General Physics I
Classnotes

Jonathan Henrique Maia de Moraes (ID: 1620855)

02/08/2016

February 08

1 Vector

$$\begin{aligned} \hat{i} &\qquad unitvectorin + xdirection \\ \hat{j} &\qquad unitvectorin + ydirection \\ \hat{k} &\qquad unitvectorin + zdirection \end{aligned}$$

A unit vector has length 1 unit.

$$\begin{aligned} |\hat{i}| &= 1 \\ |\hat{j}| &= 1 \\ |\hat{k}| &= 1 \end{aligned}$$

$$\begin{aligned} A_x &= 4 \\ A_y &= 3 \\ \vec{A} &= 4\hat{i} + 3\hat{j} \end{aligned}$$

Example:

$$\vec{A} = 8\ m@30^o$$

Find $A_x,\ A_y$

$$
\begin{aligned}
A_x &= A\cos\theta_A \\
&= (8\ m)\cos(30^o) \\
&= 6.928\ m \\
A_y &= A\sin\theta_A \\
&= (8\ m)\sin(30^o) \\
&= 4.00\ m \\
\vec{A} &= (6.928\ m)\hat{i} + (4.00\ m)\hat{j}
\end{aligned}
$$

Example:

$$
\begin{aligned}
\vec{B} &= 12\ m@140^o \\
B_x &= B\cos\theta_B \\
&= (12\ m)\cos(140^o) \\
&= -9.19\ m \\
B_y &= B\sin\theta_B \\
&= (12\ m)\sin(140^o) \\
&= 7.71\ m \\
\vec{B} &= (-9.19\ m)\hat{i} + (7.71\ m)\hat{j}
\end{aligned}
$$

Example:

$$\vec{C} = 4\hat{i} + 3\hat{j}$$

Find $c,\ \theta_C$

$$
\begin{aligned}
C &= \sqrt{C_x^2 + C_y^2} \\
&= \sqrt{4^2 + 3^2} \\
&= \sqrt{16 + 9} \\
&= \sqrt{25} \\
&= 5.0 \\
\tan\theta_C &= \frac{C_y}{C_x} = \frac{3}{4} = 0.75 \\
\theta_C &= \tan^{-1}(0.75) \\
&= 36.87^o \\
\vec{C} &= 5.0@36.87^o
\end{aligned}
$$

Example:

$$
\begin{aligned}
\vec{D} &= -9\hat{i} + 12\hat{j} \\
D &= \sqrt{D_x^2 + D_y^2} \\
&= \sqrt{(-9)^2 + 12^2} \\
&= \sqrt{81 + 144} \\
&= \sqrt{225} \\
&= 15 \\
\tan\theta_D &= \frac{D_y}{D_x} = \frac{12}{-9} = -\frac{4}{3} \\
\theta_D &= \tan^{-1}\left(-\frac{3}{4}\right) \\
&= -53.13^o + 180^o \\
&= 126.87^o \\
\vec{D} &= 15.0@126.87^o
\end{aligned}
$$

Rule: when x-component is negative:

$$\theta = \theta + 180^o \tag{1}$$

$$\begin{aligned}\vec{R} &= \vec{A} + \vec{B} \\ \vec{R}_x &= \vec{A}_x + \vec{B}_x \\ \vec{R}_y &= \vec{A}_y + \vec{B}_y\end{aligned} \tag{2}$$

Example:

$$\begin{aligned}\vec{A} &= 10 \ @ \ 37^o \\ \vec{B} &= 12 \ @ \ -60^o\end{aligned}$$

Find magnitude and direction of $\vec{R} = \vec{A} + \vec{B}$

$$\begin{aligned}A_x &= A \ \cos\theta_A \\ &= 10 \ \cos(37^o) \\ &= 7.98 \\ A_y &= A \ \sin\theta_A \\ &= 10 \ \sin(37^o) \\ &= 6.02\end{aligned}$$

$$\begin{aligned}B_x &= B \ \cos\theta_B \\ &= 12 \ \cos(-60^o) \\ &= 6.00 \\ B_x &= B \ \sin\theta_B \\ &= 12 \ \sin(-60^o) \\ &= -10.39\end{aligned}$$

$$\begin{aligned}
\vec{R}_x &= \vec{A}_x + \vec{B}_x \\
&= 7.98 + 6.00 \\
&= 13.98 \\
\vec{R}_y &= \vec{A}_y + \vec{B}_y \\
&= 6.02 + (-10.39) \\
&= -4.37
\end{aligned} \tag{3}$$

$$\begin{aligned}
\vec{R} &= 13.98\hat{i} - 4.37\hat{j} \\
R &= \sqrt{(13.98)^2 + (-4.37)^2} \\
&= 14.6 \\
\tan\theta_R &= \frac{R_y}{R_x} = \frac{-4.37}{13.98} = -0.313 \\
\theta_R &= \tan^{-1}(-0.313) = -17.4^o \\
\vec{R} &= 14.6 \ @ \ -17.4^o
\end{aligned} \tag{4}$$