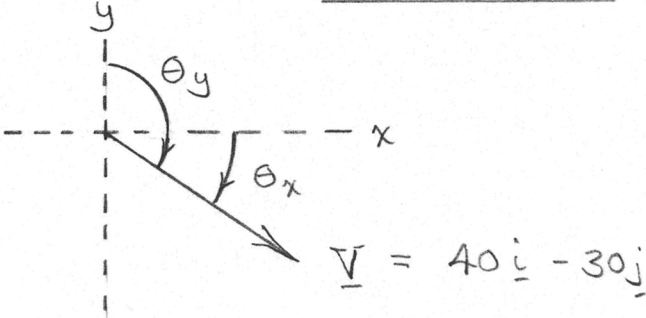
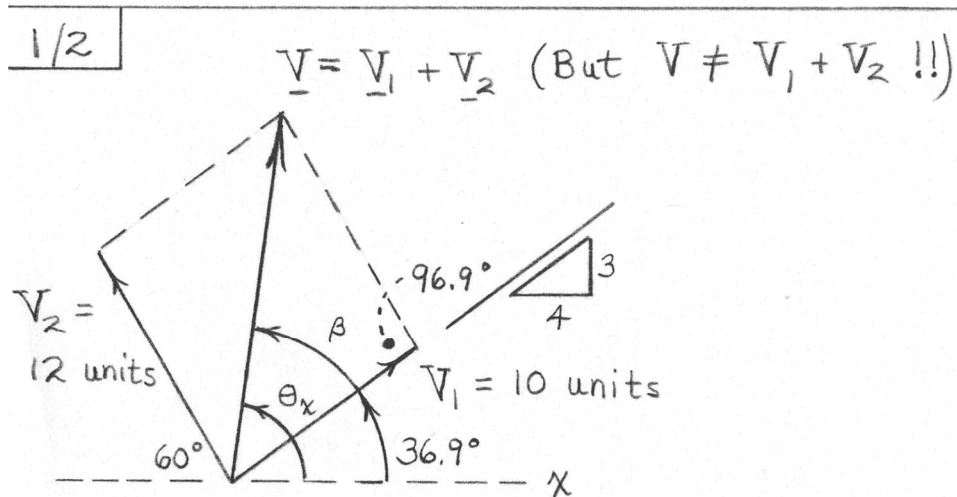


$$\begin{aligned} |V| &= \sqrt{V_x^2 + V_y^2} = \sqrt{40^2 + 30^2} = 50 \\ \underline{n} &= \frac{\underline{V}}{V} = \frac{40\underline{i} - 30\underline{j}}{50} = \underline{0.8\underline{i} - 0.6\underline{j}} \\ \cos \theta_x &= 0.8, \quad \underline{\theta_x = 36.9^\circ} \\ \cos \theta_y &= -0.6, \quad \underline{\theta_y = 126.9^\circ} \end{aligned}$$


WILEY



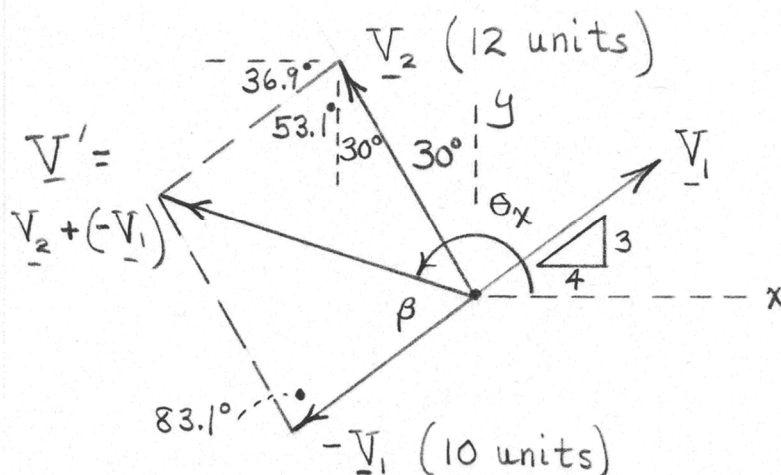
Graphically, $V = 16.4$ units, $\theta_x = 83^\circ$

Algebraically, $V^2 = 10^2 + 12^2 - 2(10)(12)\cos 96.9^\circ$
 $V = 16.51$ units

$$\frac{\sin \beta}{12} = \frac{\sin 96.9^\circ}{16.51} \quad , \quad \beta = 46.2^\circ$$

$$\theta_x = \beta + 36.9^\circ = 46.2^\circ + 36.9^\circ = \underline{83.0^\circ}$$

