Speed & Velocity

Outcomes:

S2-3-01 Analyze the relationship between displacement, time, and velocity for an object in uniform motion.

Introduction…

Recall that speed and velocity are how **FAR** something travels in a certain time **INTERVAL**.

Time Interval:

- We measure a time **INTERVAL** the same as we do for a **DISTANCE** interval…we calculate the **CHANGE** in time.

$$\Delta t = t_2 - t_1$$

  - ***Remember that time is a SCALAR quantity (no DIRECTION)!***

Unit Conversions:

- We will need to calculate distance and time in a variety of **UNITS**. To convert units, we must multiply or divide by a **CONVERSION FACTOR**:
  - Distance:
    - 1***km = 1000m***
    - ***1 m = 100cm***
  - Time:
    - ***1hr = 60 min***
    - ***1 min = 60 s***

Unit Conversions…

$\frac{1\text{km}}{1000\text{m}}$ OR $\frac{1000\text{m}}{1\text{km}}$

Examples:

How many meters in:

a. 5 km

$5\text{km} \times \frac{1000\text{m}}{1\text{km}} = 5000\text{m}$

b. 1.2 km

$1.2\text{km} \times \frac{1000\text{ m}}{1\text{ km}}$

$= 1200\text{ m}$

c. 0.76 km

$0.76\text{km} \times \frac{1000\text{ m}}{1\text{ km}}$

$= 760\text{ m}$

How many kilometers in;

a. 200 m

$200\text{m} \times \frac{1\text{km}}{1000\text{ m}} = 0.2\text{km}$

b. 2300 m

$2300\text{m} \times \frac{1\text{km}}{1000\text{m}}$

$= 2.3\text{ km}$

c. 1045 m

$1045\text{m} \times \frac{1\text{km}}{1000\text{m}}$

$= 1.045\text{ km}$

Unit Conversions…

$\frac{1\text{hr}}{60\text{min}}$ $\frac{60\text{min}}{1\text{hr}}$

Examples:

How many minutes in:

a. 1.5 hrs

$1.5\text{ hrs} \times \frac{60\text{ min}}{1\text{ hr}} = 90\text{ min}$

b. 2hr35min

$2\text{hr} \times \frac{60\text{min}}{1\text{hr}} = 120\text{min}$

$+35\text{min}$

155min

c. 0.45 hr

$0.45\text{hr} \times \frac{60\text{ min}}{1\text{ hr}} = 27\text{min}$

How many seconds in each of the above?

$90\text{ min} \times \frac{60\text{ s}}{1\text{ Min}} = 5400\text{ s}$

$155\text{min} \times \frac{60\text{ s}}{1\text{ min}} = 9300\text{ s}$

$27\text{min} \times \frac{60\text{s}}{1\text{min}} = 1620\text{ s}$

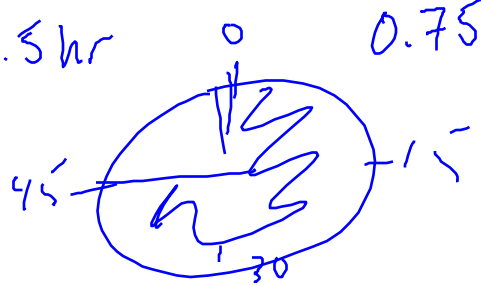
How many hours in:

a. 30 min

$30\text{min} \times \frac{1\text{hr}}{60\text{min}} = 0.5\text{hr}$

b. 45 min

0.75hr



c. 240 s

$240\text{s} \times \frac{1\text{min}}{60\text{s}} = 4\text{min}$

$4\text{min} \times \frac{1\text{hr}}{60\text{min}} = 0.07\text{hr}$

Speed & Velocity...

80 km / 1 hr

Recall that speed is scalar and velocity is a vector.

Speed (v):

- Is defined as how far something travels in a certain amount of time:

$$v_{average} = \frac{\Delta d}{\Delta t}$$

Where:

v = average speed in (m/s)

Δd = Change in distance (m)

Δt = Change in time (s)

The SI units for speed are **m/s** but we can also use **km/hr**.

↳ Systeme international (metric)

Speed Example…

Example:

You drove to Steinbach (64km) from Winnipeg in 50 min. What was your average speed in km/hr and m/s?

$50 min \times \frac{1 hr}{60 m} = 0.83 hr$

$$V = \frac{\Delta d}{\Delta t}$$

$$V = \frac{64 Km}{0.83 hr}$$

$V = 77.1 \ km/hr \xrightarrow{\div 3.6} 21.42 \ m/s$

* To convert from km/hr to m/s, divide by 3.6

to go from m/s to km/hr x 3.6

Speed & Velocity…

Velocity (v):

- Is the same as **SPEED**, but has a **DIRECTION** associated with it. The formula would look like this:

$$v_{average} = \frac{\Delta d}{\Delta t}$$

Where:

v = average speed in (m/s)

Δd = Change in distance (m)

Δt = Change in time (s)

In our example, your average velocity to Steinbach would be:

77.1 km/hr [E] OR +77 km/hr

Speed & Velocity…

Examples:

1. Which is going faster?
   - *Car A moves 10m in 4s*
   - *Car B moves 15m in 5s*

faster!

CAR A: $V = \frac{\Delta d}{\Delta t} = \frac{10m}{4s}$

$V = 2.5 m/s$

CAR B: $V = \frac{\Delta d}{\Delta t} = \frac{15m}{5s}$

$V = 3 m/s$

2. Trevor leaves his house to go to school at 8:00am. If the school is 1500m away and he arrives at 8:20, find his speed in km/hr and m/s

$V = \frac{\Delta d}{\Delta t} = \frac{1500m}{1200s} = 1.25 m/s \times 3.6 = 4.5 km/hr$

$20 min \times \frac{60s}{1 min} =$

Speed & Velocity…

Try this one…

Usain bolt is the world's fastest man. He holds the current world record in the 100m dash at 9.58s. Below is the data from a previous world record run at the summer Olympics in Beijing:

Segment	Time (s)	Speed (ms^{-1})	Speed (mph)
0-10	1.85	5.41	12.09
10-20	2.87	9.80	21.93
20-30	3.78	10.99	24.58
30-40	4.65	11.49	25.71
40-50	5.50	11.76	26.32
50-60	6.32	12.20	27.28
60-70	7.14	12.20	27.28
70-80	7.96	12.20	27.28
80-90	8.79	12.05	26.95
90-100	9.69	11.11	24.85

a) Determine Usain's average speed in m/s and km/hr.

$V = \frac{\Delta d}{\Delta t}$

$= \frac{100m}{9.69s}$

$V = 10.42 m/s \times 3.6 = 37.5 \frac{km}{hr}$

b) What is the difference between average speed and instantaneous speed

Avg speed is over the whole race, inst. is at a specific time

c) How does his speed change during his race? (ie. Explain what's happening)

increases, then decreases