## Lesson 2: Moving Functions

* Let’s represent vertical and horizontal translations using function notation.

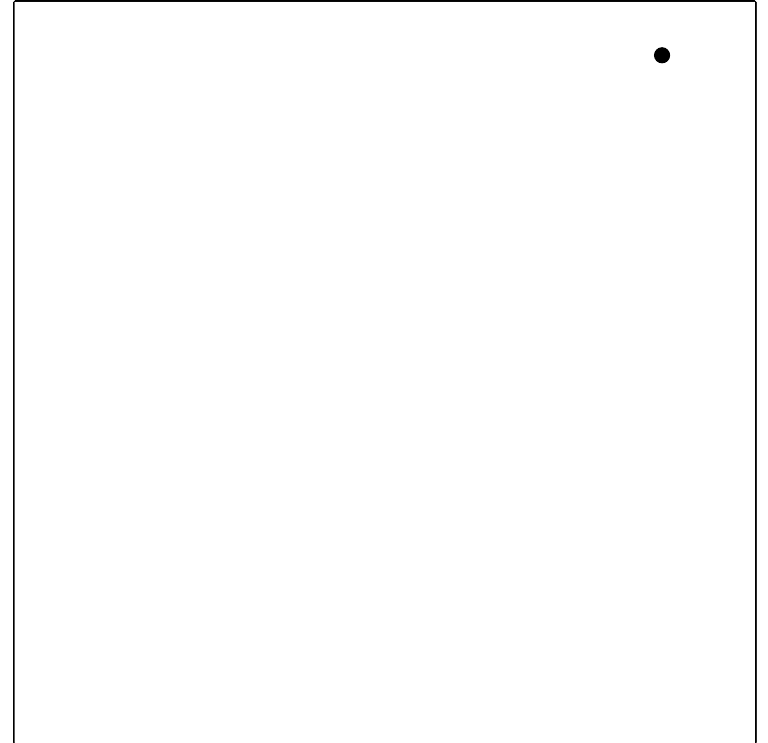
### 2.1: What Happened to the Equation?

Graph each function using technology. Describe how to transform to get to the functions shown here in terms of both the graph and the equation.

### 2.2: Writing Equations for Vertical Translations

The graph of function is a vertical translation of the graph of polynomial .

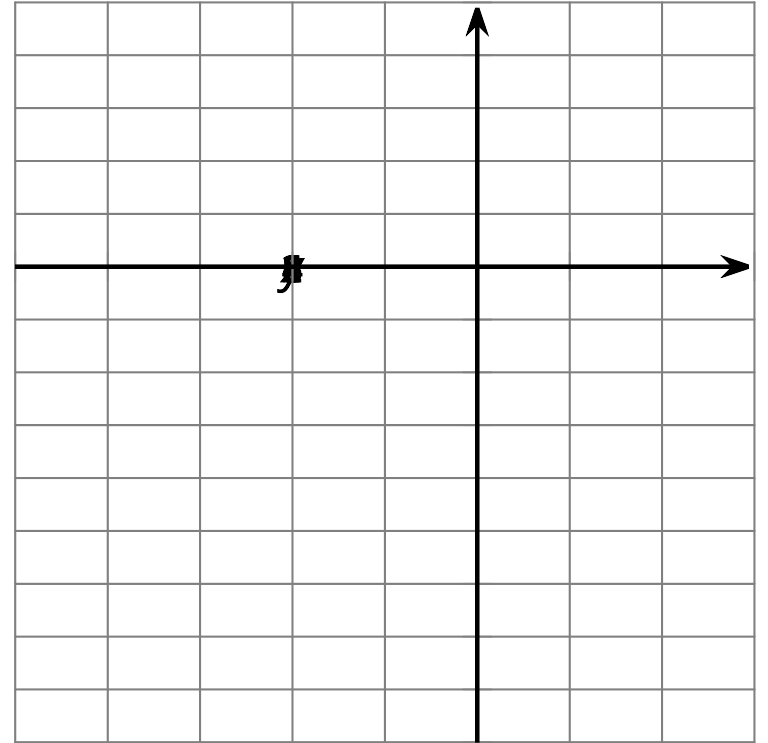




1. Complete the column of the table.
2. If , what is ? Explain how you know.
3. Write an equation for in terms of for any input .
4. The function can be written in terms of as . Complete the column of the table.

