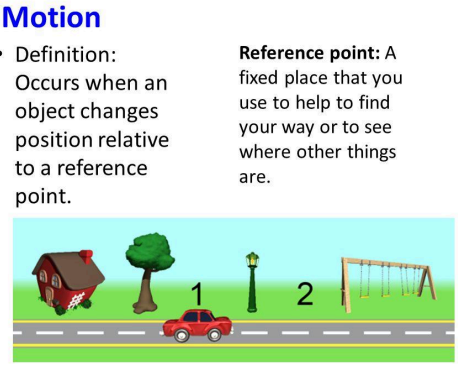
Describing Motion

If you want a copy go to file and make a copy. Do not request access.

The speed of a moving object can be calculated, if the distance traveled and the time taken is known. The faster an object moves, the steeper is the line representing it on a distance-time graph.
The velocity of an object is its speed in a particular direction. In velocity-time graphs sloping lines represent steadily increasing or decreasing velocities. Horizontal lines represent movement at constant velocities.



The equation

When an object moves in a straight line at a steady speed, you can calculate its speed if you know how far it travels and how long it takes. This equation shows the relationship between speed, distance traveled and time taken:

$$\text{speed (metre per second, m/s)} = \frac{\text{distance travelled (metre, m)}}{\text{time taken (second, s)}}$$

For example, a car travels 300m in 20s.
Its speed is 300 ÷ 20 = 15m/s.

Distance-time graphs

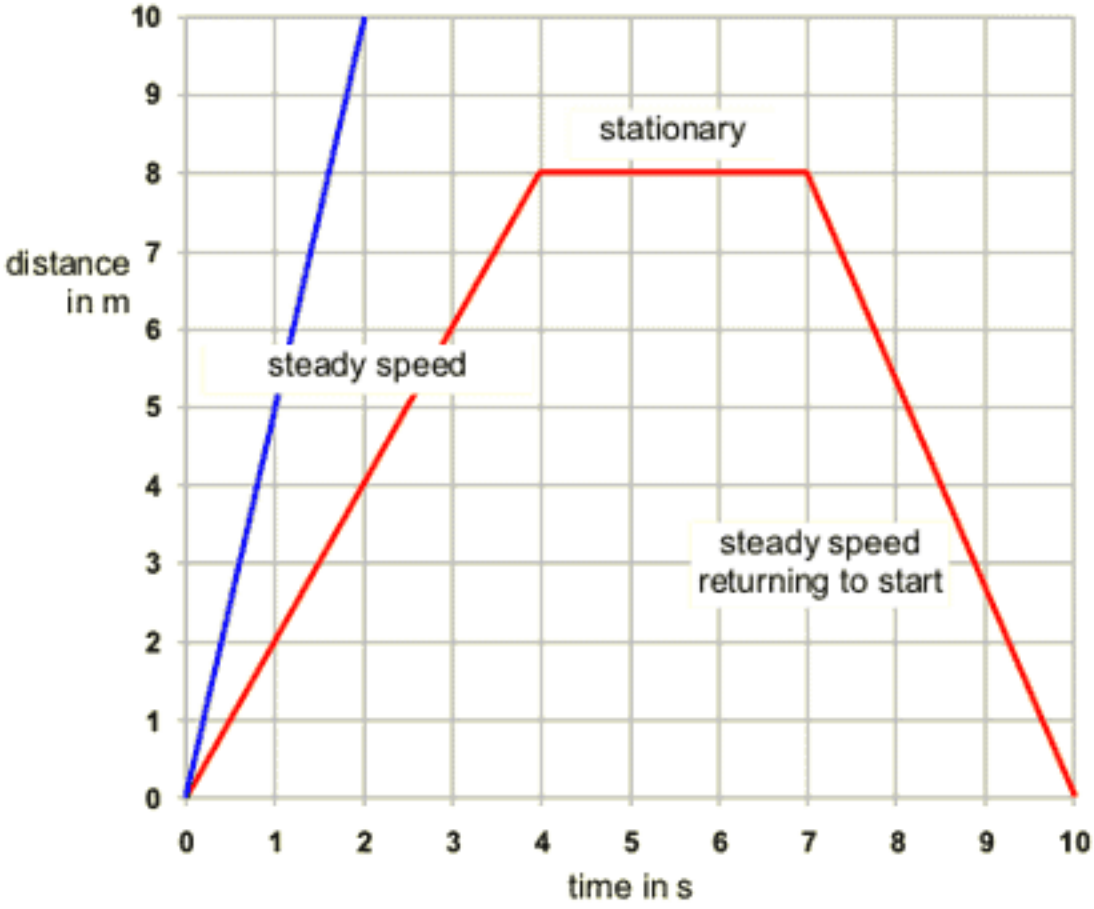
You should be able to draw and explain **distance-time graphs** for objects moving at steady speeds or standing still.

