

Investigation 1

Comparing the graphs of $y = a \sin x$ and $y = \sin x$

It is time to consider different values of a in the equation $y = a \sin x$ to see what effect it has on the graph of $y = \sin x$. In this investigation, there are three situations to consider:

- $a > 1$
- $a < -1$
- $-1 < a < 1$

When $a > 1$ for the equation $y = \sin x$

The amplitude is 1

The period is 360

The domain is $\{x \in \mathcal{R}\}$

The range is $\{y \in \mathcal{R} \mid -1 \leq y \leq 1\}$

The x intercepts are $0^\circ, 180^\circ, 360^\circ, 540^\circ, 720^\circ$

The y intercept is 0

The minimum value is -1

The maximum value is 1

When $a > 1$ for the equation $y = 2 \sin x$

The amplitude is 2

The period is 360

The domain is $\{x \in \mathcal{R}\}$

The range is $\{y \in \mathcal{R} \mid -2 \leq y \leq 2\}$

The x intercepts are $0^\circ, 180^\circ, 360^\circ, 540^\circ, 720^\circ$

The y intercept is 0

The minimum value is -2

The maximum value is 2

When $a > 1$ for the equation $y = 3 \sin x$

The amplitude is 3

The period is 360

The domain is $\{x \in \mathcal{R}\}$

The range is $\{y \in \mathcal{R} \mid -3 \leq y \leq 3\}$

The x intercepts are $0^\circ, 180^\circ, 360^\circ, 540^\circ, 720^\circ$

The y intercept is 0

The minimum value is -3

The maximum value is 3

When $a > 1$ for the equation $y = 4 \sin x$

The amplitude is 4

The period is 360

The domain is $\{x \in \mathcal{R}\}$

The range is $\{y \in \mathcal{R} \mid -4 \leq y \leq 4\}$

The x intercepts are $0^\circ, 180^\circ, 360^\circ, 540^\circ, 720^\circ$

The y intercept is 0

The minimum value is -4

The maximum value is 4

When $a < -1$ for the equation $y = \sin x$

The amplitude is 1

The period is 360

The domain is $\{x \in \mathcal{R}\}$

The range is $\{y \in \mathcal{R} \mid -1 \leq y \leq 1\}$

The x intercepts are $0^\circ, 180^\circ, 360^\circ, 540^\circ, 720^\circ$

The y intercept is 0

The minimum value is -1

The maximum value is 1

When $a < -1$ for the equation $y = -2 \sin x$

The amplitude is 2

The period is 360

The domain is $\{x \in \mathcal{R}\}$

The range is $\{y \in \mathcal{R} \mid -2 \leq y \leq 2\}$

The x intercepts are $0^\circ, 180^\circ, 360^\circ, 540^\circ, 720^\circ$

The y intercept is 0
The minimum value is -2
The maximum value is 2

When $a < -1$ for the equation $y = -3 \sin x$

The amplitude is 3
The period is 360
The domain is $\{x \in \mathcal{R}\}$
The range is $\{y \in \mathcal{R} \mid -3 \leq y \leq 3\}$
The x intercepts are $0^\circ, 180^\circ, 360^\circ, 540^\circ, 720^\circ$
The y intercept is 0
The minimum value is -3
The maximum value is 3

When $a < -1$ for the equation $y = -4 \sin x$

The amplitude is 4
The period is 360
The domain is $\{x \in \mathcal{R}\}$
The range is $\{y \in \mathcal{R} \mid -4 \leq y \leq 4\}$
The x intercepts are $0^\circ, 180^\circ, 360^\circ, 540^\circ, 720^\circ$
The y intercept is 0
The minimum value is -4
The maximum value is 4

When $-1 < a < 1$ for the equation $y = \sin x$

The amplitude is 1

The period is 360

The domain is $\{x \in \mathcal{R}\}$

The range is $\{y \in \mathcal{R} \mid -1 \leq y \leq 1\}$

The x intercepts are $0^\circ, 180^\circ, 360^\circ, 540^\circ, 720^\circ$

The y intercept is 0

The minimum value is -1

The maximum value is 1

When $-1 < a < 1$ for the equation $y = 0.25 \sin x$

The amplitude is 0.25

The period is 360

The domain is $\{x \in \mathcal{R}\}$

The range is $\{y \in \mathcal{R} \mid -0.25 \leq y \leq 0.25\}$

The x intercepts are $0^\circ, 180^\circ, 360^\circ, 540^\circ, 720^\circ$

The y intercept is 0

The minimum value is -0.25

The maximum value is 0.25

When $-1 < a < 1$ for the equation $y = 0.5 \sin x$

The amplitude is 0.5

The period is 360

The domain is $\{x \in \mathcal{R}\}$

The range is $\{y \in \mathcal{R} \mid -0.5 \leq y \leq 0.5\}$

The x intercepts are $0^\circ, 180^\circ, 360^\circ, 540^\circ, 720^\circ$

The y intercept is 0

The minimum value is -0.5

The maximum value is 0.5

When $-1 < a < 1$ for the equation $y = -0.25 \sin x$

The amplitude is -0.25

The period is 360

The domain is $\{x \in \mathbb{R}\}$

The range is $\{y \in \mathbb{R} \mid -0.25 \leq y \leq 0.25\}$

The x intercepts are $0^\circ, 180^\circ, 360^\circ, 540^\circ, 720^\circ$

The y intercept is 0

The minimum value is -0.25

The maximum value is 0.25

Summary of the role of a in $y = a \sin x$ in transforming the graph of $y = \sin x$

When $a > 1$ there is a vertical stretch by factor of a , which does not change the period, intercepts, or domain but does change the amplitude, range, minimum and maximum values.

When $a < -1$ there is a vertical stretch by factor of positive a and reflection or flip in the x-axis, which does not change the period, intercepts, or domain but does change the amplitude range, minimum and maximum values.

When $-1 < a < 1$ there is a vertical compression by factor of positive a and reflection or flip in the x-axis when a is negative, which does not change the period, intercepts, domain but does change the amplitude range, minimum and maximum values.

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