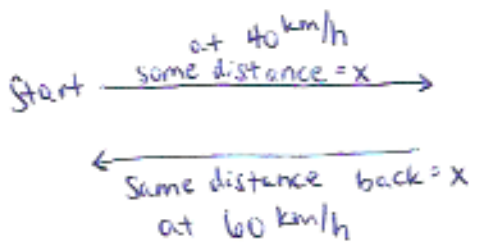
Honors Physics – Example 3 (Re-visited)

A car goes down a certain road at an average speed of 40 km/h and returns along the same road at an average speed of 60 km/h. Calculate the average speed in km/h for the round trip.

Sketch



We want to find the average speed of the entire trip. The idea is that the average speed is NOT 50 km/h - because more time was spent driving the distance (x) at 40 km/h than at 60 km/h. Therefore, the average speed is going to be slightly closer to 40 km/h (again - more time was spent at 40 km/h).

For the Entire Trip

$$\text{Average Speed} = \frac{\text{Distance}}{\text{time}} = \frac{2x}{t_1 + t_2} = \frac{2x}{\left(\frac{x}{40} + \frac{x}{60}\right)} \rightarrow t_1 + t_2 \text{ (from below)}$$

* Traveled a distance (x) out and a distance (x) back - so a total distance of $2x$
* The total time of the trip is the sum of the time at the first speed (40 km/h) - we can call this t_1. And the time at the second speed (60 km/h), we can call this t_2.

total time = $t_1 + t_2$

$$= \frac{2x}{\left(\frac{3x}{120} + \frac{2x}{120}\right)}$$

$$= \frac{2x}{\frac{5x}{120}}$$

$$= \frac{2x \cdot 120}{5x}$$

$$= \frac{(2)(120)}{5} = \boxed{48 \text{ km/h}}$$

* Looking at each part of the trip

Part 1

Avg. Speed = 40 km/h
time = t_1
distance = x

Avg. Speed = $\frac{\text{Distance}}{\text{time}}$

$40 = \frac{x}{t_1}$

$40 \cdot t_1 = x$

$\boxed{t_1 = \frac{x}{40}}$

Part 2

Avg. Speed = 60 km/h
time = t_2
distance = x

$60 = \frac{x}{t_2}$

$60 \cdot t_2 = x$

$\boxed{t_2 = \frac{x}{60}}$