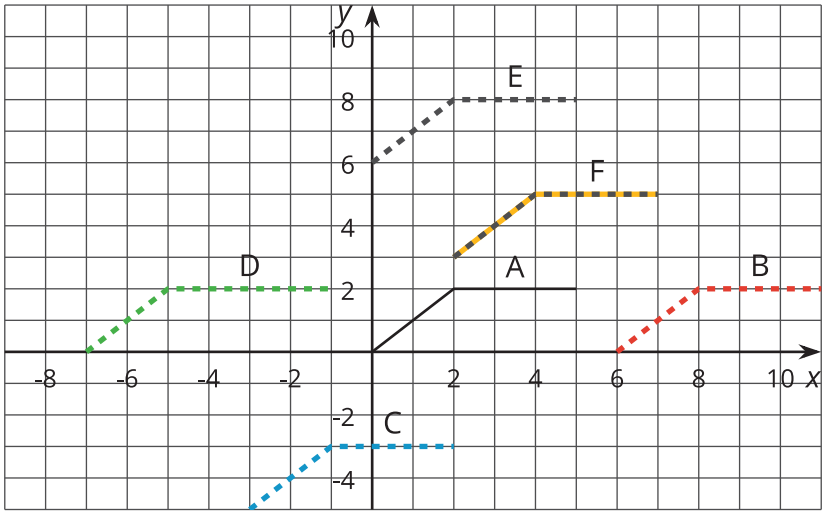
Unit 6, Lesson 3

# More Movement

Let's translate graphs vertically and horizontally to match situations.

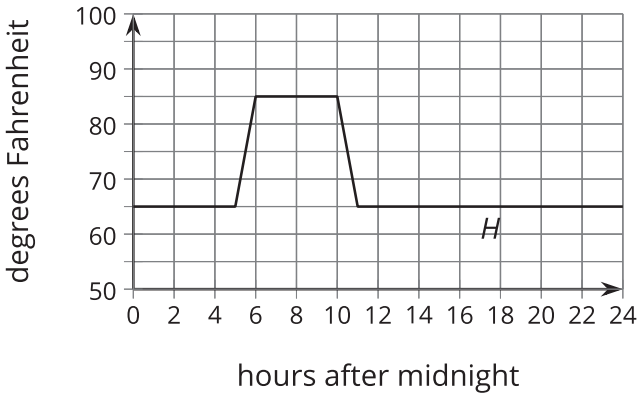
## 3.1 Moving a Graph

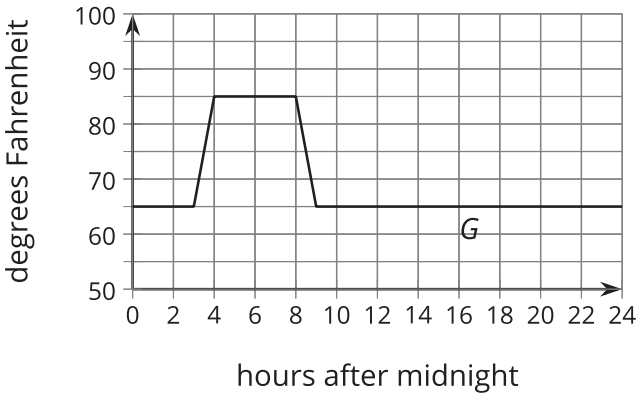
How can we translate the graph of A to match one of the other graphs?



# 3.2 New Hours for the Kitchen

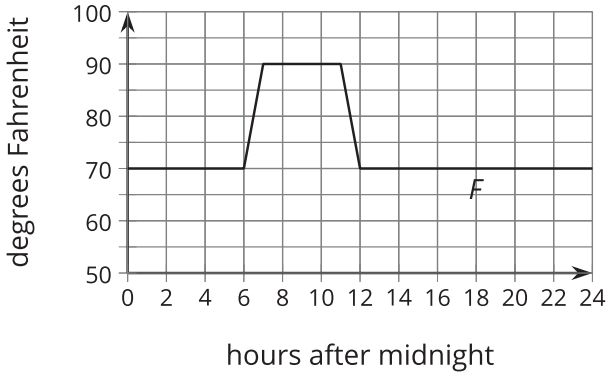
Remember the bakery with the thermostat set to $65^\circ\text{F}$? At 5:00 a.m., the temperature in the kitchen rises to $85^\circ\text{F}$ due to the ovens and other kitchen equipment being used until they are turned off at 10:00 a.m. When the owner decided to open 2 hours earlier, the baking schedule changed to match.




1. Andre thinks, "When the bakery starts baking 2 hours earlier, that means I need to subtract 2 from $x$ and that $G(x) = H(x - 2)$." How could you help Andre understand the error in his thinking?

