SB/L02

21/05/23

smoth surface ত force apply করা হলে,

component : surface এর perpendicular

—

moment m :

—

rough surface ত components : 2 (equiv. hinge)

—

free body diagram

- body আলাদা করে sketch applied
- force indicator [dependency]

- own weight
- reactive forces

roller: 1 comp

hinge: 2 com

fixed: e 3 comp

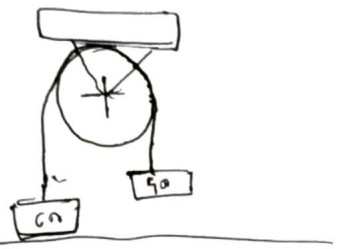
hand holding box

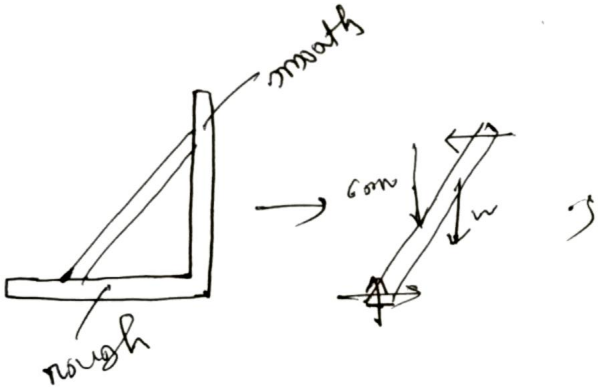




Free body diagram (FBD)





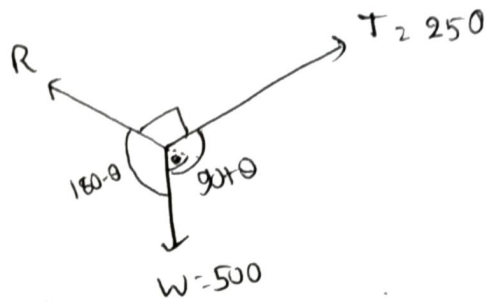


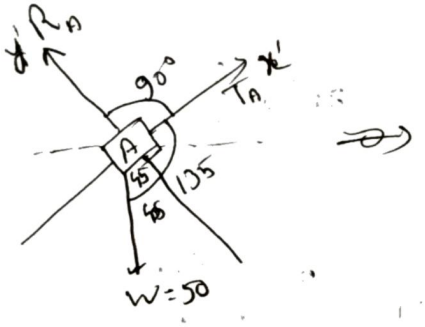
$\Sigma F_x \; (\xrightarrow{+})$

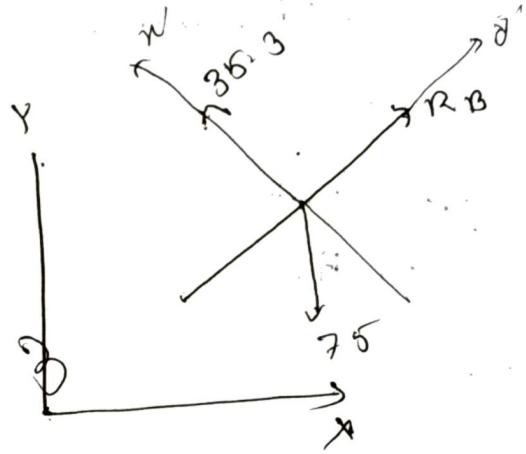
Σ

$R = 500 \cos\theta$

$500 = \frac{250}{\sin\theta}$







$\Sigma F_{x'} = 0$

$\Rightarrow T_A - 50 \sin 135^\circ = 0$

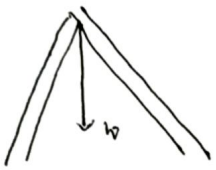
$\therefore T_A = 35.3$

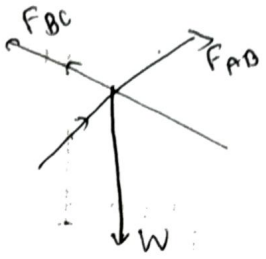
$\Sigma F_{y'} = 0$

$R_A - 500 \cos 45^\circ = 0$

$\therefore R_A =$

H.W / Prob 67, next page

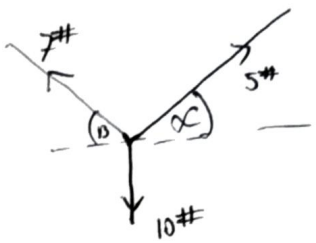




$\Sigma F_x = 0$

$\Rightarrow 5\cos\alpha - 7\cos\beta = 0$

$\Rightarrow 5\cos\alpha = 7\cos\beta$ — (i)



