FLIPPED around PHYSICS

4.3.2 Acceleration

videos

Acceleration (a) is defined as the rate of change of velocity (v). Acceleration, like velocity, is a vector quantity.

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

The unit for acceleration is the metre per second squared (ms^{-2}).

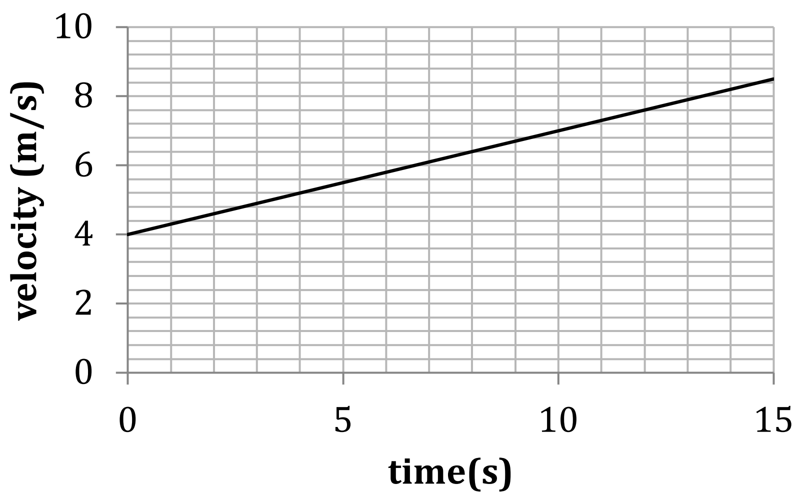
If an object accelerates from rest (in a straight line) at $1ms^{-2}$, after 1 second it would have velocity of $1ms^{-1}$, after 2 seconds it would have a velocity of $2ms^{-1}$, after 3 seconds it would have a velocity of $3ms^{-1}$, and so on. Acceleration tells us how much velocity changes every second. Uniform acceleration is when velocity changes by the same amount each second.

At present, we will only concern ourselves with motion in a straight line.

[In a later section, we will consider uniform circular motion (where the velocity vector changes in direction, but not in magnitude). In circular motion the speed stays constant but the object experiences an acceleration towards the centre of the circle.]

For motion in a straight line we indicate forward motion as positive and backward motion as negative. Hence a negative acceleration would be acceleration in the reverse direction. If we have an object slowing down, we often talk about this negative acceleration as deceleration.

Consider the graph of uniform acceleration below:



(1)✎ What is the velocity at time zero?

(2)✎ What is the velocity at 15s?

(3)✎ What is the acceleration?

(4)✏ *What is the total displacement for this journey?*

We usually give the start velocity the symbol u, and the final velocity the symbol v. Hence acceleration is given by:

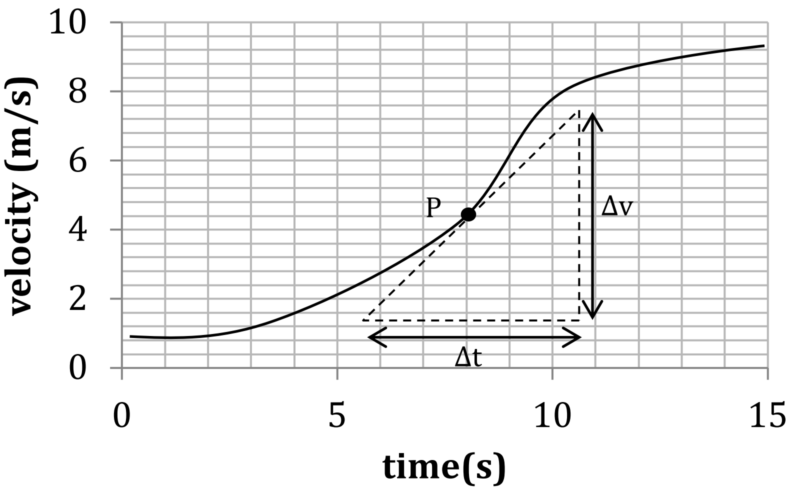
$$a = \frac{v - u}{t}$$

where t = the time interval over which the velocity changed

(5)✏ *Rearrange this equation to make the v the subject.*

(6)✏ *A car, initially travelling at 8ms⁻¹, accelerates at 3ms⁻². What is its final speed after 3.2s?*

We can find the instantaneous acceleration by finding the gradient of the velocity-time graph at any point. Consider the velocity-time graph below:



If we want to find the instantaneous acceleration (a_i) at point P, we draw a tangent to the curve and take the gradient.

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

(7)✏ *Work out the instantaneous acceleration at P.*