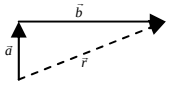
Name:	Tuesday, March 01, 2011
Ku: /31	Com:

Answer all questions using the GRFS format

1. Find the resultant (both magnitude and direction) of the following vector diagram. Where $\vec{a} = 12m\left[N\right]$ and $\vec{b} = 20m\left[E\right]$ **[ku:6]**



2. A boat sails $100km\left[E25^0N\right]$ and then sail $250km\left[S15^0E\right]$. Find the resultant (really the displacement) from the two legs of the journey. Include a detailed vector diagram. Show all steps and justify any and found angles. **[ku:10]**

3. Using the component method, determine the resultant of the following vector equation. $\vec{r} = \vec{a} + \vec{b} + \vec{c}$, where $\vec{a} = 10m\left[E15^0N\right]$, $\vec{b} = 20m\left[W42^0S\right]$, and $\vec{c} = 35m\left[N42^0W\right]$ **[ku:15]**

[See the following 3 pages for solutions]

Answer all questions using the GRFS format

1. Find the resultant (both magnitude and direction) of the following vector diagram. Where $\vec{a} = 12m[N]$ and $\vec{b} = 20m[E]$ **[ku:6]**

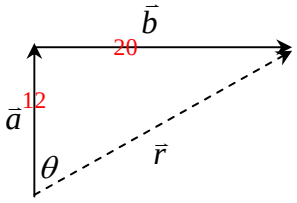
Given	**RTF**	**Formula**
$\vec{a} = 12m[N]$ $\vec{b} = 20m[E]$	Find the magnitude and direction of the resultant.	$\vec{r} = \vec{a} + \vec{b}$ $r = \sqrt{a^2 + b^2}$ $\tan\theta = \frac{b}{a}$

Solution

Vector Equation

$\vec{r} = \vec{a} + \vec{b}$

Vector Diagram



Find $|\vec{r}|$

$r = \sqrt{a^2 + b^2}$

$r = \sqrt{12^2 + 20^2}$

$r = 23.32m$

Find θ

$\tan\theta = \frac{b}{a}$

$\theta = \tan^{-1}\left(\frac{b}{a}\right)$

$\theta = \tan^{-1}\left(\frac{20}{12}\right)$

$\theta = 59^0$

$\therefore \vec{r} = 23.32m[N59^0E]$

2. A boat sails $100km\left[E25^0N\right]$ and then sail $250km\left[S15^0E\right]$. Find the resultant (really the displacement) from the two legs of the journey. Include a detailed vector diagram. Show all steps and justify any and found angles. **[ku:10]**

Given

$\vec{a}=100km\left[E25^0N\right]$

$\vec{b}=250km\left[S15^0E\right]$

RTF

the magnitude and direction of the displacement.

Formula

$r^2=a^2+b^2-2ab\cos\left(R\right)$

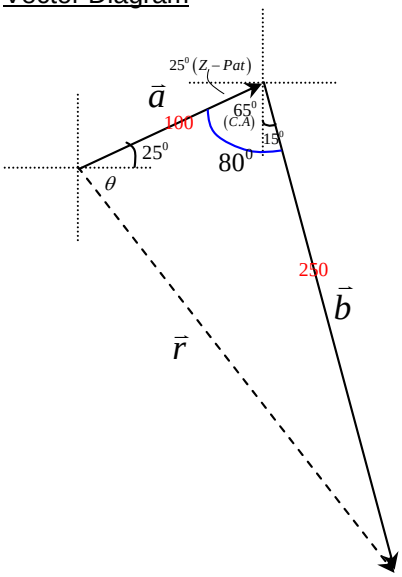
$b^2=a^2+r^2-2ar\cos\left(B\right)$

Solution

Vector Equation

$\vec{r}=\vec{a}+\vec{b}$

Vector Diagram



Find $\left|\vec{r}\right|$

$r^2=a^2+b^2-2ab\cos\left(R\right)$

$r=\sqrt{a^2+b^2-2ab\cos\left(R\right)}$

$r=\sqrt{\left(100\right)^2+\left(250\right)^2-2\left(100\right)\left(250\right)\cos\left(80^0\right)}$

