Winter 2011 Math 163A All

Section 2-1 Functions

See Reference 1 in course packet

equation: \[ y = -x^2 + 7x - 25 \]

function form: \[ f(x) = -x^2 + 7x - 25 \]

empty version: \[ f(\ ) = - ( \ )^2 + 7(\ ) - 25 \]
Example: Find \( f(2) \)

\[
f(2) = -(2)^2 + 7(2) - 25
\]

\[
= -4 + 14 - 25
\]

\[
= -15
\]

\[
f(-2) = -(-2)^2 + 7(-2) - 25
\]

\[
= -4 - 14 - 25
\]

\[
= -43
\]

Pay attention to order of operations!
\[ f(2+h) = -(2+h)^2 + 7(2+h) - 25 \]

\[ = -(4+4h+h^2) + 14 + 7h - 25 \]

because \((2+h)^2 = (2+h)(2+h) = 4 + 2h + 2h + h^2\)

\[ \frac{f(2+h) - f(2)}{h} = \frac{(-4 - 4h - h^2 + 14 + 7h - 25) - (-25)}{h} \]

\[ = -4h - h^2 + 7h \]

\[ = 3h - h^2 \]
\[
\frac{f(2+h) - f(2)}{h} = \frac{3h - h^2}{h} = \frac{k(3-h)}{h} = 3 - h
\]
a "difference quotient"
Another difference quotient problem

Goal: Find \( \frac{f(x+h) - f(x)}{h} \)

Do this in three steps

Step 1: Find \( f(x+h) \)

\[
f(x+h) = -(x+h)^2 + 7(x+h) - 25
\]

\[
= -(x^2 + 2xh + h^2) + 7x + 7h - 25
\]

Step 2: Find \( f(x+h) - f(x) \)

\[
f(x+h) - f(x) = (-x^2 - 2xh - h^2 + 7x + 7h - 25) - (-x^2 + 7x - 25)
\]

\[
= -2xh - h^2 + 7h
\]

\[
= h(-2x - h + 7)
\]
Step 3: Find \( \frac{f(x+h) - f(x)}{h} \)

\[
\frac{f(x+h) - f(x)}{h} = \frac{h(-2x-h+7)}{h}
\]

\[
= -2x - h + 7
\]

another kind of "difference quotient"
Library of Functions

horizontal line: \[ y = b \]
\[ f(x) = b \]

function form

\[ x \]
\[ f(x) \]

---

slanting line: \[ y = mx + b \]
\[ f(x) = mx + b \]

function form

vertical line: \[ x = a \]

not a function
for a single $x$-value there is more than one $y$-value. So not a function.
Some more basic functions

Basic Parabola

\[ y = x^2 \]

\[ f(x) = x^2 \]

<table>
<thead>
<tr>
<th>x</th>
<th>( y = x^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td>4</td>
</tr>
<tr>
<td>-1</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

(-2,4) (-4,1) (1,1) (3,4) Vertex
one more
Basic Cubic
$y = x^3$
$f(x) = x^3$