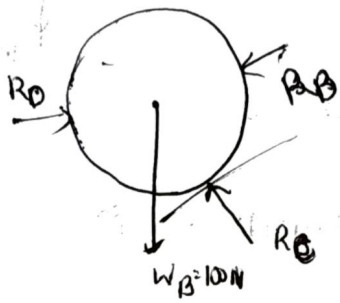
$\Sigma F_y = -10 + 5\sin\alpha + 7\sin\beta = 0$

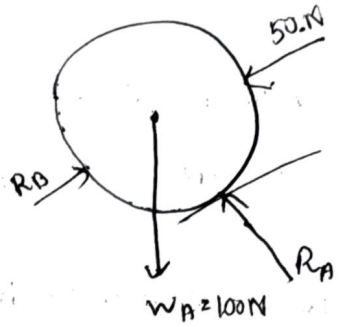
$\Rightarrow 5\sin\alpha = 10 - 7\sin\beta$ — (ii)

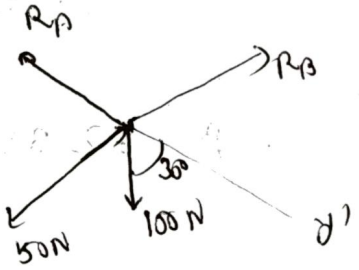
(i)^2 + (ii)^2 $\Rightarrow 25 = 49\cos^2\beta + 100 - 140\sin\beta + 49\sin^2\beta$

$= 49 + 100 - 140\sin\beta$

$\therefore \beta = 62.34°$







$\Sigma F_{y'} = 0$

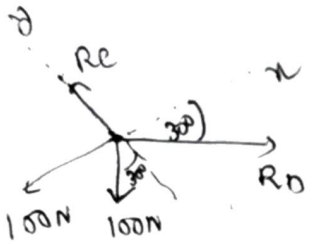
$\Rightarrow 100 \cos 30°$

$\Rightarrow R_B = 100 \cos 30°$

$= 86.6$

$\Sigma F_{x'} = -50 + R_B + 100 \cos 120° = 0$

$\therefore R_B = 100$



$\Sigma F_x = 0$

$\Rightarrow R_D \cos 30° - R_C 100 - 100 \cos 60° = 0$

$\therefore R_D = 173.2$

$\Sigma F_y = 0$

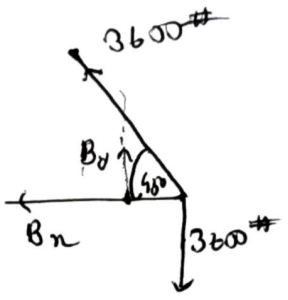
$\Rightarrow R_C - 100 \cos 30° - R_D \sin 30° = 0$

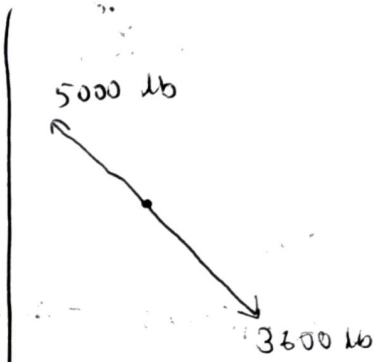
$\therefore R_C = 173.2$

$\Sigma F_x = 0$

$\Rightarrow -B_x - 3600 \cos 45^\circ = 0$

$\therefore B_x = -2545.6$





$\Sigma F_y = 0$

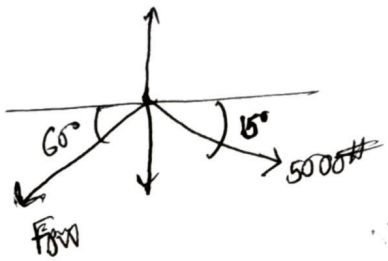
$\Rightarrow B_y + 3600 \cos 45^\circ = 3600$

