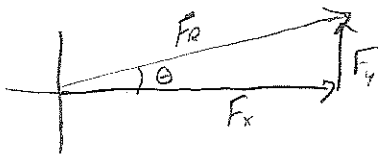
Adding Perpendicular Vectors Mathematically

Sketch means not a scale drawing.

1. Sketch the addition of these vectors showing the resultant vector. Be sure to show the angle being calculated in the sketch. Calculate both the size and direction of the resultant vector.

a) F_x = 46.9 N at 0 °
F_y = 5.9 N at 90 °



$|\vec{F}_R|^2 = |\vec{F}_x|^2 + |\vec{F}_y|^2$

$|\vec{F}_R| = \sqrt{|\vec{F}_x|^2 + |\vec{F}_y|^2} = \sqrt{(46.9\ N)^2 + (5.9\ N)^2} = \sqrt{2234.42\ N^2}$ 3 sig figs

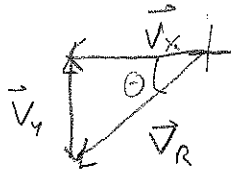
$(2199.61) + (34.81)$

$= 47.2696 N = 47.3\ N$

$\theta = \tan^{-1}\left(\frac{|\vec{F}_y|}{|\vec{F}_x|}\right) = \tan^{-1}\left(\frac{5.9\ N}{46.9\ N}\right) = 7.1701 = 7.2°$

$\vec{F}_R = 47.3\ N\ [E\ 7.2°\ N]$ or $[7.2°]$

b) $\vec{V}_x$ = 12.55 km/h at 180 °
$\vec{V}_y$ = 9.324 km/h at 270 °



$|\vec{V}_R|^2 = |\vec{V}_x|^2 + |\vec{V}_y|^2$

$|\vec{V}_R| = \sqrt{|\vec{V}_x|^2 + |\vec{V}_y|^2} = \sqrt{(12.55\ Km/h)^2 + (9.324\ Km/h)^2} = \sqrt{244.439\ Km^2/h^2}$

$157.507 \qquad 86.9369$ 4 sig figs

$= 15.634$

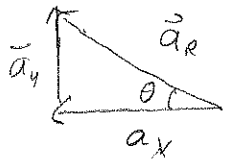
$= 15.63\ Km/h$

$\theta = \tan^{-1}\left(\frac{|\vec{V}_y|}{|\vec{V}_x|}\right) = \tan^{-1}\left(\frac{9.324\ Km/h}{12.55\ Km/h}\right) = 36.6104° = 36.61°$

$\vec{V}_R = 15.63\ Km/h\ [W\ 36.61°\ S]$ or $[216.6°]$

c) $a_x = 0.68\ m/s^2$ at $180°$

$a_y = 0.48\ m/s^2$ at $90°$



$$|\vec{a}_R|^2 = |\vec{a}_x|^2 + |\vec{a}_y|^2$$

$$|\vec{a}_R| = \sqrt{|\vec{a}_x|^2 + |\vec{a}_y|^2} = \sqrt{(0.68\ m/s^2)^2 + (0.48\ m/s^2)^2} = 0.8323\ m/s^2$$

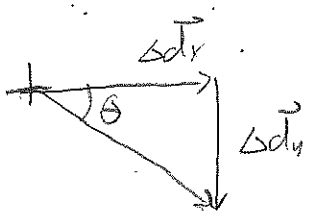
$$= 0.83\ m/s^2$$

$$\theta = \tan^{-1}\left(\frac{|\vec{a}_y|}{|\vec{a}_x|}\right) = \tan^{-1}\left(\frac{0.48\ m/s^2}{0.68\ m/s^2}\right) = 35.21° = 35°$$

$$\vec{a}_R = 0.83\ m/s^2\ [W\ 35°\ N] \text{ or } [145°]$$

d) $\Delta d_x = 3.88\ km$ at $0°$

$\Delta d_y = 5.62\ km$ at $270°$



$$|\Delta\vec{d}_r|^2 = |\Delta\vec{d}_x|^2 + |\Delta\vec{d}_y|^2$$

$$|\Delta\vec{d}_r| = \sqrt{|\Delta\vec{d}_x|^2 + |\Delta\vec{d}_y|^2} = \sqrt{(3.88\ Km)^2 + (5.62\ Km)^2}$$

$$= 6.8293\ Km$$

$$= 6.83\ Km$$

$$\theta = \tan^{-1}\left(\frac{|\Delta\vec{d}_y|}{|\Delta\vec{d}_x|}\right) = \tan^{-1}\left(\frac{5.62\ Km}{3.88\ Km}\right) = 55.38° = 55.4°$$

$$\Delta\vec{d}_r = 6.83\ Km\ [E\ 55.4°\ S] \text{ or } [304.6°]$$

Answers: 1. a) $F_R = 47.3$ N [7.2 °]
b) $\vec{V}_R = 15.63$ km/h [216.6°]
c) $a_R = 0.83$ [144.8°]
d) $\Delta d_R = 6.83$ km [304.6°]

Note angles calculated to one decimal place regardless of significant digits in original measurements.