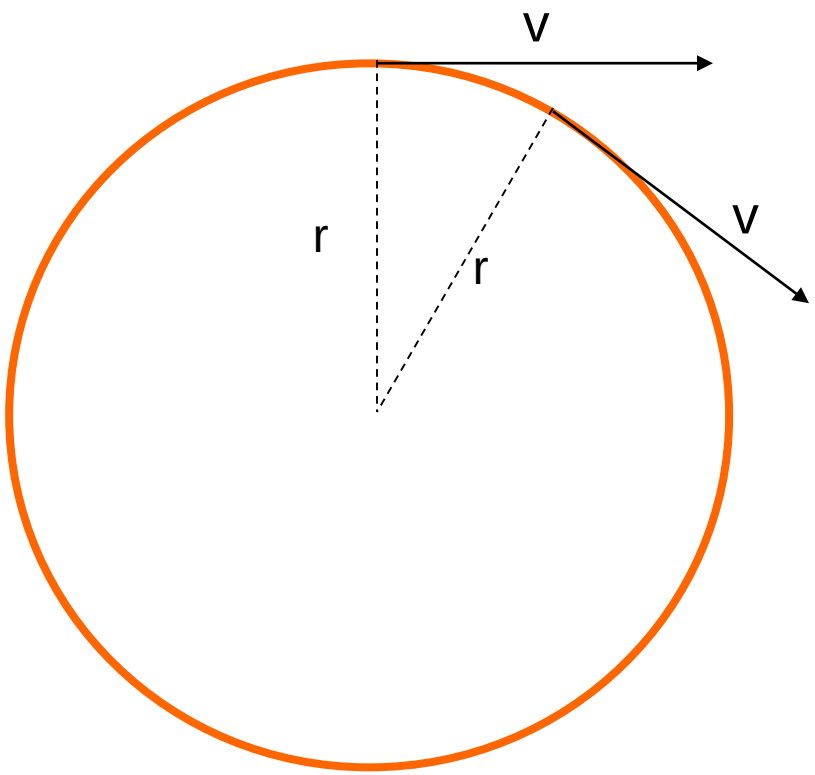
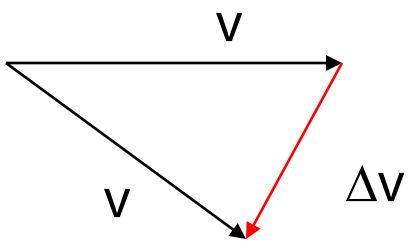
Circular Motion

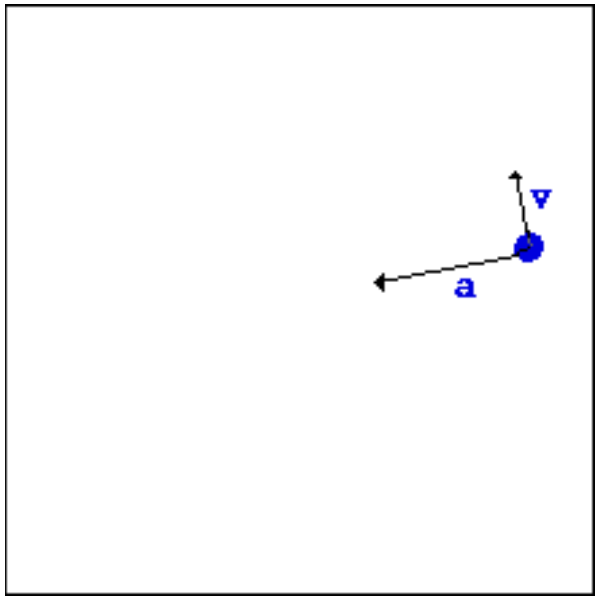




CENTRIPETAL ACCELERATION

$$\frac{\Delta \mathrm{v}}{\mathrm{v}} = \frac{\Delta r}{r} \Rightarrow a_c = \frac{\Delta \mathrm{v}}{\Delta \mathrm{t}} = \frac{\mathrm{v}}{r}\frac{\Delta r}{\Delta t} = \frac{\mathrm{v}^2}{r}$$

