

$$\begin{array}{l} 2/1 \\ \left\{ \begin{array}{l} F_x = -800 \sin 35^\circ = -459 \text{ N} \\ F_y = 800 \cos 35^\circ = 655 \text{ N} \end{array} \right. \end{array}$$

$$\underline{\underline{F = -459\mathbf{i} + 655\mathbf{j} \text{ N}}}$$

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$$\frac{2}{2} \left\{ \begin{array}{l} \underline{F} = 7(-\sin 25^\circ \underline{i} + \cos 25^\circ \underline{j}) \\ \underline{F} = -2.96 \underline{i} + 6.34 \underline{j} \text{ kN} \end{array} \right.$$

* SCALAR COMPONENTS

$$\left\{ \begin{array}{l} \underline{F}_x = -2.96 \text{ kN} \\ \underline{F}_y = 6.34 \text{ kN} \end{array} \right.$$

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2/3

$$\underline{F} = 6.5 \left(-\frac{12}{13} \underline{i} - \frac{5}{13} \underline{j} \right) \\ = -6 \underline{i} - 2.5 \underline{j} \text{ kN}$$

(Note: Writing 6, rather than 6.00, indicates an exact result.)

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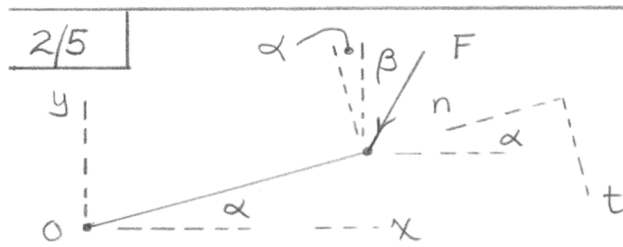
2/4

$$\underline{n} = \frac{13\underline{i} - 15\underline{j}}{\sqrt{13^2 + 15^2}} \rightarrow \underline{n} = 0.655\underline{i} - 0.756\underline{j}$$

• SCALAR COMPONENTS:

$$\begin{cases} F_x = F_{n_x} = 6(0.655) \rightarrow \underline{F_x = 3.93 \text{ kN}} \\ F_y = F_{n_y} = 6(-0.756) \rightarrow \underline{F_y = -4.53 \text{ kN}} \end{cases}$$

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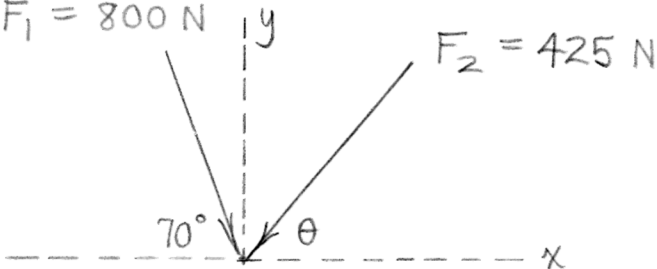


$$\begin{cases} F_x = -F \sin \beta \\ F_y = -F \cos \beta \end{cases}$$

$$\begin{cases} F_n = F \sin (\alpha + \beta) \\ F_t = F \cos (\alpha + \beta) \end{cases}$$

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2/6



$F_1 = 800 \text{ N}$ $F_2 = 425 \text{ N}$

70° θ

x y

$$R_x = \sum F_x = 800 \cos 70^\circ - 425 \cos \theta = 0$$
$$\theta = 49.9^\circ$$
$$R_y = \sum F_y = -800 \sin 70^\circ - 425 \sin 49.9^\circ$$
$$= -1077 \text{ N}$$

So $R = 1077 \text{ N}$

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2/7

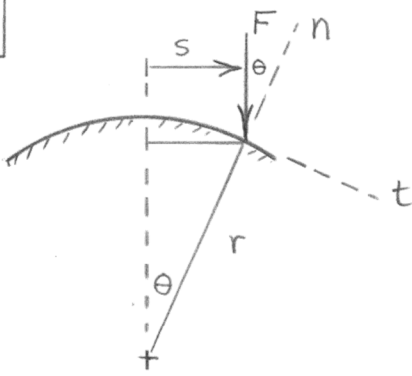
$$\begin{cases} \underline{R} = (500 + 350 \cos 60^\circ) \underline{i} + 350 \sin 60^\circ \underline{j} \\ \underline{R} = 675 \underline{i} + 303 \underline{j} \text{ N} \end{cases}$$

$$R = \sqrt{675^2 + 303^2} \longrightarrow \underline{R = 740 \text{ N}}$$

$$\theta_x = \cos^{-1} \left(\frac{R_x}{R} \right) = \cos^{-1} \left(\frac{675}{740} \right) \longrightarrow \underline{\theta_x = 24.2^\circ \text{ ABOVE } +X \text{ AXIS}}$$

