Chapter 03

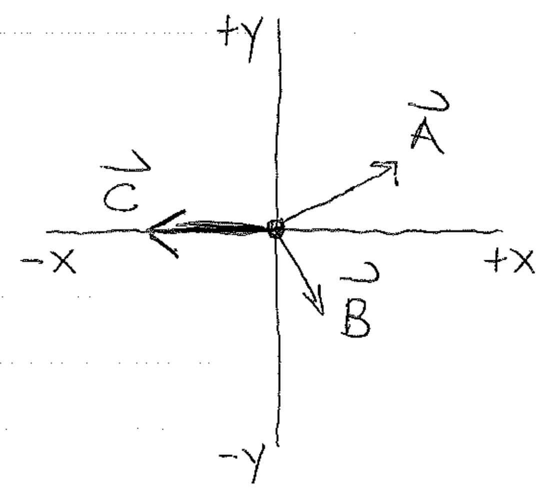
1a $\vec{A} + \vec{B} + \vec{C} = 0$ $A = 2B$ $\vec{A} \perp \vec{B}$

$\theta_C = 180^\circ$ $\theta_A = ?$ $\theta_B = ?$

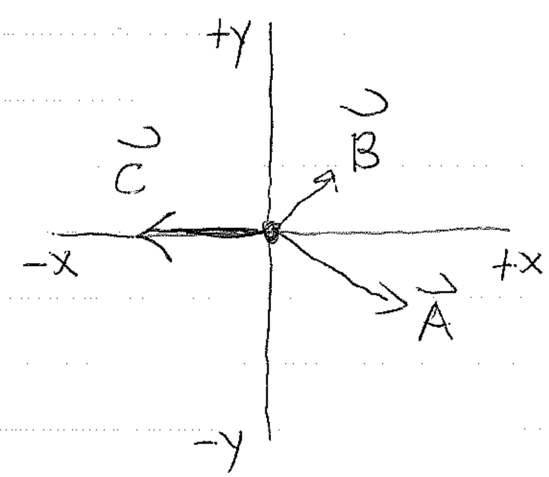
1b Assumptions and Simplifications: none

Concepts and Laws: Vector Addition and subtraction

2a Physical Representation



Vector Diagram #1



Vector Diagram #2

2b $A_y = A \sin\theta_A$ $B_y = B \sin\theta_B$

3a Solution

$\vec{A} + \vec{B} + \vec{C} = 0 \qquad (\vec{A} + \vec{B}) = -\vec{C}$

$(\vec{A} + \vec{B})$ must be in the positive x-direction and its y-component must be zero.

$A_y + B_y = 0 \qquad A\sin\theta_A + B\sin\theta_B = 0 \qquad (A = 2B)$

$2B\sin\theta_A + B\sin\theta_B = 0 \qquad 2\sin\theta_A + \sin\theta_B = 0$

Since $\vec{A} \perp \vec{B}$, $\theta_A + (360^\circ - \theta_B) = 90^\circ$ (Vector Diagram #1)

$\theta_A + 360^\circ - \theta_B = 90^\circ \qquad \theta_A = \theta_B - 270^\circ$

$2\sin(\theta_B - 270^\circ) + \sin\theta_B = 0$ solve for θ_B

$\sin(\alpha - \beta) = \sin\alpha\cos\beta - \cos\alpha\sin\beta$

$\sin(\theta_B - 270^\circ) = \sin\theta_B\cos 270^\circ - \cos\theta_B\sin 270^\circ$

$\sin(\theta_B - 270^\circ) = \cos\theta_B$

$2\cos\theta_B + \sin\theta_B = 0 \qquad \sin\theta_B = -2\cos\theta_B$

Divide by $\cos\theta_B$ on both sides

$\frac{\sin\theta_B}{\cos\theta_B} = \frac{-2\cos\theta_B}{\cos\theta_B} \qquad \tan\theta_B = -2 \qquad \theta_B = \tan^{-1}(-2)$

$\theta_B = -63^\circ + 360^\circ = 297^\circ$

$\theta_A = \theta_B - 270^\circ = 26.6^\circ$

Vector Diagram #1

For vector diagram #2, flip $\vec{A}$ and $\vec{B}$ over the x-axis.

$$\left.\begin{aligned} \theta_B &= 63.4^\circ \\ \theta_A &= -27^\circ + 360^\circ = 333^\circ \end{aligned}\right] \quad \text{Vector Diagram \#2}$$

<u>4a</u> Evaluation

The answers make sense because they are in the range $0^\circ \le \theta < 360^\circ$. The solution does not consider A_x and B_x because the magnitude of $\vec{C}$ is not given. Only its direction is given.