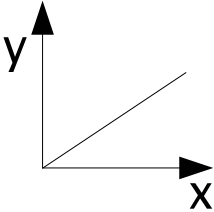
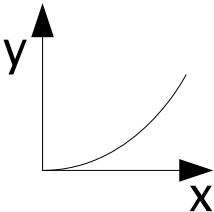
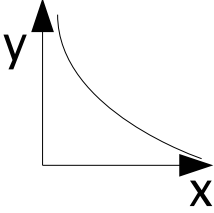


Graphical Methods

All of the laws and equations of physics that we will study this year can be constructed using just three major ideas, the idea of one quantity increasing in constant proportion with another, the idea of a quantity increasing with another - but in constantly increasing proportion, and the idea of one quantity decreasing when the other increases. Each major idea can be represented by a graph, a proportionality, words and an equation. You should strive to understand how and why each representation is associated with a corresponding major idea. At the end of the year, I can always tell the students who have tried to rote memorize which graphs, equations, etc. go together, because they still have trouble remembering. If you can understand how and why, you will have a much easier time remembering the equations of physics and knowing when and how to use them.

Graph shape	Proportionality	Mathematical Meaning	Equation
	$y \propto x$	If x doubles, y doubles. If x triples, y triples. If x is halved, y is halved. If x is multiplied by a number n , then y is multiplied by the same number n . As x increase, y increase, and the ratio between y and x remains constant.	$y = mx$
	$y \propto x^2$	If x doubles, y is quadrupled. If x triples, y is multiplied by 9. If x is halved, y is quartered. If x is multiplied by a number n , then y is multiplied by n^2 . As x increases, y also increases, but at an ever increasing ratio.	$y = Ax^2$
	$y \propto \frac{1}{x}$	If x doubles, y is halved. If x triples, y is divided by 3. If x is halved, y is doubled. If x is multiplied by a number n , y is divided by n . The ratio between y and x gets smaller and smaller as x increases.	$y = \frac{A}{x}$

Each of the above graphs may also have a non-zero y -intercept, b . In that case, the proportionalities and equations may be modified by replacing y with $y - b$. For example:

$$(y - b) = mx \text{ means that } (y - b) \propto x .$$

$$(y - b) = Ax^2 \text{ means that } (y - b) \propto x^2 .$$

$$(y - b) = \frac{A}{x} \text{ means that } (y - b) \propto \frac{1}{x} .$$

The graphs will look similar to these, but they will be shifted up or down according to the y -intercept. $y - b$ is often called the "change in y ," denoted as Δy because it is the difference between a value of y and its initial, or starting value.