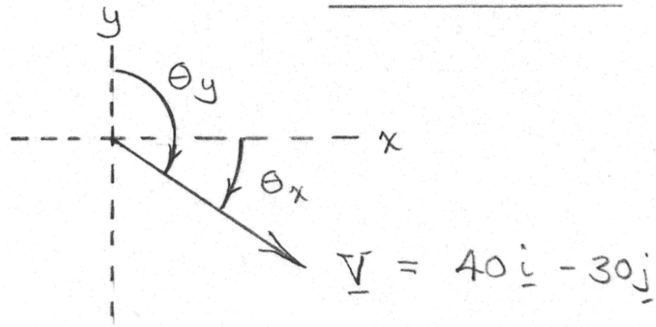
1/1

$$V = \sqrt{V_x^2 + V_y^2} = \sqrt{40^2 + 30^2} = 50$$

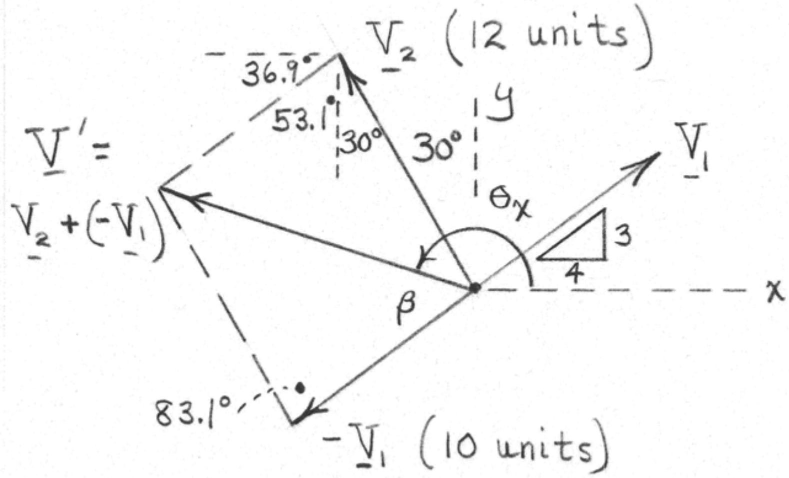
$$\underline{n} = \frac{\underline{V}}{V} = \frac{40\underline{i} - 30\underline{j}}{50} = \underline{0.8\underline{i} - 0.6\underline{j}}$$

$$\cos\theta_x = 0.8, \quad \underline{\theta_x = 36.9^\circ}$$

$$\cos\theta_y = -0.6, \quad \underline{\theta_y = 126.9^\circ}$$



1/3



Graphically, $\underline{V' = 14.7 \text{ units}, \ \theta_x = 163°}$

Algebraically, $V'^2 = 10^2 + 12^2 - 2(10)(12)\cos 83.1°$

$$\underline{V' = 14.67 \text{ units}}$$

$$\frac{\sin\beta}{12} = \frac{\sin 83.1°}{14.67}, \quad \beta = 54.3°$$

$$\theta_x = (180° + 36.9°) - \beta = 180° + 36.9° - 54.3°$$

$$= \underline{162.6°}$$

1/5 $\quad m = \dfrac{W}{g} = \dfrac{3000}{32.174} = \underline{93.2 \text{ slugs}}$

$m = 93.2 \text{ slugs} \left(\dfrac{14.594 \text{ kg}}{\text{slug}} \right) = \underline{1361 \text{ kg}}$

from inside textbook cover

To illustrate the sensitivity of such calculations to significant-figure issues, we now use $g = 32.2 \text{ ft/sec}^2$:

$m = \dfrac{W}{g} = \dfrac{3000}{32.2} = 93.2 \text{ slugs}$ ✓

$m = 93.2\,(14.594) = 1360 \text{ kg}$!

The value of $g = 32.2 \text{ ft/sec}^2$ will normally, but not always, suffice.