$\therefore B_y =$ ---

SB

18/06/23

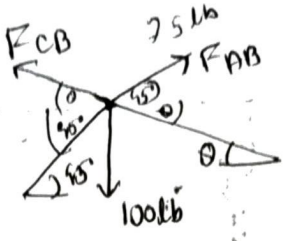
Moment, $M = Fd$



$\Sigma F_x = 0 \Rightarrow 5000 \cos 15° = F_{SW} \cos 60°$

$\therefore F_{SW} = 9659.26\#$

$\Sigma F_y = 0 \Rightarrow 5000 \sin 15° + 9659.26 \sin 60°$

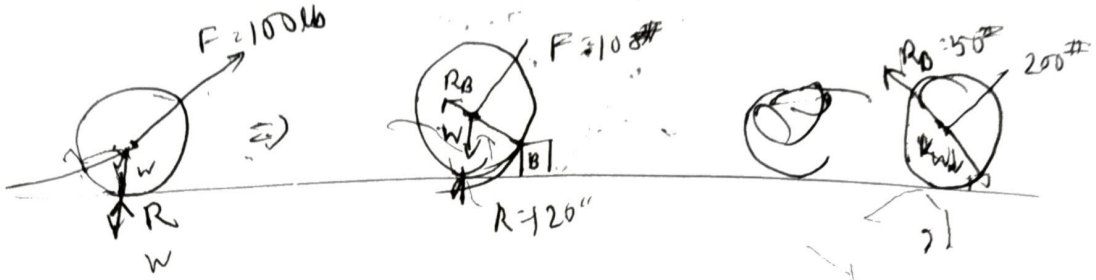


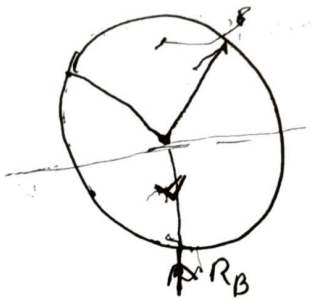
$\Sigma F_x = 0 \Rightarrow F_{CB} \cos\theta = 75 \cos 45°$ ——— (I)

$\Sigma F_y = 0 \quad F_{CB} \sin\theta = 75 \sin 45° = 100$

$\Rightarrow F_{CB} \sin\theta =$ ——— (II)

$(I)^2 + (II)^2 \Rightarrow \ldots$





(b)

$8 \times 150 - 10 \times F \sin 60^\circ = 0$

SB

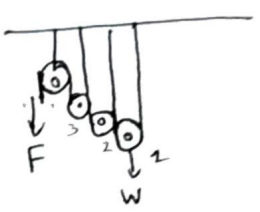
09/07/23

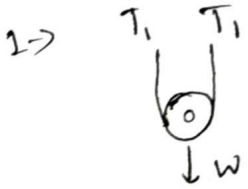
217

From 1:

$\Sigma F_y = 0 \Rightarrow 2T_1 = W$

$T_1 = \frac{W}{2}$





From 2:

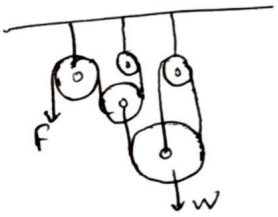
$T_2 = \frac{W}{4}$

From 3:

$T_3 = \frac{W}{8} = F$

$T_1 = W/3$

$T_2 = \frac{W}{9} = F$





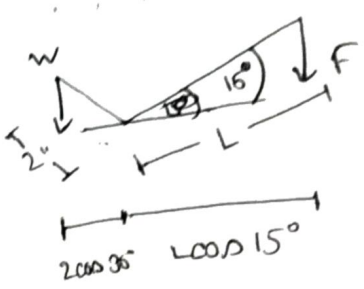
CHAP III / Moments and Parallel Coplanar Forces

$M = F \times d$ → shortest distance from line of action → perpendicular

185, 187, 188, 191, 213, 183

189/

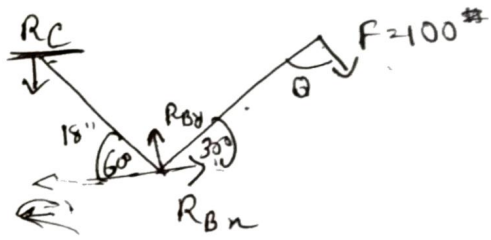
$\Sigma m_o = 0 \Rightarrow L = 36''$



99.