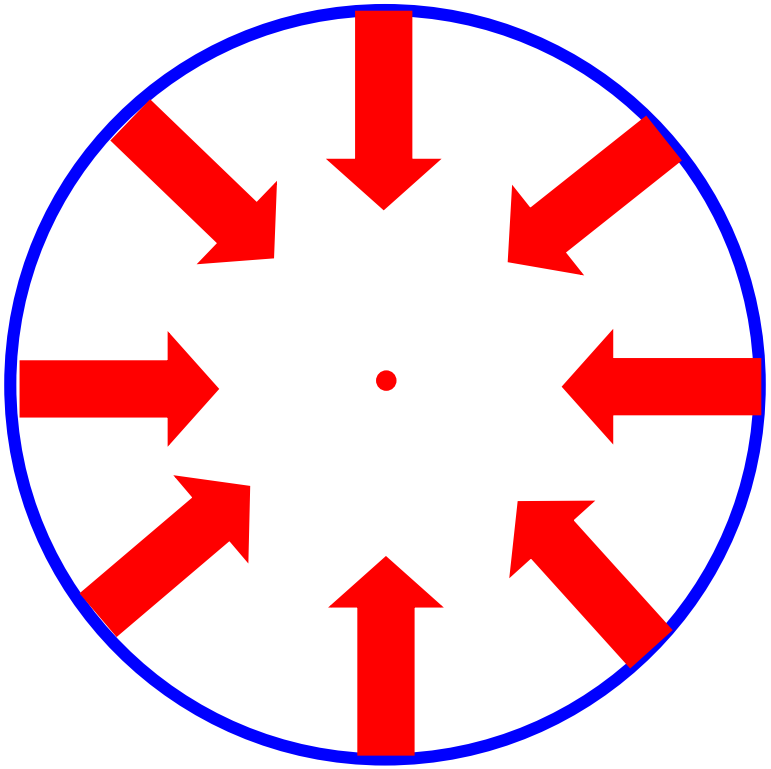
Centripetal acceleration



Magnitude

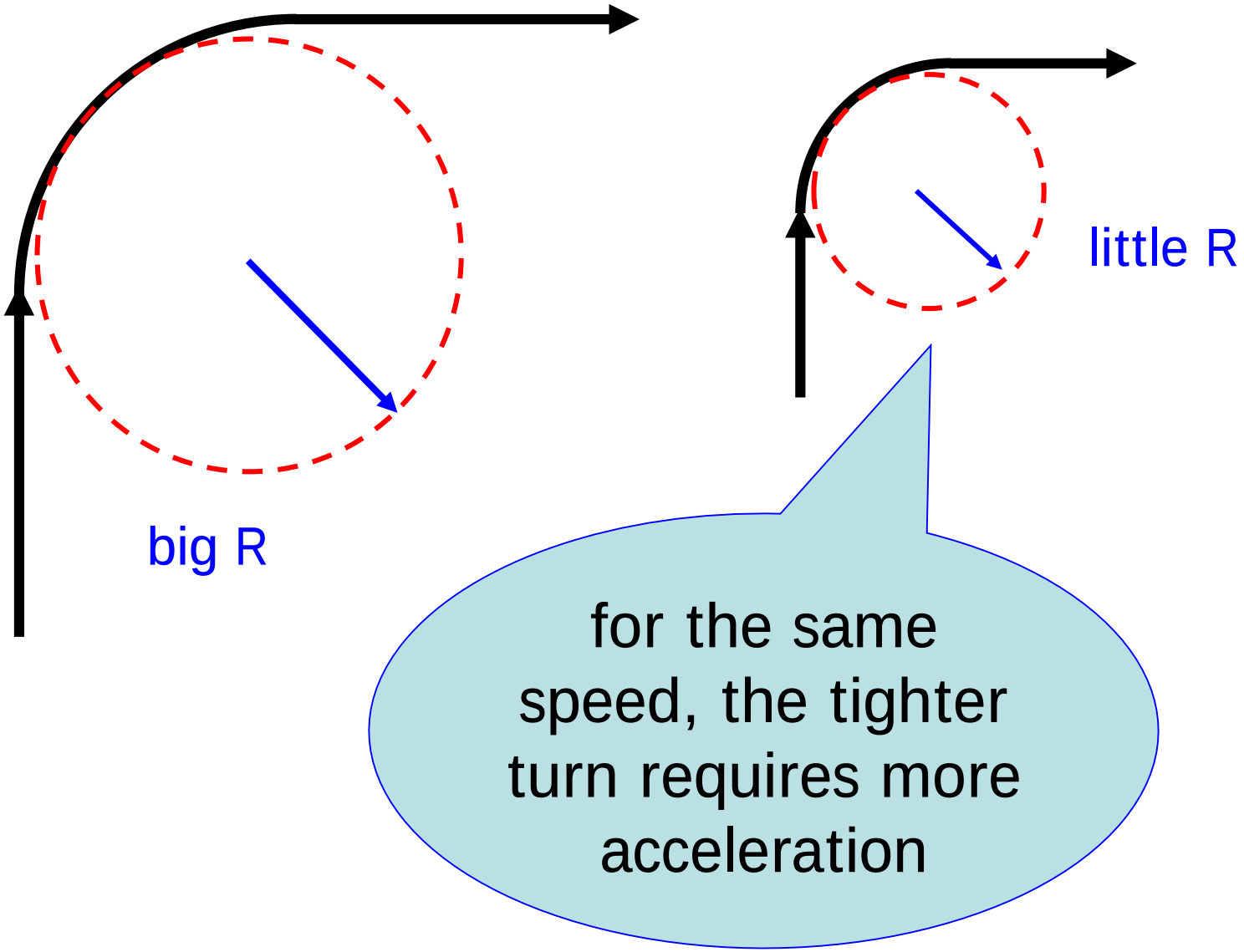
$$a_c = \frac{v^2}{r}$$

Centripetal acceleration

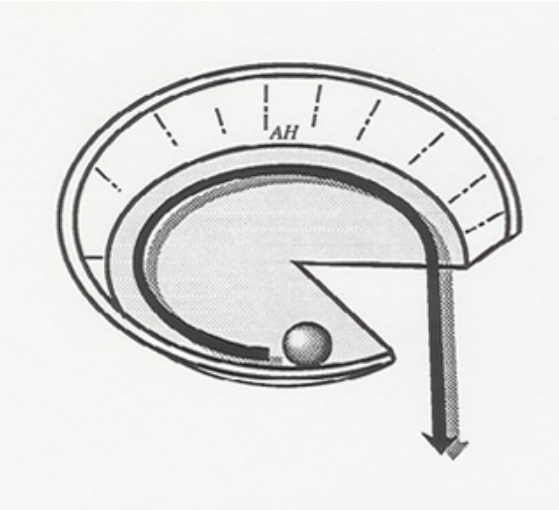


toward the
center
of the circle

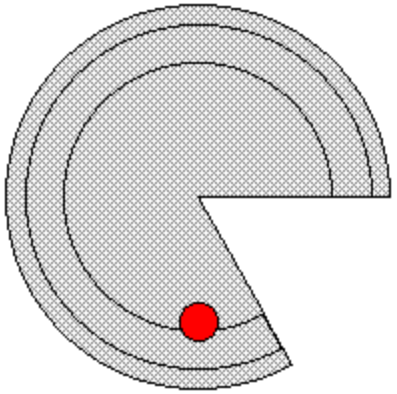
Wide turns and tight turns



A ***Scientific American*** article ("*Intuitive Physics*" by Michael McCloskey, Scientific American, April 1983) discusses how students, when asked which way the ball will go upon leaving the pie plate before having taken a course in physics, will usually answer that the ball will continue to curve around. Of course, right after taking physics the students (at least the ones that pass the course!) know that the ball moves off in a straight line. But a few years after the course, the ball starts to curve again! The students were enlightened; they knew the truth, but then they fell back into darkness! (The same article discusses several other misconceptions of motion you may wish to discuss with your students.)

