CHAPTER 1

1,53) $\vec{A} = -2{,}00\,\hat{i} + 3{,}00\,\hat{j} + 4{,}00\,\hat{k}$

$\vec{B} = 3{,}00\,\hat{i} + 1{,}00\,\hat{j} - 3{,}00\,\hat{k}$

a) $|\vec{A}| = \sqrt{(A_x)^2 + (A_y)^2 + (A_z)^2}$

$= \sqrt{(-2{,}00)^2 + (3{,}00)^2 + (4{,}00)^2} = 5{,}38$

~~b)~~ $|\vec{B}| = \sqrt{(3{,}00)^2 + (1{,}00)^2 + (-3{,}00)^2} = 4{,}36$

b) $\vec{A} - \vec{B} = (-2{,}00\,\hat{i} + 3{,}00\,\hat{j} + 4{,}00\,\hat{k}) - (-3{,}00\,\hat{i} + 1{,}00\,\hat{j} - 3{,}00\,\hat{k})$

$= -5{,}00\,\hat{i} + 2{,}00\,\hat{j} + 7{,}00\,\hat{k}$

c) $|\vec{A} - \vec{B}| = \sqrt{(-5{,}00)^2 + (2{,}00)^2 + (7{,}00)^2} = 8{,}83$

$\vec{B} - \vec{A} = (3{,}00\,\hat{i} + 1{,}00\,\hat{j} - 3{,}00\,\hat{k}) - (-2{,}00\,\hat{i} + 3{,}00\,\hat{j} + 4{,}00\,\hat{k})$

$= 5{,}00\,\hat{i} - 2{,}00\,\hat{j} - 7{,}00\,\hat{k}$

$|\vec{B} - \vec{A}| = \sqrt{(5{,}0)^2 + (-2{,}00)^2 + (7{,}00)^2} = 8{,}83$

Thus $|\vec{A} - \vec{B}| = |\vec{B} - \vec{A}|$

1.66)

$$\vec{A}+\vec{B}+\vec{C}+\vec{D}=0$$

↳ 4th vector.

$$\vec{D}=-(\vec{A}+\vec{B}+\vec{C})$$

$$A_x = A\cos 30^\circ = 86.6\,N$$

$$A_y = A\sin 30^\circ = 50.0\,N$$

$$B_x = -B\sin 30^\circ = -40.0\,N$$

$$B_y = B\cos 30^\circ = 69.28\,N$$

$$C_x = -C\cos 53^\circ = -24.07\,N$$

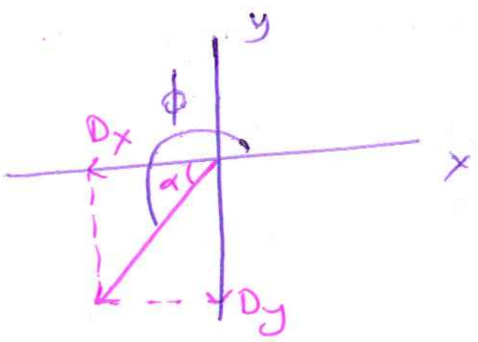
$$C_y = -C\sin 53^\circ = -31.90\,N$$

$$\vec{A}+\vec{B}+\vec{C} = (A_x+B_x+C_x)\hat{i} + (A_y+B_y+C_y)\hat{j}$$

$$= +22.53\hat{i} + 87.34\hat{j}$$

$$\vec{D} = -22.53\hat{i} - 87.34\hat{j}$$

$$|\vec{D}| = \sqrt{(-22.53)^2 + (-87.34)^2} = 90.2\,N$$



$$\tan\alpha = \left|\frac{D_y}{D_x}\right| \Rightarrow \alpha = 75.54^\circ$$

$$\phi = 180^\circ + \alpha = 256^\circ$$

1,70)

