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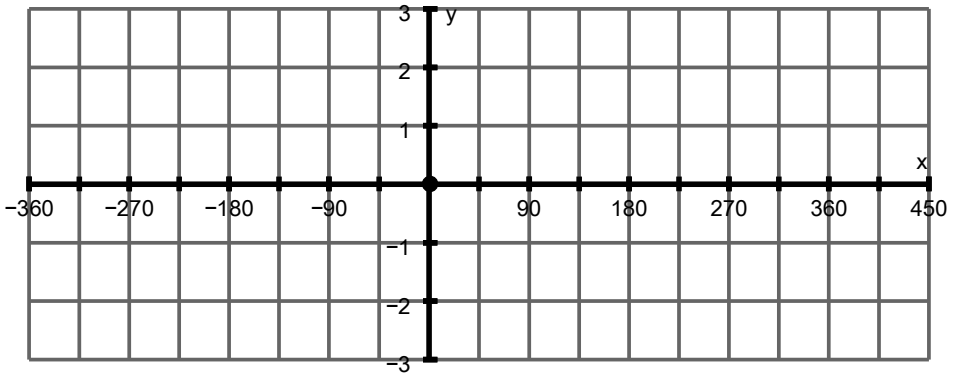
The Properties of Graphs of y=sin x

Part A - Graphing

Investigate the graph of $y = \sin x$ using Desmos:
https://www.desmos.com/calculator/ezqkuszmnc

Draw the graph below:



1. Where is the *y*-value of the lowest points of the graph? _____
   - These points are called local minimums.

2. Where is the *y*-value of the highest points of the graph? _____
   - These points are called local maximums.

3. State the domain of the function: _____

4. State the range of the function: _____

5. What is the period of the function? _____

6. What is the equation of the sinusoidal axis? _____

7. What is the amplitude? _____

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Part B – Vertical Stretches

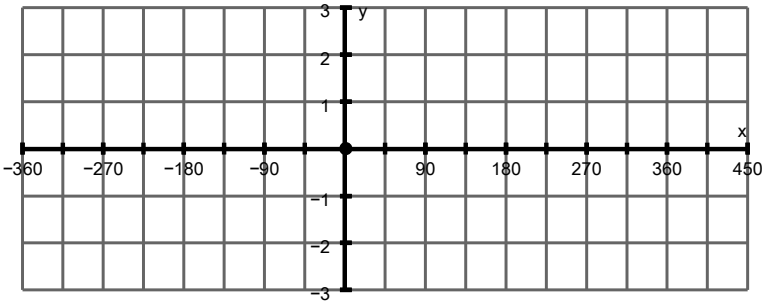
https://www.desmos.com/calculator/cvsbmbqgxw

Use the slider to investigate how changing the value of a in the equation $y = a\sin x$ affects the graph.

1. What happens to the graph when $a > 1$?

2. What happens to the graph when $0 < a < 1$?

3. Set $a = 2$ and draw the graph of $y = 2\sin x$.



4. State the domain of the function.

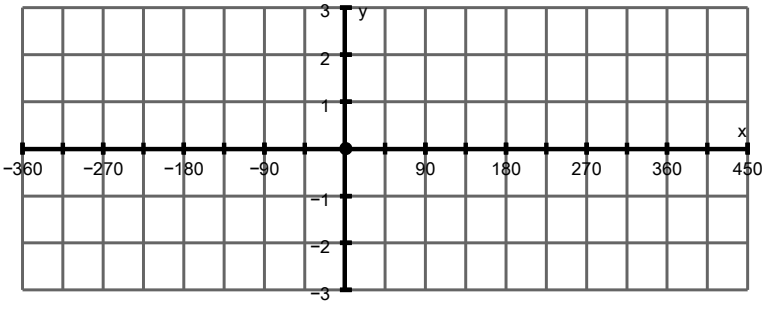
5. State the range of the function.

6. What is the period of the function?

7. What is the equation of the sinusoidal axis?

8. What is the amplitude?

9. Set $a = \frac{1}{2}$ and draw the graph of $y = \frac{1}{2}\sin x$.



10. State the domain of the function.

11. State the range of the function.

12. What is the period of the function?

13. What is the equation of the sinusoidal axis?

14. What is the amplitude?

15. This factor of change between the y-values of $y = \sin x$ and $y = a\sin x$ is known as a **vertical stretch.** What parts of the function does the vertical stretch affect? (Domain? Range? SA? Amplitude?...)

