Section 12.2

1.) a.) $3\vec{u} = 3\,\overrightarrow{(3,-2)} = \overrightarrow{(9,-6)}$

b.) $|3\vec{u}| = \sqrt{9^2+(-6)^2} = \sqrt{117} = 3\sqrt{13}$

4.) a.) $\vec{u}-\vec{v} = \overrightarrow{(3,-2)} - \overrightarrow{(-2,5)} = \overrightarrow{(5,-7)}$

b.) $|\vec{u}-\vec{v}| = \sqrt{5^2+(-7)^2} = \sqrt{74}$

6.) a.) $-2\vec{u}+5\vec{v} = -2\,\overrightarrow{(3,-2)} + 5\,\overrightarrow{(-2,5)}$

$= \overrightarrow{(-6,4)} + \overrightarrow{(-10,25)} = \overrightarrow{(-16,29)}$

b.) $|-2\vec{u}+5\vec{v}| = \sqrt{(-16)^2+(29)^2} = \sqrt{1097}$

7.) a.) $\frac{3}{5}\vec{u}+\frac{4}{5}\vec{v} = \frac{3}{5}\,\overrightarrow{(3,-2)} + \frac{4}{5}\,\overrightarrow{(-2,5)}$

$= \overrightarrow{\left(\frac{9}{5},\frac{-6}{5}\right)} + \overrightarrow{\left(\frac{-8}{5},4\right)} = \overrightarrow{\left(\frac{1}{5},\frac{14}{5}\right)}$

b.) $\left|\frac{3}{5}\vec{u}+\frac{4}{5}\vec{v}\right| = \sqrt{\left(\frac{1}{5}\right)^2+\left(\frac{14}{5}\right)^2} = \sqrt{\frac{197}{25}} = \frac{\sqrt{197}}{5}$

9.) $\overrightarrow{PQ} = \overrightarrow{(2-1,-1-3)} = \overrightarrow{(1,-4)}$

10.) $O=(0,0)$, $P=\left(\frac{2+-4}{2},\frac{-1+3}{2}\right)=(-1,1)$, so

$\overrightarrow{OP} = \overrightarrow{(-1-0,1-0)} = \overrightarrow{(-1,1)}$

11.) $A=(2,3)$, $O=(0,0)$, so

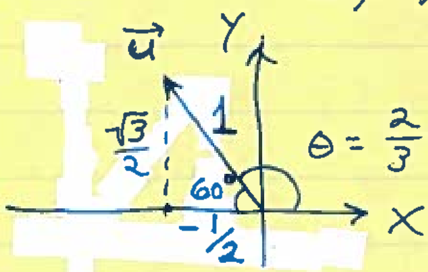
$\overrightarrow{AO} = \overrightarrow{(0-2,0-3)} = \overrightarrow{(-2,-3)}$

12.) $\overrightarrow{AB} = \overrightarrow{(2-1,\ 0-(-1))} = \overrightarrow{(1,1)}$,

$\overrightarrow{CD} = \overrightarrow{(-2-(-1),\ 2-3)} = \overrightarrow{(-1,-1)}$, so

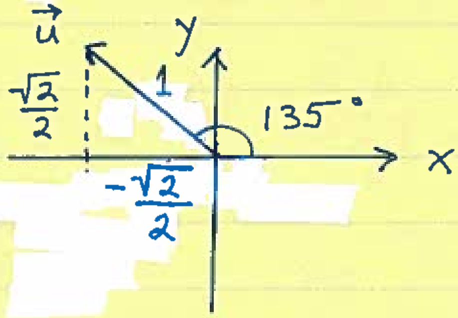
$\overrightarrow{AB} + \overrightarrow{CD} = \overrightarrow{(0,0)}$

13.)



$\vec{u} = \overrightarrow{\left(-\tfrac{1}{2},\ \tfrac{\sqrt{3}}{2}\right)}$

16.)



$\vec{u} = \overrightarrow{\left(-\tfrac{\sqrt{2}}{2},\ \tfrac{\sqrt{2}}{2}\right)}$

18.) $\overrightarrow{P_1P_2} = \overrightarrow{(-3-1,\ 0-2,\ 5-0)} = \overrightarrow{(-4,-2,5)}$

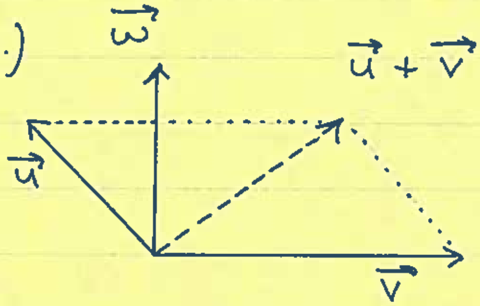
$= -4\vec{i} - 2\vec{j} + 5\vec{k}$

21.) $5\vec{u} - \vec{v} = 5\,\overrightarrow{(1,1,-1)} - \overrightarrow{(2,0,3)}$

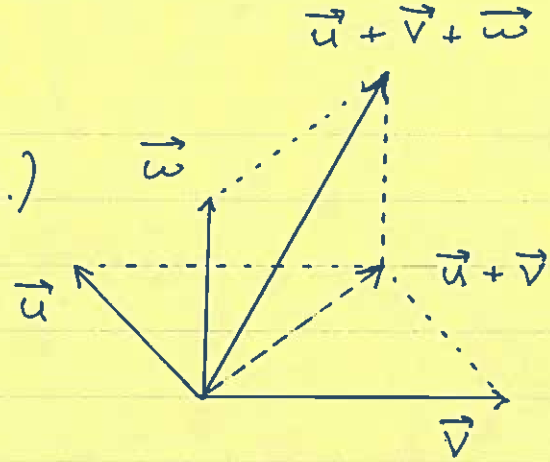
$= \overrightarrow{(5,5,-5)} - \overrightarrow{(2,0,3)} = \overrightarrow{(3,5,-8)}$

$= 3\vec{i} + 5\vec{j} - 8\vec{k}$

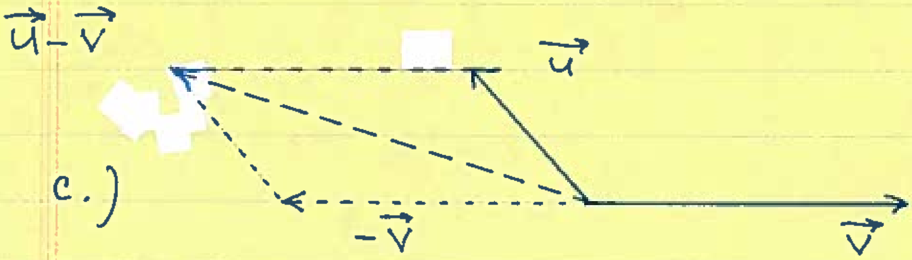
23.) a.)



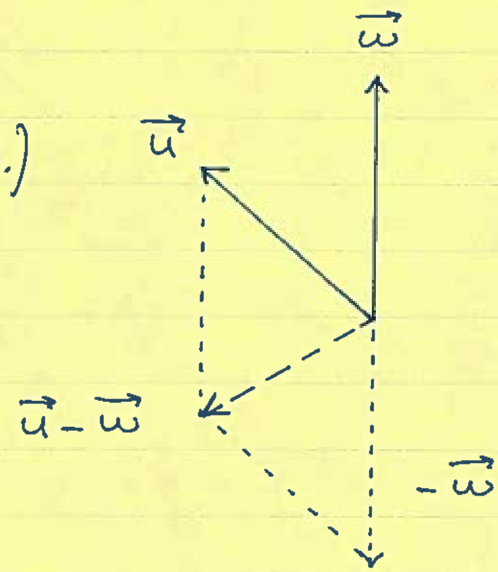
b.)



c.)



d.)



25.) $|2\vec{i}+\vec{j}-2\vec{k}| = \sqrt{2^2+1^2+(-2)^2}$

$= \sqrt{9} = 3$, so

$2\vec{i}+\vec{j}-2\vec{k} = 3 \cdot \frac{1}{3}(2\vec{i}+\vec{j}-2\vec{k})$

$= 3 \cdot \left(\frac{2}{3}\vec{i}+\frac{1}{3}\vec{j}-\frac{2}{3}\vec{k}\right)$

28.) $\left|\frac{3}{5}\vec{i}+\frac{4}{5}\vec{k}\right| = \sqrt{\left(\frac{3}{5}\right)^2+\left(\frac{4}{5}\right)^2} = \sqrt{\frac{25}{25}} = 1$, so

$$\frac{3}{5}\vec{i} + \frac{4}{5}\vec{k} = 1 \cdot \left(\frac{3}{5}\vec{i} + \frac{4}{5}\vec{k}\right)$$

29.) $\left|\frac{1}{\sqrt{6}}\vec{i} - \frac{1}{\sqrt{6}}\vec{j} - \frac{1}{\sqrt{6}}\vec{k}\right| = \sqrt{\left(\frac{1}{\sqrt{6}}\right)^2 + \left(\frac{-1}{\sqrt{6}}\right)^2 + \left(\frac{-1}{\sqrt{6}}\right)^2}$

$= \sqrt{\frac{1}{6} + \frac{1}{6} + \frac{1}{6}} = \sqrt{\frac{1}{2}} = \frac{1}{\sqrt{2}}$, ~~so~~

$\frac{1}{\sqrt{6}}\vec{i} - \frac{1}{\sqrt{6}}\vec{j} - \frac{1}{\sqrt{6}}\vec{k} = \frac{1}{\sqrt{2}} \cdot \frac{1}{1/\sqrt{2}}\left(\frac{1}{\sqrt{6}}\vec{i} - \frac{1}{\sqrt{6}}\vec{j} - \frac{1}{\sqrt{6}}\vec{k}\right)$

$= \frac{1}{\sqrt{2}} \cdot \left(\frac{\sqrt{2}}{\sqrt{6}}\vec{i} - \frac{\sqrt{2}}{\sqrt{6}}\vec{j} - \frac{\sqrt{2}}{\sqrt{6}}\vec{k}\right)$

$= \frac{1}{\sqrt{2}} \cdot \left(\frac{1}{\sqrt{3}}\vec{i} - \frac{1}{\sqrt{3}}\vec{j} - \frac{1}{\sqrt{3}}\vec{k}\right)$

