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LEARNING OBJECTIVE: We will graph the equation $y = f(x)$. (Lesson 98)

CONCEPT DEVELOPMENT:

More Pseudo-code:

IF-THEN instructions (part 1)

```
Declare x integer
For all x from 1 to 4
    If x + 2 = 4 then
        Print True
    Else
        Print False
    End if
Next x
```

Output:

FALSE
TRUE
FALSE
FALSE

When $x=2$, $x+2=4$ is true

IF-THEN instructions (part 2)

```
Declare x integer
Initialize G as { }
For all x from 0 to 4
    If x^2 − 4x + 5 = 2 then
        Append x to G
    else
        Do NOT append x to G
    End if
Next x
Print G
```

Output: $\{1, 3\}$

Set-Builder Notation:

$\{x \text{ integer} \mid x^2 - 4x + 5 = 2 \text{ and } 0 \le x \le 4\}$

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IF-THEN instructions (part 3)

```
Declare x and y  integers
Initialize G as { }
For all x in {−2, −1, 0, 1, 2}
   For all y in {−3, 0, 3}
      If y = x(x − 2)(x + 2) then
         Append (x, y) to G
      else
         Do NOT append (x, y)to G
      End if
Next y
Next x
Print G
Plot G
```

Set Builder Notation:

$\{(x,y) \mid x \text{ integer and } -2 \le x \le 2 \text{ and } y = x(x-2)(x+2)\}$

$G = \{(-2,0), (-1,3), (0,0), (1,-3), (2,0)\}$

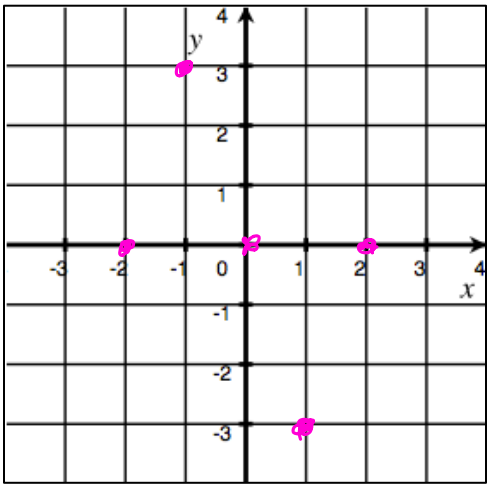
$0 = -2(-2-2)(-2+2)$

$y = x(x-2)(x+2)$

Let's fill in a table to record the decisions made by the program instructions.

	$x=-2$	$x=-1$	$x=0$	$x=1$	$x=2$
$y=-3$	NO	NO	NO	YES	NO
$y=0$	YES	NO	YES	NO	YES
$y=3$	NO	YES	NO	NO	NO

Graph the solution set G on the coordinate plane.



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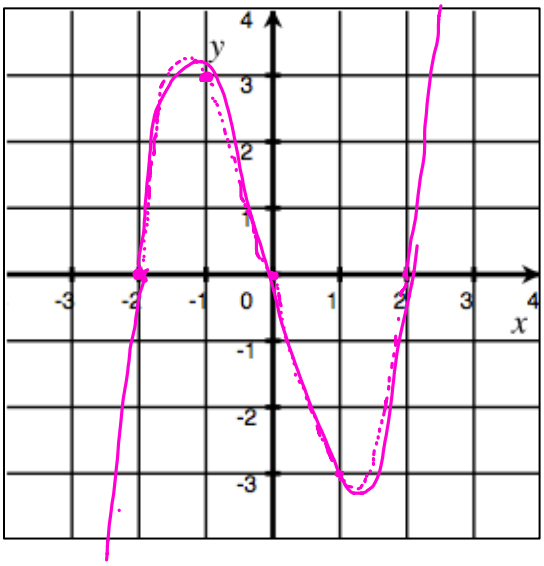
IF-THEN instructions (part 4)

Declare x and y real
Let $f(x) = x(x-2)(x+2)$
Initialize G as { }
For all x in the real numbers
  For all y in the real numbers
    If $y = f(x)$ then
      Append (x, y) to G
    else
      Do NOT append $(x, y)$to G
    End if
Next y
Next x
Plot G



Set builder notation: $\{(x,y) \mid x \text{ real and } y=f(x)\}$

A **relative maximum** occurs for the function $f(x) = x(x^2-4)$ at the coordinate pair $\left(-\frac{2}{3}\sqrt{3}, \frac{16}{9}\sqrt{3}\right)$. Verify that this point is on the graph.

A **relative minimum** occurs for the function $f(x) = x(x^2-4)$ at the coordinate pair $\left(\frac{2}{3}\sqrt{3}, -\frac{16}{9}\sqrt{3}\right)$. Verify that this point is on the graph.