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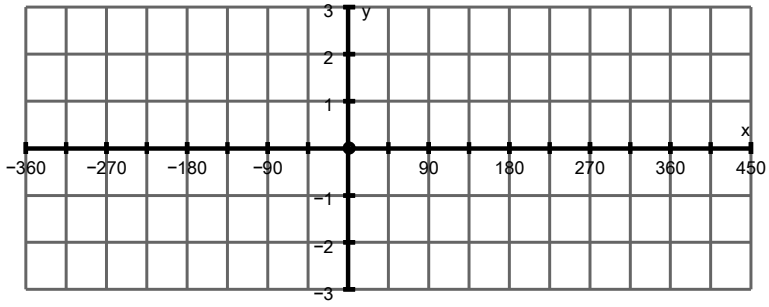
16. Set $a = -1$ and draw the graph of $y = -\sin x$. This is a **reflection over the *x*-axis**. Compare it to the graph of $y = \sin x$.



<u>Part C</u> – Vertical Translations

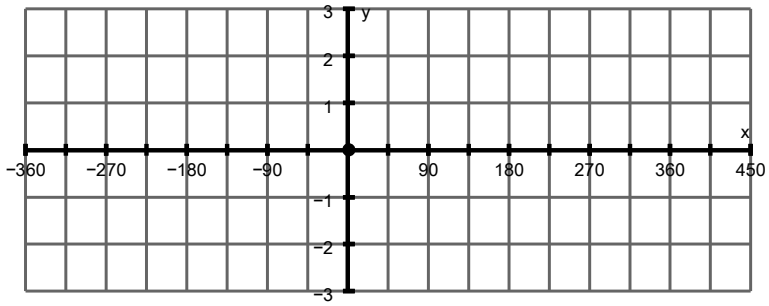
https://www.desmos.com/calculator/fltgrag5sq

Use the slider to investigate how changing the value of *d* in the equation $y = \sin x + d$ affects the graph.

1. What happens to the graph when $d > 0$?

2. What happens to the graph when $d < 0$?

3. Set $d = 2$ and draw the graph of $y = \sin x + 2$.



4. State the domain of the function.

5. State the range of the function.

6. What is the period of the function?

7. What is the equation of the sinusoidal axis?

8. What is the amplitude?

9. This change to the graph is called a **vertical translation**. What parts of the function does the vertical translation affect? (Domain? Range? SA? Amplitude?...)

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Part D – Horizontal Translations

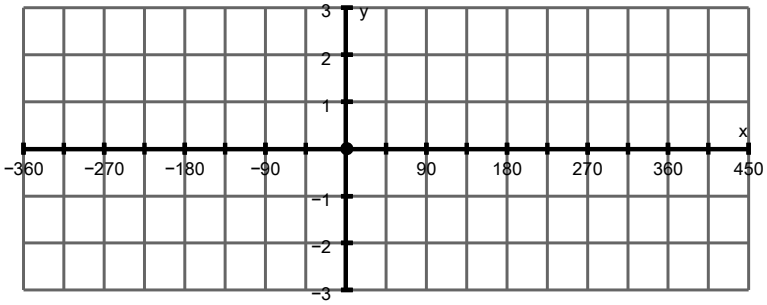
https://www.desmos.com/calculator/l0kpftr9cf

Use the slider to investigate how changing the value of c in the equation $y = \sin(x - c)$ affects the graph.

1. What happens to the graph when $c > 0$?

2. What happens to the graph when $c < 0$?

3. Set $c = 90$ and draw the graph of $y = \sin(x - 90°)$.



4. State the domain of the function.

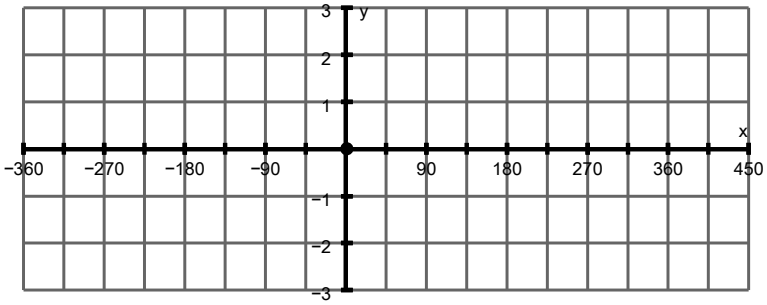
5. State the range of the function.