$\Sigma F_x = 0 \Rightarrow R_{Bx} + 100 \sin 30° = 0$

$\therefore R_{Bx} = -50^{\#}$ (←)



$\Sigma F_y = 0 \Rightarrow R_{By} - R_C - F \sin 60° = 0$

$R_{By} - R_C = 86.6^{\#}$

$\Sigma M_B = 0 \Rightarrow 26 \times F - 18 \cos 60° \times R_C = 0$ C/w +

$\Rightarrow R_C = 288.9^{\#}$

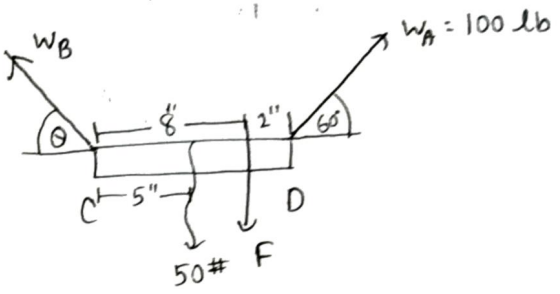
$\therefore R_{By} = 375.6^{\#}$

$\therefore R_B = \sqrt{(R_{By})^2 + (R_{Bx})^2} = 379^{\#}$

263.

$\Sigma F_y = 0$

$\Rightarrow W_B \sin\theta + 100 \sin 60° = F + 50$ — ①



$\Sigma M_C = 0$

$\Rightarrow 5 \times 50 + 8 \times F - 10 \times 100 \sin 60° = 0$

$\Rightarrow F = 77\#$

$\Sigma F_x = 0$

$\Rightarrow - W_B \cos\theta + 100 \cos 60° = 0$

$\therefore W_B \cos\theta = 50$ — (ii)

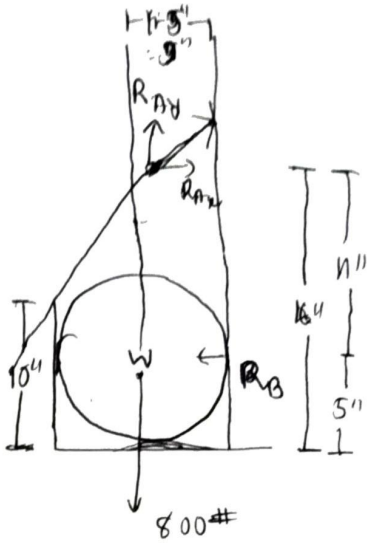
① $\Rightarrow W_B \sin\theta + 100 \sin 60° = 77 + 50$

$\therefore W_B \sin\theta = 49.4$ — (iii)

$W_B^2 = 50^2 + 49.4^2$

$\therefore W_B = \ldots$

265.