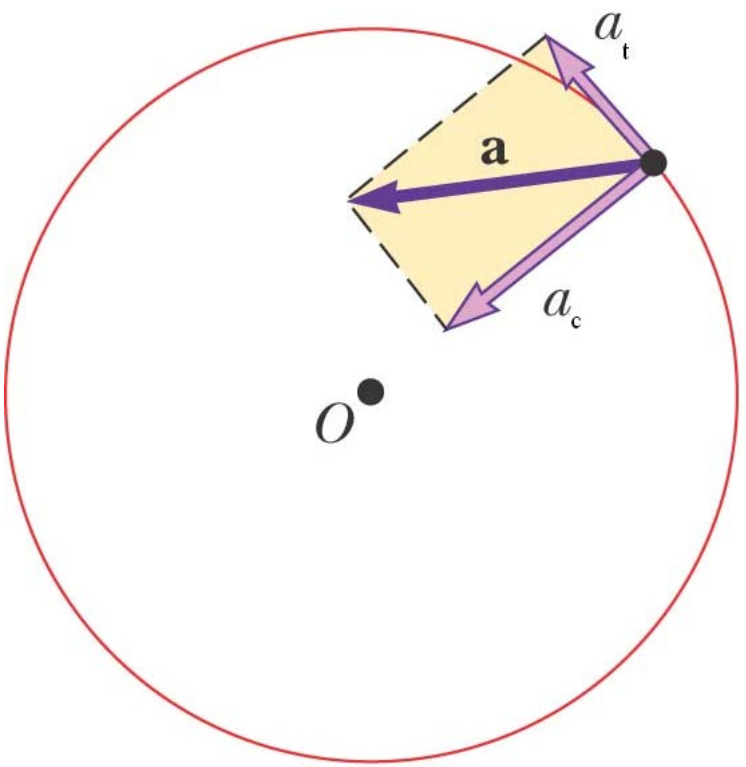


Partial Pie Plate



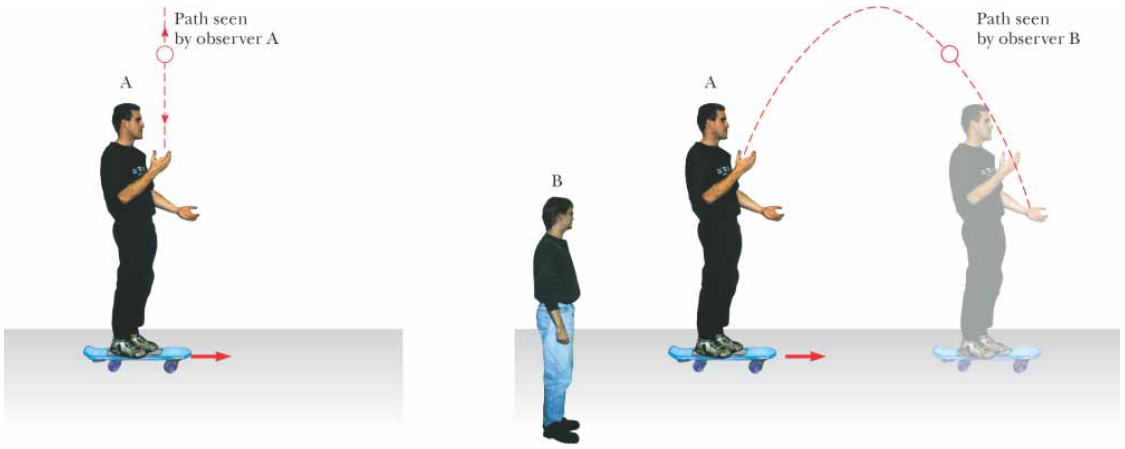
Total Acceleration

- The tangential acceleration causes the change in the *speed* of the particle
- The centripetal acceleration comes from a change in the *direction* of the velocity vector



