1. Mary has spiders and flies in her house. Yesterday she counted 5 spiders. Today she counted 8 spiders and 10 flies. The fly population triples every two days. Assuming that the number of spiders and flies in Mary's house grows exponentially, when will there be 20 times more flies than spiders in Mary's house ? Give the answer in days from today.

$f(t) = 10\left(\sqrt[2]{3}\right)^t$ fly population t days from today

$g(t) = 8\,b^t$ $\quad g(-1) = 8\,b^{-1} = 5 \quad b = \frac{8}{5}$

$g(t) = 8\left(\frac{8}{5}\right)^t$ spider population t days from today

want $f(t) = 20 \cdot g(t)$

$10\left(\sqrt[2]{3}\right)^t = 20 \cdot 8\left(\frac{8}{5}\right)^t$

$\left(\frac{\sqrt[2]{3}}{\frac{8}{5}}\right)^t = 16$

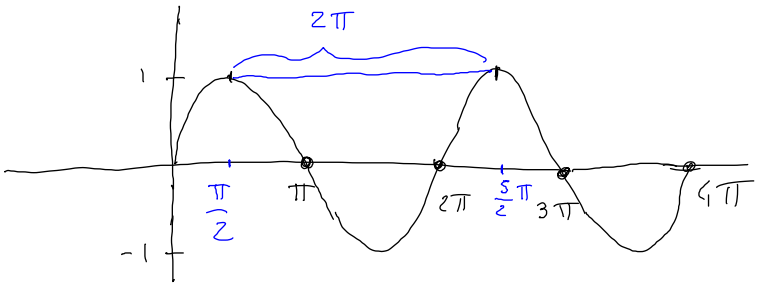
$t = \frac{\ln 16}{\ln\left(\frac{5}{8}\sqrt[2]{3}\right)} \approx 35 \text{ days}$ (34.96)

Consider

~~In class we graphed~~ $y = 3\sin(2x - 5) + 1$. In this worksheet you are going to ~~use a slightly different method to~~ graph this function.

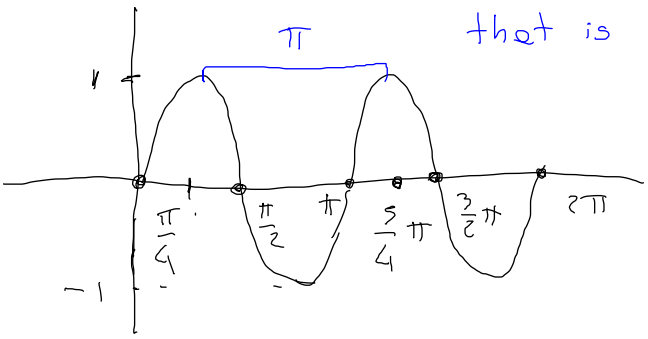
First write $y = 3\sin(2(x - \frac{5}{2})) + 1$

1. Start with the function $f(x) = \sin x$ restricted to the domain $0 \le x \le 4\pi$. Graph this function. Mark the values of all x intercepts on the x axis. Mark the highest and lowest y values on the y axis. What is the range of $f(x)$? What is the horizontal distance between two consecutive peaks (points with biggest y coordinate)?



Range $-1 \le y \le 1$

2. Now graph $g(x) = f(2x)$ Mark the values of all x intercepts on the x axis , mark the highest and lowest y values on the y axis. What are the domain and range of this new function ? What is the distance between two consecutive peaks ?



that is $2\pi \cdot \frac{1}{2}$ scaling factor

Domain $0 \le 2x \le 4\pi$

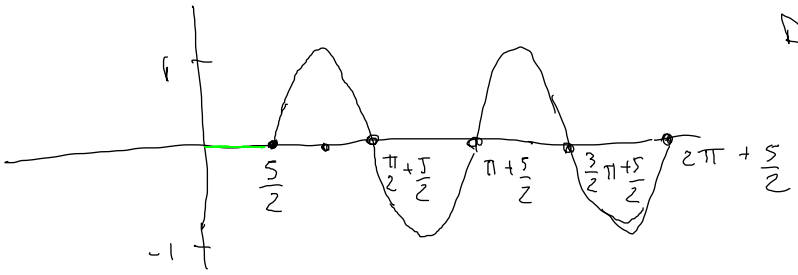
gives $0 \le x \le 2\pi$

domain of g

Range $-1 \le y \le 1$

no change

3. Now graph $g(x-\frac{5}{2}) = f(2(x-\frac{5}{2}))$ Mark the values of all x intercepts on the x axis , mark the highest and lowest y values on the y axis. What are the domain and range of this new function ?

