If **A** = 28 m [E75°N], **B** = 35 m [E24°S], **C** = 22 m [W50°N], and **D** = 40 m [W30°S] Find:

4C + 3D {160 m [W2.6°N]}

$C = 22\text{m}\ [W50°N]$

$D = 40\text{m}\ [W30°S]$

$C_E = -22\cos 50° = -14.1\text{m}$ $C_N = 22\sin 50 = 17\text{m}$

$D_E = -40\cos 30° = -35\text{m}$ $D_N = -40\sin 30 = -20\text{m}$

$R_E = 4C_E + 3D_E$

$= 4(-14.1) + 3(-35)$

$R_E = -161\text{m}$

$R_N = 4C_N + 3D_N$

$= 4(17) + 3(-20)$

$R_N = 8\text{m}$

$|\vec{R}| = \sqrt{(R_E)^2 + (R_N)^2} = \sqrt{(-161)^2 + (8)^2}$

$|\vec{R}| = 161\text{m}$

$\theta = \tan^{-1}\left|\frac{R_N}{R_E}\right| = \tan^{-1}\frac{8}{161}$

$\theta = 2.8°$

$\vec{R} = 161\text{m}\ [W2.8°N]$

Physics 122: Application of Vectors Examples

1. What is the average velocity of a car that drives 66 km [E], 52 km [W33°N], and 45 km [W73°S] in 3.1 hours?

$\vec{v}_{avg} = \frac{\vec{d}}{t}$ ← add all displacement vectors together.
* Break up to perpendicular components.

$\vec{d}_1 = 66\,km\,[E]$; $\vec{d}_2 = 52\,km\,[W\,33N]$; $\vec{d}_3 = 45\,[W73S]$

$d_{1E} = 66\cos 0 = 66$ $\quad d_{1N} = 66\sin 0 = 0$

$d_{2E} = -52\cos 33 = -44$ $\quad d_{2N} = 52\sin 33 = 28$

$d_{3E} = -45\cos 73 = -13$ $\quad d_{3N} = -45\sin 73 = -43$

$d_E = d_{1E} + d_{2E} + d_{3E}$
$= 66 + (-44) + (-13)$
$= 9\,km$

$d_N = d_{1N} + d_{2N} + d_{3N}$
$= 0 + 28 + (-43)$
$= -15\,km$

$|\vec{d}| = \sqrt{d_E^2 + d_N^2} = \sqrt{(9)^2 + (-15)^2}$

$|\vec{d}| = 17.5\,km$

$\theta = \tan^{-1}\left|\frac{d_N}{d_E}\right| = \tan^{-1}\frac{15}{9} = 57°$

$\vec{d} = 17.5\,km\,[E\,57°S]$

$\vec{v}_{avg} = \frac{\vec{d}}{t} = \frac{17.5\,km\,[E57°S]}{3.1\,h}$

$\vec{v}_{avg} = 5.7\,\frac{km}{h}\,[E57°S]$

Physics 122: Application of Vectors Examples

2. What is the acceleration of a glider that goes from 10 m/s [N] to 10 m/s [E] in 2.5 seconds?

$\vec{v}_f = 10\ m/s\ [E]$ $\quad v_{oE} = 0\ m/s$ $\quad v_{oN} = 10\ m/s$

$\vec{v}_o = 10\ m/s\ [N]$ $\quad v_{fE} = 10\ m/s$ $\quad v_{fN} = 0\ m/s$

$t = 2.5\ s$

$\vec{a} = ?$

$$\vec{a} = \frac{\vec{v}_f - \vec{v}_o}{t}$$

$$a_E = \frac{v_{fE} - v_{oE}}{t}$$

$$a_N = \frac{v_{fN} - v_{oN}}{t}$$

$$a_E = \frac{10 - 0}{2.5}$$

$$a_N = \frac{0 - 10}{2.5}$$

$$a_E = 4\ m/s^2$$

$$a_N = -4\ m/s^2$$

$$|\vec{a}| = \sqrt{a_E^2 + a_N^2} = \sqrt{(4)^2 + (-4)^2}$$

$$|\vec{a}| = 5.6\ m/s^2$$

$$\theta = \tan^{-1}\left|\frac{a_N}{a_E}\right| = \tan^{-1}\frac{4}{4} = 45^\circ$$

$$\vec{a} = 5.6\ m/s^2\ [E\ 45^\circ\ S]$$

Physics 122: Application of Vectors Examples

3. What is the average force on the glider if it has a mass of 92kg?

$$\vec{F}_{avg} = m\vec{a}$$

← from #2

$$= (92)(5.6)$$

$$= 515\,N\,[E\,45^\circ S]$$