Finding and Interpreting Inverse Functions

Let's find the inverses of linear functions.

18.1 Shopping for Cookbooks

Lin is comparing the cost of buying cookbooks at different online stores.

- Store A sells them at $9 each and offers free shipping.
- Store B sells them at $9 each and charges $5 for shipping.
- Store C sells them at p dollars and charges $5 for shipping.
- Store D sells them at p dollars and charges f dollars for shipping.

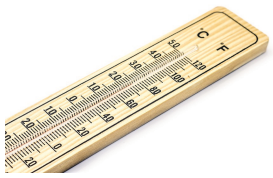
1. For each store, write an equation to represent the total cost, T, in dollars as a function of n cookbooks bought.

2. For each store, write an equation to find the number of books, n, that Lin could buy if she spent a total of T dollars.

18.2 From Celsius to Fahrenheit

If we know the temperature in degrees Celsius, C, we can find the temperature in degrees Fahrenheit, F, using the equation:

$$F = \frac{9}{5}C + 32$$



1. Complete the table with temperatures in degrees Fahrenheit or degrees Celsius.

C	0	100	25			
F				104	50	62.6

2. The equation $F = \frac{9}{5}C + 32$ represents a function. Write an equation to represent the inverse function. Be prepared to explain your reasoning.

3. The equation $R = \frac{9}{5}(C + 273.15)$ defines the temperature in degrees Rankine as a function of the temperature in degrees Celsius.

   Show that the equation $C = (R - 491.67) \cdot \frac{5}{9}$ defines the inverse of that function.

Are you ready for more?

One day in Alaska, it was cold enough for the temperature to be the same in degrees Fahrenheit and degrees Celsius. How cold was it? Explain or show how you know.

18.3 Info Gap: Custom Mugs

Your teacher will give you either a problem card or a data card. Do not show or read your card to your partner.

If your teacher gives you the problem card:

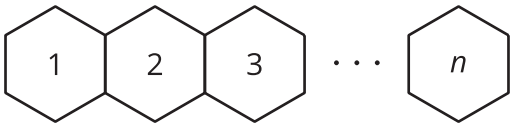
1. Silently read your card and think about what information you need to answer the question.
2. Ask your partner for the specific information that you need. "Can you tell me _____?"
3. Explain to your partner how you are using the information to solve the problem. "I need to know _____ because . . . ." Continue to ask questions until you have enough information to solve the problem.
4. Once you have enough information, share the problem card with your partner, and solve the problem independently.
5. Read the data card, and discuss your reasoning.

If your teacher gives you the data card:

1. Silently read your card. Wait for your partner to ask for information.
2. Before telling your partner any information, ask, "Why do you need to know _____?"
3. Listen to your partner's reasoning and ask clarifying questions. Only give information that is on your card. Do not figure out anything for your partner!
   These steps may be repeated.
4. Once your partner says they have enough information to solve the problem, read the problem card, and solve the problem independently.
5. Share the data card, and discuss your reasoning.

18.4 Tables and Seats

At a party, hexagonal tables are placed side by side along one side, as shown here.



1. Explain why the equation $S = 4n + 2$ represents the number of seats, S, as a function of the number of tables, n.

2. What domain and range make sense for this function?

3. Write an equation to represent the inverse of the given function. Explain what this inverse function tells us.

4. How many tables are needed if the following number of people are attending the party? Be prepared to explain your reasoning.

   a. 94 people

   b. 95 people

5. What domain makes sense for the inverse function? Is it the same set of values as the range of the original function? Explain your reasoning.

Lesson 18 Summary

It is helpful to interpret the inverse of a function in terms of a situation and the quantities it represents.

Suppose a linear function gives the dollar cost, C, of renting some equipment for n hours. The function is defined by this equation:

$$C = 8.25n + 30$$

If we know the number of hours of rental, n, we can substitute it into the expression $8.25n + 30$ and evaluate it to find the cost, C.

What is the inverse of this function, and what does it tell us about the length and cost of rental?

To find the inverse, let's solve for n:

$$\begin{aligned} 8.25n + 30 &= C \\ 8.25n &= C - 30 \\ n &= \frac{C - 30}{8.25} \end{aligned}$$

If we know the cost of rental, C, we can substitute it into the expression $\frac{C - 30}{8.25}$ and evaluate it to find the hours of rental, n.

Notice that the equation defining the inverse function is found by reversing the process that defines the original linear function.

- The original rule, $C = 8.25n + 30$, tells us to multiply the input, n, by 8.25 and add 30 to the result to get the output, C.
- The rule of the inverse function, $\frac{C - 30}{8.25}$, suggests that we subtract 30 from the input and then divide the result by 8.25 to get the output n.