Graphs

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Let's learn how to draw graphs

Let's draw the graph of $f(x) = x + 1$.

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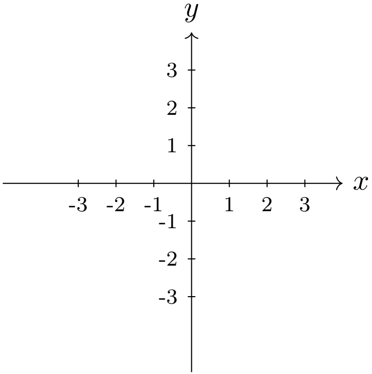
Step 1: At first draw the X-axis and Y-axis,



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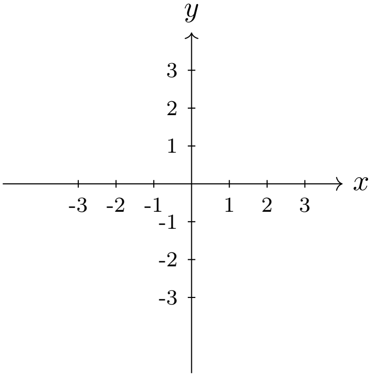
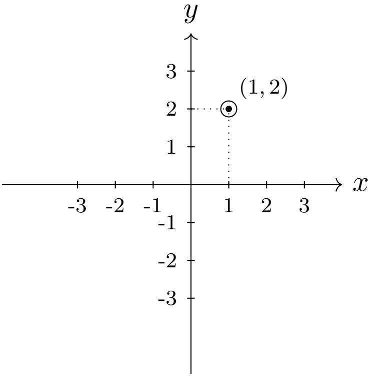


Step 2: Now, take a point $x = 1$. From that we get f(1)=2



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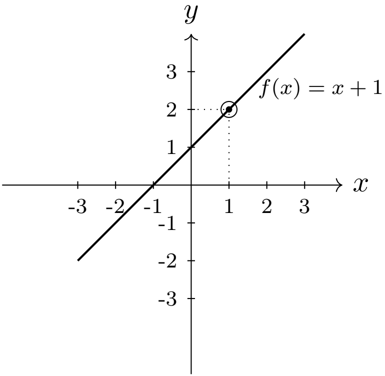
Let's draw the graph of $f(x) = x + 1$.

Step 3: Similarly for each values of x we will get a point. For example, if we take $x = 1.2$ then $f(x) = f(1.2) = 1.2 + 1 = 2.2$



Straight Lines

Let's observe some functions:

$$2x + 7, -x + 5, 2x$$

All of them looks similar, We are just multiplying a number(m) with x and then adding a constant(c)
So we can say that these functions are of the form :

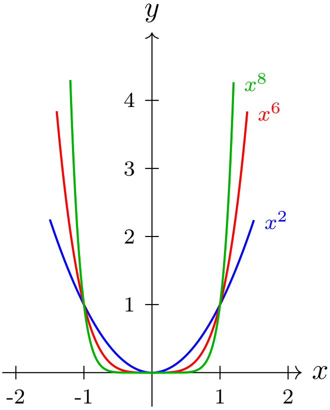
$$f(x) = mx + c$$

Question 1

Check if the function is of the form $mx + c$ or not then find the values of m and c.

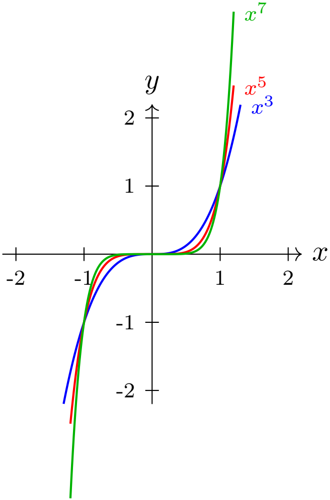
- $2x + 5$
- $-x + 500$
- $x^2 + 5x + 2$
- x
- $(x+1)^2 - x^2$

Graphs of $f(x) = x^n$ for $n = 2, 6, 8$



- All graphs are U-shaped and symmetric about y-axis.
- For $|x| < 1$, higher powers are flatter (closer to x-axis).
- For $|x| > 1$, higher powers grow faster.