6. What is the period of the function?

7. What is the equation of the sinusoidal axis?

8. What is the amplitude?

9. Set $c = -45$ and draw the graph of $y = \sin(x + 45°)$.



10. State the domain of the function.

11. State the range of the function.

12. What is the period of the function?

13. What is the equation of the sinusoidal axis?

14. What is the amplitude?

15. This change to the graph is called a **horizontal translation**. What parts of the function does the horizontal translation affect? (Domain? Range? SA? Amplitude?...)

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Part E – Horizontal Stretches

https://www.desmos.com/calculator/amy8daqrlk

Use the slider to investigate how changing the value of b in the equation $y = \sin(bx)$ affects the graph.

1. What happens to the graph when $b > 1$?

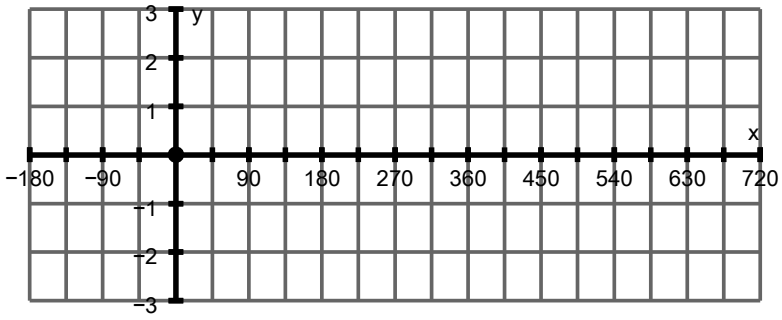
2. What happens to the graph when $0 < b < 1$?

3. Set $b = \frac{1}{2}$ and draw the graph of $y = \sin\left(\frac{1}{2}x\right)$.

4. State the domain of the function.

5. State the range of the function.

6. What is the period of the function?



7. What is the equation of the sinusoidal axis?

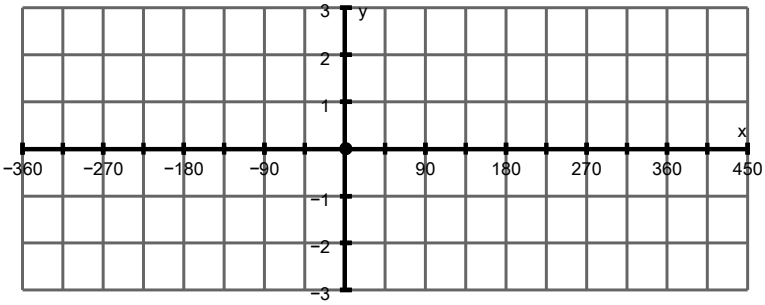
8. What is the amplitude?

9. Set $b = 2$ and draw the graph of $y = \sin(2x)$.

10. State the domain of the function.

11. State the range of the function.

12. What is the period of the function?



13. What is the equation of the sinusoidal axis?

14. What is the amplitude?

15. This change to the graph is called a **horizontal stretch**. What parts of the function does the horizontal stretch affect? (Domain? Range? SA? Amplitude?...)

Part F – Putting it all together

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$y = a\sin\left(b(x-c)\right)+d$

Transformation	Part of graph that is affected
Vertical Stretch: a	
Vertical Translation: d	
Horizontal Stretch: $1/b$	
Horizontal Translation: c	
Reflection: $a < 0$	

Example: List the transformations, amplitude, equation of the sinusoidal axis and period for $y = 2\sin(x+45°)-3$. Graph and check your answer using Desmos.

Vertical Stretch: Amplitude:

Vertical Translation: Equation of S.A.:

Horizontal Stretch: Period:

Horizontal Translation: