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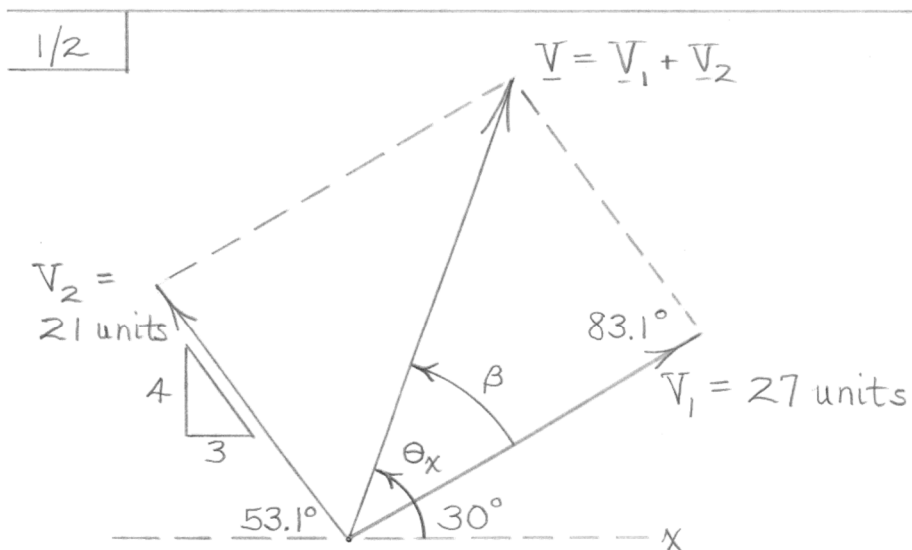
$$|V| = \sqrt{V_x^2 + V_y^2} = \sqrt{36^2 + 15^2} = 39$$

$$\cos \theta_x = \frac{V_x}{V} = \frac{-36}{39}, \quad \theta_x = 157.4^\circ$$

$$\cos \theta_y = \frac{V_y}{V} = \frac{15}{39}, \quad \theta_y = 67.4^\circ$$

$$\underline{\underline{n}} = \frac{\underline{V}}{V} = \frac{-36\underline{i} + 15\underline{j}}{39} = \underline{\underline{-0.923\underline{i} + 0.385\underline{j}}}$$

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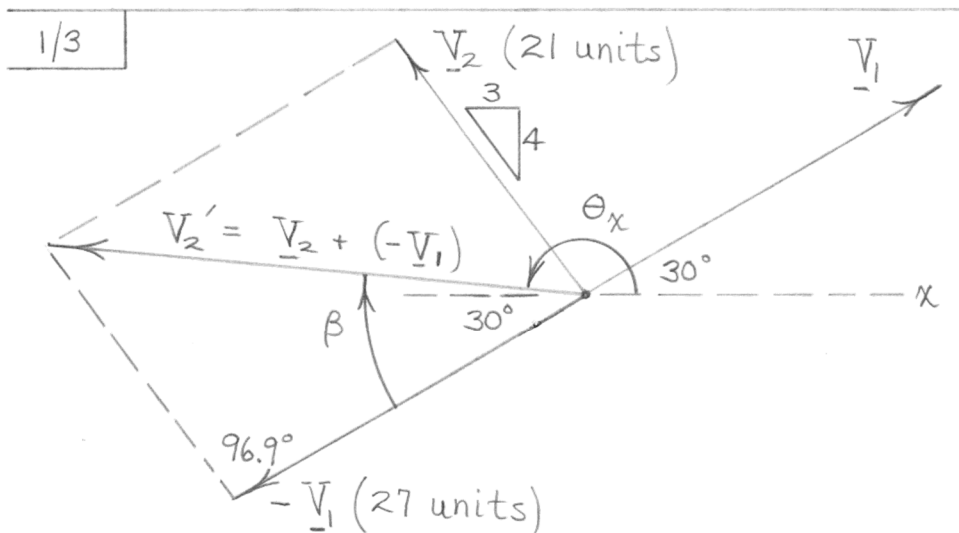
Graphically, $\underline{V} = \underline{32}$ units, $\theta_x = 70^\circ$

Algebraically, $V^2 = 27^2 + 21^2 - 2(27)(21)\cos 83.1^\circ$

$$V = \underline{32.2} \text{ units}$$

$$\frac{\sin \beta}{21} = \frac{\sin 83.1^\circ}{32.2} \quad \beta = 40.4^\circ$$

$$\theta_x = \beta + 30^\circ = 40.4^\circ + 30^\circ = \underline{70.4^\circ}$$



Graphically, $\underline{V}' = 36 \text{ units}$, $\theta_x = 175^\circ$

Algebraically, $V'^2 = 27^2 + 21^2 - 2(27)(21) \cos 96.9^\circ$
 $\underline{V}' = 36.1 \text{ units}$

$$\frac{\sin \beta}{21} = \frac{\sin 96.9^\circ}{36.1}, \quad \beta = 35.2^\circ$$

$$\theta_x + \beta = 210^\circ, \quad \theta_x = 210 - 35.2^\circ = \underline{174.8^\circ}$$

$$\frac{1}{4} \quad F = \sqrt{160^2 + 80^2 + 120^2} = 215 \text{ N}$$

$$\cos \theta_x = \frac{F_x}{F} = \frac{160}{215} = 0.743, \quad \underline{\theta_x = 42.0^\circ}$$

$$\cos \theta_y = \frac{F_y}{F} = \frac{80}{215} = 0.371, \quad \underline{\theta_y = 68.2^\circ}$$

$$\cos \theta_z = \frac{F_z}{F} = \frac{-120}{215} = -0.557, \quad \underline{\theta_z = 123.9^\circ}$$

