Summary $\vec{v} = (a,b)$ < initial point $(0,0)$ / endpoint (a,b)

$\vec{u} = (c,d)$

$\vec{v} + \vec{u} = (a+c, b+d)$

$\vec{v} - \vec{u} = (a-c, b-d)$

$k\vec{v} = (ka, kb)$

$\vec{u} \cdot \vec{v} = ac + bd$

$\vec{u} \bullet \vec{v} = |\vec{u}| \bullet |\vec{v}| \cdot \cos\theta$

$\cos\theta = \frac{\vec{u} \cdot \vec{v}}{|\vec{u}| \cdot |\vec{v}|}$

$\vec{v} = a\vec{i} + b\vec{j}$

$\vec{i} = (1,0)$; $\vec{j} = (0,1)$

Unit vector in direction of $\vec{v}$

$\frac{\vec{v}}{|\vec{v}|} = \left(\frac{a}{\sqrt{a^2+b^2}}, \frac{b}{\sqrt{a^2+b^2}}\right)$

Component form of $\vec{v}$

$a = |\vec{v}| \cos\theta$

$b = |\vec{v}| \sin\theta$

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Applications

(1) An airplane is heading north at an airspeed of 600 km/hr. There is a wind blowing 45° east of north at 80 km/hr.

How many degrees will the plane end up flying off course and what is the groundspeed of the airplane?

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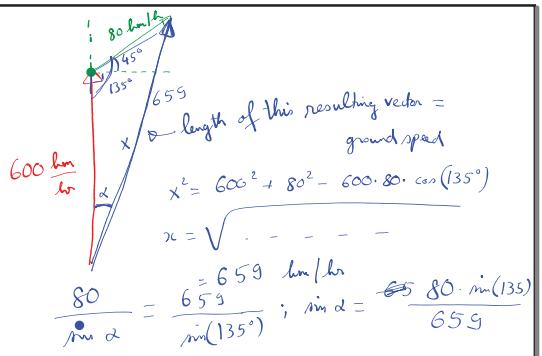

length of this resulting vector = groundspeed

$x^2 = 600^2 + 80^2 - 600 \cdot 80 \cdot \cos(135°)$

$x = \sqrt{\quad - \quad - \quad - \quad -}$

$= 659$ km/hr

$\frac{80}{\sin\alpha} = \frac{659}{\sin(135°)}$; $\sin\alpha = \frac{80 \cdot \sin(135)}{659}$

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