

# 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.**

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### 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*.

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### 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).

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### 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.

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## 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**

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## How to Calculate Velocity

$$velocity = \frac{\text{change in distance}}{\text{change in time}}$$
$$v = \frac{\Delta d}{\Delta t}$$

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

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## How Do We Solve Problems?

1. Knowns
  2. Unknowns
  3. Formula
  4. Substitute
  5. Solve
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### Question 1: Velocity

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

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### Question 1: Answer

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

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

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### 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:**

$$\begin{aligned} v &= \frac{\Delta d}{\Delta t} && \text{formula} \\ v &= \frac{4610}{1276} && \text{substitute} \\ v &= 3.61 \frac{m}{s} && \text{solve} \end{aligned}$$

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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.

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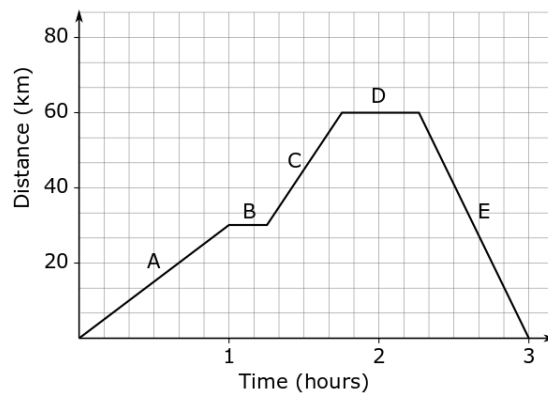


Figure 1: Distance-Time Graph

### Interpreting Distance-Time Graphs

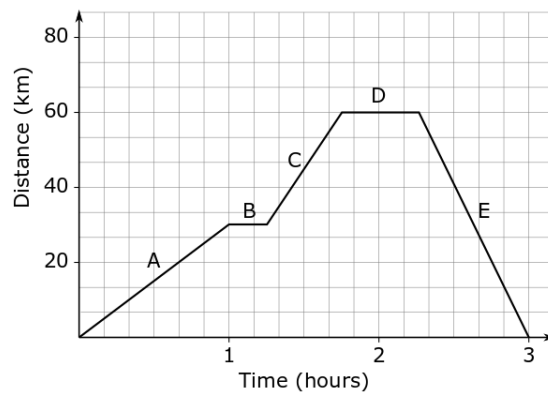


Figure 2: Distance-Time Graph

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

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### Interpreting Distance-Time Graphs

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

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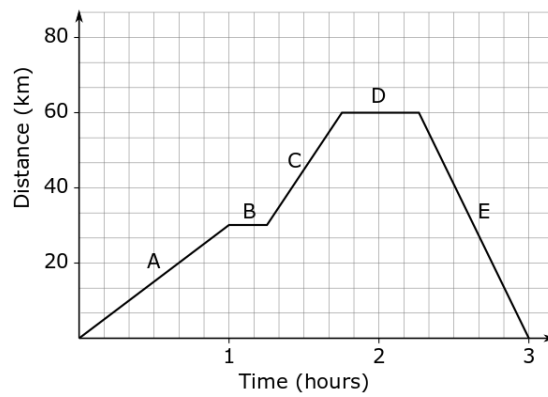


Figure 3: Distance-Time Graph

## Drawing Graphs

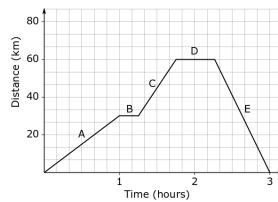


Figure 4: Distance-Time Graph

- 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

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

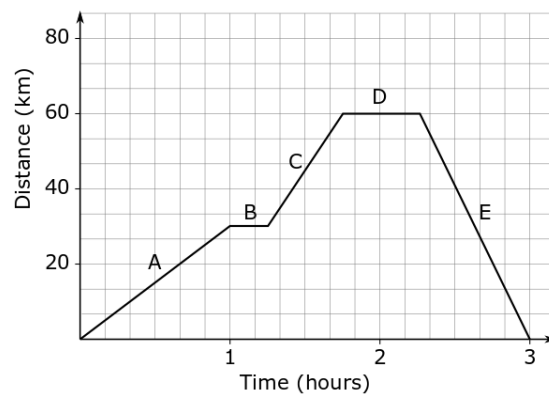


Figure 5: Distance-Time Graph