

### Answer on Question #38542, Physics, Other

#### Question:

Is average speed the magnitude of average velocity?

#### Answer:

Velocity is a vector, having both a direction and a magnitude (speed). Average speed equals:

$$v_a = \frac{\text{distance travelled}}{\text{time}}$$

and average velocity equals:

$$|\vec{v}_a| = \frac{\text{displacement}}{\text{time}}$$

Therefore average speed equals magnitude of average velocity only when distance equals displacement i.e. straight line motion in one direction

For example, let an object move with the speed of  $v$  in positive direction during time  $t$  and with the same speed  $v$  during time  $t$  in opposite direction. Then, displacement equals 0 and distance equals  $2vt$ . Therefore average speed is

$$v_a = \frac{2vt}{2t} = v$$

and average velocity is

$$|\vec{v}_a| = 0$$

which are not equal.