a) $A_x = 0$ $\quad B_x = 7{,}50m$ $\quad C_x = -10{,}9m$

$A_y = -8{,}00m$ $\quad B_y = 13{,}0m$ $\quad C_y = -5{,}07m$

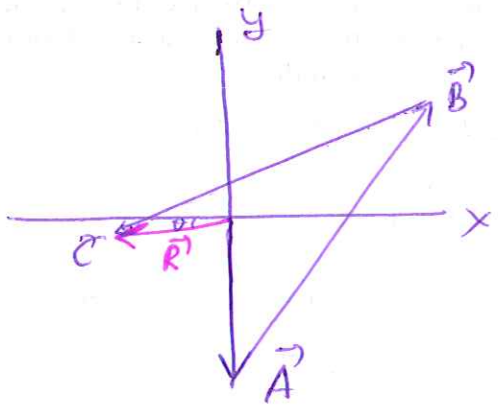
Resultant vector: $\vec{R} = \vec{A} + \vec{B} + \vec{C}$

$R_x = A_x + B_x + C_x = -3{,}4m$

$R_y = A_y + B_y + C_y = -0{,}07m$

$R = \sqrt{R_x^2 + R_y^2} = 3{,}4m$ $\quad \tan\theta = \left| \frac{R_y}{R_x} \right| = \frac{0{,}07m}{3{,}4m}$

$\theta = 1{,}2^\circ$

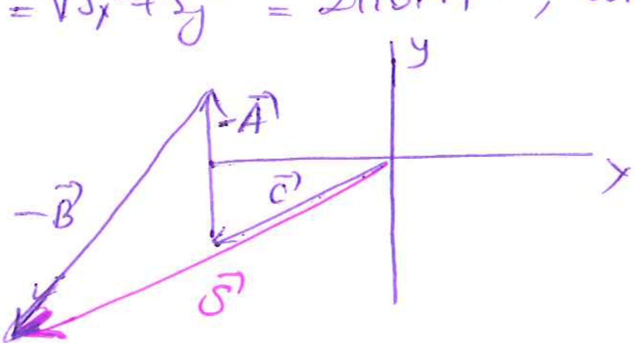


b) $\vec{S} = \vec{C} - \vec{A} - \vec{B}$

$S_x = C_x - A_x - B_x = -18{,}4m$

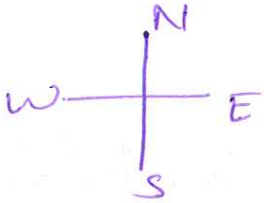
$S_y = C_y - A_y - B_y = -10{,}1m$

$S = \sqrt{S_x^2 + S_y^2} = 21{,}0m$, $\tan\theta' = \frac{S_y}{S_x} = \frac{-10{,}1m}{-18{,}4m} \Rightarrow \theta = 288^\circ$



1,74)

a)



$\vec{D}$; distance from Manhattan to Lincoln.

$$\vec{D} = -(\vec{A}+\vec{B}+\vec{C})$$

$$D_x = -A_x - B_x - C_x = -[(147\,km)\sin 85° + (106\,km)(\sin 167°) + (166\,km)(\sin 235°)]$$

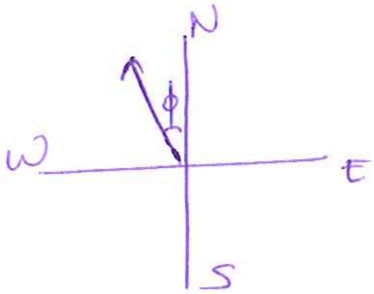
$$= -34{,}3\ km$$

$$D_y = -A_y - B_y - C_y = -[(147\,km)\cos 85° + 106\,km(\cos 167°) + (166\,km)(\cos 235°)]$$

$$= 185{,}7\ km$$

$$D = \sqrt{D_x^2 + D_y^2} = \sqrt{(-34{,}3\ km)^2 + (185{,}7\ km)^2} = 189\ km$$

b) $\tan\phi = \dfrac{34{,}3\ km}{185{,}7\ km} \Rightarrow \phi = 10{,}5°$



10,5° west of north.