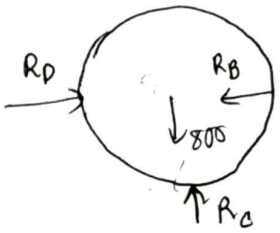
$\Sigma M_A = 0$

$\Rightarrow 11 \times R_B - 9 \times 800 = 0$

$\therefore R_B = 654.54\#$

$\Sigma F_x = 0$

$\Rightarrow R_D = R_B = 654.54\#$



$\Sigma F_y = 0$

$\Rightarrow R_C = 800\#$

$\Sigma F_x = 0$

$R_{Ax} - R_B = 0$

$\therefore R_{Ax} = R_B = 654.54\#$

Midterm syllabus: prev class

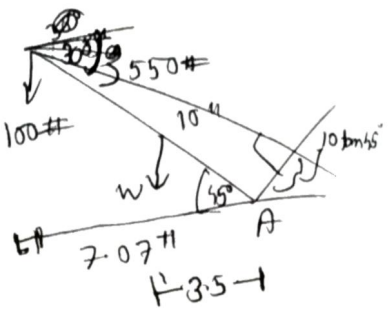
Worked out pb: 46, 47, 49

252

$\Sigma M_A = -3.5 \times 75 - 100 \times 7.07 - 550 \sin 30^\circ \times 7.07$

$+ 550 \cos 30^\circ \times 7.07$

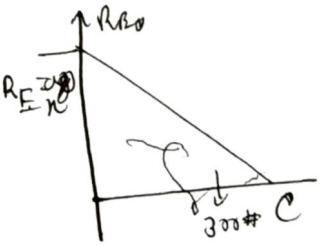
$= +45.3$ lb



255

271

$-T_{BC} \sin 30^\circ \times 60 + R_{Ay} - 300 = 0$

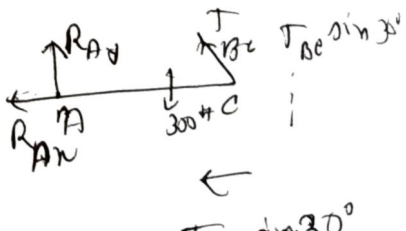


$\Rightarrow \dots$

$\Sigma F_x = 0$

$-R_{Ax} - 450 \cos 30^\circ = 0$

$\therefore R_{Ax} = \dots$



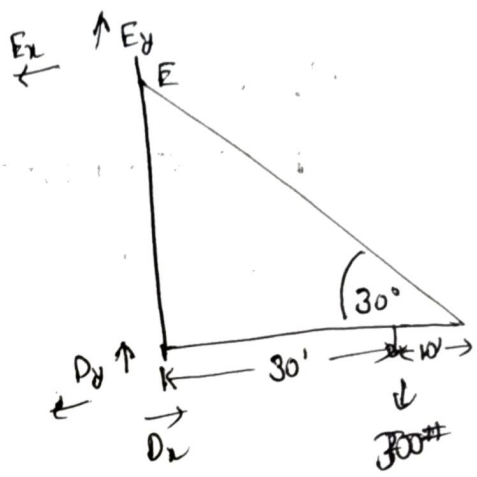
$\Sigma F_y = 0 \Rightarrow R_{Ay} + 450 \sin 30^\circ - 300 = 0$

$\therefore R_{Ay} = 75$# (↑)

SB

23/07/23

271/



$\Sigma M_D = 0$

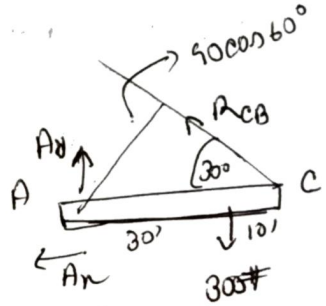
$\Rightarrow -E_x + 300 = 0$

$\therefore E_x = 300\#$

~~$\Sigma M_E = 0$~~ $\Sigma F_y = 0$

$\Rightarrow D_y + E_y = 300\# \Rightarrow D_y = 300\#$

$(E_y = 0)$



$\Sigma M_A = 0 \Rightarrow 30 \times 300 = 90\, R_{CB} \sin 30°$

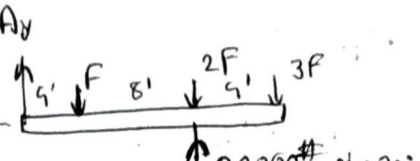
$\therefore R_{CB} = 450\#$

$\Sigma M_C = 0 \Rightarrow A_y = \dfrac{300 \times 10}{90} = 75\#$

273/ a)

$\Sigma m_A = 0$

$\Rightarrow 4F + 12 \times 2F + 16 \times 3F = 30000 \sin 30 \times 12$



$\therefore F = 2368.42^{\#}$

b)

