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DEPARTMENT OF AEROSPACE ENGINEERING

19ASB304 – COMPUTATIONAL FLUID DYNAMICS FOR AEROSPACE APPLICATIONS
III YEAR VI SEM
UNIT-III FINITE ELEMENT TECHNIQUES
TOPIC: Piecewise defined shape functions

NAME: Mr.N.Venkatesh., M.Tech
Assistant Professor
Aerospace Engineering
SNS College of Technology

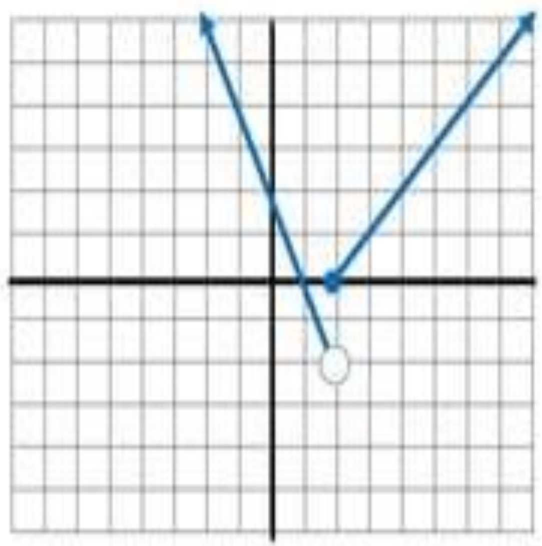
Piecewise-Defined Functions

- Notice that this function is defined by different rules for different parts of its domain. Functions whose definitions involve more than one rule are called **piecewise-defined** functions.
- Graphing one of these functions involves graphing each rule over the appropriate portion of the domain.

Example of a Piecewise-Defined Function

Graph the function

$$f(x) = \begin{cases} 2-2x & \text{if } x < 2 \\ x-2 & \text{if } x \geq 2 \end{cases}$$



Notice that the point (2,0) is included but the point (2, –2) is not.

- Up to now, we've been looking at functions represented by a single equation.
- In real life, however, functions are represented by a combination of equations, each corresponding to a part of the domain.
- These are called **piecewise functions**.

Piecewise Functions

many real-life problems, however, functions are represented by a combination of equations, each corresponding to a part of the domain. Such functions are called **piecewise functions.** For example, the piecewise function given by

$$f(x) = \begin{cases} 2x - 1, & \text{if } x \leq 1 \\ 3x + 1, & \text{if } x > 1 \end{cases}$$

is defined by two equations. One equation gives the values of $f(x)$ when x is less than or equal to 1, and the other equation gives the values of $f(x)$ when x is greater than 1.

$$f(x)=\begin{cases} 2x-1, if\ x\le 1 \\ 3x+1, if\ x>1 \end{cases}$$

- One equation gives the value of f(x) when x ≤ 1
- And the other when x>1

Evaluate f(x) when x=0, x=2, x=4

$$f(x)=\begin{cases} x+2, if\ x<2 \\ 2x+1, if\ x\geq 2 \end{cases}$$

- ***First you have to figure out which equation to use***
- ***You NEVER use both***

X=0
This one fits Into the top equation

X=2
This one fits here

X=4
This one fits here

So:
$0+2=2$

So:
$2(2)+1=5$

So:
$2(4)+1=9$

Graph:

$$f(x)=\begin{cases}\frac{1}{2}x+\frac{3}{2}, if\ x<1 \\ -x+3, if\ x\geq 1\end{cases}$$

•For all x's < 1, use the top graph (to the left of 1)

•For all x's ≥ 1, use the bottom graph (to the
•right of 1)

Graphing a Piecewise Function

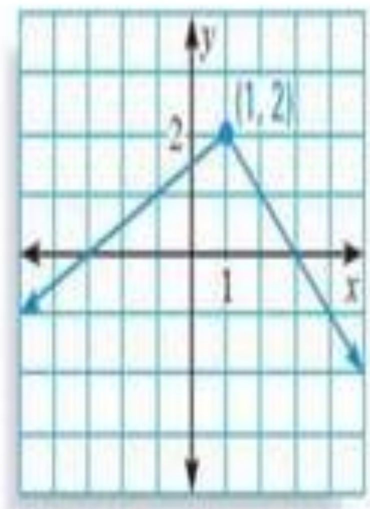
Graph this function: $f(x) = \begin{cases} \frac{1}{2}x + \frac{3}{2}, & \text{if } x < 1 \\ -x + 3, & \text{if } x \geq 1 \end{cases}$

SOLUTION

To the left of $x = 1$, the graph is given by $y = \frac{1}{2}x + \frac{3}{2}$.