31.) a.) $\vec{w} = 2 \cdot \vec{i}$

b.) $\vec{w} = \sqrt{3} \cdot -\vec{k} = -\sqrt{3} \cdot \vec{k}$

c.) $\vec{w} = \frac{1}{2} \cdot \left(\frac{3}{5}\vec{j} + \frac{4}{5}\vec{k}\right) = \frac{3}{10}\vec{j} + \frac{4}{10}\vec{k}$

d.) $\vec{w} = 7 \cdot \left(\frac{6}{7}\vec{i} - \frac{2}{7}\vec{j} + \frac{3}{7}\vec{k}\right) = 6\vec{i} - 2\vec{j} + 3\vec{k}$

33.) $\vec{v} = 12\vec{i} - 5\vec{k} \rightarrow |\vec{v}| = \sqrt{12^2 + (-5)^2} = 13$

so direction is $\vec{u} = \frac{1}{13}\vec{v} = \frac{12}{13}\vec{i} - \frac{5}{13}\vec{k}$,

so vector in same direction of magnitude 7 is

$\vec{w} = 7\vec{u} = \frac{84}{13}\vec{i} - \frac{35}{13}\vec{k}$

35.) a.) $\overrightarrow{P_1P_2} = \overrightarrow{(2-(-1), 5-1, 0-5)}$

$= \overrightarrow{(3, 4, -5)} \rightarrow |\overrightarrow{(3,4,-5)}| = \sqrt{3^2 + 4^2 + (-5)^2}$

$= \sqrt{50} = 5\sqrt{2}$, so direction is

$$\vec{u} = \frac{1}{5\sqrt{2}}\overrightarrow{(3,4,-5)} = \overrightarrow{\left(\frac{3}{5\sqrt{2}}, \frac{4}{5\sqrt{2}}, \frac{-1}{\sqrt{2}}\right)}$$

b.) midpoint: $\left(\frac{2-1}{2}, \frac{5+1}{2}, \frac{0+5}{2}\right) = \left(\frac{1}{2}, 3, \frac{5}{2}\right)$

38.) a.) $\overrightarrow{P_1P_2} = \overrightarrow{(2,-2,-2)} \longrightarrow$

$$\left|\overrightarrow{(2,-2,-2)}\right| = \sqrt{2^2+(-2)^2+(-2)^2} = \sqrt{12} = 2\sqrt{3},$$

so direction is

$$\vec{u} = \frac{1}{2\sqrt{3}}\overrightarrow{(2,-2,-2)} = \overrightarrow{\left(\frac{1}{\sqrt{3}}, \frac{-1}{\sqrt{3}}, \frac{-1}{\sqrt{3}}\right)}$$

b.) midpoint: $\left(\frac{0+2}{2}, \frac{0-2}{2}, \frac{0-2}{2}\right) = (1,-1,-1)$

40.) $\overrightarrow{AB} = -7\vec{i} + 3\vec{j} + 8\vec{k}$, $A = (-2,-3,6)$,

$B = (a,b,c)$, so

$(a-(-2), b-(-3), c-6) = (a+2, b+3, c-6) = (-7, 3, 8)$

$$\left.\begin{aligned} &\rightarrow a+2 = -7 \rightarrow a = -9 \\ &\rightarrow b+3 = 3 \rightarrow b = 0 \\ &\rightarrow c-6 = 8 \rightarrow c = 14 \end{aligned}\right\} \text{so}$$

$B = (-9, 0, 14)$

41.) $\vec{u} = 2\vec{i} + \vec{j}$, $\vec{v} = \vec{i} + \vec{j}$, and

$\vec{w} = \vec{i} - \vec{j}$; we want

$\vec{u} = a\vec{v} + b\vec{w} \longrightarrow$

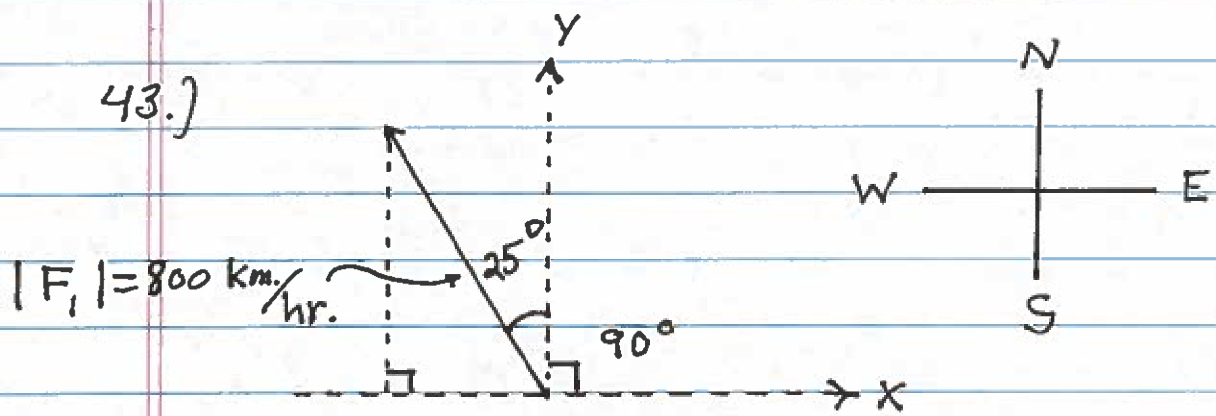
$\overrightarrow{(2,1)} = a\overrightarrow{(1,1)} + b\overrightarrow{(1,-1)} \longrightarrow$

$$\overrightarrow{(2,1)} = \overrightarrow{(a+b,\ a-b)} \longrightarrow$$

$$\left.\begin{array}{l} a+b=2 \\ a-b=1 \end{array}\right\} \quad 2a = 3 \longrightarrow a = 3/2$$