$\Sigma F_y = 0 \Rightarrow 6F + A_y = 30000 \sin 30°$

$\therefore A_y = 789.48^{\#}$

$\Sigma F_x = 0 \Rightarrow A_x = 30000 \cos 30°$

$= 25980.76^{\#}$

2771

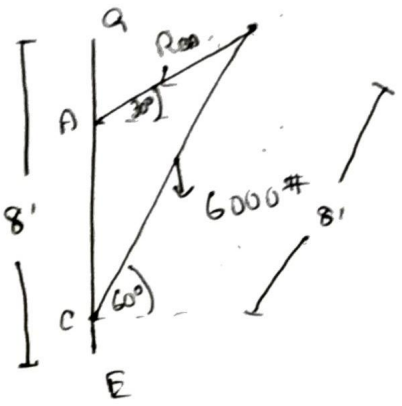
a)

$\Sigma M_E = 0 \Rightarrow 8 G_x = 6000 \times 8 \cos 60$

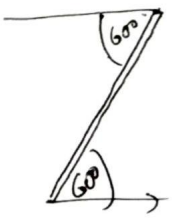
$\therefore G_x = 3000\#$

$\Sigma M_G = 0 \Rightarrow 8 E_x = 6000 \times 8 \cos 60$

$\therefore E_x = 3000\#$



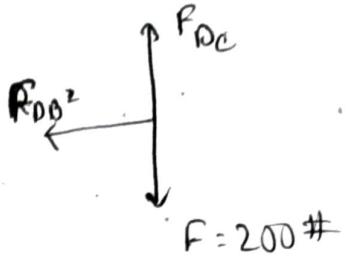
b)



282/

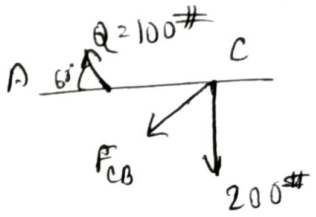
$\Sigma F_x = 0$

$\Rightarrow F_{DB} = 0$



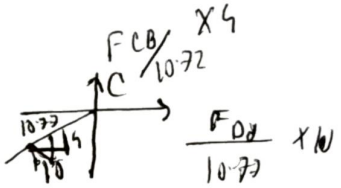
$\Sigma F_y = 0$

$\Rightarrow F_{DC} = 200^{\#}$



$\Sigma M_A = 0$

$\Rightarrow 100 \sin 60° \times 3 + \ldots$



SB

30/07/23

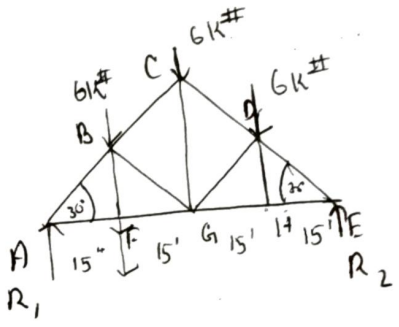
Truss

tension, compression

best to assume tension

point method, section method

291/



$\Sigma M_A = 0$

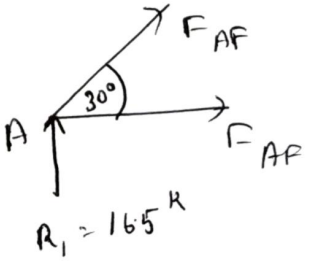
$\Rightarrow$ ...

$\Rightarrow R_1 =$ ...

$\Sigma F_y = 0$

$\Rightarrow R_1 + R_2 = (6+6+6) \times 10^3$

$\therefore R_2 =$ ...



$\Sigma F_y = 0$

$\Rightarrow F_{AB} \sin 30° + 16.5 = 0$

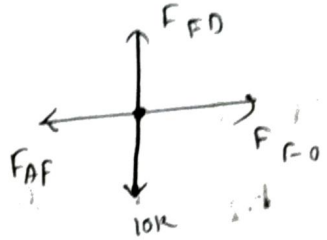
$\therefore F_{AB} =$ ... (C)

$\Sigma F_x = 0 \Rightarrow F_{AB} \cos 30° + F_{AF} = 0$

$\therefore F_{AF} =$ ... (T)