$r=252.62km$

Find $\angle B$

$b^2=a^2+r^2-2ar\cos\left(B\right)$

$2ar\cos\left(B\right)=a^2+r^2-b^2$

$\cos\left(B\right)=\dfrac{a^2+r^2-b^2}{2ar}$

$B=\cos^{-1}\left(\dfrac{a^2+r^2-b^2}{2ar}\right)$

$B=\cos^{-1}\left(\dfrac{\left(100\right)^2+\left(252.62\right)^2-\left(250\right)^2}{2\left(100\right)\left(252.62\right)}\right)$

$B=77.1^0$

Find θ

$\angle B=\theta+25^0$

$\angle B-25^0=\theta$

$\theta=77.1^0-25^0$

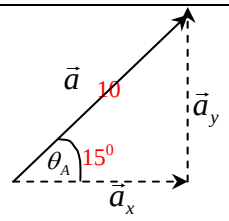
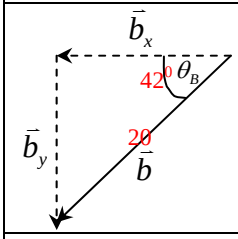
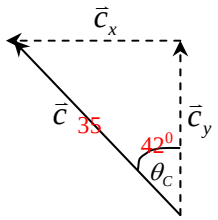
$\theta=52.1^0$

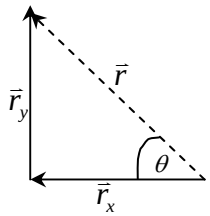
$\therefore\vec{d}=252.62km\left[E52.1^0S\right]$

3. Using the component method, determine the resultant of the following vector equation.
$\vec{r} = \vec{a} + \vec{b} + \vec{c}$, where $\vec{a} = 10m\left[E15^0N\right]$, $\vec{b} = 20m\left[W42^0S\right]$, and $\vec{c} = 35m\left[N42^0W\right]$ **[ku:15]**

Given	**RTF**	**Formula**
$\vec{a} = 10m\left[E15^0N\right]$ $\vec{b} = 20m\left[W42^0S\right]$ $\vec{c} = 35m\left[N42^0W\right]$	the magnitude and direction of the displacement.	

Solution

Vector	X-comp	Y-comp
	$a_x = a\cos\theta_A$ $a_x = 10\cos\left(15^0\right)$ $\vec{a}_x = 9.66km\left[E\right]$	$a_y = a\sin\theta_A$ $a_y = 10\sin\left(15^0\right)$ $\vec{a}_y = 2.59km\left[N\right]$
	$b_x = b\cos\theta_B$ $b_x = 20\cos\left(42^0\right)$ $\vec{b}_x = 14.86km\left[W\right]$	$b_y = b\sin\theta_B$ $b_y = 20\sin\left(42^0\right)$ $\vec{b}_y = 13.38km\left[S\right]$
	$c_x = c\sin\theta_C$ $c_x = 35\sin\left(42^0\right)$ $\vec{c}_x = 23.42km\left[W\right]$	$c_y = c\cos\theta_C$ $c_y = 35\cos\left(42^0\right)$ $\vec{c}_y = 26.01km\left[N\right]$
$\vec{r} = \vec{r}_x + \vec{r}_y$	$\vec{r}_x = \vec{a}_x + \vec{b}_x + \vec{c}_x$ $r_x = \left(+9.66\right) + \left(-14.86\right) + \left(-23.42\right)$ $r_x = -28.62km$ $r_x = 28.62km\left[W\right]$	$\vec{r}_y = \vec{a}_y + \vec{b}_y + \vec{c}_y$ $r_y = \left(+2.59\right) + \left(-13.38\right) + \left(+26.01\right)$ $r_y = 15.22km$ $\vec{r}_y = 15.22km\left[N\right]$

Vector Diagram	Find $\left\|\vec{r}\right\|$	Find θ	
	$r = \sqrt{r_x^2 + r_y^2}$ $r = \sqrt{\left(28.62\right)^2 + \left(15.22\right)^2}$ $r = 32.42km$	$\tan\theta = \frac{r_y}{r_x}$ $\theta = \tan^{-1}\left(\frac{r_y}{r_x}\right)$ $\theta = \tan^{-1}\left(\frac{15.22}{28.62}\right)$ $\theta = 28^0$	$\therefore \vec{r} = 32.42km\left[W28^0N\right]$