To the right of and including $x = 1$, the graph is given by $y = -x + 3$.

The graph is composed of two rays with common initial point $(1, 2)$.

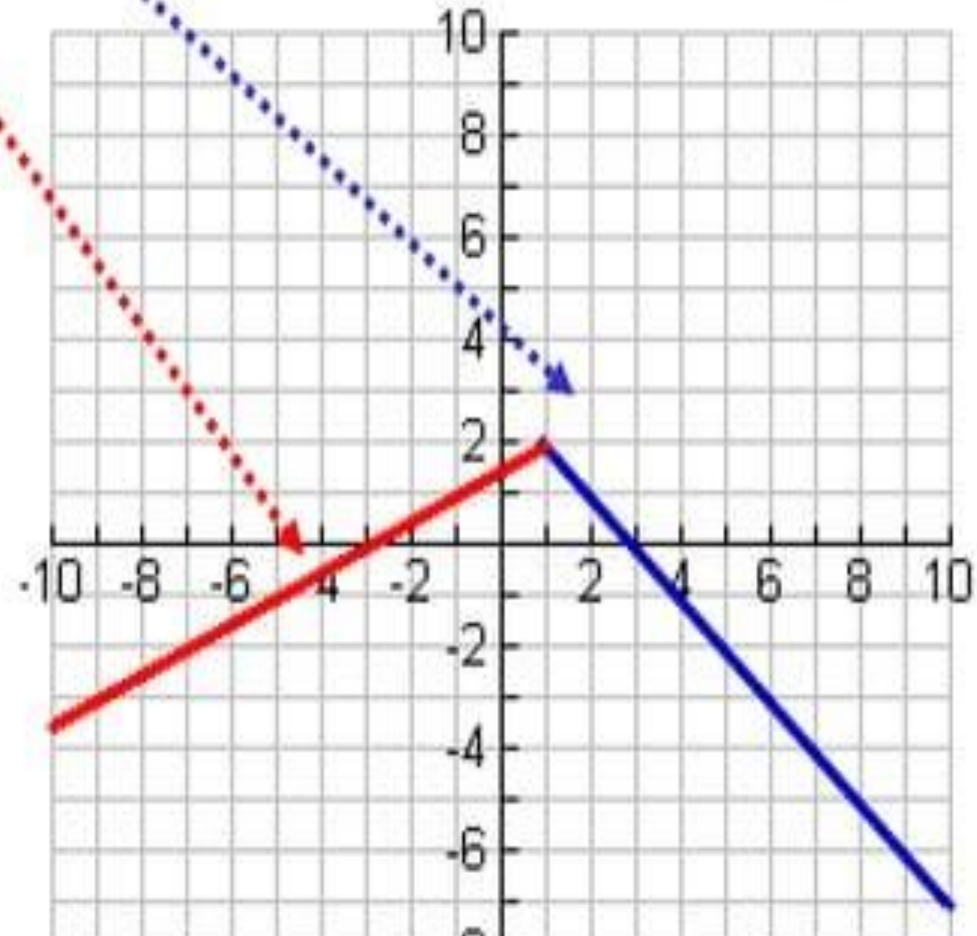


$$f(x) = \begin{cases} \frac{1}{2}x + \frac{3}{2}, if\ x < 1 \\ -x + 3, if\ x \geq 1 \end{cases}$$

x=1 is the breaking point of the graph.

To the left is the top equation.

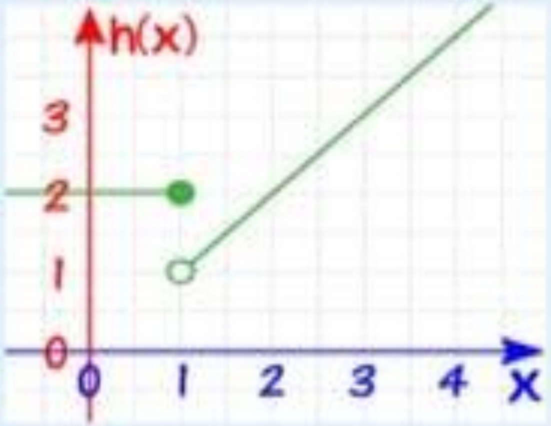
To the right is the bottom equation.



