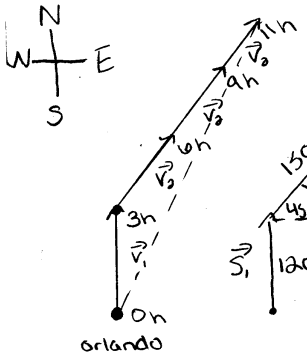
Test 1 Solution: Problem 5 (18 points)

One day in the early 1960's, at 11 AM the eye of hurricane David passed over Orlando heading due North at a speed of 40.0 km/h. Three hours later, the course of the hurricane shifted to Northeast towards the Florida Atlantic coast and its speed decreased to 30.0 km/h. David continued on this course at this speed for eight hours before turning due north again.

A. How far from Orlando was the hurricane at 7 PM on the same day?



$\vec{v}_1 = 40\text{ km/h}$ for 3 hrs. $\quad \vec{v}_2 = 30\text{ km/h}$ for 5 hrs.

$\vec{s}_1 = 0\hat{i} + 120\hat{j}$

$\vec{s}_2 = 150\cos 45\,\hat{i} + 150\sin 45\,\hat{j}$

$\vec{s}_2 = 106.066\hat{i} + 106.066\hat{j}$

$\vec{s}_1 + \vec{s}_2 = 106.066\hat{i} + 226.066\hat{j}$

$\text{displacement} = \sqrt{(106.066)^2 + (226.066)^2}$

$= 249.711\text{ km} = 250.\text{ km}$

$\text{direction} = 90° - \tan^{-1}\left(\frac{226.066}{106.066}\right) = 25.1°$ East of north

B. What was David's average speed during this time?

$\langle s \rangle = \frac{d}{\Delta t}$ $\quad d$ = total distance traveled

Δt = time interval = 11 AM to 7 PM

$\langle s \rangle = \frac{(120\text{ km} + 150\text{ km})}{8\text{ h}} = \frac{270\text{ km}}{8\text{ h}} = 33.8\text{ km/h}$

C. What was David's average velocity during this time?

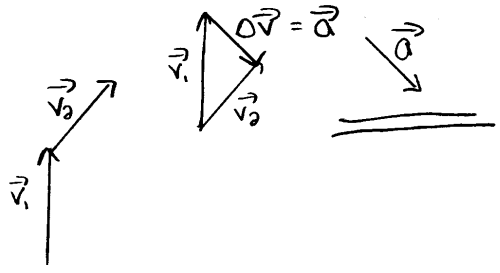
$\langle \vec{v} \rangle = \frac{\Delta \vec{r}}{\Delta t}$ $\quad \Delta \vec{r}$ = displacement = 250 km

Δt = time interval = 11 AM to 7 PM

$\langle \vec{v} \rangle = \frac{250\text{ km}}{8\text{ h}} = 31.3\text{ km/h}$

D. Sketch a vector representing hurricane David's average acceleration during this time.

$\langle \vec{a} \rangle = \frac{\Delta \vec{v}}{\Delta t}$



Instructor's note: A very good solution with two minor omissions. First the solution does not show the calculation for distance or displacement for s1 and s2. Second, part C with average velocity should indicate the direction of the velocity explicitly. A note saying the direction of the velocity is in the direction of the displacement calculated in part A would have been sufficient.