The function f is **decreasing** on the interval between
$-\frac{2}{3}\sqrt{3} \le x \le \frac{2}{3}\sqrt{3}$ *or* $[-\frac{2}{3}\sqrt{3}, \frac{2}{3}\sqrt{3}]$

The function f is **increasing** on the intervals when
$x \le -\frac{2}{3}\sqrt{3}$ *or* $x \ge \frac{2}{3}\sqrt{3}$ *or* $\left(-\infty, -\frac{2}{3}\sqrt{3}\right]$ *or* $[\frac{2}{3}\sqrt{3}, \infty)$

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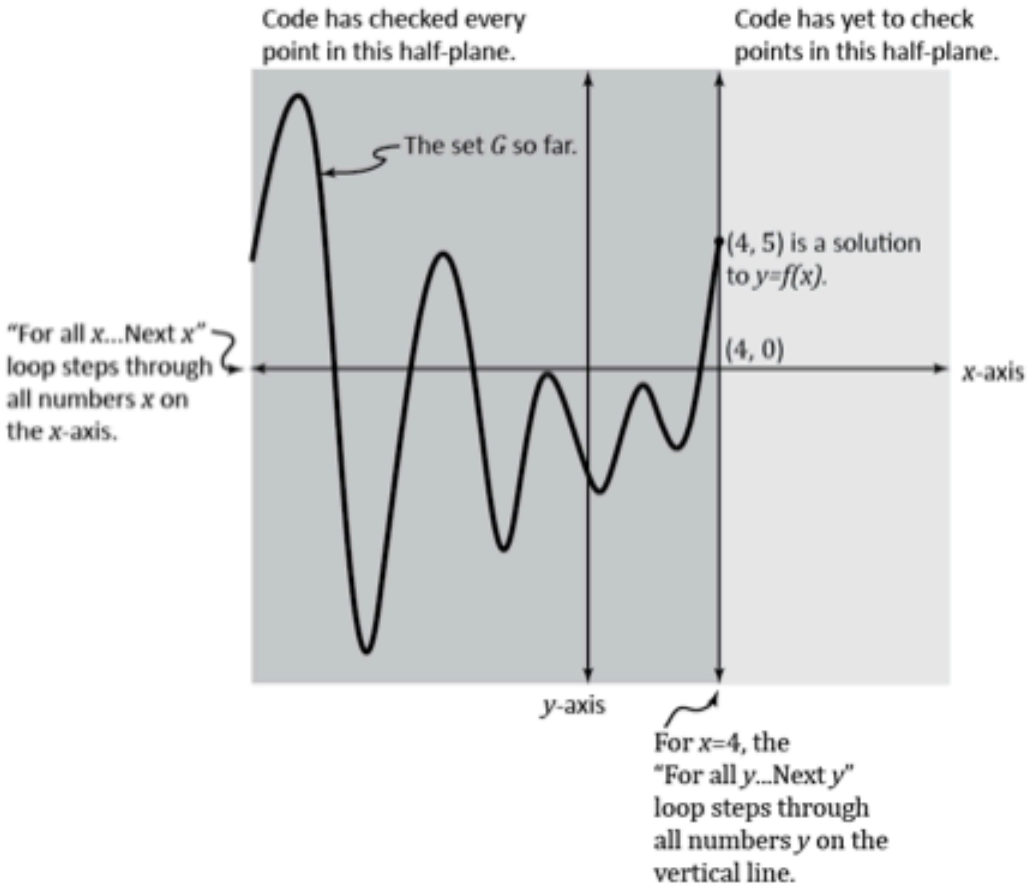

Nested for-next loops check all numbers y for each new x value chosen. In a sense, this performs a vertical line test for every point on the graph.

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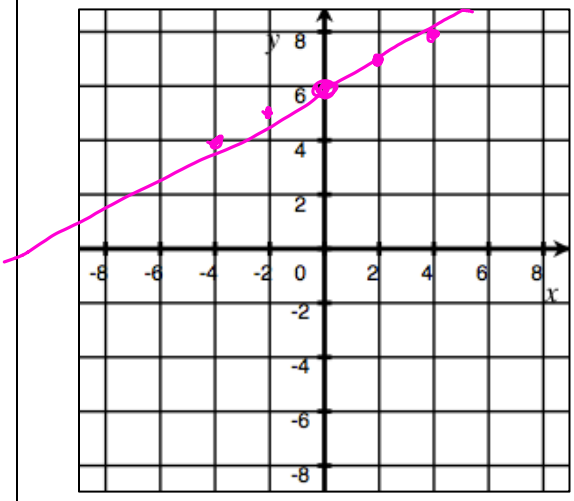
Guided Practice:

Sketch each graph and write the graph of $y = f(x)$ as a set using set builder notation.