1/7

$$W = (130\ \text{lb})\left(\frac{4.4482\ \text{N}}{\text{lb}}\right) = \underline{578\ \text{N}}$$

$$m = \frac{W}{g} = \frac{130}{32.2} = \underline{4.04\ \text{slugs}}$$

$$m = \frac{W}{g} = \frac{578}{9.81} = \underline{58.9\ \text{kg}}$$

1/9

$$F = \frac{G m_e m_m}{d^2} = \frac{6.673(10^{-11})(5.976 \cdot 10^{24})^2(1)(0.0123)}{(384\,398 \cdot 10^3)^2}$$

$$= \underline{1.984(10^{20})\ N}$$

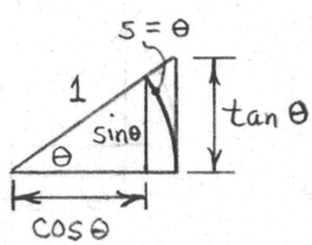
$$F = 1.984(10^{20})\ N \left(\frac{1\ lb}{4.4482\ N}\right) = \underline{4.46(10^{19})\ lb}$$

1/11

θ (deg)	θ (rad)	sin θ	n_s (%)	tan θ	n_t (%)
5	0.0873	0.0872	+0.1270	0.0875	-0.254
10	0.1745	0.1736	+0.510	0.1763	-1.017
20	0.3491	0.3420	+2.06	0.3640	-4.09

$$\begin{cases} \text{Error} \quad n_s = \dfrac{\theta - \sin\theta}{\sin\theta}(100\%) \\ \text{Error} \quad n_t = \dfrac{\theta - \tan\theta}{\tan\theta}(100\%) \end{cases}$$

The magnitude of both errors increases as θ increases. The approximation $\sin\theta \cong \theta$ is better than the approximation $\tan\theta \cong \theta$, because the former involves the approximation that $s = \theta$ is the vertical side of the triangle, whereas the latter, <u>in addition</u>, involves the approximation that 1 is the horizontal side of the triangle.



2/1

$$\begin{cases} F_x = 600 \cos 40° = \underline{460 \text{ N}} \\ F_y = -600 \sin 40° = \underline{-386 \text{ N}} \end{cases}$$

$$\underline{\underline{F} = 460\underline{i} - 386\underline{j} \text{ N}}$$

2/3

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

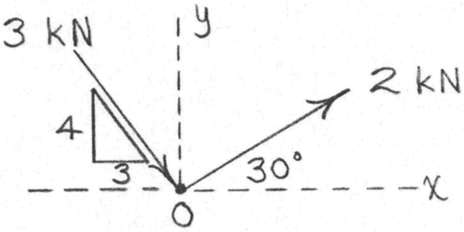
$$= \overline{-6\underline{i} - 2.5\underline{j} \text{ kN}}$$

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

2/5

$$\underline{F} = 1800\left(-\frac{3}{5}\underline{i} - \frac{4}{5}\underline{j}\right) = -1080\underline{i} - 1440\underline{j} \text{ N}$$

2/7



$$\begin{cases} R_x = \Sigma F_x = +3\left(\frac{3}{5}\right) + 2\cos 30^\circ = \quad 3.53\ \text{kN} \\ R_y = \Sigma F_y = -3\left(\frac{4}{5}\right) + 2\sin 30^\circ = -1.4\ \text{kN} \end{cases}$$

$$R = \sqrt{R_x^2 + R_y^2} = \underline{3.80\ \text{kN}}$$

$$\theta = \tan^{-1}\left(\frac{R_y}{R_x}\right) = \tan^{-1}\left(\frac{-1.4}{3.53}\right) = 338^\circ$$

$$\underline{(\text{or } -21.6^\circ)}$$

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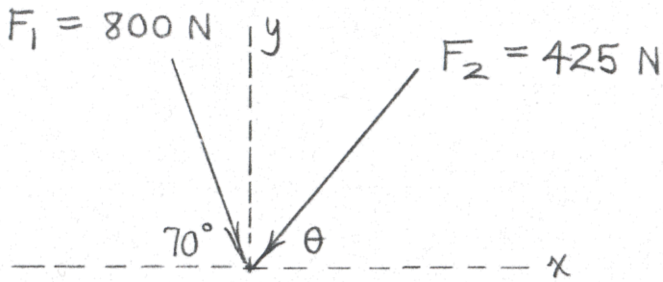