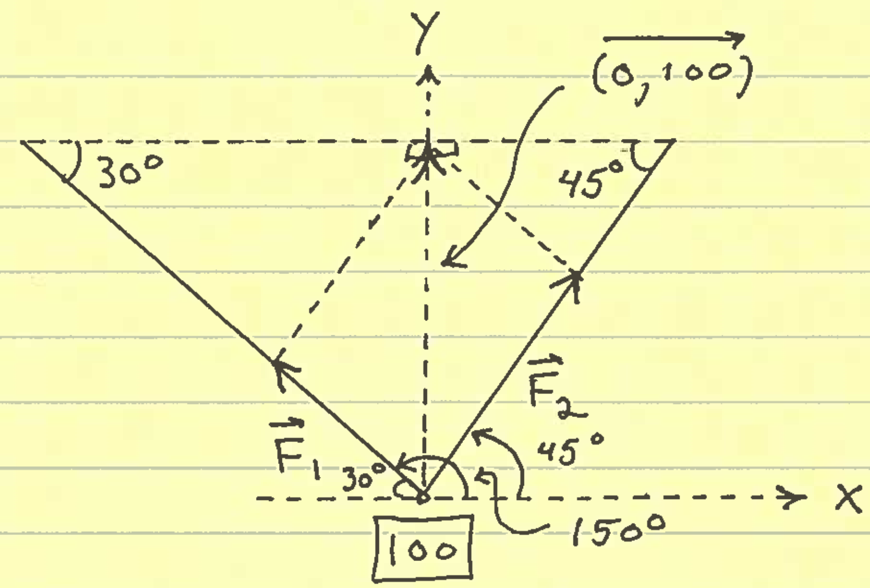
$$\frac{3}{2} + b = 2 \longrightarrow b = 2 - \frac{3}{2} \longrightarrow b = 1/2$$

43.)



$$\overrightarrow{F_1} = (800 \cos 115°,\ 800 \sin 115°)$$

45.)



By geometry of vectors:

$$\boxed{\vec{F}_1 + \vec{F}_2 = \overrightarrow{(0, 100)}} \quad \text{and}$$

$$\vec{F}_1 = |\vec{F}_1| \, \overrightarrow{(\cos 150°, \sin 150°)}$$

$$= |\vec{F}_1| \, \overrightarrow{\left(-\tfrac{\sqrt{3}}{2}, \tfrac{1}{2}\right)} = \overrightarrow{\left(-\tfrac{\sqrt{3}}{2}|\vec{F}_1|, \tfrac{1}{2}|\vec{F}_1|\right)} ,$$

$$\vec{F}_2 = |\vec{F}_2| \, \overrightarrow{(\cos 45°, \sin 45°)}$$

$$= |\vec{F}_2| \, \overrightarrow{\left(\sqrt{2}/2, \sqrt{2}/2\right)} = \overrightarrow{\left(\tfrac{\sqrt{2}}{2}|\vec{F}_2|, \tfrac{\sqrt{2}}{2}|\vec{F}_2|\right)} ;$$

then

$$\vec{F}_1 + \vec{F}_2 = \overrightarrow{\left(-\tfrac{\sqrt{3}}{2}|\vec{F}_1| + \tfrac{\sqrt{2}}{2}|\vec{F}_2|, \tfrac{1}{2}|\vec{F}_1| + \tfrac{\sqrt{2}}{2}|\vec{F}_2|\right)}$$

$$= \overrightarrow{(0, 100)} \quad \text{so that}$$

$$\left.\begin{aligned} -\tfrac{\sqrt{3}}{2}|\vec{F}_1| + \tfrac{\sqrt{2}}{2}|\vec{F}_2| &= 0 \\ \tfrac{1}{2}|\vec{F}_1| + \tfrac{\sqrt{2}}{2}|\vec{F}_2| &= 100 \end{aligned}\right\} \left(\tfrac{1}{2} + \tfrac{\sqrt{3}}{2}\right)|\vec{F}_1| = 100 \rightarrow$$

$$|\vec{F}_1| = \frac{100}{\frac{1+\sqrt{3}}{2}} = \frac{200}{1+\sqrt{3}} \approx 73.205 \text{ N} \quad \text{and}$$

$$F_1 = \overrightarrow{\left(-\frac{\sqrt{3}}{2}\cdot\frac{200}{1+\sqrt{3}},\ \frac{1}{2}\cdot\frac{200}{1+\sqrt{3}}\right)}$$

$$= \overrightarrow{\left(\frac{-100\sqrt{3}}{1+\sqrt{3}},\ \frac{100}{1+\sqrt{3}}\right)} \approx \overrightarrow{(63.397,\ 36.603)} \quad ;$$