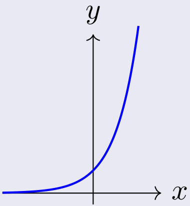
Graphs of $f(x) = x^n$ for $n = 3, 5, 7$



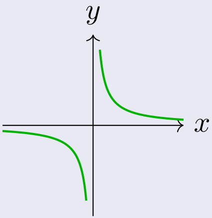
- All graphs are symmetric about the origin.
- For $|x| < 1$, higher powers are flatter.
- For $|x| > 1$, higher powers grow faster.
- Negative x gives negative y, positive x gives positive y.

Graphs of e^x, $\log x$, $\frac{1}{x}$, $|x|$

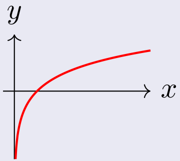
$y = e^x$



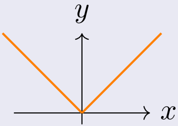
$y = \frac{1}{x}$



$y = \log x$

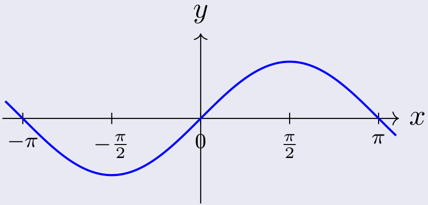


$y = |x|$

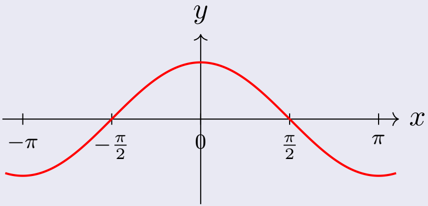


Trigonometric Graphs

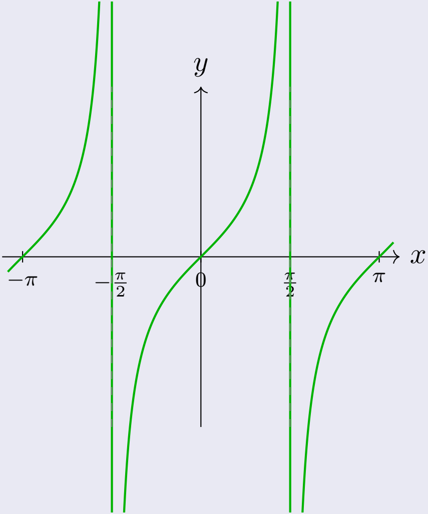
$\sin x$



$\cos x$



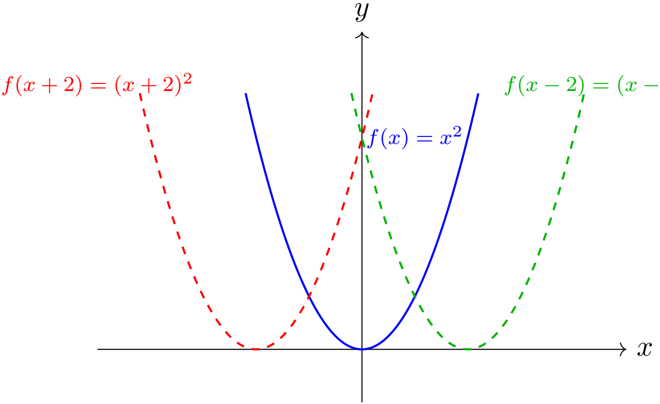
$\tan x$



Horizontal Shifts: $f(x+a)$ vs $f(x-a)$

Rule

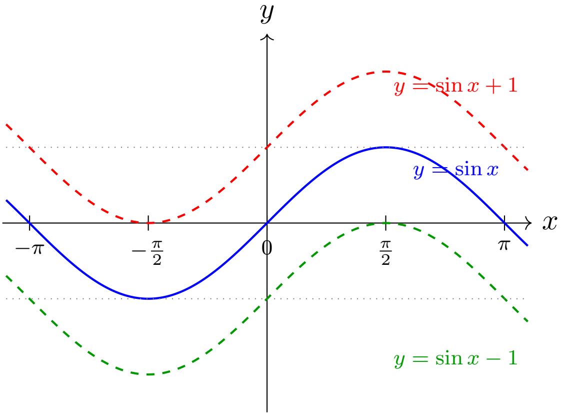
- $f(x+a)$ $\Rightarrow$ shift **left** by a units
- $f(x-a)$ $\Rightarrow$ shift **right** by a units