$R_x = \Sigma F_x = 800 \cos 70° - 425 \cos\theta = 0$

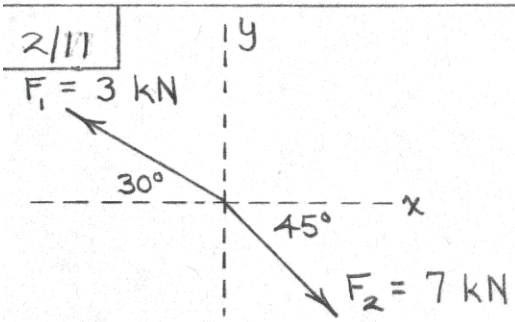
$\underline{\theta = 49.9°}$

$R_y = \Sigma F_y = -800 \sin 70° - 425 \sin 49.9°$

$= -1077$ N

So $\underline{R = 1077 \text{ N}}$

2/11



$$R_x = \Sigma F_x = -3\cos 30° + 7\cos 45° = 2.35 \text{ kN}$$

$$R_y = \Sigma F_y = 3\sin 30° - 7\sin 45° = -3.45 \text{ kN}$$

$$\underline{R} = 2.35\underline{i} - 3.45\underline{j} \text{ kN}$$

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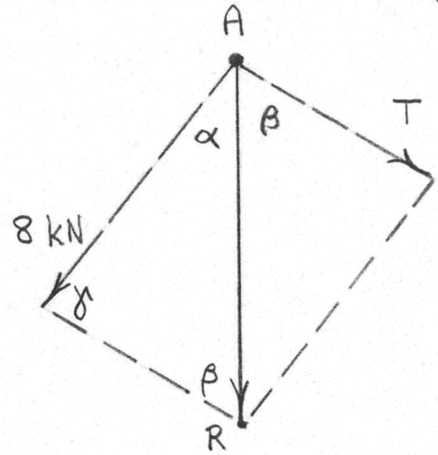

$$\begin{cases} \alpha = \tan^{-1} \frac{40}{50} = 38.7° \\ \beta = \tan^{-1} \frac{50}{30} = 59.0° \end{cases}$$

$$\gamma = 180° - \alpha - \beta$$

$$= 82.3°$$

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

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

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

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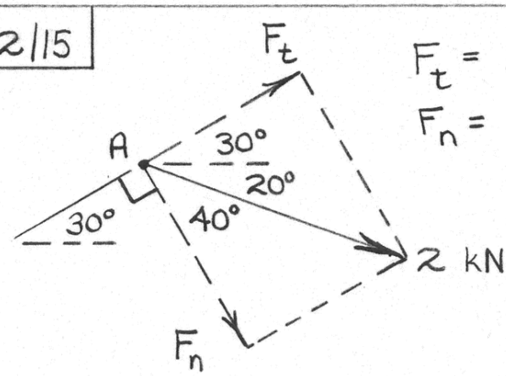
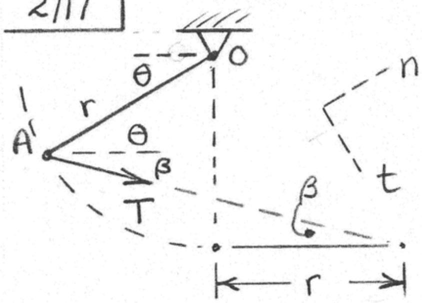


$F_t = 2 \cos 50° = \underline{1.286 \text{ kN}}$

$F_n = 2 \sin 50° = \underline{1.532 \text{ kN}}$

2/17



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 $T = 100$ N and $\theta = 35°$:

$\beta = 13.19°$

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

2/19 Using the coordinates of the problem figure:

$$R_x = \Sigma F_x = 200 \cos 35° - 150 \sin 30°$$
$$= 88.8 \text{ N}$$

$$R_y = \Sigma F_y = 200 \sin 35° + 150 \cos 30°$$
$$= 245 \text{ N}$$

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

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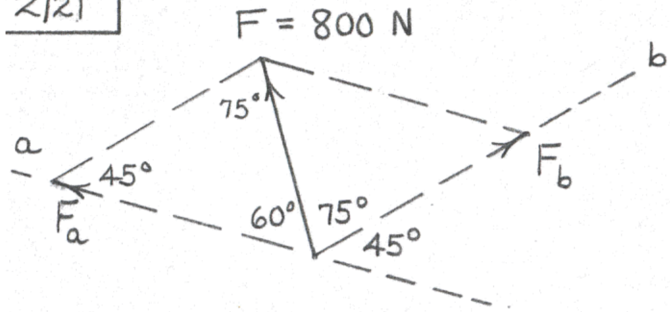

$$\frac{\sin 45°}{800} = \frac{\sin 75°}{F_a} = \frac{\sin 60°}{F_b}$$

Components : $\begin{cases} \underline{F_a = 1093 \text{ N}} \\ \underline{F_b = 980 \text{ N}} \end{cases}$

Projections : $\begin{cases} P_a = 800 \cos 60° = \underline{400 \text{ N}} \\ P_b = 800 \cos 75° = \underline{207 \text{ N}} \end{cases}$