Mechanics Unit Speed vs Velocity gpb video: Phys Std:

10a

Warmup Question:

A person drives around in a 100 ft circle for 2 min.

Calculate the person's:

scalar → a. speed - depends on distance

vector → b. velocity - depends on displacement

$s = \frac{d}{t} = \frac{100\text{ ft}}{2\text{ min}} = 50\text{ ft/min}$

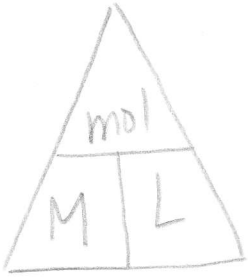
$\vec{v} = \frac{\Delta\vec{x}}{t} = \frac{0\text{ ft}}{2\text{ min}} = 0\text{ ft/min}$

- What is the difference between speed & velocity?

- Commonalities:
  1. They are both rates (how quickly an object is moving)=> divided by time
  2. They both have units of m/s
- Differences:
  1. Speed is a scalar and depends on <u>distance, d:</u>
     How fast an object is traveling
  2. Velocity is a vector and depends on <u>displacement, $\Delta\vec{x}$:</u>
     The rate at which an object's position changes.
  3. Velocity can also be thought of as speed with a direction:
     Ex: 55 mi/hr is speed, whereas 55 mi/hr, East is velocity

recall the Molarity triangle for the Molarity eqn:

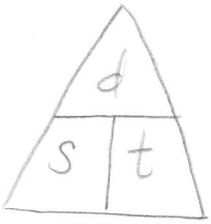
$M = \frac{mol}{L}$



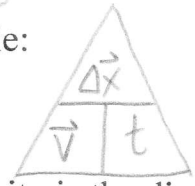
$s = d/t$ and $\vec{v} = \Delta\vec{x}/t$

speed triangle:

especially useful when solving for t



velocity triangle:



- What is the difference between instantaneous speed/velocity and average speed/velocity?

- Instantaneous velocity is the displacement that occurred in an INSTANT in time (very small amount of time)
  --measured with a speedometer
- Average velocity is TOTAL displacement/TOTAL time

$$\vec{v}_{avg} = \Delta\vec{x}_{total}/t_{total}$$

- The instantaneous velocity may change during the trip. By concentrating on start to finish only, the average velocity of the entire trip is calculated.

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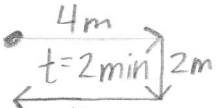
You must learn to be a good communicator. Pay attention to how detailed the solutions ave. This is how detailed I want you to be.

Practice Problems:

1. Lisa traveled a total distance of 440 miles. Her trip took 8 hours. What was her average speed?

$S = \frac{d}{t} = \frac{440\text{mi}}{8\text{ hr}} = \boxed{55\text{ mi/hr}}$

2. See diagram below. $s = ?$ $\vec{v} = ?$



$d = 10\text{m}$

$\Delta\vec{x} = 2\text{m, S}$

$S = \frac{d}{t} = \frac{10\text{m}}{2\text{min}} = \boxed{5\text{m/min}}$

$\vec{v} = \frac{\Delta\vec{x}}{t} = \frac{2\text{m, S}}{2\text{min}} = \boxed{1\frac{\text{m}}{\text{min}}\text{, S}}$

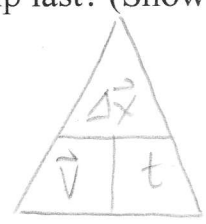
3. Heather & Matt walk East with a speed of 0.58 m/s. If it takes them 34 minutes to walk to the store, what is their displacement? (Show your work!)

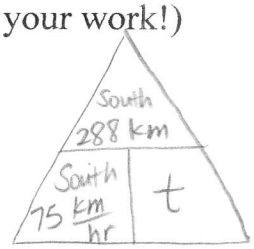
$\vec{v} = \frac{\Delta\vec{x}}{t}$

$\Delta\vec{x} = \left(.58\frac{\text{m}}{\text{s}}\text{, E}\right)\left(\frac{2040\text{ s}}{}\right) = \boxed{1{,}183\text{m,}}$

$\Delta\vec{x} = \vec{v} \cdot t$ $34\text{min} \xrightarrow{\times 60} 2040\text{ sec}$

4. A bus travels 288 km, South along a straight path with velocity of 75 km/hr, South. How long does the trip last? (Show your work!)



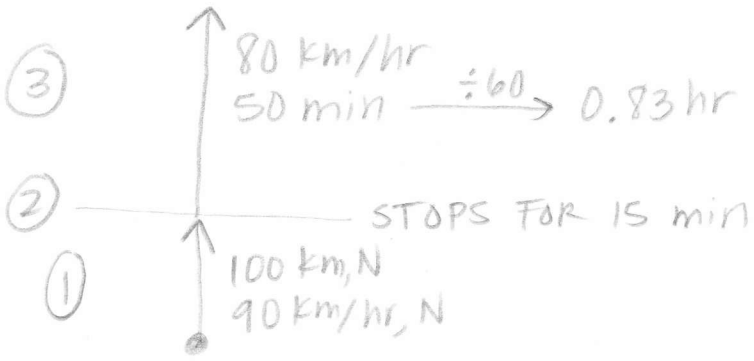


$\boxed{t = 3.84\text{ hr}}$

5. A bus travels 100 km, North with a velocity of 90 km/hr. He stops for 15 minutes and then continues driving North with a velocity of 80 km/hr for 50 minutes. Show your work when you calculate:
   a) total displacement
   b) total time of entire trip
   c) average velocity for entire trip (average velocity is calculated by dividing total displacement over the time interval. Don't simply average the velocities together, because the time intervals are different.)

(See separate pg)

(5) There are 3 parts to this trip:



a) $\Delta\vec{x} = ?$ $\Delta\vec{x}_1 + \Delta\vec{x}_2 + \Delta\vec{x}_3$

$\Delta\vec{x}_1$: 100 km, N

$\Delta\vec{x}_2$: 0 km

$\Delta\vec{x}_3$:

$$\vec{v} = \frac{\Delta\vec{x}}{t}$$

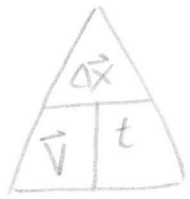
$$\Delta\vec{x} = \vec{v} \cdot t$$

$$\Delta\vec{x}_3 = 80 \frac{km}{hr}, N \times 0.83\ hr = \boxed{66.4\ km, N}$$

b) $t = ?$ $t_1 + t_2 + t_3 = \boxed{2.18\ hr}$

t_2: 15 min ÷60 → .25 hr

t_3: .83 hr



$t_1 = 1.1\ hr$

c) $\vec{v} = ?$ $\frac{\Delta\vec{x}}{t} = \frac{66.4\ km, N}{2.18\ hr} = \boxed{76.3\ km/hr, N}$