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$$\frac{1}{5} \quad m = \frac{W}{g} = \frac{1000}{32.174} = \underline{31.1 \text{ slugs}}$$

$$m = 31.1 \text{ slugs} \left(\frac{14.594 \text{ kg}}{\text{slug}} \right) = \underline{454 \text{ kg}}$$

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$$\frac{1}{6} \quad F = W = \frac{Gm_1m_2}{r^2},$$

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

$$m_1 = 85 \text{ kg}$$

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

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

Substitute these numbers $\frac{1}{6}$ obtain $W = 773 \text{ N}$

U.S. units : $W = 773 \text{ N} \left(\frac{1 \text{ lb}}{4.4482 \text{ N}} \right) = \underline{173.8 \text{ lb}}$

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$$\frac{1}{7} \quad W = (125 \text{ lb}) \left(\frac{4.4482 \text{ N}}{\text{lb}} \right) = \underline{556 \text{ N}}$$

$$m = \frac{W}{g} = \frac{125}{32.2} = \underline{3.88 \text{ slugs}}$$

$$m = \frac{W}{g} = \frac{556}{9.81} = \underline{56.7 \text{ kg}}$$

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$$\frac{1}{8} \quad A = 8.67, \quad B = 1.429$$

$$(A+B) = 8.67 + 1.429 = \underline{10.10}$$

$$(A-B) = 8.67 - 1.429 = \underline{7.24}$$

$$(AB) = (8.67)(1.429) = \underline{12.39}$$

$$(A/B) = 8.67/1.429 = \underline{6.07}$$

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$$\begin{aligned} \frac{1}{9} \\ F &= \frac{Gm_1m_2}{d^2} = \frac{3.439(10^{-8})(1)(333,000)(4.095 \cdot 10^{23})^2}{(92.96 \cdot 10^6 \cdot 5280)^2} \\ &= \frac{7.97(10^{21}) \text{ lb}}{F = 7.97(10^{21}) \text{ lb} \left(\frac{4.4482 \text{ N}}{\text{lb}} \right) = \underline{3.55(10^{22}) \text{ N}} \end{aligned}$$

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$$\frac{1}{10} \quad \underline{F} = \underline{F}_n = F \left(\frac{-4\underline{i} - 2\underline{j}}{\sqrt{4^2 + 2^2}} \right),$$

$$\text{where } F = \frac{G m_{cu} m_{st}}{d^2}$$

$$= \frac{G \left(\rho_{cu} \frac{4}{3} \pi r^3 \right) \left(\rho_{st} \frac{4}{3} \pi \left(\frac{r}{2} \right)^3 \right)}{(4r)^2 + (2r)^2}$$

$$= \frac{1}{90} G \rho_{cu} \rho_{st} \pi^2 r^4$$

$$= \frac{1}{90} (6.673 \cdot 10^{-11}) (8910) (7830) \pi^2 (0.050)^4$$

$$= 3.19 (10^{-9}) \text{ N}$$

$$\begin{aligned} \text{Then } \underline{F} &= 3.19 (10^{-9}) \left[\frac{-4\underline{i} - 2\underline{j}}{\sqrt{20}} \right] \\ &= (-2.85\underline{i} - 1.427\underline{j}) 10^{-9} \text{ N} \end{aligned}$$

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$$\boxed{1/11} \quad E = 3 \sin^2 \theta \tan \theta \cos \theta$$

$$\text{Exact: } E = 3 \sin^2 2^\circ \tan 2^\circ \cos 2^\circ \\ = \underline{1.275 (10^{-4})}$$

$$\text{Approx: } E_{ap} = 3(\theta^2)(\theta)(1) \\ = 3\theta^3 \quad (\theta \text{ in rad})$$

$$E_{ap} = 3 \left[2 \frac{\pi}{180} \right]^3 = \underline{1.276 (10^{-4})}$$

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$$\begin{aligned} \boxed{1/12} \quad \text{SI: } [\varphi] &= (1)(\text{kg})(\text{m}^2)/\text{s}^2 \\ &= \text{kg}\cdot\text{m}^2/\text{s}^2 \\ \text{U.S.: } [\varphi] &= (1)(\text{slug})(\text{ft}^2)/\text{sec}^2 \\ &= \left(\frac{\text{lb}\cdot\text{sec}^2}{\text{ft}}\right)(\text{ft})^2/\text{sec}^2 = \underline{\underline{\text{lb}\cdot\text{ft}}} \end{aligned}$$

Note: The SI units reduce to

$(\text{kg}\cdot\text{m}/\text{s}^2)\text{m} = \text{N}\cdot\text{m}$, but N is not a base unit.

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