Vertical Shifts: $f(x) + k$ vs $f(x) - k$

Rule

- $f(x) + k \quad \Rightarrow$ shift **up** by k units
- $f(x) - k \quad \Rightarrow$ shift **down** by k units



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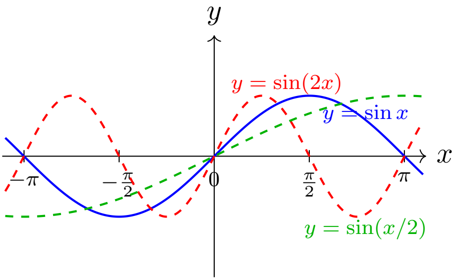
Question

Try to draw the graphs of :

- $f(x) = |x + 4| + 5$
- $f(x) = (x + 4)^2 + 5$
- $f(x) = \frac{1}{x+2} + 2$

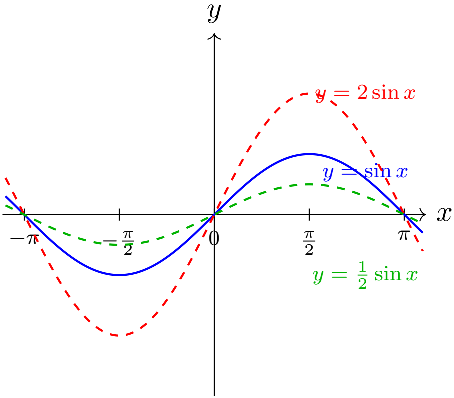
Horizontal Scaling: $f(ax)$

- $f(ax)$ compresses/stretch the graph **horizontally**.
- If $a > 1$, graph is **compressed** (period decreases).
- If $0 < a < 1$, graph is **stretched** (period increases).



Vertical Scaling: $af(x)$

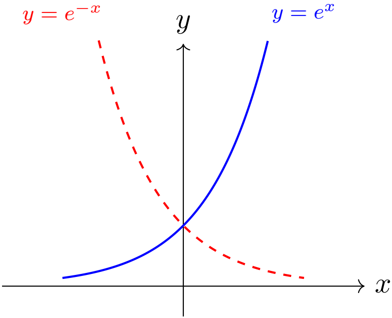
- $af(x)$ stretches or compresses the graph **vertically**.
- If $a > 1$, amplitude increases.
- If $0 < a < 1$, amplitude decreases.
- If $a < 0$, also reflects across x-axis.



Reflection: $f(-x)$

Key Idea

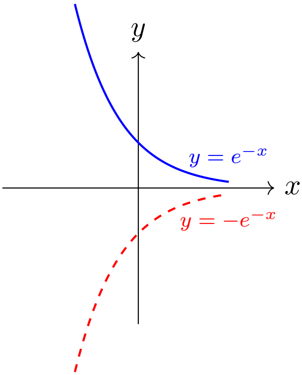
- $f(-x)$ reflects the graph of $f(x)$ across the y-axis.
- Negative x values are mapped to positive ones (and vice versa).
- Shape remains the same, but the curve is mirrored horizontally.



Reflection: $-f(x)$

Key Idea

- $-f(x)$ reflects the graph of $f(x)$ across the x-axis.
- Positive y-values become negative, and vice versa.
- Shape of the curve remains unchanged, only orientation flips.



Inverse Function: $f^{-1}(x)$

Key Idea

- The graph of $y = f^{-1}(x)$ is the reflection of $y = f(x)$ across the line $y = x$.
- Domain of f becomes range of f^{-1}, and range of f becomes domain of f^{-1}.