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| * -4 | * 0 |  |  |
| * -3 | * -5.8 |  |  |
| * -0.7 | * 0 |  |  |
| * 1.2 | * -3.3 |  |  |
| * 2 | * 0 |  |  |

1. Sketch the graph of function .

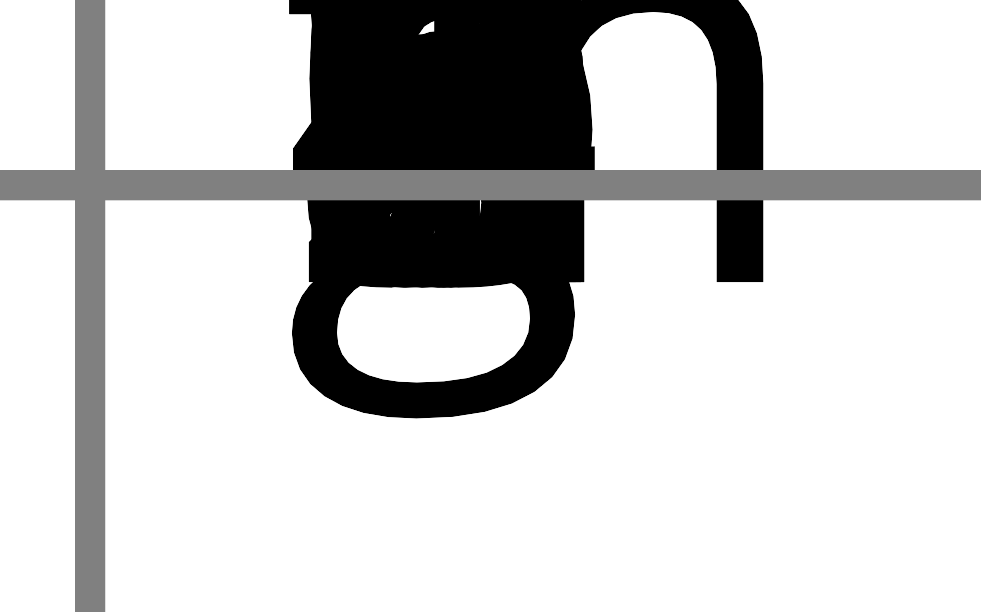
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1. Write an equation for in terms of for any input .

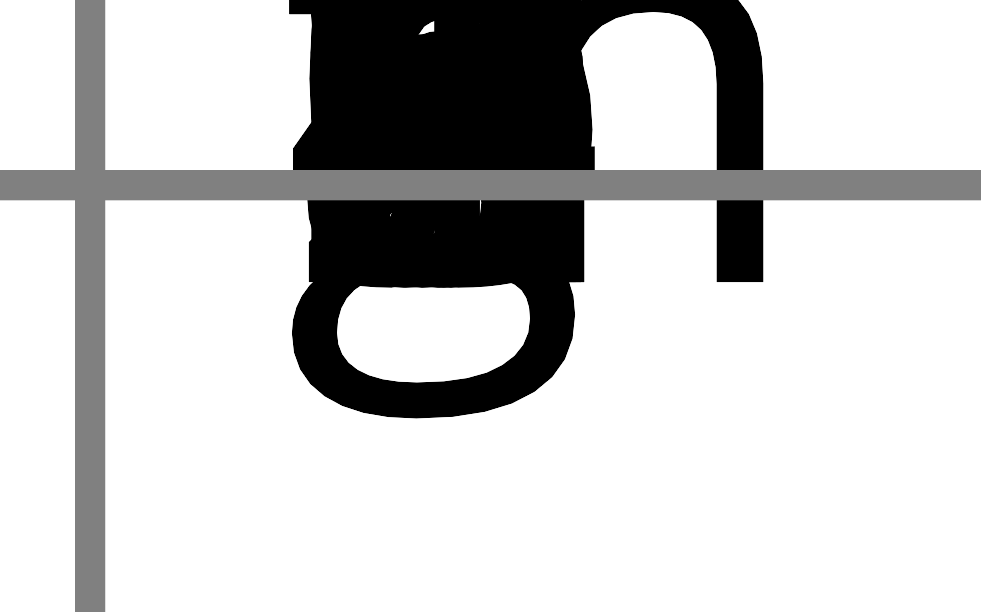
### 2.3: Heating the Kitchen

A bakery kitchen has a thermostat set to . Starting at 5:00 a.m., the temperature in the kitchen rises to  when the ovens and other kitchen equipment are turned on to bake the daily breads and pastries. The ovens are turned off at 10:00 a.m. when the baking finishes.

1. Sketch a graph of the function that gives the temperature in the kitchen , in degrees Fahrenheit, hours after midnight.