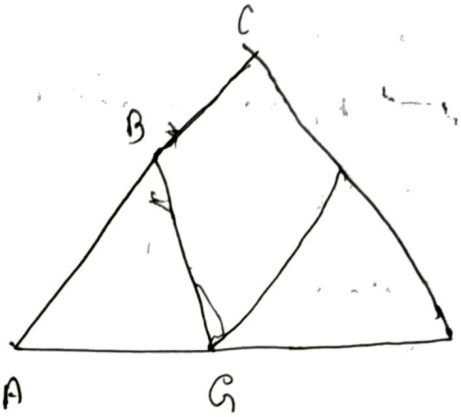
$\Sigma F_y = 0$:)

$\Sigma F_x = 0$ ⇉



Section method

Σ



205)

$\Sigma F_x = 0$

$\Rightarrow A_x + F_3 \cos 60° + F_1 = 0$

$\therefore A_x = - -$

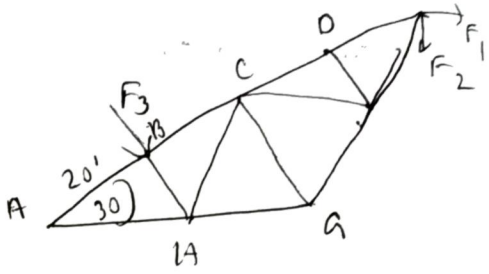
$F_y = 0$

$\Rightarrow A_y + F_3 \sin 60° = F_2$

$\Rightarrow A_y = \cdots$

$\Sigma M_z = 0$

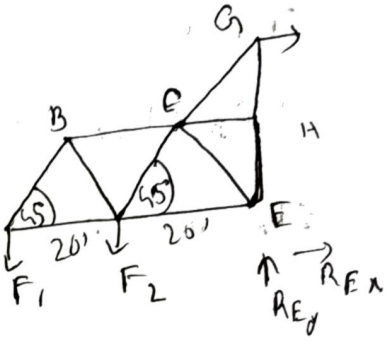
$\Rightarrow$



209/

$\Sigma M_g = 0 \Rightarrow -40 \times 1000 - 20 \times 5000 + R_{Ex} = 0$

$\Rightarrow R_{Ex} =$



Σ

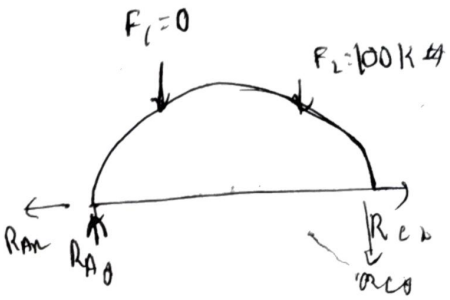
310, 311, 315, 317, 320, 332

332)

