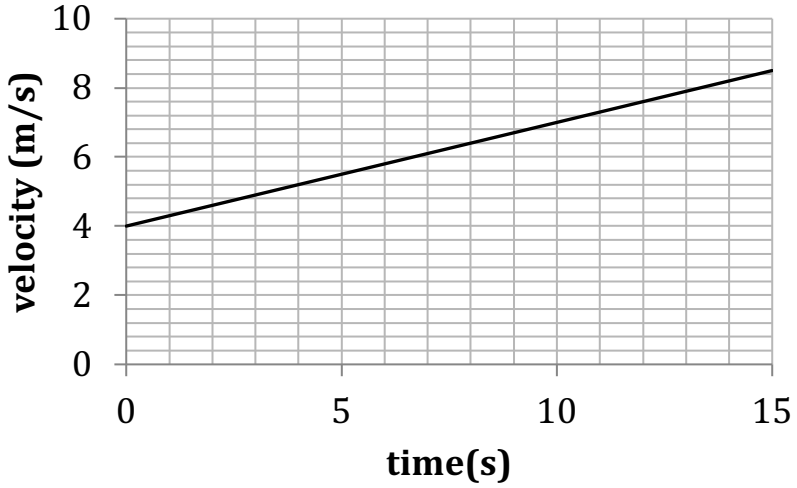
4.3.3 Uniform acceleration

videos

Uniform acceleration occurs when there are equal changes in velocity per unit time. The following graph shows that the velocity is increasing by *0.3ms^{-1}* every second. Acceleration is *0.3ms^{-2}*.



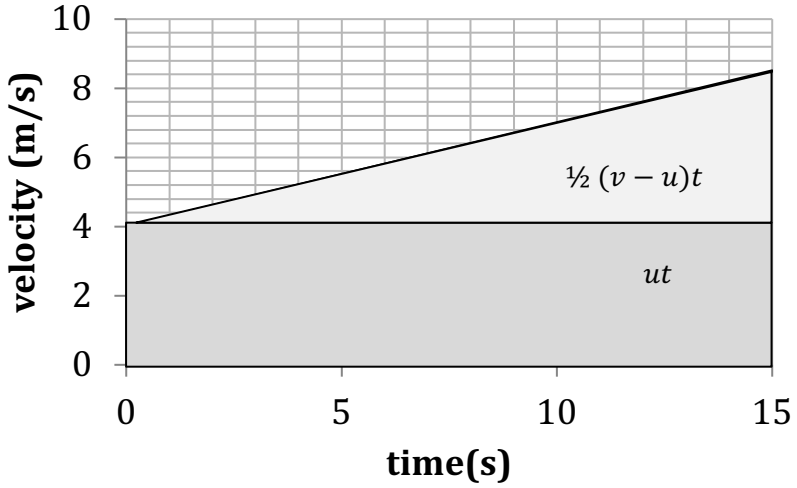
The equation for the graph above is:

$$v = u + at \qquad (i)$$

where v = final velocity, u = velocity and t = time.

(1) Check that this gives the correct value for velocity for t=12s.

We know that the displacement is the area under the *velocity-time* graph. In the following graph, we can sum the two areas:



Hence displacement (s) is given by:

$$s = ut + ½(v - u)t$$

(2) Substitute for v, using the first equation (i), and simplify.

We will call the equation you have written for displacement as equation (ii).

The displacement can also be calculated by using the average velocity for the journey:

$$displacement = average\ velocity\ \times\ time$$

$$s = \frac{(v+u)}{2} \times\ t \qquad (iii)$$

(3) Rearrange equation (i) to make a the subject.

(4) Multiply this by equation (iii) to get an expression for $a\ \times\ s$.

(5) Rearrange and simplify to find an expression for v^2. We will call the equation (iv).

We now have 4 equations of motion for bodies undergoing uniform acceleration.

equation	*u*	*v*	*a*	*t*	*s*
(i) *v = u + at*	✓	✓	✓	✓	✗
(ii)					
(iii)					
(iv)					

We use equation (i) to solve problems where we are given 3 of the terms ticked and need to find the fourth. We can't use it for problems where we are given *s*.

(6) Write in the other equations and complete the table, above.

(7) A car travelling at $3ms^{-1}$ accelerates at $0.1ms^{-2}$ for 10s. How far does it travel during this time? What is its final velocity?