1/3



Graphically, $\underline{V}' = 14.7$ units, $\theta_x = 163^\circ$

Algebraically, $V'^2 = 10^2 + 12^2 - 2(10)(12)\cos 83.1^\circ$
 $\underline{V}' = 14.67$ units

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

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

$$= \underline{162.6^\circ}$$

$$\begin{aligned} \frac{1}{4} \quad F &= \sqrt{120^2 + 160^2 + 80^2} = 215 \text{ lb} \\ \cos \theta_x &= \frac{F_x}{F} = \frac{120}{215} = 0.557, \quad \underline{\theta_x = 56.1^\circ} \\ \cos \theta_y &= \frac{F_y}{F} = \frac{-160}{215} = -0.743, \quad \underline{\theta_y = 138.0^\circ} \\ \cos \theta_z &= \frac{F_z}{F} = \frac{80}{215} = 0.371, \quad \underline{\theta_z = 68.2^\circ} \end{aligned}$$

WILEY

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

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

↑ from inside textbook cover

To illustrate the sensitivity of such calculations to significant-figure issues,

we now use $g = 32.2 \text{ ft/sec}^2$:

$$m = \frac{W}{g} = \frac{3000}{32.2} = 93.2 \text{ slugs} \checkmark$$

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

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

WILEY

$$\frac{1}{6} \quad F = W = \frac{G m_1 m_2}{r^2}$$

where $G = 6.673 (10^{-11}) \text{ m}^3/(\text{kg} \cdot \text{s}^2)$

$m_1 = 90 \text{ kg}$

$m_2 = 5.976 (10^{24}) \text{ kg}$

and $r = (6371 + 250) (10^3) \text{ m}$

Substitute these numbers & obtain $W = 819 \text{ N}$

U.S. units : $W = 819 \text{ N} \left(\frac{1 \text{ lb}}{4.4482 \text{ N}} \right) = \underline{184.1 \text{ lb}}$

WILEY

$$\begin{aligned} \frac{1}{7} \quad W &= (130 \text{ lb}) \left(\frac{4.4482 \text{ N}}{\text{lb}} \right) = \underline{578 \text{ N}} \\ m &= \frac{W}{g} = \frac{130}{32.2} = \underline{4.04 \text{ slugs}} \\ m &= \frac{W}{g} = \frac{578}{9.81} = \underline{58.9 \text{ kg}} \end{aligned}$$

WILEY

$1/8$	$A = 6.67, B = 1.726$
$(A + B)$	$= \underline{8.40}$
$(A - B)$	$= \underline{4.94}$
(AB)	$= \underline{11.51}$
(A/B)	$= \underline{3.86}$

WILEY

1/9

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

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

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

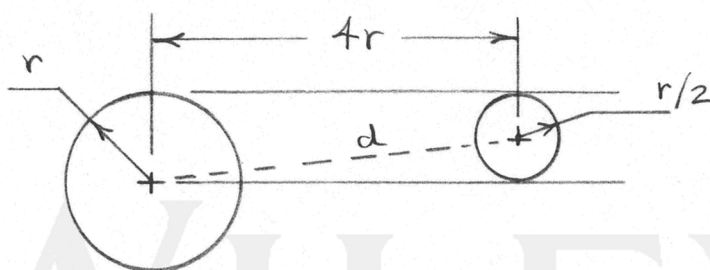
WILEY

$$\boxed{1/10} \quad F = \frac{G m_s m_t}{d^2}$$

$$= \frac{G \left(\frac{4}{3} \pi r^3 \rho_s \right) \left(\frac{4}{3} \pi \left(\frac{r}{2} \right)^3 \rho_t \right)}{(4r)^2 + \left(\frac{r}{2} \right)^2}$$

With $\begin{cases} G = 6.673(10^{-11}) \text{ m}^3/(\text{kg} \cdot \text{s}^2) \\ r = 0.050 \text{ m} \\ \rho_s = 7830 \text{ kg/m}^3, \rho_t = 3080 \text{ kg/m}^3 \end{cases}$

$$F = 1.358(10^{-9}) \text{ N}$$



1/11

θ (deg)	θ (rad)	$\sin \theta$	n_s (%)	$\tan \theta$	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

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

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