and

$$\frac{1}{2}\cdot|\vec{F_1}| + \frac{\sqrt{2}}{2}|\vec{F_2}| = 100 \rightarrow \frac{1}{2}\cdot\frac{200}{1+\sqrt{3}} + \frac{\sqrt{2}}{2}|\vec{F_2}| = 100 \rightarrow$$

$$\frac{\sqrt{2}}{2}|\vec{F_2}| = \frac{100}{1} - \frac{100}{1+\sqrt{3}} = \frac{\cancel{100+}\,100\sqrt{3}-\cancel{100}}{1+\sqrt{3}} = \boxed{\frac{100\sqrt{3}}{1+\sqrt{3}}}$$

$$\rightarrow |\vec{F_2}| = \frac{2}{\sqrt{2}}\cdot\frac{100\sqrt{3}}{1+\sqrt{3}} = \frac{200\sqrt{3}}{\sqrt{2}+\sqrt{6}} \approx 89.658\ N.$$

and

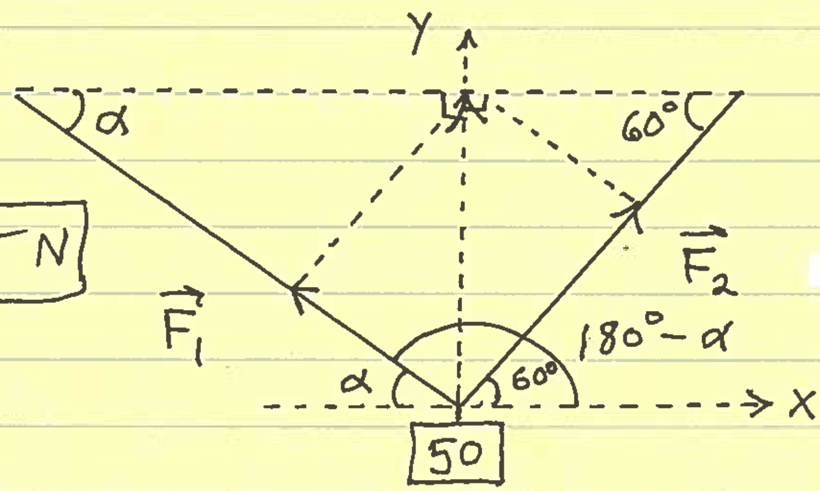
$$\vec{F_2} = |\vec{F_2}|\,\overrightarrow{(\cos 45°,\ \sin 45°)}$$

$$= \frac{200\sqrt{3}}{\sqrt{2}+\sqrt{6}}\,\overrightarrow{\left(\frac{\sqrt{2}}{2},\ \frac{\sqrt{2}}{2}\right)} =$$

$$= \left(\frac{100\sqrt{6}}{\sqrt{2}+\sqrt{6}},\ \frac{100\sqrt{6}}{\sqrt{2}+\sqrt{6}}\right) \approx \overrightarrow{(63.397,\ 63.397)}$$

46.)

$\boxed{|\vec{F_1}| = 35\ N}$



By geometry of vectors :

$$\boxed{\vec{F_1} + \vec{F_2} = \overrightarrow{(0,\ 50)}} \quad \text{and}$$

$$\vec{F}_1 = |F_1| \, \overrightarrow{(\cos(180^\circ-\alpha), \sin(180^\circ-\alpha))}$$
$$= 35 \, \overrightarrow{(\cos(180^\circ-\alpha), \sin(180^\circ-\alpha))}$$
$$= \overrightarrow{(35\cos(180^\circ-\alpha), 35\sin(180^\circ-\alpha))},$$

$$\vec{F}_2 = |\vec{F}_2| \, \overrightarrow{(\cos 60^\circ, \sin 60^\circ)}$$
$$= |\vec{F}_2| \, \overrightarrow{(1/2, \sqrt{3}/2)} = \overrightarrow{\left(\tfrac{1}{2}|F_2|, \tfrac{\sqrt{3}}{2}|F_2|\right)};$$

then

$$\vec{F}_1 + \vec{F}_2 = \overrightarrow{\left(35\cos(180^\circ-\alpha) + \tfrac{1}{2}|F_2|, 3\sin(180^\circ-\alpha) + \tfrac{\sqrt{3}}{2}|F_2|\right)}$$
$$= \overrightarrow{(0, 50)} \quad \text{so that}$$

$$\left.\begin{array}{l} 35\cos(180^\circ-\alpha) + \frac{1}{2}|\vec{F}_2| = 0 \\ 35\sin(180^\circ-\alpha) + \frac{\sqrt{3}}{2}|\vec{F}_2| = 50 \end{array}\right\} \rightarrow$$

$$\left.\begin{array}{l} 35\cos(180^\circ-\alpha) = \frac{-1}{2}|\vec{F}_2| \\ 35\sin(180^\circ-\alpha) = 50 - \frac{\sqrt{3}}{2}|F_2| \end{array}\right\} \rightarrow$$

