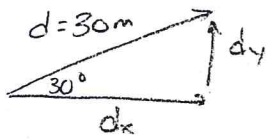
Vector Components

Draw each of the following vectors on a Cartesian coordinate system and break them down into vertical and horizontal components.

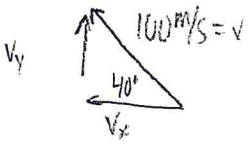
a) $\bar{d}$ = 30 m [E30°N]



$d_x = d\cos\theta$
$= (30)\cos 30°$
$= 26\text{ m [E]}$

$d_y = d\sin\theta$
$= (30)\sin 30°$
$= 15\text{ m [N]}$

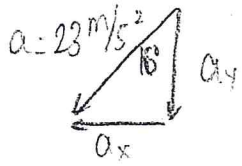
b) $\bar{v}$ = 100 m/s [W40°N]



$V_x = v\cos\theta$
$= (100)\cos 40°$
$= 77\text{ m/s [W]}$

$V_y = v\sin\theta$
$= (100)\sin 40°$
$= 64\text{ m/s [N]}$

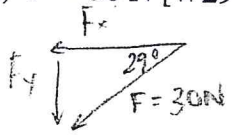
c) $\bar{a}$ = 23 m/s^2 [S16°W]



$a_x = a\sin\theta$
$= (23)\sin 16$
$= 6.3\text{ m/s}^2\text{ [W]}$

$a_y = a\cos\theta$
$= (23)\cos 16°$
$= 22\text{ m/s}^2\text{ [S]}$

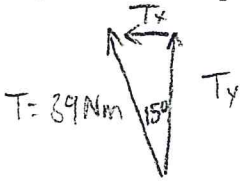
d) $\bar{F}$ = 30 N [W29°S]



$F_x = F\cos\theta$
$= 30\cos 29°$
$= 26\text{ N [W]}$

$F_y = F\sin\theta$
$= (30)\sin 29$
$= 14\text{ N [S]}$

e) $\bar{T}$ = 39 N·m [N15°W]



$T_x = T\sin\theta$
$= (39)\sin 15°$
$= 10\text{ N m [W]}$

$T_y = T\cos\theta$
$= (39)\cos 15°$
$= 38\text{ N·m [N]}$

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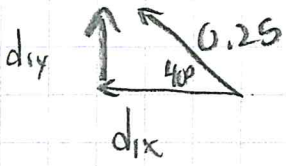
VECTOR ADDITION BY COMPONENTS - ANSWERS.

