## Answer on Question \#63070, Physics / Mechanics | Relativity

1. an automobile travels 9 miles due south, then 20 miles in a direction 40 degrees south of east, determine the resultant displacement.

## Solution:

$\alpha=180-40=140^{\circ}$
Cosine Law
$\mathrm{d}=\operatorname{sqrt}\left\{9^{2}+20^{2}-2 \cdot 9 \cdot 20 \cdot \cos 140^{\circ}\right\}=23,5$ miles

## Answer: $\mathbf{2 3 . 5}$ miles

2. find the sum or resultant of the following displacements: $\mathrm{A}, 10 \mathrm{ft}$ northwest, $\mathrm{B}, 20 \mathrm{ft} 30$ degrees north of east; C, 35 ft due south.

## Solution:



1 units $=5 \mathrm{ft}$
At the terminal point of $A$ place the initial point of $B$. At the terminal point of $B$ place the initial point of $C$. The resultant $D$ is formed by joining the initial point of $A$ to the terminal point of $C$, i.e. $D=A+B+C$. Graphically the resultant is measured to have magnitude of 4.1 units $=20.5 \mathrm{ft}$ and direction $60^{\circ}$ south of east.

## Answer: $\mathbf{2 0 . 5 \mathrm { ft }}$ and $\mathbf{6 0}{ }^{\circ}$ south of east

3. Which of the vector $r=x i+y j+z k$ makes with the positive directions of the coordinate axes.

## Answer:

zk makes with the positive directions of the coordinate axes
4. An airplane pilot sets a course due north and his speed is $150 \mathrm{~km} / \mathrm{hr}$. There is a wind $40 \mathrm{~km} / \mathrm{hr}$ from the east. What is the actual velocity of the airplane?

## Solution:

$\mathrm{v}=\mathrm{sqrt}\left\{125^{2}+40^{2}\right)=155 \mathrm{~km} / \mathrm{hr}$

## Answer: 155 km/hr

5. A river flows at a steady speed of $3 \mathrm{~m} / \mathrm{s}$. A man wishes to cross in a motorboat, which travels at $5 \mathrm{~km} / \mathrm{hr}$ to reach a point directly across the river. In what direction should he steer?

## Solution:

$(1.4 \mathrm{~m} / \mathrm{s})^{2}+(3.0 \mathrm{~m} / \mathrm{s})^{2}=R^{2}$
$1.96 \mathrm{~m}^{2} / \mathrm{s}^{2}+9 \mathrm{~m}^{2} / \mathrm{s}^{2}=\mathrm{R}^{2}$
$10.96 \mathrm{~m}^{2} / \mathrm{s}^{2}=\mathrm{R}^{2}$
SQRT $\left(10.96 \mathrm{~m}^{2} / \mathrm{s}^{2}\right)=R$

## $3.3 \mathrm{~m} / \mathrm{s}=\mathrm{R}$

The direction

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tan (theta) = (opposite/adjacent)
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$\tan ($ theta $)=(1.4 / 3)$
theta $=$ invtan (1.4/3)
theta $=24.9$ degree
Answer: 24.9 degree
6. If $r 1=2 i-j+k, r 2=i+3 j-2 k, r 3=-2 i+j-3 k$ and $r 4=3 i+2 j+5 k$, find the scalars $a, b, c$ such that r4=ar1+br2+cr3

## Solution:

We require
$3 i+2 j+5 k=a(2 i-j+k)+b(i+3 j-2 k)+c(-2 i+j-3 k)=(2 a+b-2 c) i+(-a+3 b+c) j+(a-2 b-3 c) k$.
Since
$\mathrm{i}, \mathrm{j}, \mathrm{k}$ are non-coplanar we have,
$2 a+b-2 c=3$,
$-a+3 b+c=2$,
$a-2 b-3 c=5$.
$\mathrm{a}=-2$,
$b=1$,
$c=-3$
and
$r 4=-2 r 1+r 2-3 r 3$.
Answer: $a=-2, b=1, c=-3$

