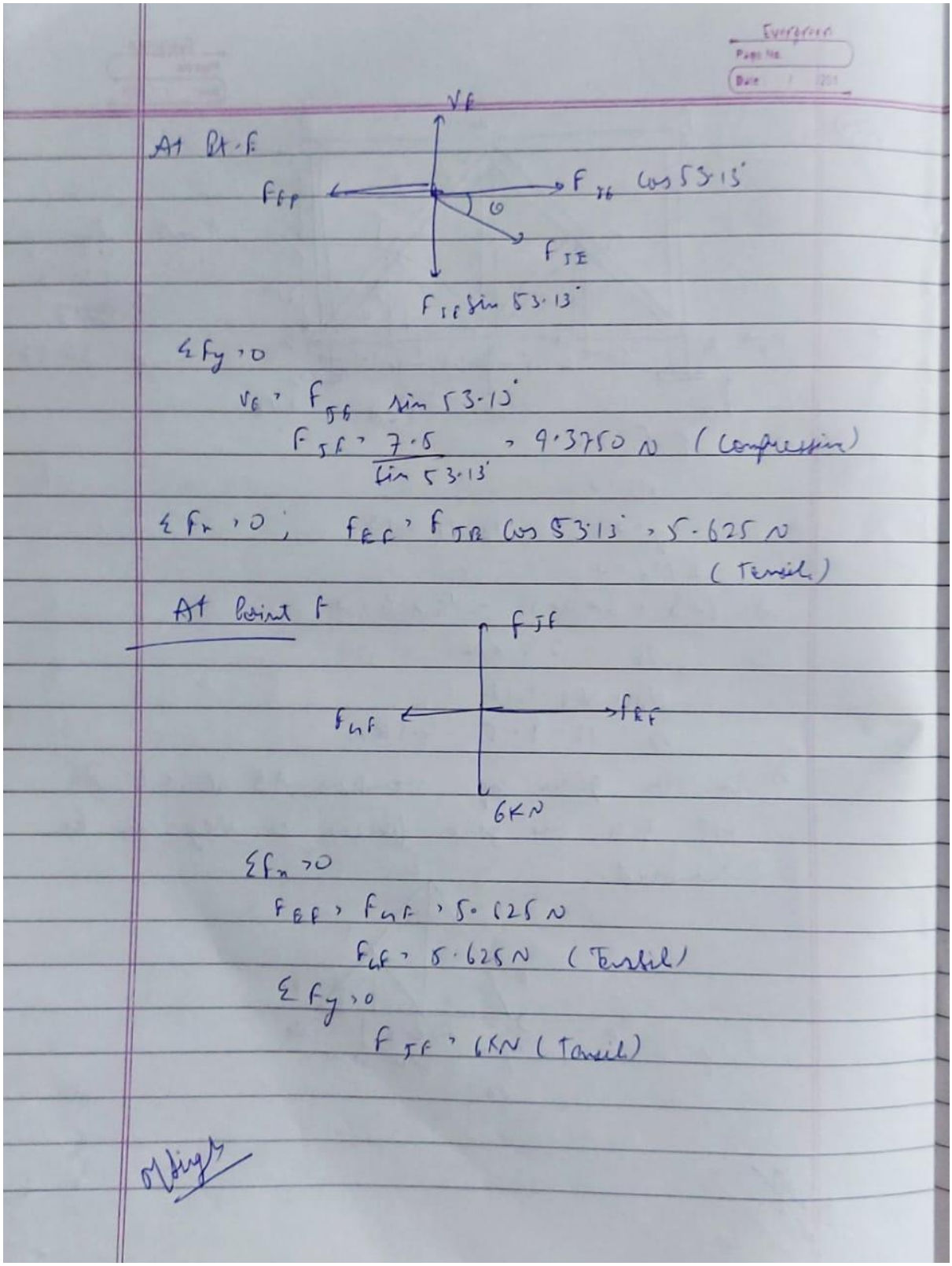
$V_E = 7.5\ KN$

$V_A + V_E = 12$

$V_A = 12 - 7.5 = 4.5\ KN$

2) In the given fig. members AB, BC, CD, DE, HI, FG are zero forces so they can be removed.




Everyday
Page No.
Date
At Pt. E
V_E
F_{EF}
$F_{JE}\cos 53.13^\circ$
θ
F_{JE}
$F_{JE}\sin 53.13^\circ$
$\Sigma F_y = 0$
$V_E = F_{JE}\sin 53.13^\circ$
$F_{JE} = \frac{7.5}{\sin 53.13^\circ} = 9.3750\ N$ (Compression)
$\Sigma F_x = 0$; $F_{EF} = F_{JE}\cos 53.13^\circ = 5.625\ N$
(Tensile)
At point F
F_{JF}
F_{GF}
F_{EF}
6KN
$\Sigma F_x = 0$
$F_{EF} = F_{GF} = 5.625\ N$
$F_{GF} = 5.625\ N$ (Tensile)
$\Sigma F_y = 0$
$F_{JF} = 6KN$ (Tensile)