Answer on Question #38542, Physics, Mechanics

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:

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

and average velocity equals:

$$|\overrightarrow{v_a}| = \frac{displacement}{time}$$

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

$$|\overrightarrow{v_a}| = 0$$

which are not equal.