

Example: Calculating Average Speed

You drive at 100 km/hr for 10 minutes, and 50 km/hr for 20 minutes. What is your average speed?

Note: $\frac{100 + 50}{2} = 75 \frac{\text{km}}{\text{hr}}$ is

→ you spend longer going 50 km/hr, so it is weighted more. **NOT** correct!

CORRECT SOLUTION:

split the motion into segments:



$$v_1 = 100 \frac{\text{km}}{\text{hr}}$$

$$t_1 = 10 \text{ min}$$

$$v_2 = 50 \frac{\text{km}}{\text{hr}}$$

$$t_2 = 20 \text{ min}$$

$$v_1 = \frac{d_1}{t_1}$$

$$v_2 = \frac{d_2}{t_2}$$

$$\text{total distance} = d = d_1 + d_2$$

$$\text{total time} = t = t_1 + t_2$$

$$\text{average speed} = \bar{v} = \frac{d}{t} = \frac{d_1 + d_2}{t_1 + t_2}$$

↘ $d_1 = v_1 t_1$, let's convert t_1 to hours

$$t_1 = 10 \cancel{\text{min}} \left(\frac{1 \text{ hr}}{60 \cancel{\text{min}}} \right)$$

$$t_1 = \left(\frac{10}{60} \right) \text{ hr} = 0.16667 \text{ hr}$$

$$d_1 = 100 \frac{\text{km}}{\text{hr}} (0.16667 \text{ hr}) = 16.667 \text{ km}$$

$$d_2 = 50 \frac{\text{km}}{\text{hr}} \left(20 \cancel{\text{min}} \left(\frac{1 \text{ hr}}{60 \cancel{\text{min}}} \right) \right) = 16.667 \text{ km}$$

$$d = d_1 + d_2 = 33.333 \text{ km}$$

$$\begin{aligned} \bar{v} &= \frac{d}{t} = \frac{33.333 \text{ km}}{0.16667 + 0.333} = \frac{33.333 \text{ km}}{0.5 \text{ hr}} \\ &= 66.667 \text{ km/hr} \end{aligned}$$

$$\boxed{\bar{v} = 67 \frac{\text{km}}{\text{hr}}}$$