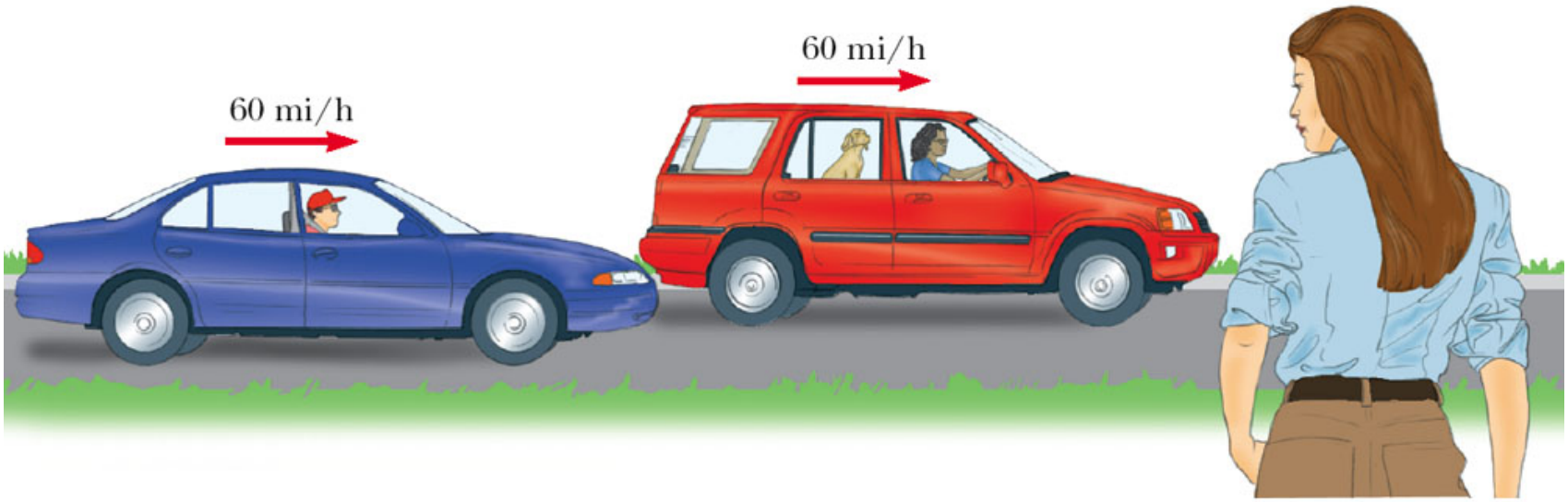
Relative Velocity

- Two observers moving relative to each other generally do not agree on the outcome of an experiment
- For example, observers A and B below see different paths for the ball