2. The graph of $F$ shows the temperatures after a change to the thermostat settings. What did the owner do?

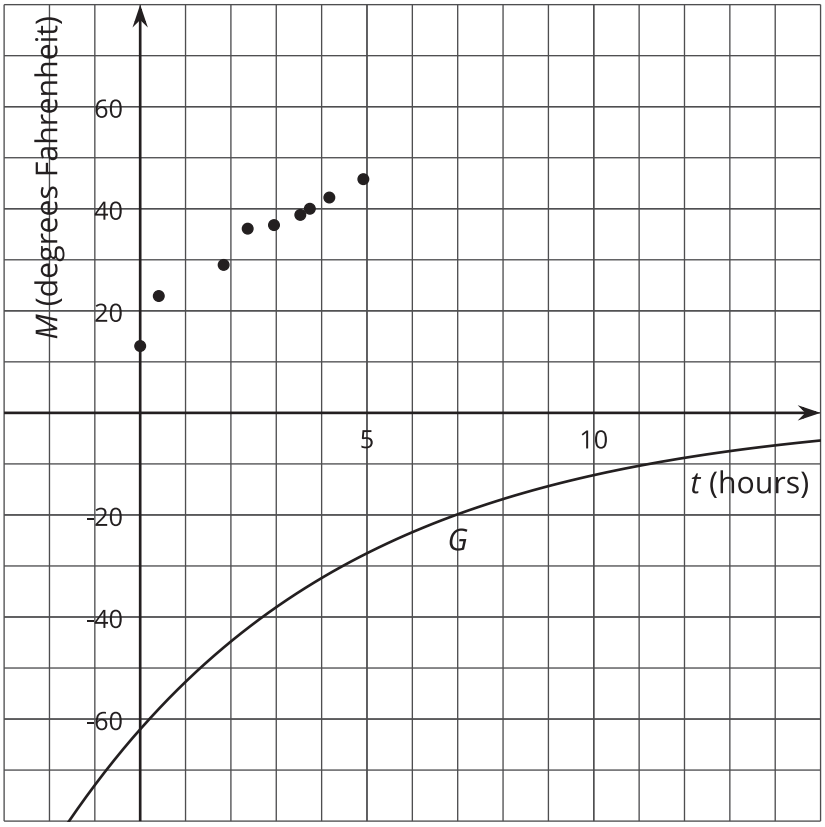



3. Write an expression for $F$ in terms of the original baking schedule, $H$.

# 3.3 Thawing Meat

A piece of meat is taken out of the freezer to thaw. The data points show its temperature $M$, in degrees Fahrenheit, $t$ hours after it was taken out. The graph $M = G(t)$, where $G(t) = -62(0.85)^t$, models the shape of the data but is in the wrong position.

| $t$ | $M$ |
|---|---|
| 0 | 13.1 |
| 0.41 | 22.9 |
| 1.84 | 29 |
| 2.37 | 36.1 |
| 2.95 | 36.8 |
| 3.53 | 38.8 |
| 3.74 | 40 |
| 4.17 | 42.2 |
| 4.92 | 45.8 |




Jada thinks changing the equation to $J(t) = -62(0.85)^t + 75.1$ makes a good model for the data. Noah thinks $N(t) = -62(0.85)^{(t+1)} + 68$ is better.

1. Without graphing, describe how Jada and Noah each transformed the graph of $G$ to make their new functions to fit the data.

2. Use technology to graph the data, $J$ and $N$, on the same axes.
3. Whose function do you think best fits the data? Be prepared to explain your reasoning.

## Are you ready for more?

Elena excludes the first data point and chooses a linear model, $E(t) = 21.32 + 5.06t$, to fit the remaining data.

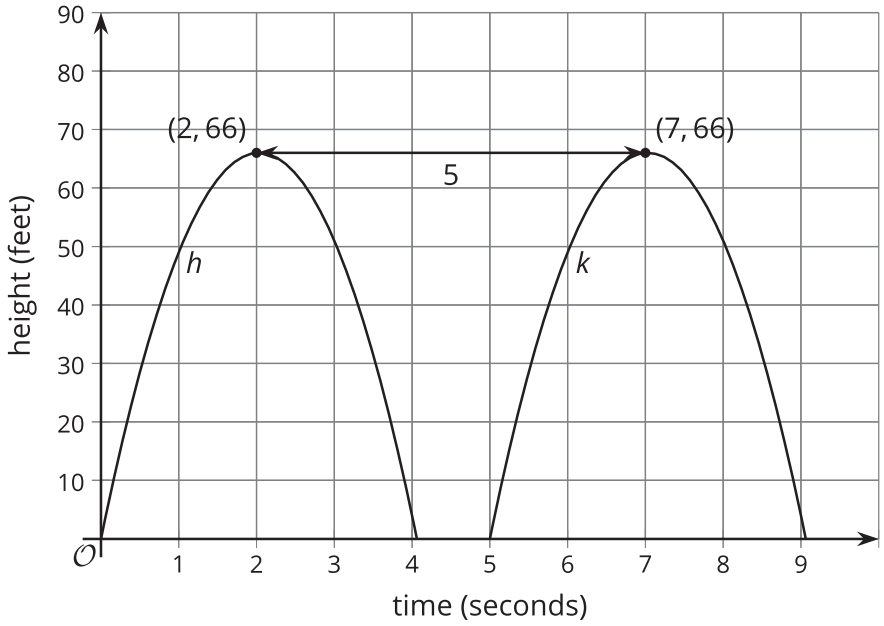
1. How well does Elena's model fit the data?

2. Is Elena's idea to exclude the first data point a good one? Explain your reasoning.

## Lesson 3 Summary

Remember the pumpkin catapult? The function $h$ gives the height $h(t)$, in feet, of the pumpkin above the ground $t$ seconds after launch.

Now suppose $k$ represents the height $k(t)$, in feet, of the pumpkin if it were launched 5 seconds later. If we graph $k$ and $h$ on the same axes they looks identical, but the graph of $k$ is translated 5 units to the right of the graph of $h$.




Since we know the pumpkin's height $k(t)$ at time $t$ is the same as the height $h(t)$ of the original pumpkin at time $t - 5$, we can write $k$ in terms of $h$ as $k(t) = h(t - 5)$.

Suppose there was a third function, $j$, where $j(t) = h(t + 4)$. Even without graphing $j$, we know that the graph reaches a maximum height of 66 feet. To evaluate $j(t)$, we evaluate $h$ at the input $t + 4$, which is zero when $t = -4$. So the graph of $j$ is translated 4 seconds to the left of the graph of $h$. This means that $j(t)$ is the height, in feet, of a pumpkin launched from the catapult 4 seconds earlier.