Background information

The vertical axis of a distance-time graph is the distance traveled from the start, and the horizontal axis is the time taken from the start.

Features of the graphs

When an object is stationary, the line on the graph is horizontal. When an object is moving at a steady speed, the line on the graph is straight, but sloped.
The diagram shows some typical lines on a distance-time graph.



Distance - time graph

Note that the **steeper** the line, the greater the **speed** of the object. The blue line is steeper than the red line because it represents an object moving faster than the object represented by the red line.

The red lines on the graph represent a typical journey where an object returns to the start again. Notice that the line representing the return journey slopes downwards.

Changes in distances in one direction are positive, and negative in the other direction. If you walk 10m away from me, that can be written as +10m; if you walk 3m towards me, that can be written as –3 m.

Velocity-time graphs

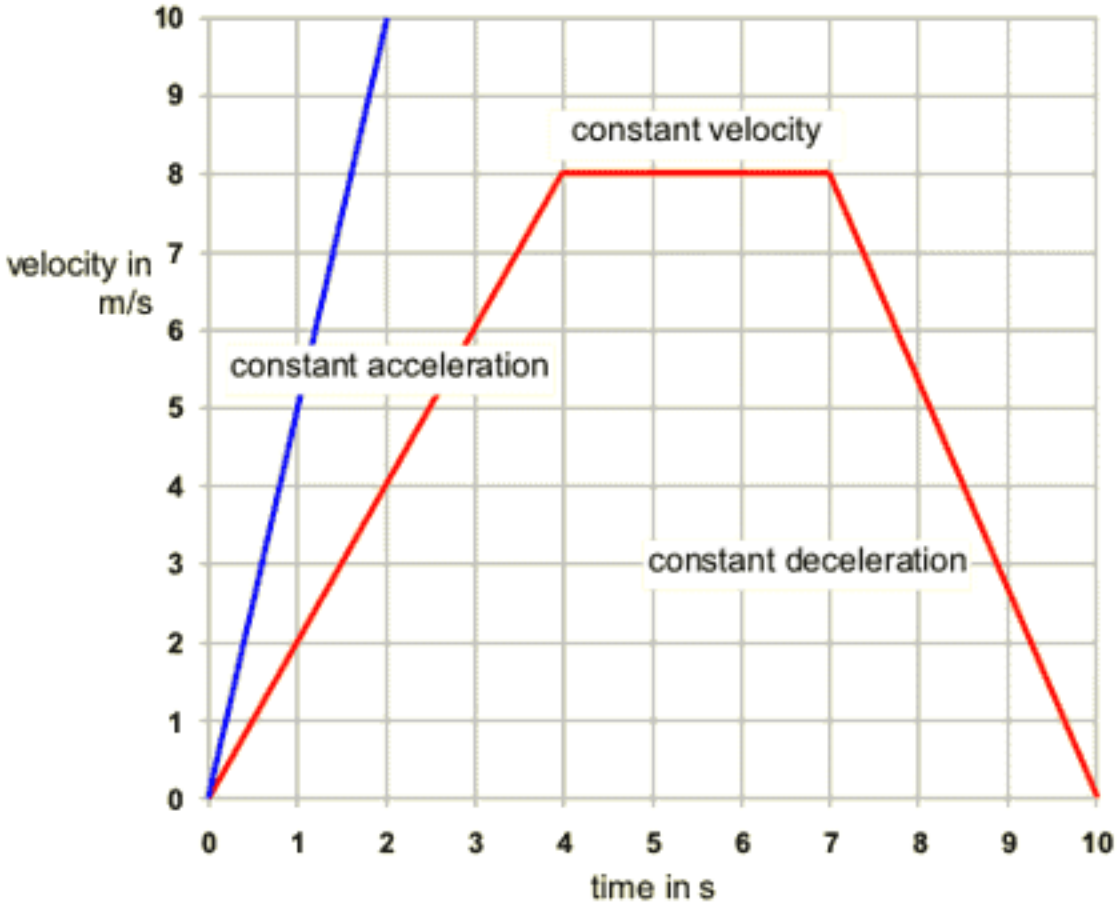
You should be able to explain **velocity-time graphs** for objects moving with a constant velocity or a changing velocity.