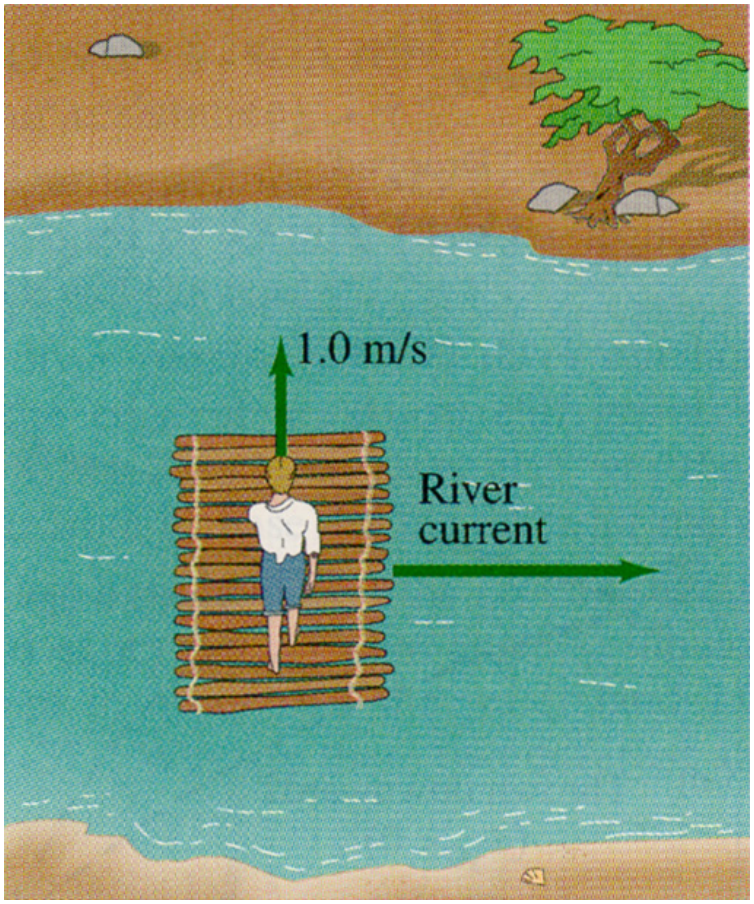


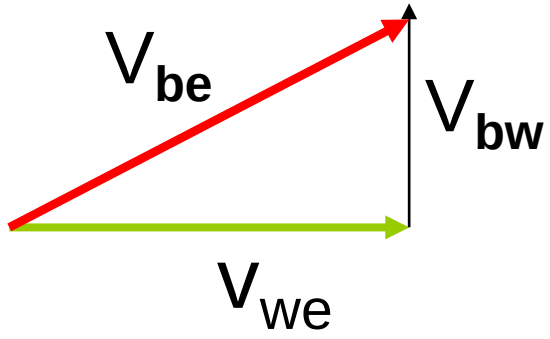
Relative Velocity

- Two observers moving relative to each other generally do not agree on the outcome of an experiment
- For example, the observer on the side of the road observes a different speed for the red car than does the observer in the blue car



Relative Motion



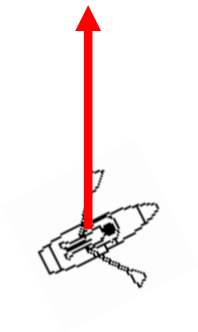


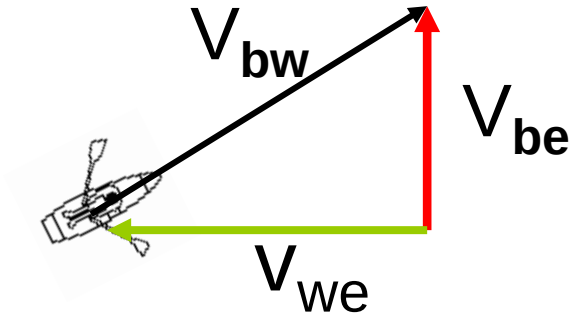
V_{be} Velocity of boat relative to earth

V_{be} Velocity of boat relative to water

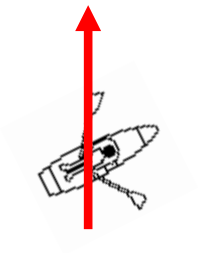
V_{we} Velocity of water relative to earth

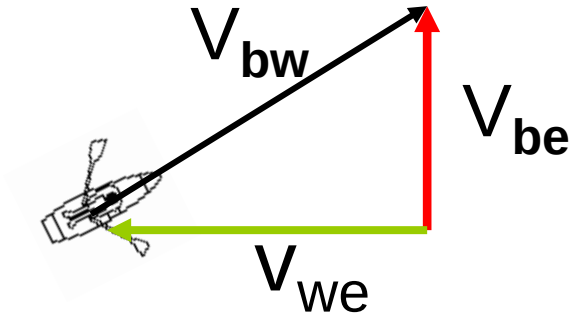
Resultant



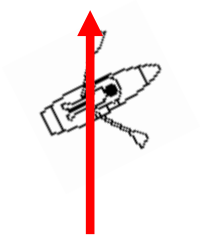


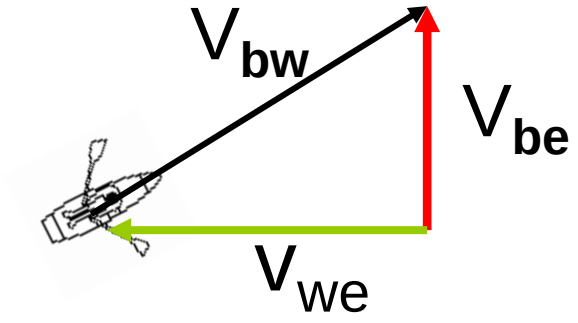
Resultant





Resultant





Resultant