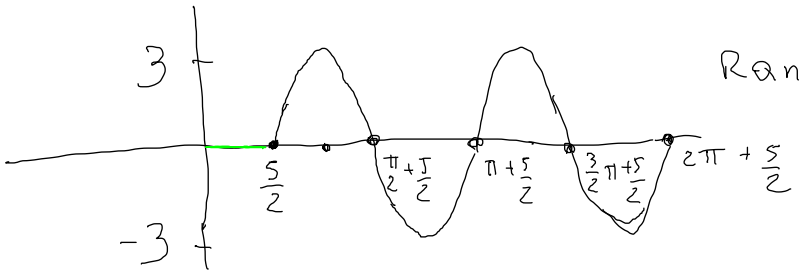


Domain : $0 \le x - \frac{5}{2} \le 2\pi$

gives $\frac{5}{2} \le x \le 2\pi + \frac{5}{2}$

Range $-1 \le y \le 1$

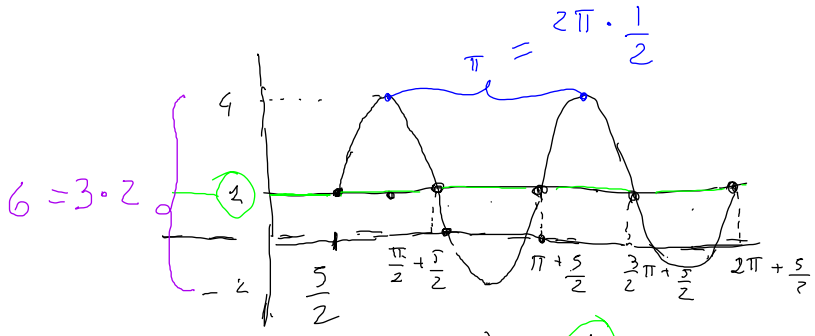
4. Now graph $3g(x-\frac{5}{2}) = 3f(2(x-\frac{5}{2}))$ Mark the values of all x intercepts on the x axis , mark the highest and lowest y values on the y axis. What are the domain and range of this new function ?



Domain $\frac{5}{2} \le x \le 2\pi + \frac{5}{2}$

Range $-3 \le y \le 3$

5. Now graph $3g(x - \frac{5}{2}) + 1 = 3f(2(x - \frac{5}{2}))) + 1$ Mark the values of all x intercepts on the x axis , mark the highest and lowest y values on the y axis. What are the domain and range of this new function ?



$3 \cdot \sin\left(2\left(x - \frac{5}{2}\right)\right) + 1$

Domain $\frac{5}{2} \leq x \leq 2\pi + \frac{5}{2}$

Range $-3+1 \leq y \leq 3+1$

$-2 \leq y \leq 4$

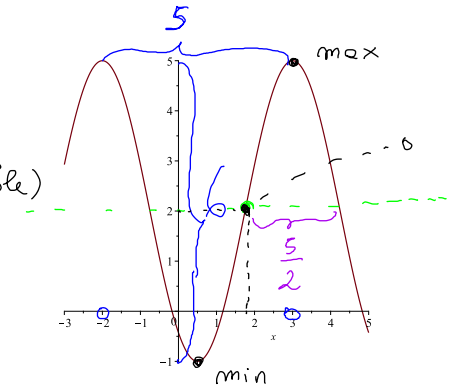
Find a formula of the form $y = A\sin(b(x-C)) + D$ for the function graphed below.

$A = \frac{6}{2} = 3$,

$2\pi \cdot \frac{1}{b} = 5$ $\quad b = \frac{2\pi}{5}$

$C = 1.5$ (other values possible)

$D = 2$



half way between min and max

x coord is C

y coord is D

You can use the following formulas but discuss them with your group to make sure they make sense to all.

A: half of the vertical distance between a max y value and a min y value. (A is the vertical scaling factor, multiplying $\sin x$ by A changes the range of the function (vertical distance) from $-1 \le x \le 1$ to $-A \le x \le A$

$\frac{1}{b}$ is the horizontal scaling factor so the horizontal distance between two consecutive peaks (max y values) is $\frac{2pi}{b}$.

C: x-coordinate of a point half way between a min and the next max to the right. C is the horizontal shift. The point (0,0) which is halfway between a min and a max in the function $\sin(bx)$ is shifted horizontally to the point $(C, 0)$

D: y value of a point half way between a peak (highest point) and a valley (lowest point)

Note $C = \frac{7}{4}$ is also equal to $x_{max} - \frac{5}{4} = 3 - \frac{5}{4} = \frac{7}{4}$