Background information

The **velocity** of an object is its **speed** in a particular **direction**. This means that two cars traveling at the same speed, but in opposite directions, have different velocities. One velocity will be **positive**, and the velocity in the other direction will be **negative**.
The vertical axis of a velocity-time graph is the velocity of the object and the horizontal axis is the time taken from the start.

Features of the graphs

When an object is moving with a constant velocity, the line on the graph is horizontal. When an object is moving with a steadily increasing velocity or a steadily decreasing velocity, the line on the graph is straight, but sloped. The diagram shows some typical lines on a velocity-time graph.

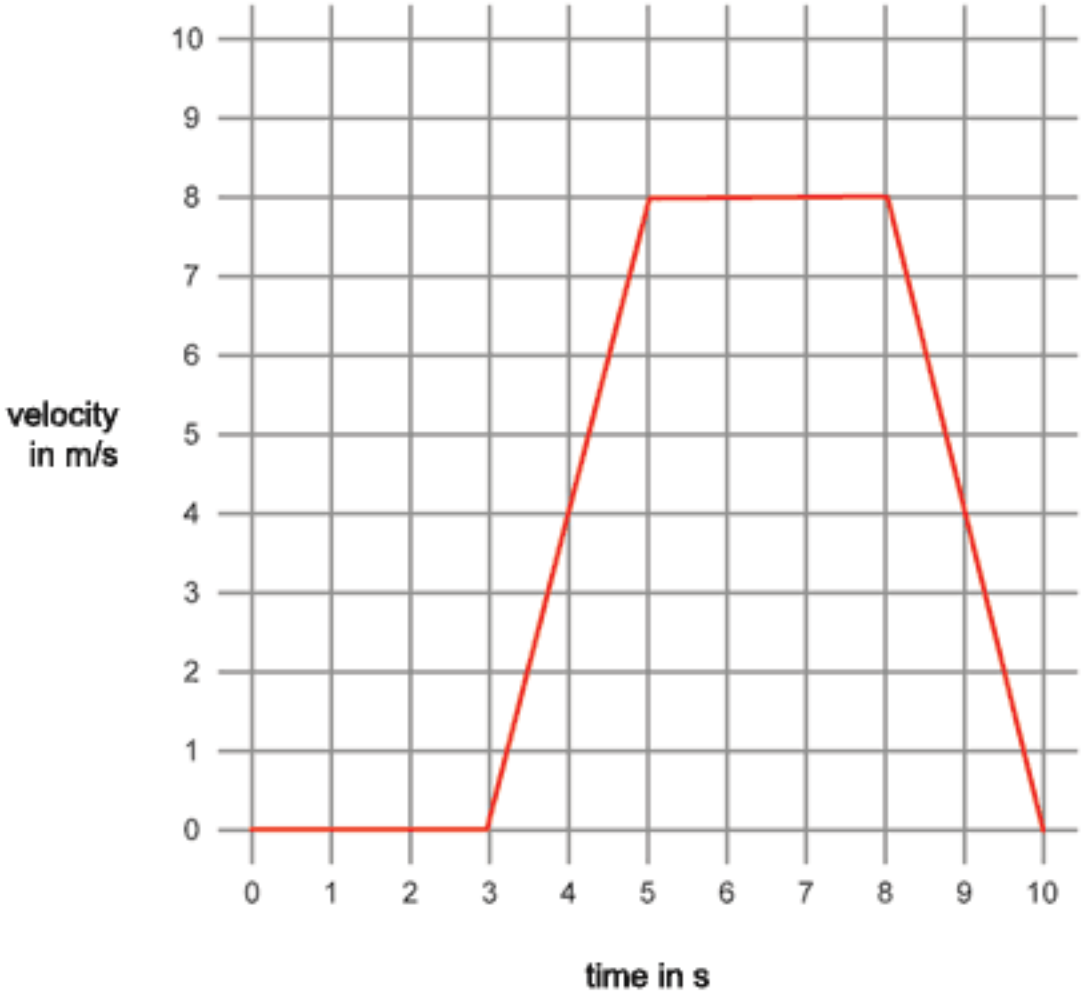


Speed - time graph
The steeper the line, the more rapidly the velocity of the object is changing. The blue line is steeper than the red line because it represents an object that is increasing in velocity much more quickly than the one represented by the red line.

