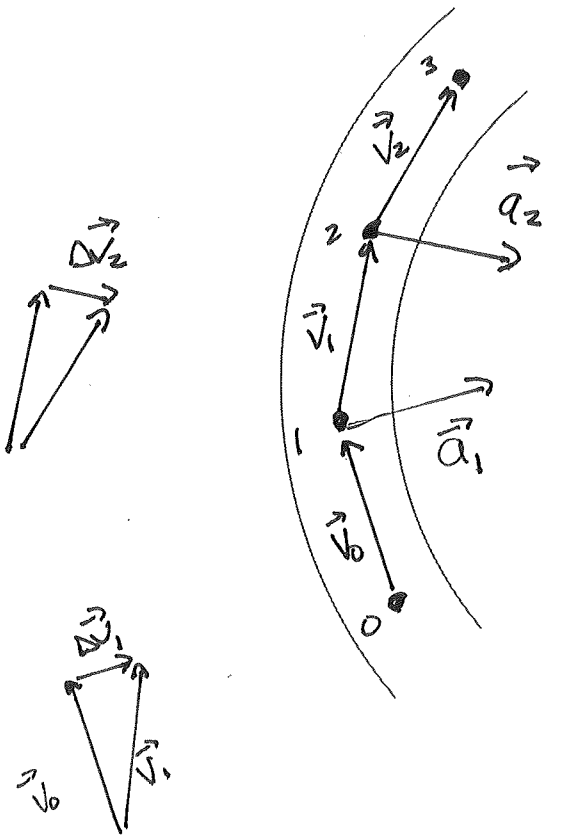
3.2 - Using Vectors on Motion Diagrams

(1.) A car travels along the road shown below with a constant speed. Draw a picture resembling Examples 3.2 and 3.3 from the textbook by following the procedure below.

- Draw a motion diagram with four separate locations of the car.
- Draw the car's three average velocity vectors, $\vec{v}_0$, $\vec{v}_1$, $\vec{v}_2$.
- Below the picture, use your preferred method to draw the two change in velocity vectors, $\overrightarrow{\Delta \mathbf{v_1}} = \vec{v}_1 - \vec{v}_0$ and $\overrightarrow{\Delta \mathbf{v_2}} = \vec{v}_2 - \vec{v}_1$.
- At points 1 and 2 on your motion diagram, draw the car's average acceleration vectors. Assume that the elapsed time between points on the motion diagram is $0.5\,s$.



Constant speed ⇒ EQUALLY SPACED

$\Delta t = 0.5s$

$\Rightarrow \vec{a} = \frac{\Delta\vec{v}}{\Delta t} = \frac{\Delta\vec{v}}{0.5} = 2\Delta\vec{v}$

$\Rightarrow \vec{a}$ is twice length of $\Delta\vec{v}$

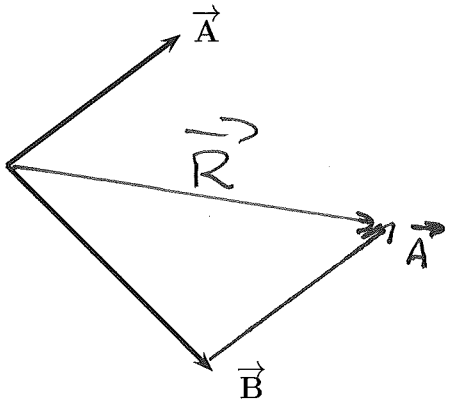
Chapter 3, Sections 3.1-3.2

3.1 - Using Vectors

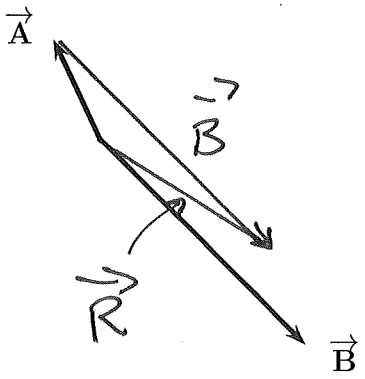
(1.) Using graphical addition, draw and label the vector sum $\vec{\mathbf{R}} = \vec{\mathbf{A}} + \vec{\mathbf{B}}$.

