

## Answer on Question #43160 – Physics – Kinematics | Mechanics | Dynamics

### Question.

A car goes from 'A' town to 'B' town with speed of 40 km/hr & returns back to town 'A' with speed of 60km/hr. calculate average speed & average velocity of the car.

$$v_1 = 40 \frac{km}{h};$$

$$v_2 = 60 \frac{km}{h};$$

$$v_{average} = ?$$

$$|\vec{v}_{average}| = ?$$

### Solution.

By definition the speed of an object is the magnitude of its velocity. It is a scalar quantity.

Velocity is the rate of change of the position of an object, equivalent to a specification of its speed and direction of motion. It is a vector physical quantity.

The average speed of an object in an interval of time is the distance travelled by the object divided by the duration of the interval.

So, average speed is equal to the ratio of total distance traveled to total time of motion:

$$v_{average} = \frac{l_1 + l_2 + \dots + l_n}{t_1 + t_2 + \dots + t_n}$$

And magnitude of average velocity equal to the ratio of total vector sum of the distance traveled to total time of motion:

$$|\vec{v}_{average}| = \frac{\vec{l}_1 + \vec{l}_2 + \dots + \vec{l}_n}{t_1 + t_2 + \dots + t_n}$$

In our case,

$$l = l_1 = l_2$$

$$t_1 = \frac{l}{v_1}; t_2 = \frac{l}{v_2}$$

So, average speed of car is:

$$v_{average} = \frac{l + l}{\frac{l}{v_1} + \frac{l}{v_2}} = \frac{2v_1v_2}{v_1 + v_2}$$

Calculate:

$$v_{average} = \frac{2 \cdot 40 \cdot 60}{40 + 60} = \frac{4800}{100} = 48 \frac{km}{h}$$

Choose  $|\vec{l}|$  is positive, if we move towards B, and negative, if we move towards A. So, average velocity is:

$$|\vec{v}_{average}| = \frac{|l_1 - l_2|}{\frac{l}{v_1} + \frac{l}{v_2}} = \frac{|l - l|}{\frac{l}{v_1} + \frac{l}{v_2}} = 0$$

**Answer.**

The average speed:

$$v_{average} = \frac{2v_1v_2}{v_1 + v_2} = 48 \frac{km}{h}$$

The average velocity:

$$|\vec{v}_{average}| = 0$$