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2/8



$$\theta = \sin^{-1}\left(\frac{s}{r}\right)$$

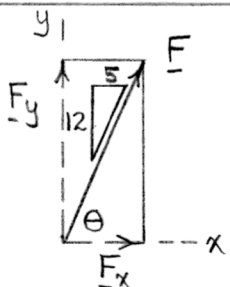
$$F_t = F \sin \theta = F \sin \left[\sin^{-1}\left(\frac{s}{r}\right) \right] = \underline{\underline{\frac{Fs}{r}}}$$

$$F_n = -F \cos \theta = -F \cos \left[\sin^{-1}\left(\frac{s}{r}\right) \right]$$

$$= - \underline{\underline{\frac{F\sqrt{r^2 - s^2}}{r}}}$$

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2/9



$\cos \theta = \frac{5}{13}, \sin \theta = \frac{12}{13}$

$F_y = F \sin \theta = F \frac{12}{13} = 320 \text{ N}$

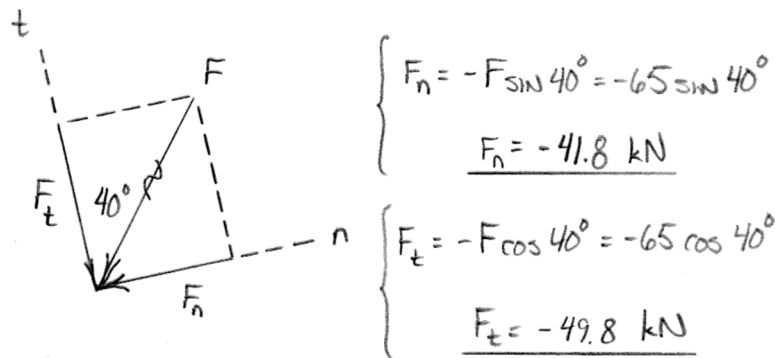
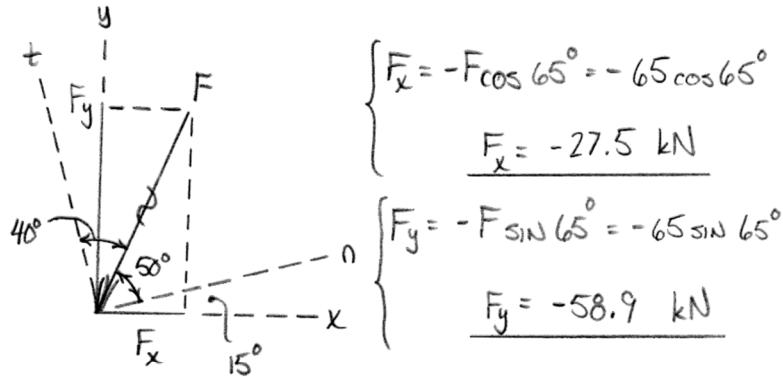
$F = 347 \text{ N}$

$F_x = F \cos \theta = 347 \left(\frac{5}{13} \right) = 133.3 \text{ N}$

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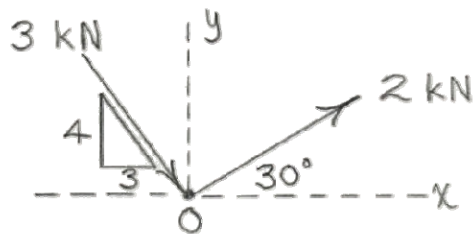
2/10

$F = 65 \text{ kN}$



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2/11



$$\begin{aligned} R_x &= \sum F_x = +3\left(\frac{3}{5}\right) + 2 \cos 30^\circ = 3.53 \text{ kN} \\ R_y &= \sum F_y = -3\left(\frac{4}{5}\right) + 2 \sin 30^\circ = -1.4 \text{ kN} \\ R &= \sqrt{R_x^2 + R_y^2} = 3.80 \text{ kN} \\ \theta &= \tan^{-1}\left(\frac{R_y}{R_x}\right) = \tan^{-1}\left(\frac{-1.4}{3.53}\right) = 338^\circ \\ &\quad \text{(or } -21.6^\circ) \end{aligned}$$

