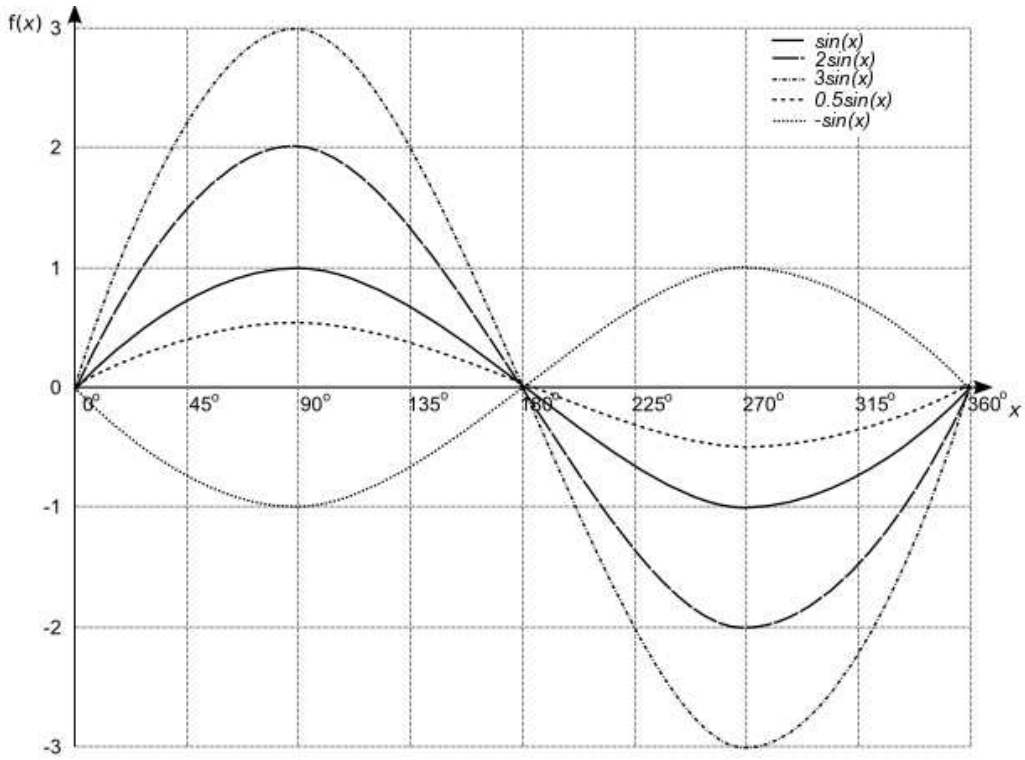
Secondary 3 Express — Akmal bin Abd Rahman
Exploring Maths: Understanding sinusoidal functions $a\sin(bx)$ — October 5, 2005

Amplitude In this section,we'll explore what happens when we vary the value of a in the sinusoidal function $a\sin(x)$. We'll set different values for a to see how it affects the function. We will set a to be $\frac{1}{2}$, 2 and 3. Fill in the corresponding values of these functions at various points along the x-axis in the table below:

x	$\sin(x)$	$\frac{1}{2}\sin(x)$	$2\sin(x)$	$3\sin(x)$
$0°$	0	0	0	0
$90°$	1	$\frac{1}{2}$	2	3
$180°$	0	0	0	0
$270°$	-1	$-\frac{1}{2}$	-2	-3
$360°$	0	0	0	0

Now we have enough information to plot the curves $\frac{1}{2}\sin(x)$, $2\sin(x)$ and $3\sin(x)$. Sketch in these functions in the grid below.



- What changes have you noticed? Which properties of the sinusoidal function remain the same?

