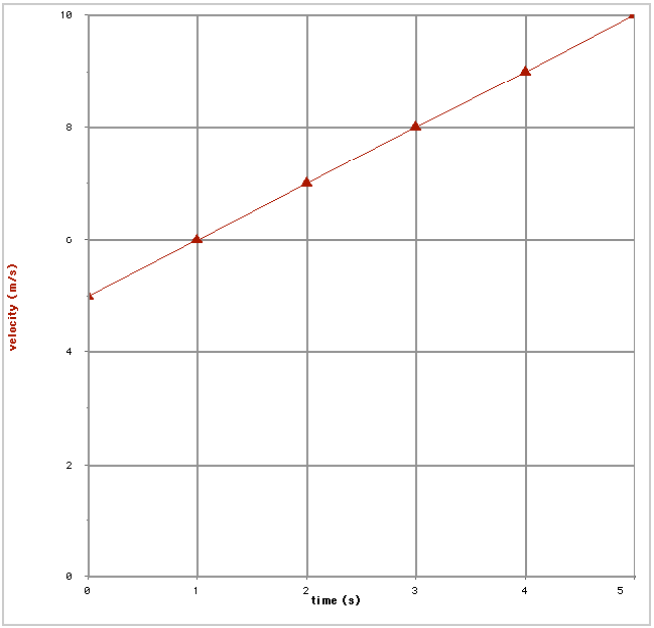
Interpreting Slopes, Areas, and Intercepts of Graphs

Sometimes slopes, areas, and intercepts in graphs have physical interpretations. At other times they have no real meaning at all. Consider how one can interpret meaningful terms in the following graph.



Here we have a linear relationship between velocity and time. The slope of the graph can be found from the relationship

$$m = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$$

Because this is a linear relationship, arbitrarily choosing two pairs of (x, y) coordinates on the line and performing the calculation results in a slope of $1 m/s^2$. The slope represents the change in velocity with time which is nothing other than acceleration. Note that the calculated slope units are those of acceleration.

What does the area under the curve represent, say, from time equals $1s$ to time equals $5s$? Consider adding up a series of very narrow vertical columns to find total area. The height of each vertical column is velocity, v, at a particular time and the width of each column is Δt. The product of these terms is $v\Delta t$ which equals a distance. Hence the sum total of these rectangles giving the area under the curve during the specified time interval is the distance that the object has traveled from time $1s$ to $5s$. Can you see how the distance the object travels between $t = 1s$ and $t = 5s$ is $32m$? You can readily see this by adding the area of the rectangle below and to the right of the point (1, 6) (area = height x width = $(6m/s)(4s) = 24m$) to the triangle to the upper right of this point (area = 0.5 height x base = $0.5(4m/s)(4s) = 8m$). Note the $24m + 8m = 32m$.

The y-intercept can also be readily interpreted in the above graph. It is merely the value of the y term at time = $0s$. That is, the y-intercept is $5m/s$, the velocity of the object at $t = 0s$.

Not all graphs are so readily interpreted. Some graph's slopes, areas, and intercepts might well be meaningless. Consider the following examples, not all of which are meaningful. Can you tell which is which?

What does the area under the curve of an acceleration-versus-time graph represent?

What does the slope of an acceleration-versus-time graph represent?

What does the y-intercept of an acceleration-versus-time graph represent?

What does the area under the curve of a displacement-versus-time graph represent?

What does the slope of a displacement-versus-time graph represent?

What does the y-intercept of a displacement-versus-time graph represent?