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2/12

$$\begin{cases} \alpha = \tan^{-1} \frac{40}{50} = 38.7^\circ \\ \beta = \tan^{-1} \frac{50}{30} = 59.0^\circ \end{cases}$$

$$\gamma = 180^\circ - \alpha - \beta = 82.3^\circ$$

$$\frac{\sin \beta}{8} = \frac{\sin \alpha}{T}$$

$$\underline{T = 5.83 \text{ kN}}$$

$$\frac{\sin \beta}{8} = \frac{\sin \gamma}{R}, \quad \underline{R = 9.25 \text{ kN}}$$

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2/13

$$R_x = \sum F_x = 400 + 400 \cos 60^\circ = 600 \text{ N}$$

$$R_y = \sum F_y = 400 \sin 60^\circ = 346 \text{ N}$$

$$\Rightarrow \underline{R} = \underline{600 \text{ i} + 346 \text{ j} \text{ N}}$$

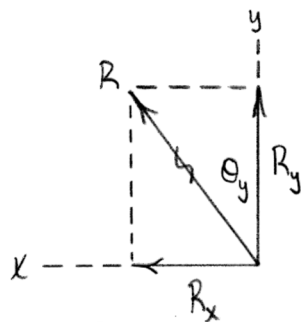
$$R = \sqrt{600^2 + 346^2} = \underline{693 \text{ N}}$$

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2/14

$$\underline{R} = (175 \cos 40^\circ + 125 \sin 15^\circ) \underline{i} + (175 \sin 40^\circ + 125 \cos 15^\circ) \underline{j}$$

$$\underline{R} = 166.4 \underline{i} + 233 \underline{j} \text{ N}$$

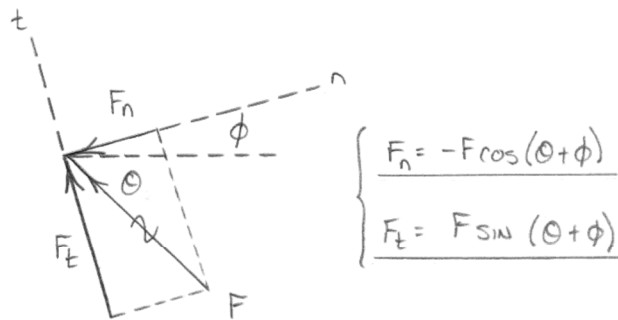


$$\theta_y = \tan^{-1} \left(\frac{R_x}{R_y} \right) = \tan^{-1} \left(\frac{166.4}{233} \right)$$

$$\theta_y = 35.5^\circ \text{ CCW OFF } +y\text{-Axis}$$

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2/15

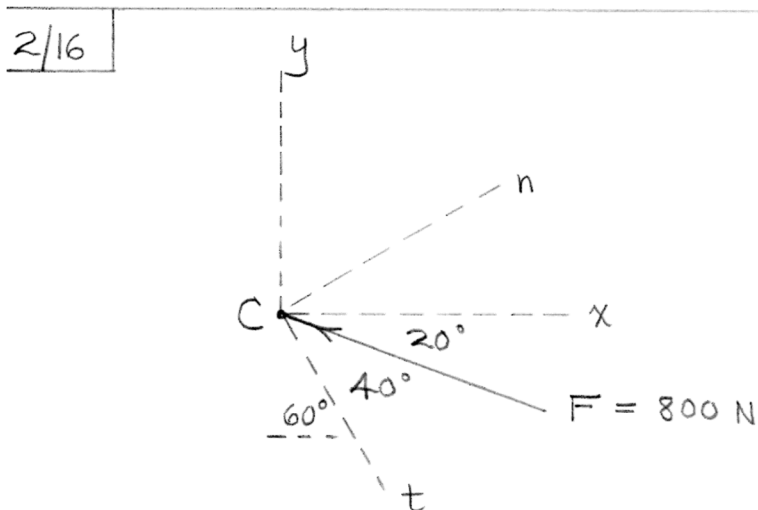


a) $F = 500 \text{ N}$, $\theta = 60^\circ$, $\phi = 20^\circ$

$$\begin{cases} F_n = -500 \cos(60^\circ + 20^\circ) \rightarrow \underline{F_n = -86.8 \text{ N}} \\ F_t = 500 \sin(60^\circ + 20^\circ) \rightarrow \underline{F_t = 492 \text{ N}} \end{cases}$$