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1. The bakery owner decides to change the shop hours to start and end 2 hours earlier. This means the daily baking schedule will also start and end two hours earlier. Sketch a graph of the new function , which gives the temperature in the kitchen as a function of time.

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1. Explain what means in this situation. Why is this reasonable?
2. If , then what would the corresponding point on the graph of be? Use function notation to describe the point on the graph of .
3. Write an equation for in terms of . Explain why your equation makes sense.

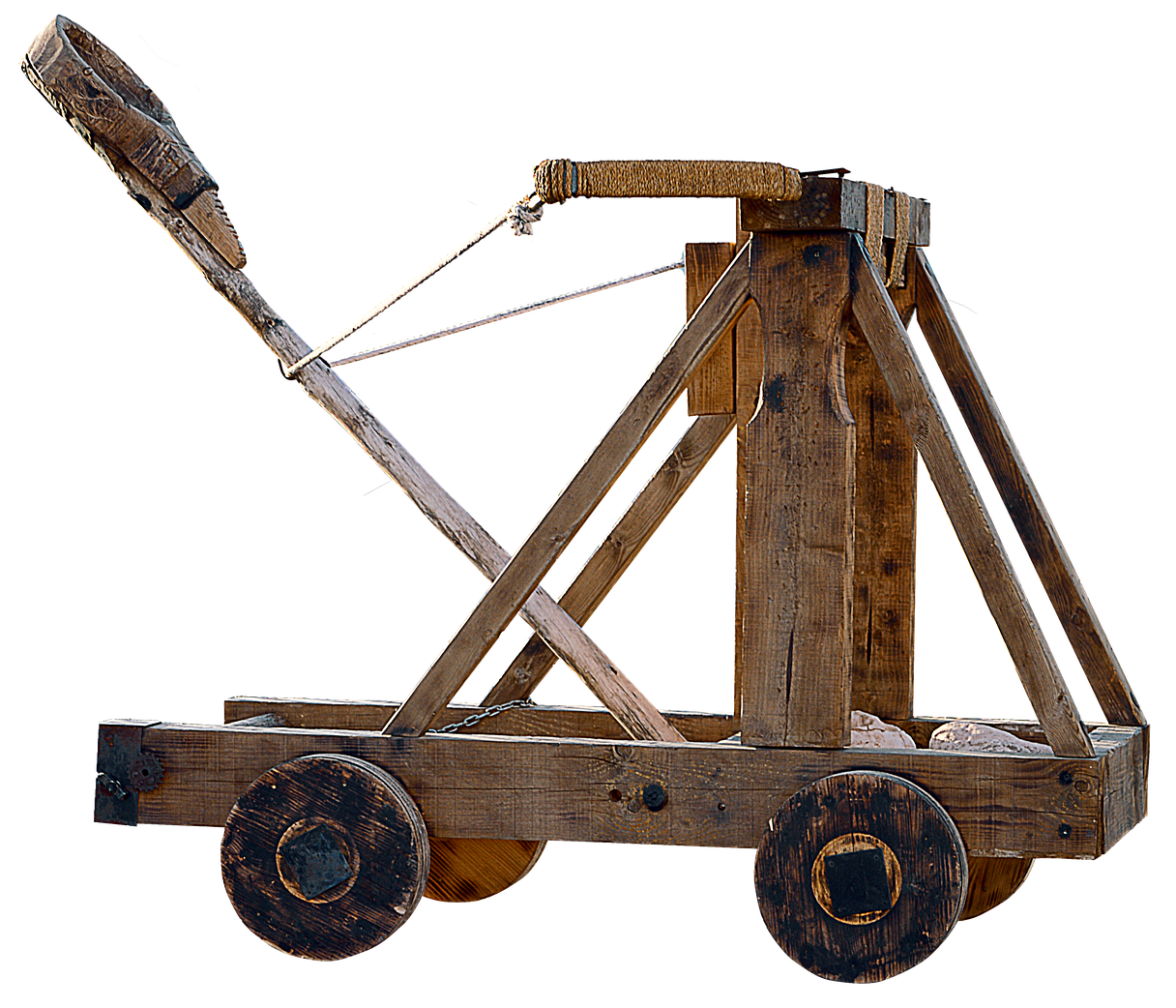
#### Are you ready for more?