$\Sigma F_y = 0$

$\Rightarrow R_{Ay} + R_{Cy} = 100K$

$\Sigma F_x = 0 \Rightarrow -R_x + R_{Cx} = 0$

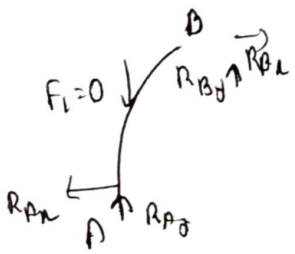


$\Sigma M_A = 0$

$\Rightarrow$

$\Sigma F_y = 0$

$\Rightarrow$



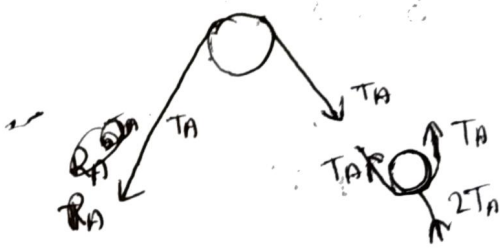
06/08/23

SB

Friction



426/



$R_A = 400 \sin 30^\circ = 200\#$

$T_A = \frac{1}{3} \times 400 \cos 30 + 200$

$= 315.47\#$

$2T_A + F_B = W_B \cos 15^\circ$

2) ---

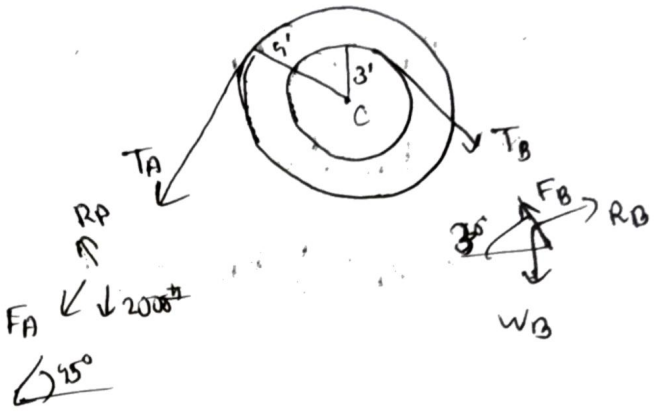
432/

$T_A = F_A + 2000 \sin 45°$

$= f_A \times R_A + 2000 \sin 45°$

$= \frac{1}{3} \times 2000 \cos 45° + 2000 \sin 45°$

$= 1886^{\#}$



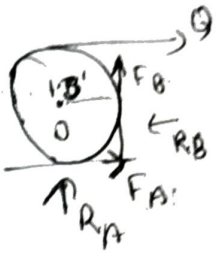
$\Sigma M_C = 0 \Rightarrow 5T_A = 3T_B$

$\Rightarrow T_B = 2515^{\#}$

$\Rightarrow W_B \sin 30° - W_B \cos 30° \times 0.15 = 2515$

$\therefore W_B = 6796^{\#}$

433/



$Q = R_B = F_A$ ~~R_B~~ — (i)

$300 = R_A + F_B$

$= R_A + \frac{1}{3} R_B$ — (ii)

$\Sigma M_0 = 0 \Rightarrow Q = F_A + F_B$ — (iii)

$= \frac{1}{3}(R_A + R_B)$

437.

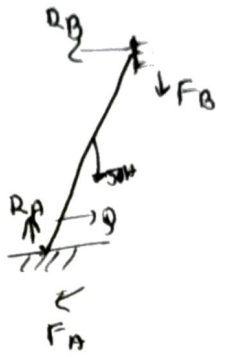
$\Sigma F_x = 0 \Rightarrow F_A + R_B = 0$

$\Rightarrow 0.2R_B + R_B = 0$

439

$\Sigma F_y = 0 \Rightarrow R_A - F_B = 500$

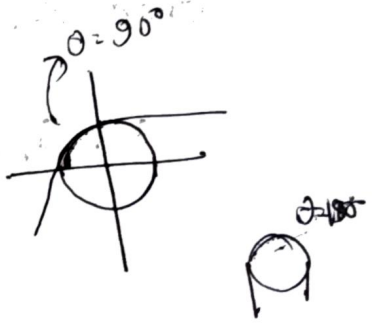
$\Rightarrow R_A - 0.3R_B = 500$



Belt Friction

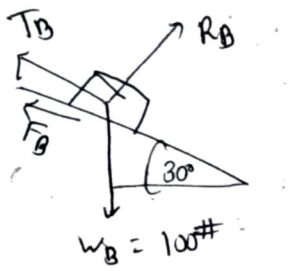
$T_1 = T_2 e^{f\theta}$ → contact area

θ is in radian



462, 464.

964/



$R_B = 1000 \cos 30^\circ$

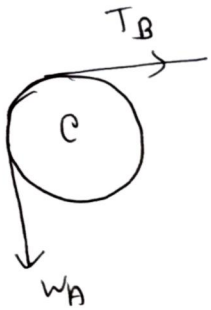
$= 86.6^{\#}$

$F_B = \mu_B \times R_B = 173^{\#}$



$T_B = W_B \sin 30^\circ - F_B$

$= 32.67^{\#}$



$T_B = W_A e^{\mu_C \theta}$

$= W_A e^{\frac{1}{\pi} \frac{\pi}{2}}$

$\therefore W_A = 19.8^{\#}$

$F_A \times \frac{6}{7} = 600^{\#}$

Fig. 292, 293, 294, 322

Example 17

Prob. 622, 612