Graph the function

$$h(x) = \begin{cases} 2, & \text{if } x \le 1 \\ x, & \text{if } x > 1 \end{cases}$$

which looks like:

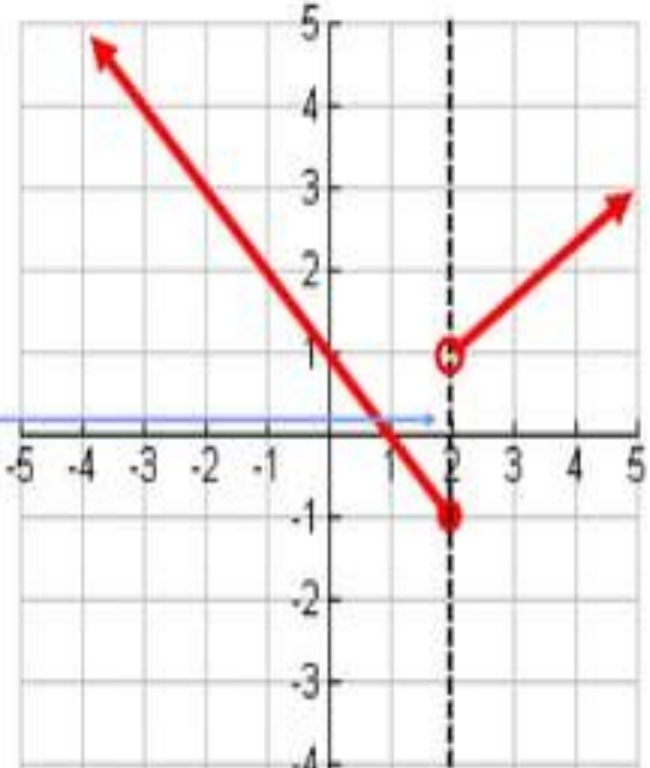


What is h(-1)? x is ≤ 1, so we use h(x) = 2, so **h(-1) = 2**

Graph:

$$f(x) = \begin{cases} x-1, if\ x > 2 \\ -x+1, if\ x \leq 2 \end{cases}$$

Point of Discontinuity



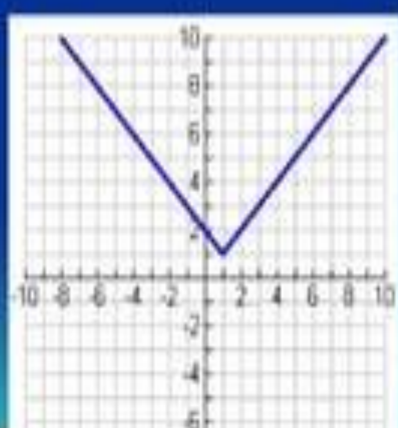
Maxima and Minima

(aka extrema)

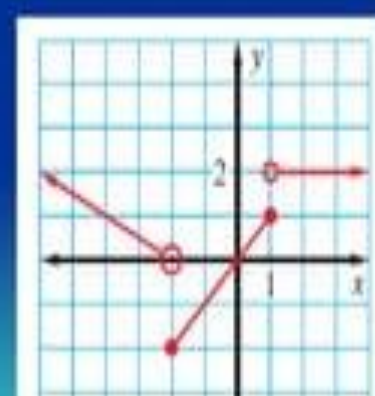
Highest point on the graph

Lowest point on the graph

In this function, the minimum is at y = 1

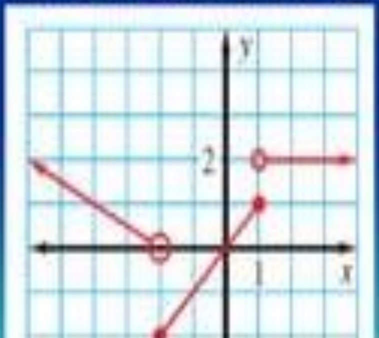


In this function, the minimum is at y = -2



Intervals of Increase and Decrease

- By looking at the graph of a piecewise function, we can also see where its slope is **increasing** (uphill), where its slope is **decreasing** (downhill) and where it is **constant** (straight line). We use the domain to define the 'interval'.



This function is decreasing on the interval $x < -2$, is Increasing on the interval $-2 \leq x \leq 1$, and constant over $x > 1$