Notice that the part of the red line between 7 and 10 seconds is a line sloping downwards (with a negative gradient). This represents an object that is steadily slowing down.

Interpreting velocity-time graphs

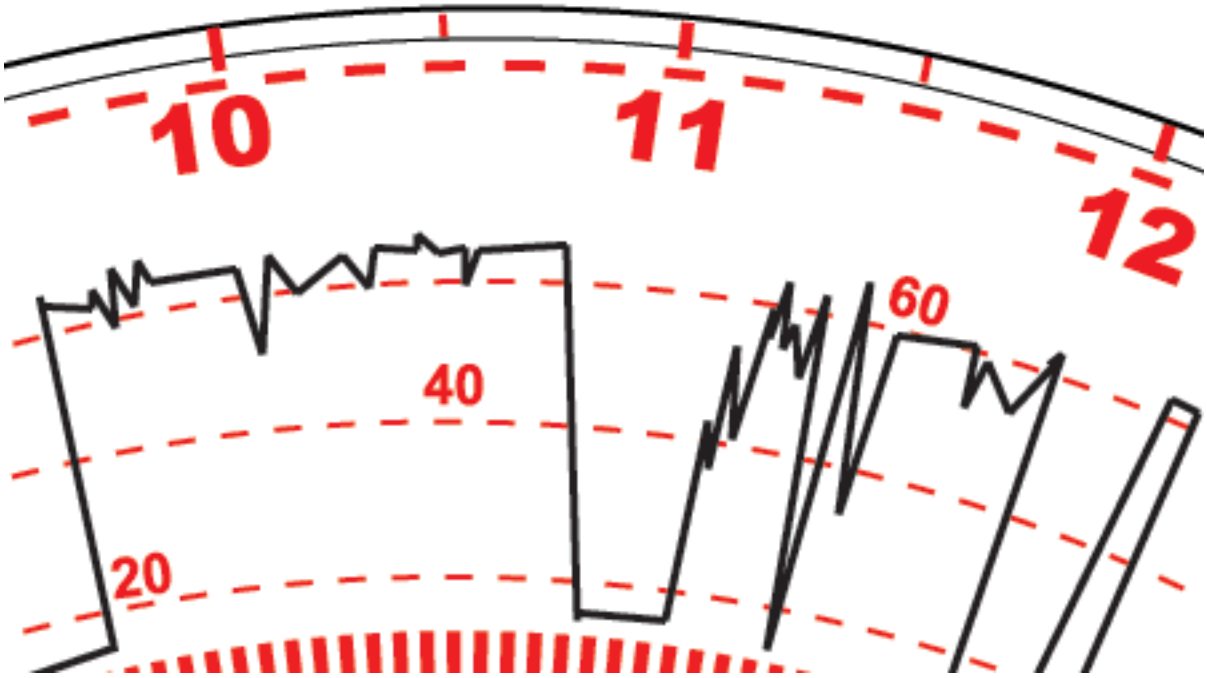
You should be able to draw and interpret the shape of a velocity-time graph for an object that is stationary, for an object moving in a straight line with constant speed, and for an object moving in a straight line with steadily increasing or decreasing speed.



Velocity-time graph

In the graph, the object is **stationary** for the first 3 seconds, then has a **steadily increasing** speed for 2 seconds. For the next 3 seconds, it has a **constant** speed, and for the last 2 seconds, it has a **steadily decreasing** speed.

You can see that the speeds are changing steadily between 3 and 5 seconds and between 8 and 10 seconds, because the lines are not just going up and down, but are also straight.
One example of a velocity-time graph is a **lorry tachograph**. Tachograph records are circular disks recording the speed of the vehicle. This shows whether the lorry driver has been keeping to the **speed limit** and taking regular **rest breaks**.



