Velocity

11SCIE - Mechanics

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What is Speed?

You know that someone who finishes a race in the least time is the fastest. That they have the highest speed.

Speed is the amount of distance covered in some amount of time.

What is Speed: Let's be Precise!

Cars often have their speed displayed in the number of kilometers that they can travel in an hour (*kilometers per hour*).

But, in Physics we prefer to give speed in the **number of meters** travelled in **one second**.

We call this *meters per second*.

Determining Speed

In order to determine speed we need to know two things, both of which you measured on Friday!

Distance: measured using a ruler, or tape measure, and measured in **meters** (m).

Time: measured using a stopwatch and measured in **seconds** (s).

Symbols and Units

Distance: has unit meters (m) and is represented by symbol **d** in equations.

Time: has unit seconds (s) and is represented by symbol **t** in equations.

Speed & Velocity

Speed is a measure of distance covered in a certain amount of time.

e.g 13 meters per second

Velocity includes a direction

e.g. 13 meters per second **east**

How to Calculate Velocity

$$velocity = \frac{\text{change in distance}}{\text{change in time}}$$

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

it is measured in meteres per second, also shown as $\frac{m}{s}$ or ms^{-1}.

How Do We Solve Problems?

1. Knowns
2. Unknowns
3. Formula
4. Substitute
5. Solve

Question 1: Velocity

A rock climber climbs 15 meters in 5.48 seconds. What velocity was he travelling?

Question 1: Answer

A rock climber climbs 15 meters in 5.48 seconds. What velocity was he travelling?

$$v = \frac{\Delta d}{\Delta t} \qquad \text{show the equation}$$
$$v = \frac{15}{5.48} \qquad \text{substitute values}$$
$$v = 2.74\frac{m}{s}$$

Question 2:

Mr LeSueur ran 4.61km in 21 minutes and 16 seconds. How fast did he run?

Question 2: Answer

Step 1: Convert to SI units

- $d = 4.61 \times 1000 = 4610m$
- $t = (21 \times 60) + 16 = 1276s$
- $v =?$

Step 2:

$$v = \frac{\Delta d}{\Delta t} \qquad \text{formula}$$
$$v = \frac{4610}{1276} \qquad \text{substitute}$$
$$v = 3.61\frac{m}{s} \qquad \text{solve}$$

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Distance-Time Graphs

We can plot a graph with **time on the x-axis** and **distance on the y-axis** to help us visualise data. Graphs are very useful to easily gain information from measurements.

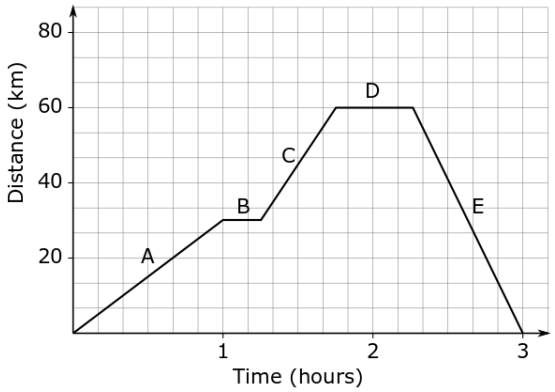

Figure 1: Distance-Time Graph

Interpreting Distance-Time Graphs

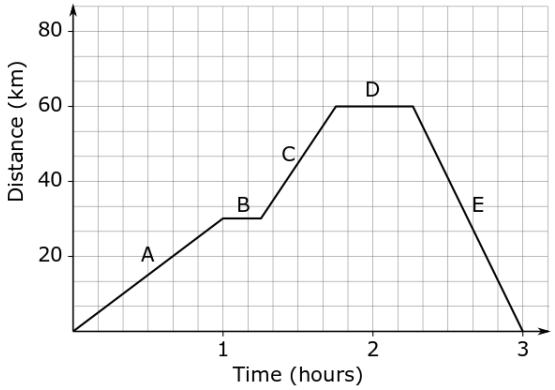

Figure 2: Distance-Time Graph

What can you tell me about the velocity of the runner in seconds A, B, C, D and E?

Interpreting Distance-Time Graphs

- **Positive gradient**: Moving away
- **Flat gradient**: Stationary
- **Negative gradient**: Moving towards

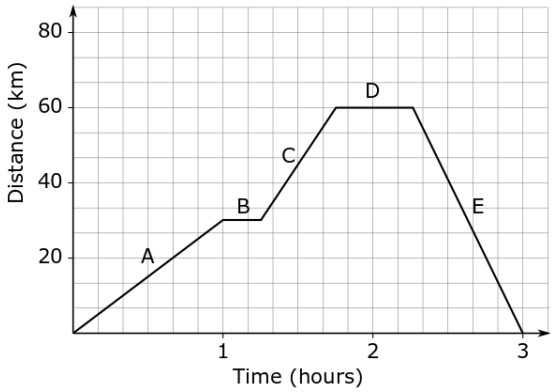

Figure 3: Distance-Time Graph

Drawing Graphs

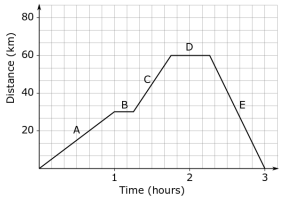

Figure 4: Distance-Time Graph

- Start the axis at zero
- Title each axis
- Units on each axis
- Title the graph
- Use a ruler
- Make your scale even

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Calculating Velocity From Graphs

$$v = \frac{\Delta d}{\Delta t}$$
$$v = \frac{rise}{run}$$

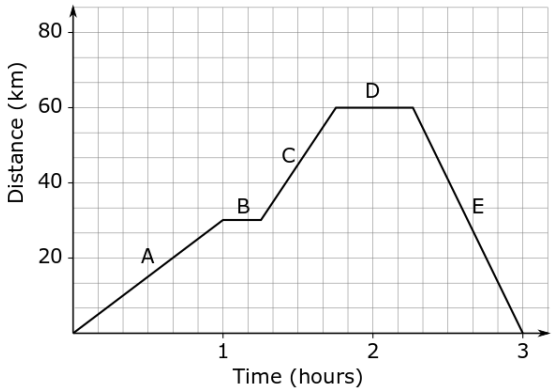

Figure 5: Distance-Time Graph