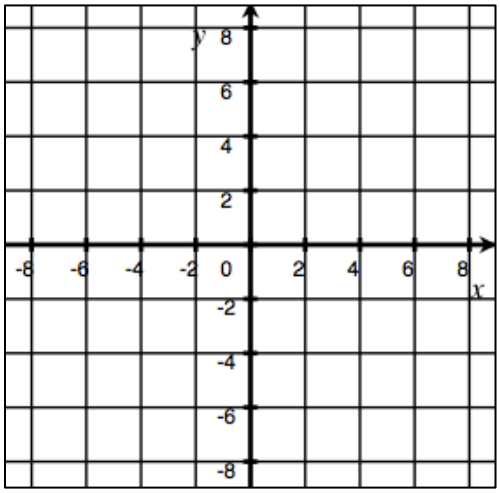
$f(x) = \frac{1}{2}x + 6$



Set builder notation:

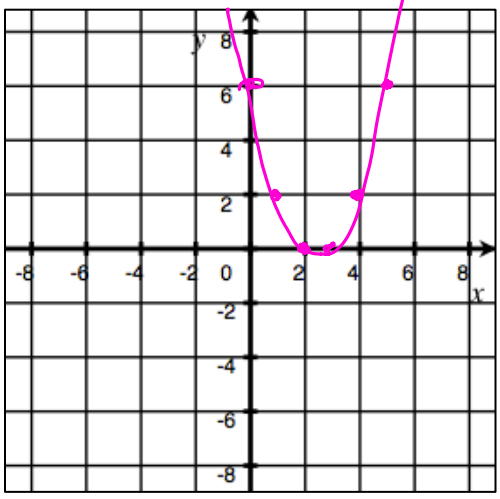
$\{(x,y) \mid x \text{ real and } y = \frac{1}{2}x + 6\}$

$f(x) = x^2 + 3$



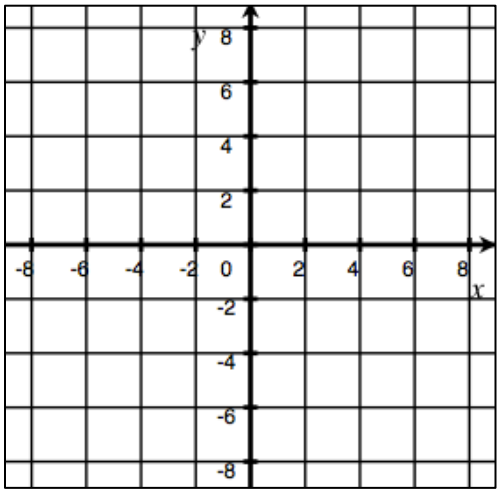
Set builder notation:

$f(x) = x^2 - 5x + 6$



Set builder notation:

$f(x) = x^3 - x$



Set builder notation:

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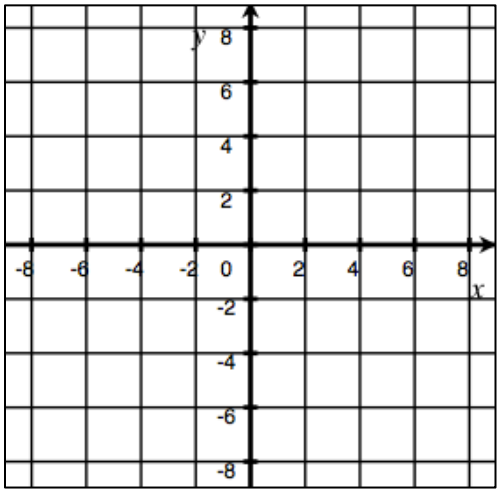
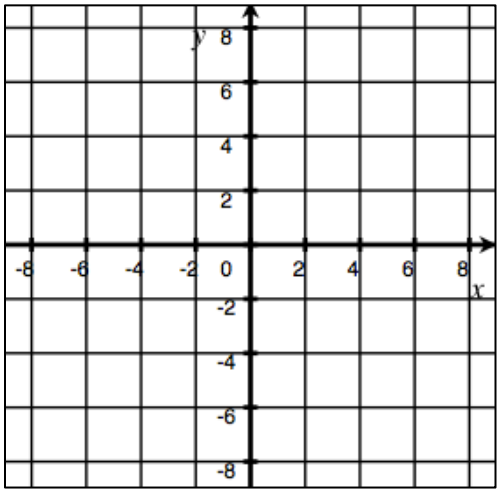
$f(x) = -x^2 + x - 1$



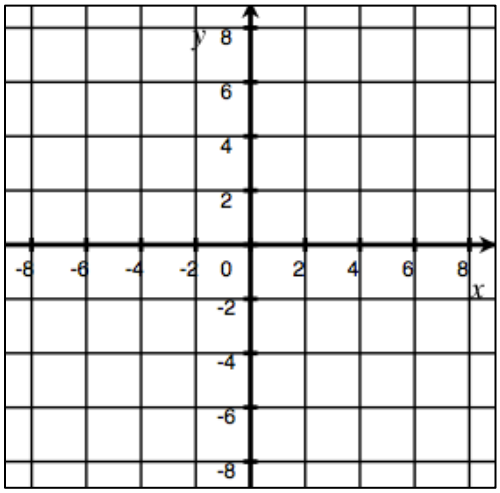
Set builder notation:

$f(x) = (x-3)^2 + 2$



Set builder notation:

$f(x) = x^3 - 2x^2 + 3$



Set builder notation:

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Independent Practice:
None…

Activating Prior Knowledge:
Remind students about for next loops and contrast with if-then programming instructions.

Closure:
Exit Ticket??

Notes:
This maps to lesson 12 from ENY Alg 1 Mod 3—almost certain to be 2 day lesson??