$$(*) \left\{\begin{array}{l} \cos(180^\circ-\alpha) = \frac{-1}{70}|\vec{F}_2| \\ \sin(180^\circ-\alpha) = \frac{50}{35} - \frac{\sqrt{3}}{70}|\vec{F}_2| \end{array}\right\} \rightarrow$$

$$1 = \cos^2(180^\circ-\alpha) + \sin^2(180^\circ-\alpha)$$
$$= \left(\frac{-1}{70}|\vec{F}_2|\right)^2 + \left(\frac{10}{7} - \frac{\sqrt{3}}{70}|\vec{F}_2|\right)^2$$
$$= \frac{1}{4900}|F_2|^2 + \frac{100}{49} - \frac{2\sqrt{3}}{49}|\vec{F}_2| + \frac{3}{4900}|\vec{F}_2|^2 \rightarrow$$

$$0 = \left(\frac{4}{4900}\right)|\vec{F_2}|^2 - \frac{2\sqrt{3}}{49}|\vec{F_2}| + \frac{51}{49} \longrightarrow$$

$$0 \approx 0.000816\,|\vec{F_2}|^2 - 0.070696\,|\vec{F_2}| + 1.040816 \longrightarrow$$

$$|\vec{F_2}| \approx \frac{0.070696 \pm \sqrt{(-0.070696)^2 - 4(0.000816)(1.040816)}}{2(0.000816)}$$

$$= \frac{0.070696 \pm 0.040009}{0.001632}$$

$$\approx \boxed{67.834}\,N. \text{ or } \boxed{18.803}\,N.\text{; then}$$

if $\underline{|\vec{F_2}| = 18.803}$ in (A) we get

$$\cos(180° - \alpha) = \frac{-1}{70}(18.803) \approx -0.2686 \longrightarrow$$

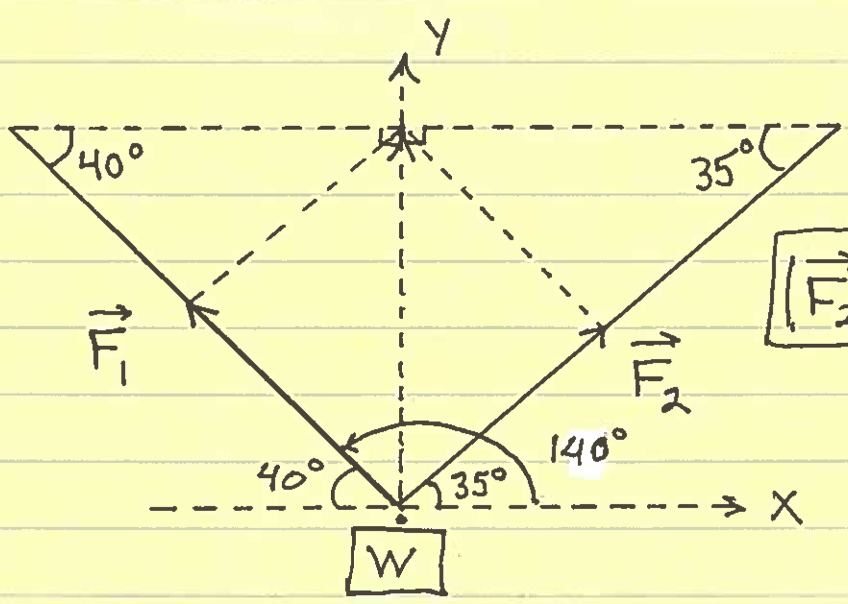
$$180° - \alpha \approx 105.6° \longrightarrow \boxed{\alpha \approx 74.4°}\ ;$$

if $\underline{|\vec{F_2}| = 67.834}$ in (A) we get

$$\cos(180° - \alpha) = \frac{-1}{70}(67.834) \approx -0.9691 \longrightarrow$$

$$180° - \alpha \approx 165.7° \longrightarrow \boxed{\alpha \approx 14.3°}$$

47.)



$$\boxed{|\vec{F_2}| = 100\,N}$$

By geometry of vectors :

$$\boxed{\vec{F}_1 + \vec{F}_2 = \overrightarrow{(0, w)}}$$ and

$$\vec{F}_1 = |\vec{F}_1| \overrightarrow{(\cos 140°, \sin 140°)}$$

$$= \overrightarrow{(|\vec{F}_1| \cos 140°, |\vec{F}_1| \sin 140°)} ,$$

$$\vec{F}_2 = |\vec{F}_2| \overrightarrow{(\cos 35°, \sin 35°)}$$

$$= 100 \overrightarrow{(\cos 35°, \sin 35°)}$$

$$= \overrightarrow{(100 \cos 35°, 100 \sin 35°)}$$; then

$$\vec{F}_1 + \vec{F}_2 = \overrightarrow{(|\vec{F}_1| \cos 140° + 100 \cos 35°, |\vec{F}_1| \sin 140° + 100 \sin 35°)}$$

$$= \overrightarrow{(0, w)}$$ so that

$$\left.\begin{array}{l} |\vec{F}_1| \cos 140° + 100 \cos 35° = 0 \\ |\vec{F}_1| \sin 140 + 100 \sin 35° = w \end{array}\right\} \rightarrow$$