Tip-To-Tail For ME.

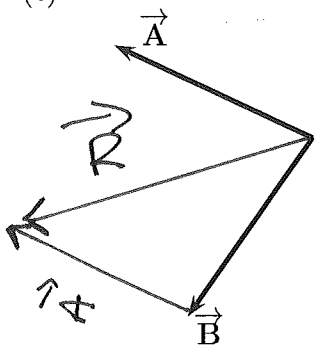
(a)



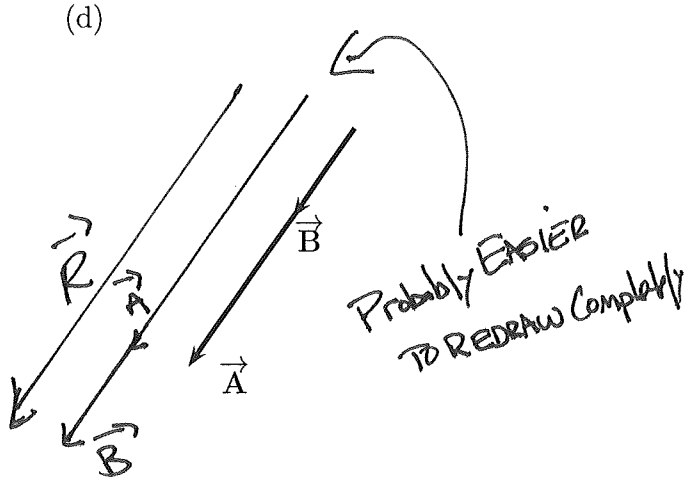
(b)



(c)

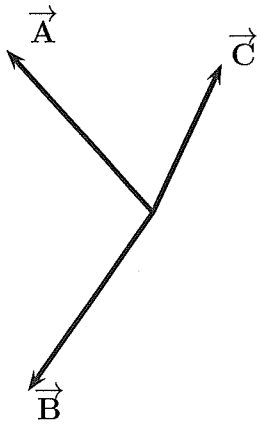


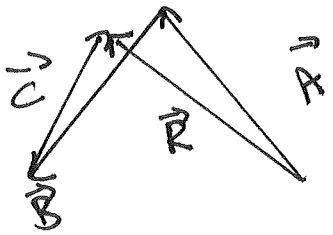
(d)



(2.) Using graphical addition, draw and label the vector sum $\vec{\mathbf{R}} = \vec{\mathbf{A}} + \vec{\mathbf{B}} + \vec{\mathbf{C}}$.

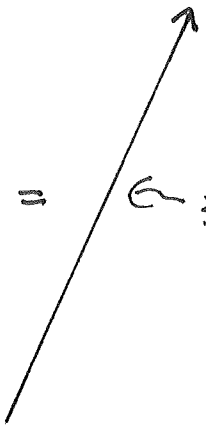
3 vectors $\Rightarrow$ tip-to-tail to-tail

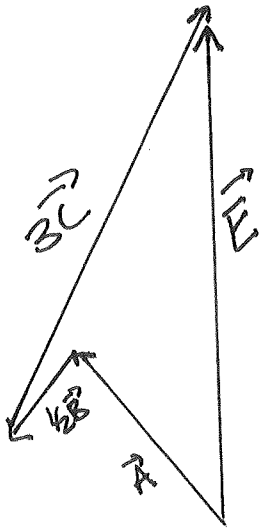




(3.) Using the vectors from the previous example, draw and label the vector $\vec{\mathbf{E}} = \vec{\mathbf{A}} + \frac{1}{2}\vec{\mathbf{B}} + 3\vec{\mathbf{C}}$.