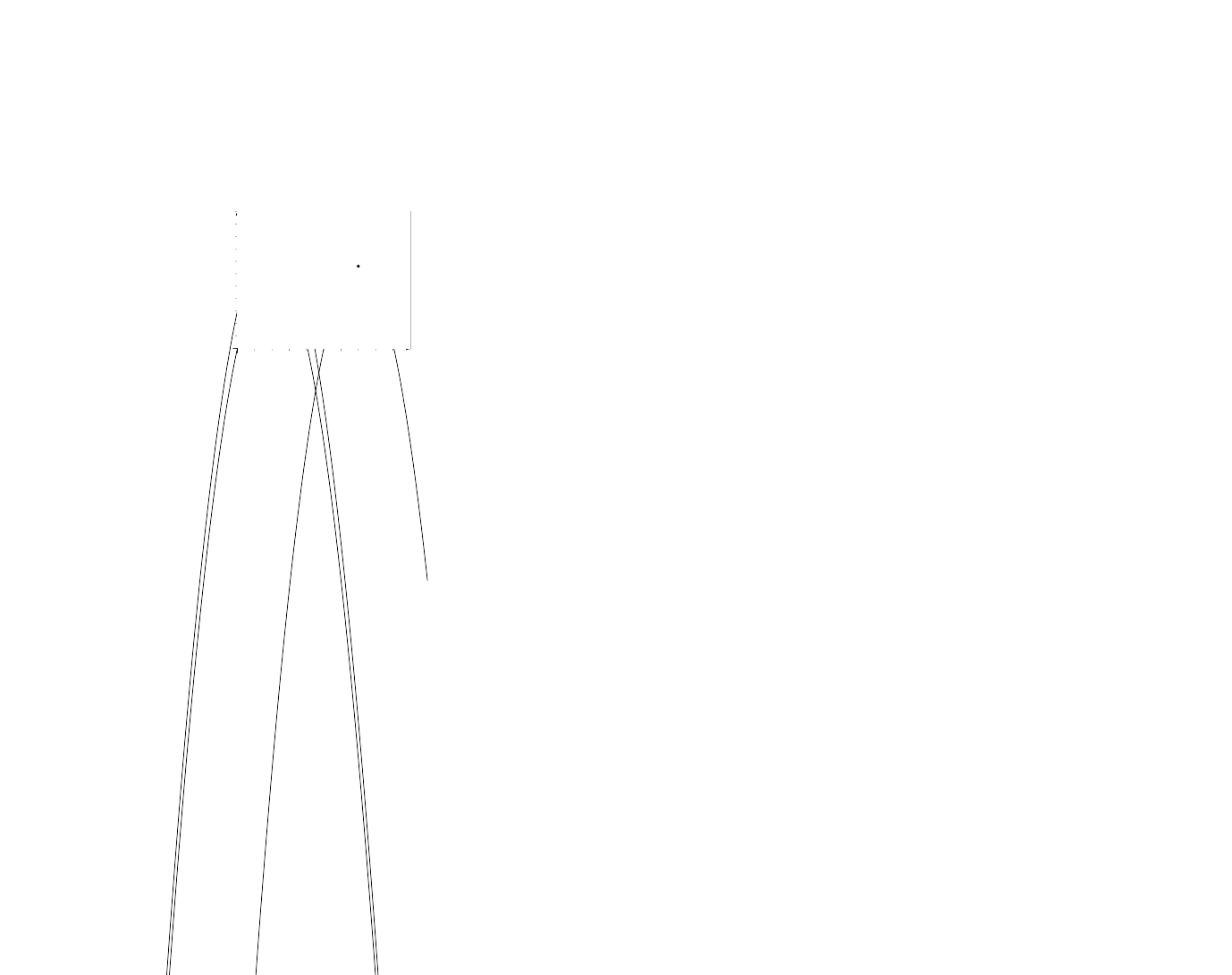
Write an equation that defines your piecewise function, , algebraically.

### Lesson 2 Summary

A pumpkin catapult is used to launch a pumpkin vertically into the air. The function gives the height , in feet, of this pumpkin above the ground seconds after launch.

Now consider what happens if the pumpkin had been launched at the same time, but from a platform 30 feet above the ground. Let function represent the height , in feet, of this pumpkin. How would the graphs of and compare?





Since the height of the second pumpkin is 30 feet greater than the first pumpkin at all times , the graph of function is translated up 30 feet from the graph of function . For example, the point on the graph of tells us that , so the original pumpkin was 66 feet high after 2 seconds. The new pumpkin would be 30 feet higher than that, so . Since all the outputs of are 30 more than the corresponding outputs of , we can express in terms of using function notation as .

Now suppose instead the pumpkin launched 5 seconds later. Let function represent the height , in feet of this pumpkin. The graph of  is translated right 5 seconds from the graph of . We can also say that the output values of are the same as the output values of 5 seconds earlier. For example, and . This means we can express in terms of as



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