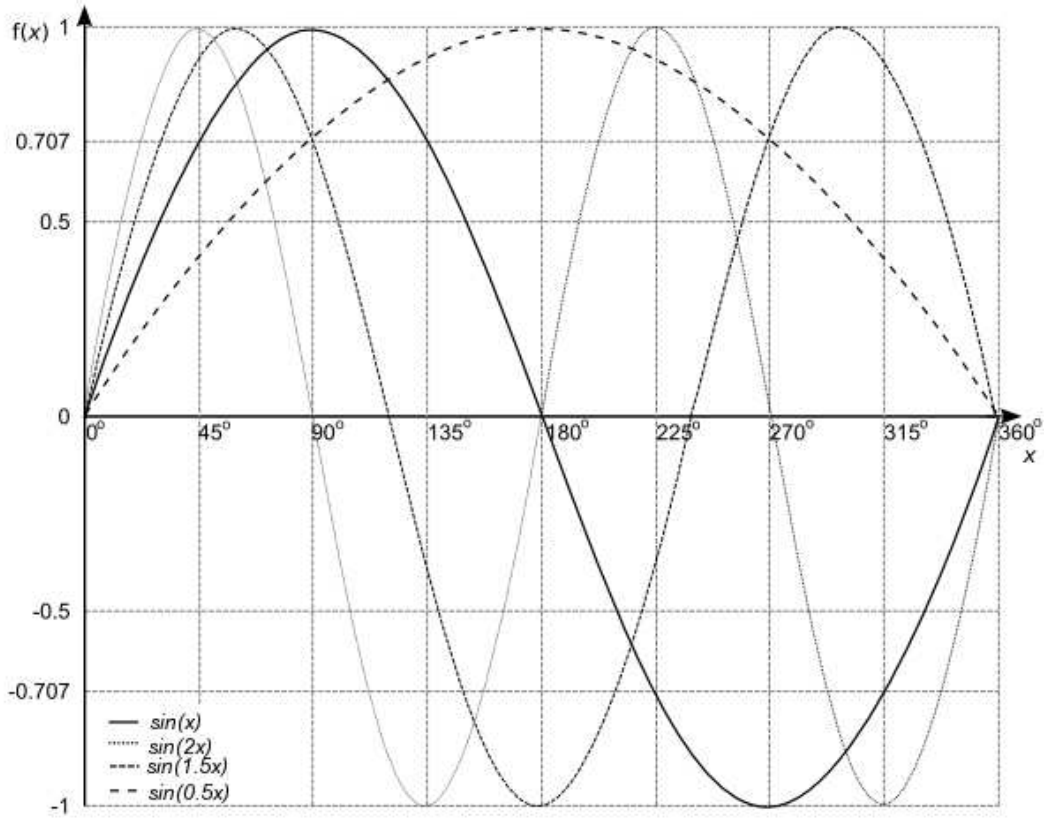
  The amplitude changes proportional to a. The x-intercepts remain the same. Thus the period of the wave is the same.

- Can you also sketch the function $-sin(x)$ in the grid above?

Periodicity We've seen that the value a in the sinusoidal function $a\sin(bx)$ only affects the *amplitude* of the resultant curve. Now, we'll explore what happens when we vary the value of b. We will investigate for values $b = \frac{1}{2}$ and $b = 2$.
Fill in the values of these functions at various points along the x-axis in the table below:

x	$\sin(x)$	$2x$	$sin(2x)$	$\frac{1}{2}x$	$\sin(\frac{1}{2}x)$
$0°$	0	$0°$	0	$0°$	0
$45°$	$\frac{1}{\sqrt{2}}$	$90°$	1		
$90°$	1	$180°$	0	$45°$	$\frac{1}{\sqrt{2}}$
$135°$	$\frac{1}{\sqrt{2}}$	$270°$	-1		
$180°$	0	$360°$	0	$90°$	1
$225°$	$-\frac{1}{\sqrt{2}}$				
$270°$	-1			$135°$	$\frac{1}{\sqrt{2}}$
$315°$	$-\frac{1}{\sqrt{2}}$				
$360°$	0			$180°$	0

Now we are able to plot the functions $\sin(2x)$ and $\sin(\frac{1}{2}x)$. Plot the points you've calculated above in the grid below and sketch the graphs of the two sinusoidal functions. (Remember to plot the curves against x and not $2x$ or $\frac{1}{2}x$)



- What changes have you observed? Which properties of the sinusoidal function remain the same?

  The period of the functions has changed. The bigger b is, the smaller the period. The amplitude of the functions have remained the same.

- Can you also sketch the function $sin(\frac{3}{2}x)$ in the grid above? Where are the x-intercepts?
  The x-intercepts are at $x = 0°$, $120°$, $x = 240°$ and $x = 360°$.
- Varying the values of b will affect the *periodicity* of the sinusoidal function. For $b > 1$, the period of the function will **become smaller**; it will become compressed. For $b < 1$, the period of the function will **become larger**; it will become more spread out.