$\frac{1}{2}\vec{B}$ =  ← HALF the length

$3\vec{C}$ =  ← 3x length



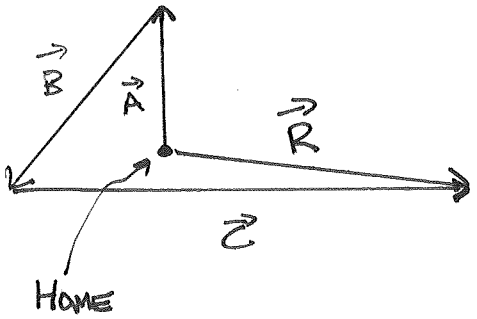
(4.) A man leaves his house and walks 50 m due north. He then walks southwest 75 m. Finally, he walks 150 m east. By drawing his displacement vectors using a ruler and protractor, estimate how far the man must walk to get back to his house.

My scale is 2cm $\leftrightarrow$ 50m walking

Let $\vec{A}$ = 50m North, $\vec{B}$ = 75m Southwest
∠ 45° between South AND West

$\vec{C}$ = 150m east, so $\vec{B}$ is 1.5× longer than A
$\vec{C}$ is 3× longer than A

Let's use traditional W ← N → E, S



$\vec{R} = \vec{A} + \vec{B} + \vec{C}$
points from Home to ~~From~~ man's Final location
$\therefore$ R = distance from home to MAN

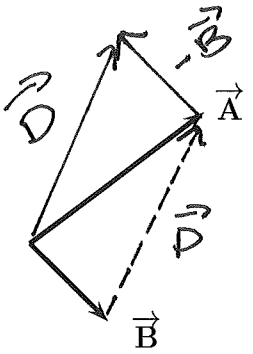
I measure R to be 4cm $\Rightarrow$ MAN is 100m from home

(5.) Using your preferred method, find the vector difference $\vec{D} = \vec{A} - \vec{B}$.

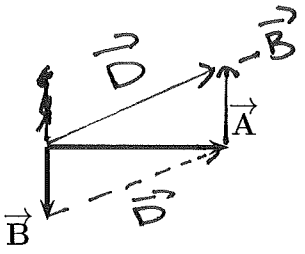
Solid lines are ~~[illegible]~~ $\vec{A} + (-\vec{B})$ ↑ Flip $\vec{B}$ put $\vec{B}$ tip-to-tail with $\vec{A}$

Dashed lines are vectors from $\vec{B}$ to $\vec{A}$

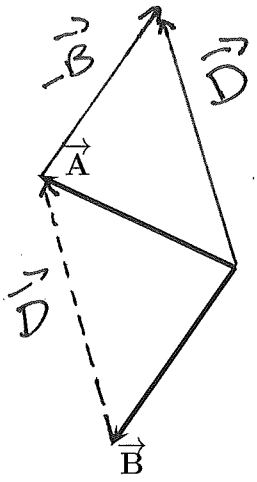
(a)



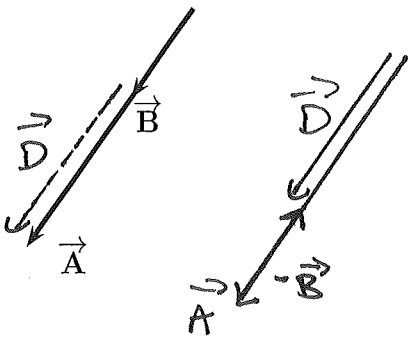
(b)



(c)



(d)



(2.) Repeat the previous procedure, but now assume the car is increasing speed as it goes along the road.

- Draw a motion diagram with four separate locations of the car.
- Draw the car's three average velocity vectors, $\vec{v}_0$, $\vec{v}_1$, $\vec{v}_2$.
- Below the picture, use your preferred method to draw the two change in velocity vectors, $\overrightarrow{\Delta \mathbf{v_1}} = \vec{v}_1 - \vec{v}_0$ and $\overrightarrow{\Delta \mathbf{v_2}} = \vec{v}_2 - \vec{v}_1$.
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