$$|\vec{F}_1| \cos 140° = -100 \cos 35° \rightarrow$$

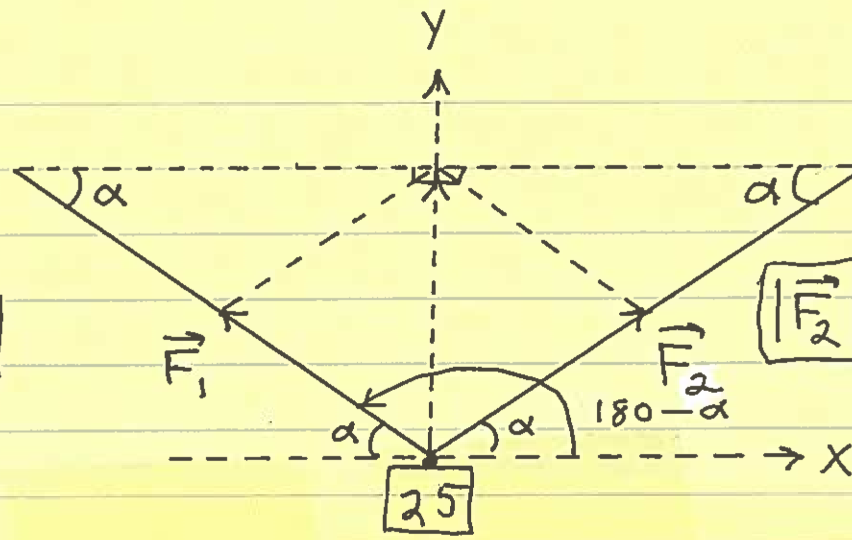
$$|\vec{F}_1| = \frac{-100 \cos 35°}{\cos 140°} \approx \boxed{106.93 \ N}$$, then

$$(106.93) \sin 140° + 100 \sin 35° = w \rightarrow$$

$$\boxed{w \approx 126.1 \ N}$$

48.)

$\boxed{|\vec{F}_1| = 75\,N}$ $\boxed{|\vec{F}_2| = 75\,N}$



By geometry of vectors:

$$\boxed{\vec{F}_1 + \vec{F}_2 = \overrightarrow{(0, 25)}} \quad \text{and}$$

$$\vec{F}_1 = |\vec{F}_1| \, \overrightarrow{(\cos(180-\alpha), \sin(180-\alpha))}$$

$$= 75 \, \overrightarrow{(\cos(180-\alpha), \sin(180-\alpha))}$$

$$= \overrightarrow{(75\cos(180-\alpha), 75\sin(180-\alpha))} \, ,$$

$$\vec{F}_2 = |\vec{F}_2| \, \overrightarrow{(\cos\alpha, \sin\alpha)}$$

$$= 75 \, \overrightarrow{(\cos\alpha, \sin\alpha)}$$

$$= \overrightarrow{(75\cos\alpha, 75\sin\alpha)} \quad ; \text{ then}$$

$$\vec{F}_1 + \vec{F}_2 = \overrightarrow{(75\cos(180-\alpha) + 75\cos\alpha, 75\sin(180-\alpha) + 75\sin\alpha)}$$

$$= \overrightarrow{(-75\cos\alpha + 75\cos\alpha, 75\sin\alpha + 75\sin\alpha)}$$

$$= \overrightarrow{(0, 150\sin\alpha)}$$

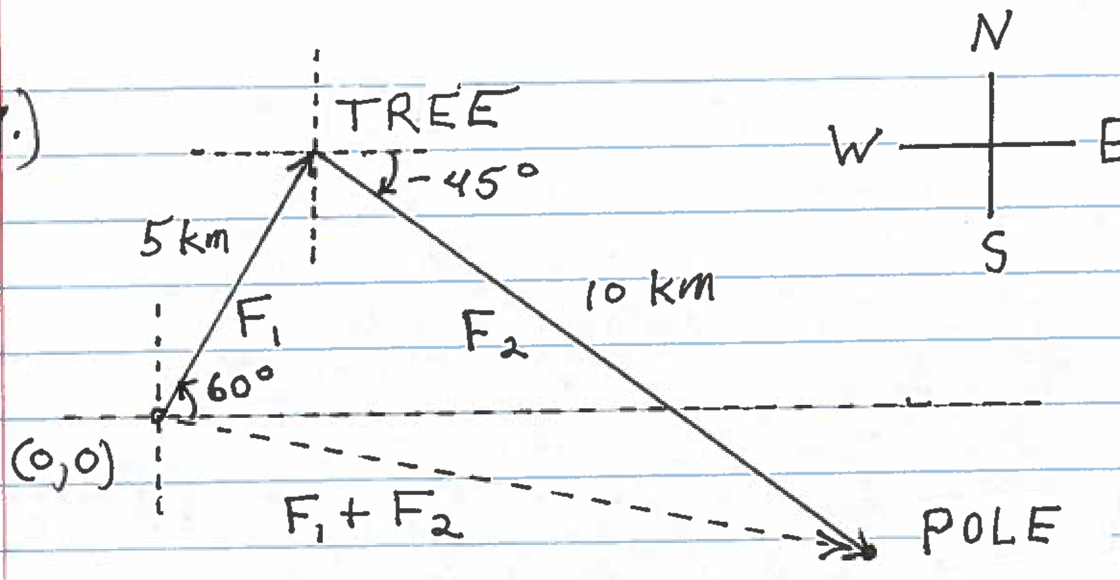
$$= \overrightarrow{(0, 25)} \quad , \text{ so that}$$

$150 \sin\alpha = 25 \longrightarrow$

$\sin\alpha = \frac{25}{150} = \frac{1}{6} \longrightarrow$

$\boxed{\alpha = 9.6^\circ}$

49.)