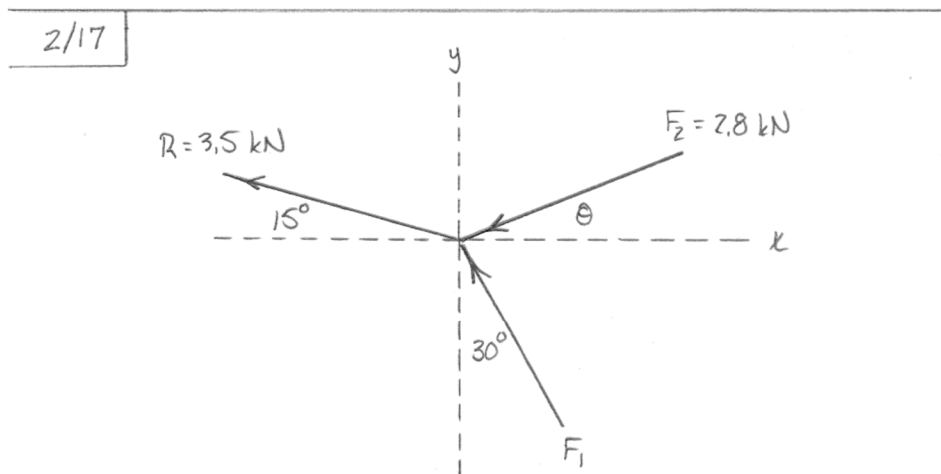
b) $F = 800 \text{ N}$, $\theta = 45^\circ$, $\phi = 150^\circ$

$$\begin{cases} F_n = -800 \cos(45^\circ + 150^\circ) \rightarrow \underline{F_n = 773 \text{ N}} \\ F_t = 800 \sin(45^\circ + 150^\circ) \rightarrow \underline{F_t = -207 \text{ N}} \end{cases}$$



$$\begin{cases} F_x = -800 \cos 20^\circ = -752 \text{ N} \\ F_y = 800 \sin 20^\circ = 274 \text{ N} \\ F_n = -800 \sin 40^\circ = -514 \text{ N} \\ F_t = -800 \cos 40^\circ = -613 \text{ N} \end{cases}$$

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$$\begin{cases} R_x = \sum F_x: & -3.5 \cos 15^\circ = -F_1 \sin 30^\circ - 2.8 \cos \theta & (1) \\ R_y = \sum F_y: & 3.5 \sin 15^\circ = F_1 \cos 30^\circ - 2.8 \sin \theta & (2) \end{cases}$$

Solving (1) AND (2)...

$$\begin{cases} F_1 = 1.165 \text{ kN} \\ \theta = 2.11^\circ \end{cases} \quad \text{OR} \quad \begin{cases} F_1 = 3.78 \text{ kN} \\ \theta = 57.9^\circ \end{cases}$$

2/18

$$L^2 = (r - r \sin \theta)^2 + (r + r \cos \theta)^2$$

$$= r^2 - 2r^2 \sin \theta + r^2 \sin^2 \theta + r^2 + 2r^2 \cos \theta + r^2 \cos^2 \theta$$

$$= r^2 (3 + 2 \cos \theta - 2 \sin \theta)$$

$$\text{So } \cos \beta = \frac{r(1 + \cos \theta)}{r \sqrt{3 + 2 \cos \theta - 2 \sin \theta}}$$

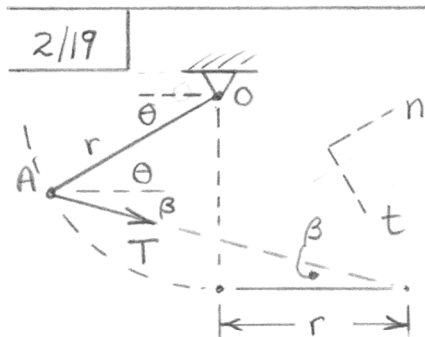
$$= \frac{1 + \cos \theta}{\sqrt{3 + 2 \cos \theta - 2 \sin \theta}}$$

$$\sin \beta = \frac{1 - \sin \theta}{\sqrt{3 + 2 \cos \theta - 2 \sin \theta}}$$

$$T_x = T \cos \beta = \frac{T(1 + \cos \theta)}{\sqrt{3 + 2 \cos \theta - 2 \sin \theta}}$$

$$T_y = -T \sin \beta = \frac{T(\sin \theta - 1)}{\sqrt{3 + 2 \cos \theta - 2 \sin \theta}}$$

