

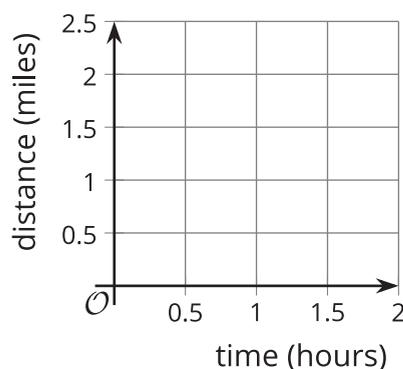
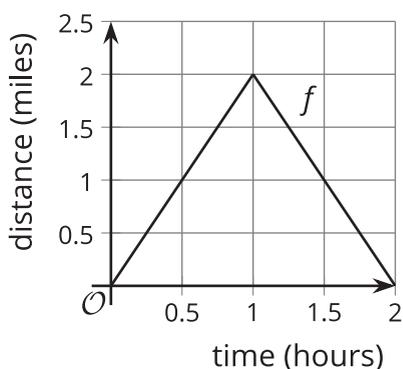
# Lesson 9: Scaling the Inputs

## 9.1: Out and Back

Every weekend, Elena takes a walk along the straight road in front of her house for 2 miles, then turns around and comes back home. Let's assume Elena walks at a constant speed.



Here is a graph of the function  $f$  that gives her distance  $f(t)$ , in miles, from home as a function of time  $t$  if she walks 2 miles per hour.



1. Sketch a graph of the function  $g$  that gives her distance  $g(t)$ , in miles, from home as a function of time  $t$  if she walks 4 miles per hour.
2. Write an equation for  $g$  in terms of  $f$ . Be prepared to explain why your equation makes sense.

## 9.2: A New Set of Wheels

Remember Clare on the Ferris wheel? In the table, we have the function  $F$  which gives her height  $F(t)$  above the ground, in feet,  $t$  seconds after starting her descent from the top. Today Clare tried out two new Ferris wheels.

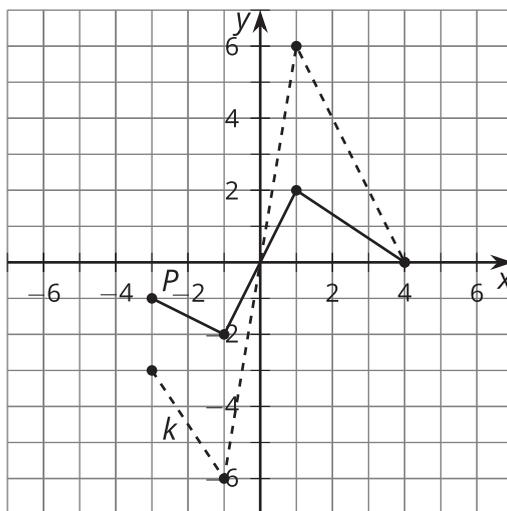
- The first wheel is twice the height of  $F$  and rotates at the same speed. The function  $g$  gives Clare's height  $g(t)$ , in feet,  $t$  seconds after starting her descent from the top.
- The second wheel is the same height as  $F$  but rotates at half the speed. The function  $h$  gives Clare's height  $h(t)$ , in feet,  $t$  seconds after starting her descent from the top.

$t$	$F(t)$	$g(t)$	$h(t)$
0	212		
20	181		
40	106		
60	31		
80	0		

1. Complete the table for the function  $g$ .
2. Explain why there is not enough information to find the exact values for  $h(20)$  and  $h(60)$ .
3. Complete as much of the table as you can for the function  $h$ , modeling Claire's height on the second Ferris wheel.
4. Express  $g$  and  $h$  in terms of  $f$ . Be prepared to explain your reasoning.

## 9.3: The Many Transformations of a Function $P$

Function  $k$  is a transformation of function  $P$  due to a scale factor.



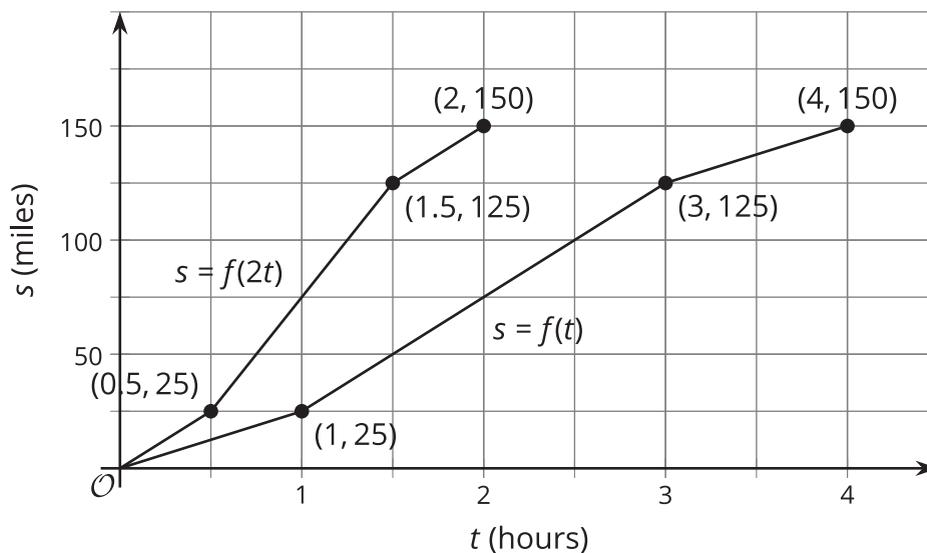
1. Write an equation for  $k$  in terms of  $P$ .
2. On the same axes, graph the function  $m$  where  $m(x) = P(0.75x)$ .
3. The highest point on the graph of  $P$  is  $(1, 2)$ . What is the highest point on the graph of a function  $n$  where  $n(x) = P(5x)$ ? Explain or show your reasoning.
4. The point furthest to the right on the graph of  $P$  is  $(4, 0)$ . If the point furthest to the right on the graph of a function  $q$  is  $(18, 0)$ , write a possible equation for  $q$  in terms of  $P$ .

### Are you ready for more?

What transformation takes  $f(x) = 2x(x - 4)$  to  $g(x) = 8x(x - 2)$ ?

## Lesson 9 Summary

Here are two graphs showing the distance traveled by two trains  $t$  hours into their journeys. What do you notice?



Where Train A traveled 25 miles in 1 hour, Train B traveled 25 miles in half the time. Similarly, Train A traveled 150 miles in 4 hours while Train B traveled 150 miles in only 2 hours. Train B is traveling twice the speed of Train A.

A train travelling twice the speed gets to any particular point along the track in half the time, so the graph for Train B is compressed horizontally by a factor of  $\frac{1}{2}$  when compared to the graph of Train A. If the function  $f(t)$  represents the distance Train A travels in  $t$  hours, then  $f(2t)$  represents the distance Train B travels in  $t$  hours, because Train B goes as far in  $t$  hours as Train A goes in  $2t$  hours.

If a different Train C were going one fourth the speed of Train A, then its motion would be represented by  $s = f(0.25t)$  and the graph would be stretched horizontally by a factor of 4 since it would take four times as long to travel the same distance.