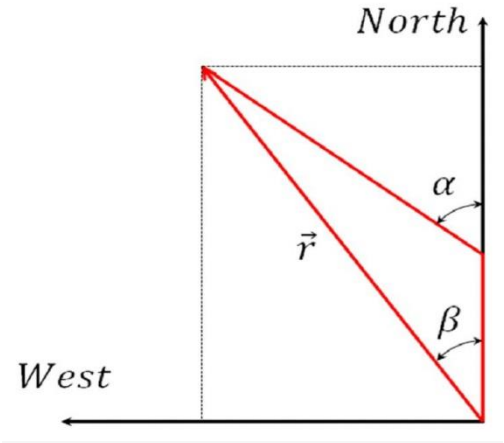
Answer on Question #84137, Physics / Mechanics | Relativity

Question. A car travels $a = 20\ km$ due North and then $b = 35\ km$ in a direction $\alpha = 60°$ west of North. Using a graph, find the magnitude ($|\vec{r}|$) and direction (β) of a single vector that gives the net effect of the car's trip.

Solution



To calculate magnitude $|\vec{r}|$, we can use the law of cosines. The internal angle $\gamma = 180° - 60° = 120°$. We have

$$|\vec{r}|^2 = a^2 + b^2 - 2ab\cos\gamma \rightarrow$$

$$|\vec{r}| = \sqrt{20^2 + 35^2 - 2 \cdot 20 \cdot 35 \cdot \cos 120°} = 48.22\ km.$$

The direction of $\vec{r}$

$$\frac{b}{\sin\beta} = \frac{|\vec{r}|}{\sin 120°} \rightarrow \beta = \sin^{-1}\left(\frac{b \cdot \sin 120°}{|\vec{r}|}\right) = \sin^{-1}\left(\frac{35 \cdot \sin 120°}{48.22}\right) = 38.95°.$$

Answer. $|\vec{r}| = 48.22\ km; \beta = 38.95°$.

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