1,83)

Let's choose the starting point to be origin

$\vec{A}$: 12.0 m to east

$\vec{B}$: 28.0m, 50° west of north

$\vec{C}$: ?

$\vec{D}$: From origin to end point (10.0m to south)

$\vec{A}+\vec{B}+\vec{C}=\vec{D}$

$A_x+B_x+C_x=D_x$, $A_y+B_y+C_y=D_y$

$A_x=12.0m$, $B_x=-28.0m(\sin 50°)=-21.45m$, $D_x=0$

$A_y=0$, $B_y=(28.0m)\cos 50°=18.0m$, $D_y=-10.0m$

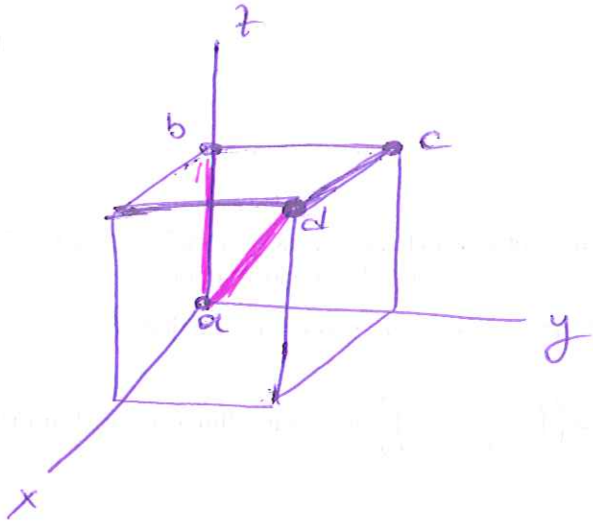
$C_x=D_x-(A_x+B_x)=9.45m$

$C_y=D_y-(A_y+B_y)=-28.0m$

$C=\sqrt{C_x^2+C_y^2}=\sqrt{(9.45m)^2+(-28.0m)^2}=29.6m$

$\tan\alpha=\frac{9.45}{28.0} \Rightarrow \alpha=18.6°$ east of south.

1.91)



a) ab line, from a to b : $\vec{A} = \hat{k}$

ad line, from a to d : $\vec{B} = \hat{i} + \hat{j} + \hat{k}$

Use scalar product: $\vec{A} \cdot \vec{B} = |\vec{A}|\,|\vec{B}| \cos\phi$

$|\vec{A}| = \sqrt{1^2} = 1$

$|\vec{B}| = \sqrt{1^2+1^2+1^2} = \sqrt{3}$

$\vec{A} \cdot \vec{B} = \hat{k} \cdot (\hat{i} + \hat{j} + \hat{k}) = 1 \cdot 1 = 1$

$\cos\phi = \dfrac{\vec{A} \cdot \vec{B}}{|\vec{A}|\,|\vec{B}|} = \dfrac{1}{\sqrt{3}}$, $\phi = 54{,}7^\circ$

b) ac line: $\vec{C} = \hat{j} + \hat{k}$

$|\vec{C}| = \sqrt{1^2+1^2} = \sqrt{2}$

$\vec{A} \cdot \vec{C} = (\hat{i} + \hat{j} + \hat{k}) \cdot (\hat{j} + \hat{k}) = 1 + 1 = 2$

$\cos\alpha = \dfrac{2}{\sqrt{2}\sqrt{3}} = \dfrac{2}{\sqrt{6}}$, $\alpha = 35{,}3^\circ$

1,96) $A=3{,}00$, $B=3{,}00$, $\vec{A}\times\vec{B}=-5{,}0\hat{k}+2{,}0\hat{\imath}$

$$|\vec{A}\times\vec{B}|=|\vec{A}|\,|\vec{B}|\sin\phi$$

$$|\vec{A}\times\vec{B}|=\sqrt{(-5{,}0)^2+(2{,}0)^2}=\sqrt{29}$$

$$|\vec{A}|\,|\vec{B}|=9{,}0$$

$$\sin\phi=\frac{\sqrt{29}}{9}\ ,\quad \phi=36{,}8^\circ.$$