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From solution to previous problem:

$$\beta = \tan^{-1} \left[\frac{1 - \sin \theta}{1 + \cos \theta} \right]$$

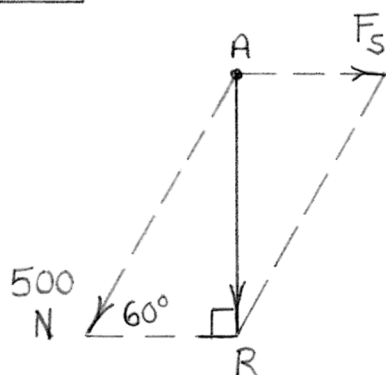
$$\begin{cases} T_n = T \cos(\theta + \beta) \\ T_t = T \sin(\theta + \beta) \end{cases}$$

For $T = 100 \text{ N}$ and $\theta = 35^\circ$:

$$\beta = 13.19^\circ$$

$$\begin{cases} T_n = 66.7 \text{ N} \\ T_t = 74.5 \text{ N} \end{cases}$$

2/20



$$\cos 60^\circ = \frac{F_s}{500}$$

$$F_s = 250 \text{ N}$$

$$\sin 60^\circ = \frac{R}{500}$$

$$R = 433 \text{ N}$$

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2/21

Using the coordinates of the problem figure :

$$\begin{aligned} R_x = \sum F_x &= 200 \cos 35^\circ - 150 \sin 30^\circ \\ &= 88.8 \text{ N} \end{aligned}$$

$$\begin{aligned} R_y = \sum F_y &= 200 \sin 35^\circ + 150 \cos 30^\circ \\ &= 245 \text{ N} \end{aligned}$$

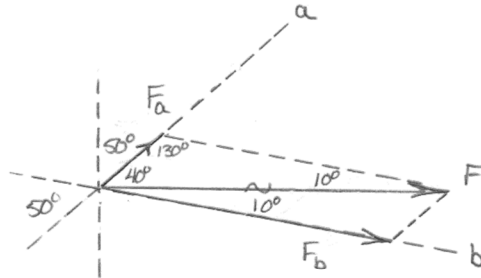
$$\therefore \underline{R = 88.8 \underline{i} + 245 \underline{j} \text{ N}}$$

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2/22

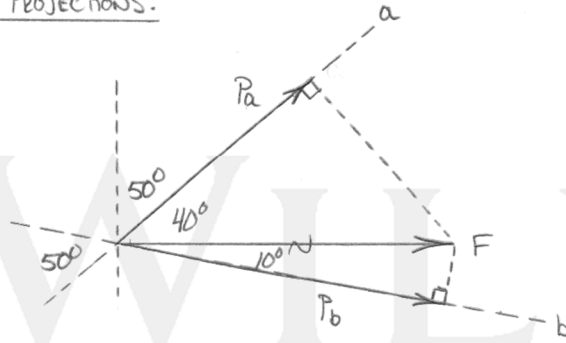
$F = 2.5 \text{ kN}$

• COMPONENTS:

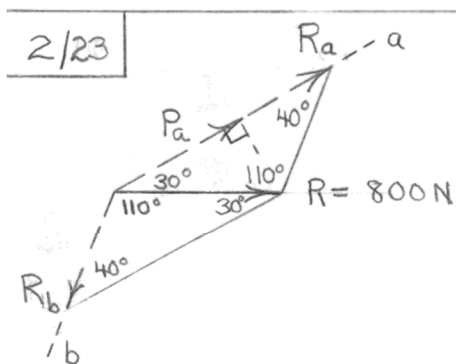


$$\frac{F}{\sin 130^\circ} = \frac{F_a}{\sin 10^\circ} = \frac{F_b}{\sin 40^\circ} \rightarrow \begin{cases} F_a = 0.567 \text{ kN} \\ F_b = 2.10 \text{ kN} \end{cases}$$

