$\boxed{1/1}$

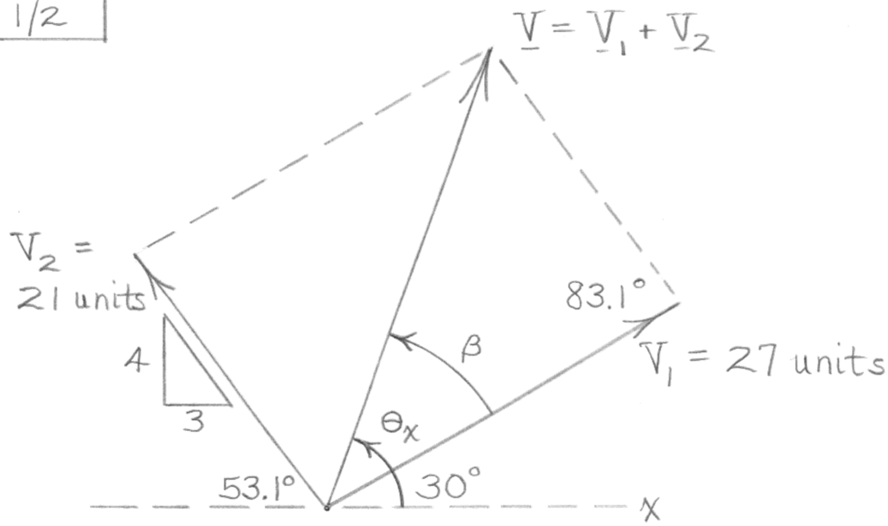
$$V = \sqrt{V_x^2 + V_y^2} = \sqrt{36^2 + 15^2} = 39$$

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

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

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

1/2



Graphically, $V = \underline{32 \text{ units}}$, $\underline{\theta_x = 70°}$

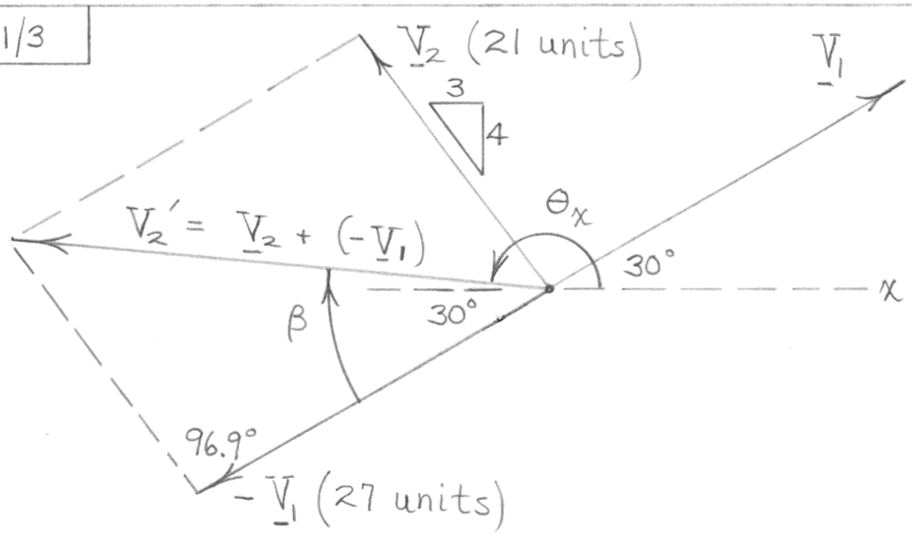
Algebraically, $V^2 = 27^2 + 21^2 - 2(27)(21)\cos 83.1°$

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

$$\frac{\sin\beta}{21} = \frac{\sin 83.1°}{32.2}, \quad \beta = 40.4°$$

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

1/3



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

Algebraically, $V'^2 = 27^2 + 21^2 - 2(27)(21)\cos 96.9°$

$\underline{V' = 36.1 \text{ units}}$

$\dfrac{\sin\beta}{21} = \dfrac{\sin 96.9°}{36.1}$, $\beta = 35.2°$

$\theta_x + \beta = 210°$, $\theta_x = 210 - 35.2° = \underline{174.8°}$

1/4

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

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

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

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

1/5

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

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

$\boxed{1/6}$ $F = W = \dfrac{G m_1 m_2}{r^2}$

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

$m_1 = 85\ kg$

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

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

Substitute these numbers & obtain $\underline{W = 773\ N}$

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

1/7

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

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

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

1/8

$A = 8.67, \quad B = 1.429$

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

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

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

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

1/9

$$F = \frac{G m_e m_s}{d^2} = \frac{3.439(10^{-8})(1)(333{,}000)(4.095 \cdot 10^{23})^2}{(92.96 \cdot 10^6 \cdot 5280)^2}$$

$$= \underline{7.97(10^{21})\ \text{lb}}$$

$$F = 7.97(10^{21})\ \text{lb}\left(\frac{4.4482\ \text{N}}{\text{lb}}\right) = \underline{3.55(10^{22})\ \text{N}}$$

1/10

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

where

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

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

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

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

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

Then

$$\underline{F} = 3.19(10^{-9})\left[\frac{-4\underline{i}-2\underline{j}}{\sqrt{20}}\right]$$

$$= \underline{(-2.85\underline{i} - 1.427\underline{j})10^{-9}\text{ N}}$$

1/11 $E = 3 \sin^2\theta \tan\theta \cos\theta$

Exact: $E = 3 \sin^2 2° \tan 2° \cos 2°$

$= \underline{1.275(10^{-4})}$

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

$= 3\theta^3$ (θ in rad)

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

1/12

SI : $[Q] = (1)(kg)(m^2)/s^2$

$= \underline{kg \cdot m^2/s^2}$

U.S. : $[Q] = (1)(slug)(ft^2)/sec^2$

$= \left(\frac{lb\text{-}sec^2}{ft}\right)(ft)^2/sec^2 = \underline{lb\text{-}ft}$

Note: The SI units reduce to

$(kg \cdot m/s^2)\, m = N \cdot m$, but N is

not a base unit.