1 $\vec{d}_1 = 25\text{cm}\ [W40°N]$

$= 0.25\text{m}\ [W\ 40°\ N]$



$d_{1x} = d_1 \cos\theta$

$= (.25)\cos 40°$

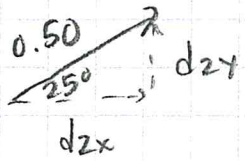
$= 0.192\text{m}\ [W]$

$d_{1y} = d_1 \sin\theta$

$= (0.25)\sin 40°$

$= 0.161\text{m}\ [N]$

$\vec{d}_2 = 50\text{cm}\ [E\ 25°N]$



$d_{2x} = d_2 \cos\theta$

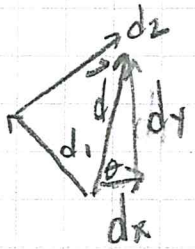
$= (0.50)\cos 25°$

$= 0.453\text{m}\ [E]$

$d_{2y} = d_2 \sin\theta$

$= (0.50)\sin 25°$

$= 0.211\text{m}\ [N]$



$d_x = d_{2x} - d_{1x}$

$= (0.453) - (0.192)$

$= 0.261\text{m}\ [E]$

$d_y = d_{1y} + d_{2y}$

$d_y = 0.161\text{m} + 0.211\text{m}$

$d_y = 0.372\text{m}\ [N]$

$\tan\theta = \frac{d_y}{d_x}$

$\tan\theta = \frac{0.372}{0.261}$

$\theta = 55°$

$d = \sqrt{d_x^2 + d_y^2}$

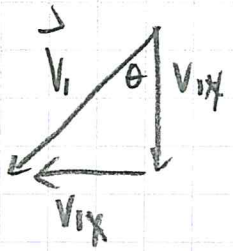
$d = \sqrt{(0.261)^2 + (0.372)^2}$

$d = 0.45\text{ m}$

$\therefore \vec{d} = 0.45\text{m}\ [E\ 55°N]$

Vector Addition By Components – Answers

2. $\vec{V}_1 = 35\ m/s\ [S\ 37°\ W]$



$V_{1x} = V_1 \sin\theta$

$= (35)\sin 37$

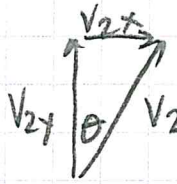
$= 21.1\ m/s\ [W]$

$V_{1y} = V_1 \cos\theta$

$= (35)\cos 37$

$= 28.0\ m/s\ [S]$

$\vec{V}_2 = 62\ m/s\ [N\ 15°\ E]$



$V_{2x} = V_2 \sin\theta$

$= (62)\sin 15$

$= 16.0\ m/s\ [E]$

$V_{2y} = V_2 \cos\theta$

$= (62)\cos 15°$

$= 59.9\ m/s\ [N]$

$V_x = V_{1x} - V_{2x}$

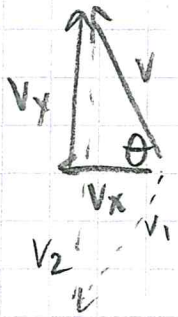
$= 21.1 - 16.0$

$= 5.1\ m/s\ [W]$

$V_y = V_{2y} - V_{1y}$

$V_y = 59.9 - 28.0$

$V_y = 31.9\ m/s\ [N]$



$\tan\theta = \frac{V_y}{V_x}$

$\tan\theta = \left(\frac{31.9}{5.1}\right)$

$\theta = 81°$

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

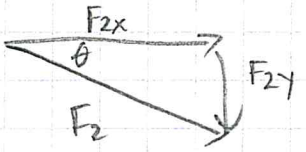
$V = \sqrt{(5.1)^2 + (31.9)^2}$

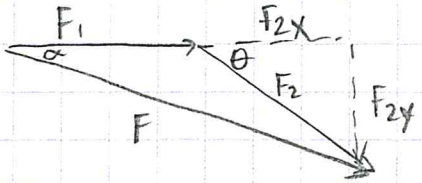
$V = 32\ m/s$

$\therefore\ \vec{V} = 32\ m/s\ [W\ 81°\ N]$

Vector Addition By Components - Answers

3. $\vec{F}_1 = 200N\,[E]$ $\quad F_2 = 150N\,[E60°S]$





$F_{2x} = F_2\cos\theta \qquad F_{2y} = F_2\sin\theta$

$F_x = F_1 + F_{2x}$

$= F_1 + F_2\cos\theta$

$= 200N + (150N)(\cos 60°)$

$= 275N\,[E]$

$F_y = F_{2y} = F_2\sin\theta$

$F_y = (150)\sin 60°$

$F_y = 129.9\,N\,[S]$

$F = \sqrt{F_x^2 + F_y^2}$

$F = \sqrt{(275)^2 + (129.9)^2}$

$F = 304.1N$

$\tan\alpha = \frac{F_y}{F_x}$

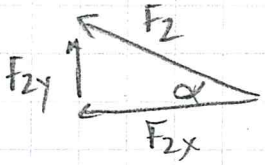
$\alpha = \tan^{-1}\left(\frac{129.9}{275}\right)$

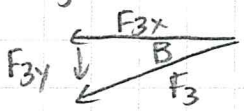
$\alpha = 25°$

$\therefore F = 3.0 \times 10^2 N\,[E\,25°S]$

Vector Addition By Components - Answers

4. $\vec{F}_1 = 140\,N\,[E]$ $\vec{F}_2 = 190\,N\,[W\,40°N]$ $\vec{F}_3 = 250\,N\,[W\,15°S]$





$F_{2x} = F_2 \cos\alpha$ $F_{3x} = F_3 \cos\beta$

$F_{2y} = F_2 \sin\alpha$ $F_{3y} = F_3 \sin\beta$

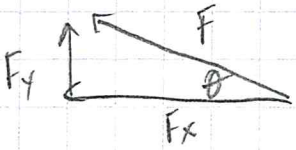
$F_x = F_1 - F_{2x} - F_{3x}$ $F_y = F_{2y} - F_{3y}$

$F_x = F_1 - F_2\cos\alpha - F_3\cos\beta$ $F_y = F_2\sin\alpha - F_3\sin\beta$

$F_x = 140 - (190)\cos 40 - (250)\cos 15$ $F_y = 190\sin 40 - 250\sin 15$

$F_x = -247\,N\,[E]$ $F_y = 57.4\,N\,[N]$

$= 247\,N\,[W]$



$\tan\theta = \frac{F_y}{F_x}$ $F = \sqrt{F_x^2 + F_y^2}$

$\tan\theta = \frac{57.4}{247}$ $F = \sqrt{(247)^2 + (57.4)^2}$

$F = 253.58\,N$

$\theta = 13°$

$\therefore \vec{F} = 2.5 \times 10^2\,N\,[W\,13°N]$