• PROJECTIONS:



$$\begin{cases} P_a = F \cos 40^\circ = 2.5 \cos 40^\circ \rightarrow P_a = 1.915 \text{ kN} \\ P_b = F \cos 10^\circ = 2.5 \cos 10^\circ \rightarrow P_b = 2.46 \text{ kN} \end{cases}$$



Law of sines :

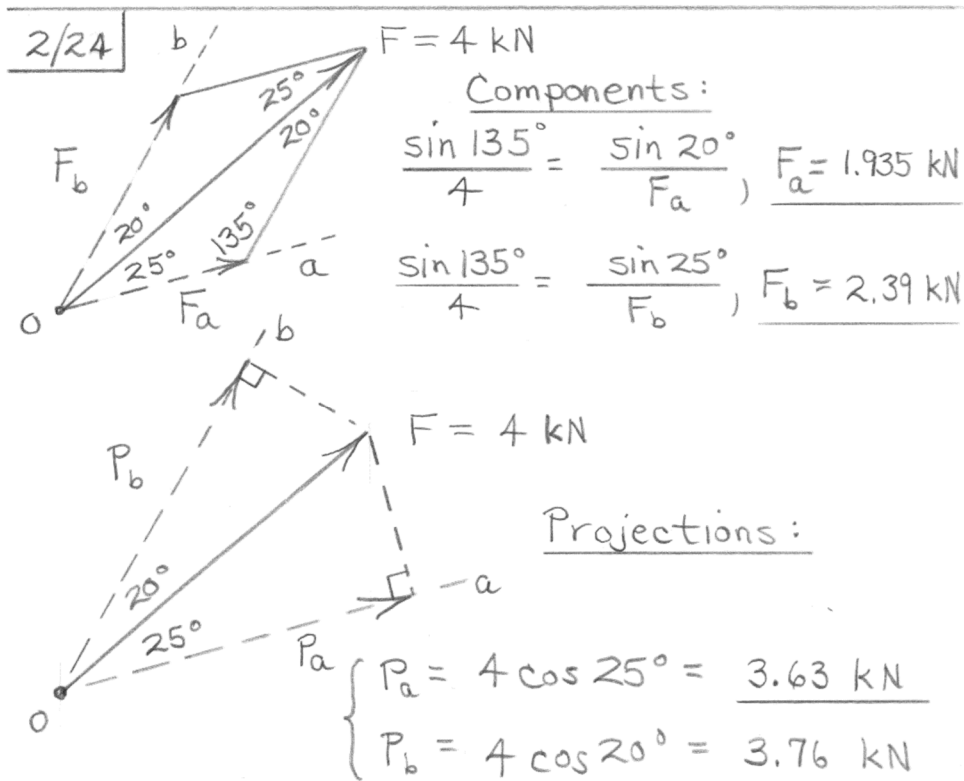
$$\frac{800}{\sin 40^\circ} = \frac{R_a}{\sin 110^\circ} = \frac{R_b}{\sin 30^\circ}$$

$$R_a = 1170\text{ N}$$

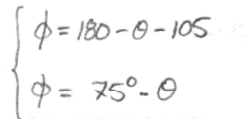
$$R_b = 622\text{ N}$$

Projection $P_a = R \cos 30^\circ = 800 \cos 30^\circ = \underline{693\text{ N}}$

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$$\left[\frac{F}{\sin \phi} = \frac{F_b}{\sin 40^\circ} \rightarrow \frac{424}{\sin(75^\circ - \theta)} = \frac{325}{\sin 40^\circ} \right]$$

SOLVING THIS YIELDS... $\theta = 17.95^\circ$ OR -48.0°

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2/26

$$\alpha = \tan^{-1} \frac{100}{200} = 26.57^\circ$$

$$\theta = \tan^{-1} \frac{150}{200} = 36.87^\circ$$

$$\beta = 180 - (\alpha + \theta) = 116.57^\circ$$

$$\frac{P}{\sin 36.87^\circ} = \frac{1.6}{\sin 26.57^\circ}$$

$$P = 1.6 \frac{0.6}{0.4472} = \underline{2.15 \text{ kN}}$$

$$\frac{T}{\sin 116.57^\circ} = \frac{1.6}{\sin 26.57^\circ} \quad T = 1.6 \frac{0.8944}{0.4472} = \underline{3.20 \text{ kN}}$$

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