A tachograph records the speed of the vehicle
This section of a tachograph disk shows that the driver started driving shortly after 9:30, and was traveling at 60 miles/hour until 10:50 when he took a 20-minute break. At 11:10 he speeded up again and took a 10-minute break at about 12:00.

Distance-time graphs (Higher Tier)

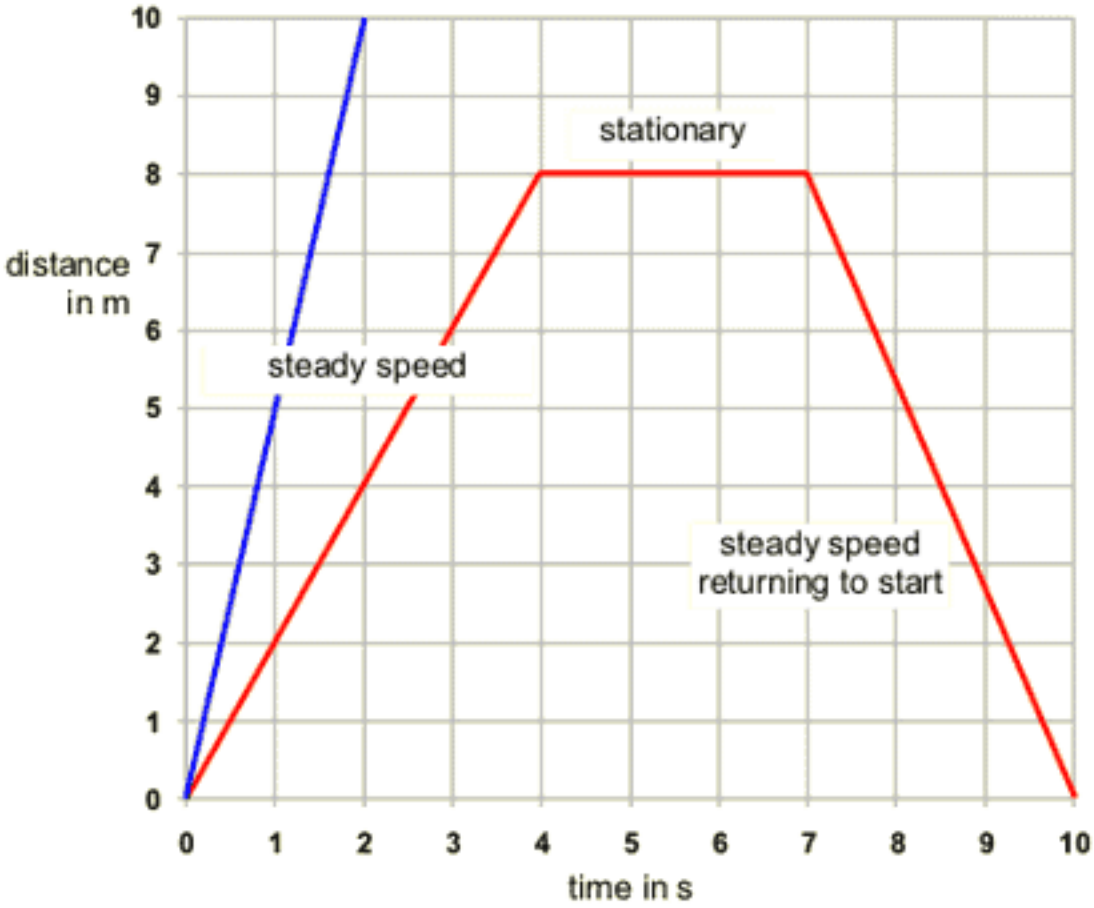
You should be able to calculate gradients on distance-time graphs and to draw and interpret graphs where the speed is increasing or decreasing.

Background information

To calculate the gradient of the line on a graph, you need to **divide** the **change** in the **vertical** axis by the **change** in the **horizontal** axis.

Distance-time graphs

The gradient of a line on a distance-time graph represents the speed of the object. Study this distance-time graph.



Distance - time graph

Information from:
http://www.bbc.co.uk/schools/gcsebitesize/science/add_ocr_pre_2011/explaining_motion/describingmotionrev2.shtml