Vector $F_1 = 5\,\overrightarrow{(\cos 60°, \sin 60°)}$

$= 5\,\overrightarrow{\left(\frac{1}{2}, \frac{\sqrt{3}}{2}\right)} = \overrightarrow{\left(\frac{5}{2}, \frac{5\sqrt{3}}{2}\right)}$;

Vector $F_2 = 10\,\overrightarrow{(\cos(-45°), \sin(-45°))}$

$= 10\,\overrightarrow{\left(\frac{\sqrt{2}}{2}, -\frac{\sqrt{2}}{2}\right)}$

$= \overrightarrow{\left(5\sqrt{2}, -5\sqrt{2}\right)}$; then

Vector $F_1 + F_2 = \overrightarrow{\left(\frac{5}{2}, \frac{5\sqrt{3}}{2}\right)} + \overrightarrow{\left(5\sqrt{2}, -5\sqrt{2}\right)}$

$= \overrightarrow{\left(\frac{5}{2} + 5\sqrt{2}, \frac{5\sqrt{3}}{2} - 5\sqrt{2}\right)}$

$\approx \overrightarrow{(9.571, -2.741)}$

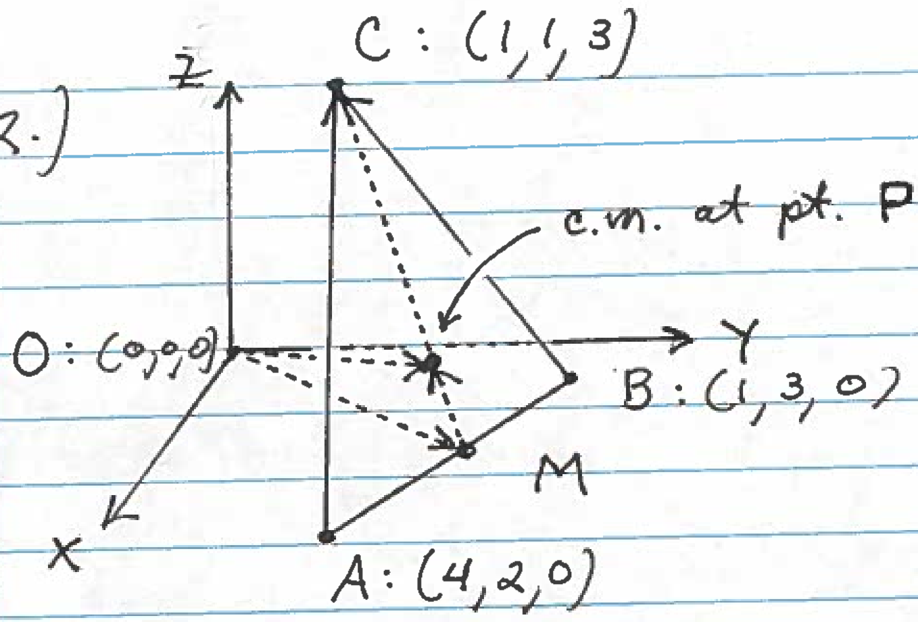
a.) TREE position is

$\left(\frac{5}{2}, \frac{5\sqrt{3}}{2}\right) \approx (2.5, 4.330)$

b.) POLE position is $\approx$

$(9.571, -2.741)$

52.)



pt. M is $M = \left(\frac{4+1}{2}, \frac{2+3}{2}, \frac{0+0}{2}\right) = \left(\frac{5}{2}, \frac{5}{2}, 0\right)$;

vector $\overrightarrow{OM} = \overrightarrow{\left(\frac{5}{2}-0, \frac{5}{2}-0, 0-0\right)} = \overrightarrow{\left(\frac{5}{2}, \frac{5}{2}, 0\right)}$;

vector $\overrightarrow{MC} = \overrightarrow{\left(1-\frac{5}{2}, 1-\frac{5}{2}, 3-0\right)} = \overrightarrow{\left(\frac{-3}{2}, \frac{-3}{2}, 3\right)}$;

vector $\overrightarrow{MP} = \frac{1}{3}\overrightarrow{MC}$ (See prob. 51)

$= \frac{1}{3}\overrightarrow{\left(\frac{-3}{2}, \frac{-3}{2}, 3\right)} = \overrightarrow{\left(\frac{-1}{2}, \frac{-1}{2}, 1\right)}$;

vector $\overrightarrow{OP} = \overrightarrow{OM} + \overrightarrow{MP}$

$= \overrightarrow{\left(\frac{5}{2}, \frac{5}{2}, 0\right)} + \overrightarrow{\left(\frac{-1}{2}, \frac{-1}{2}, 1\right)} = \overrightarrow{(2, 2, 1)}$, so center of mass is at point

$P: (2, 2, 1)$