Appendix **3**
The Function Game

Guess the Answer

In the game shown below, your job is to guess the answer to each number shown in the left side of the table. The original number is called x and the expression shown above is called the rule. *The rule tells you how to find the answer from x.*

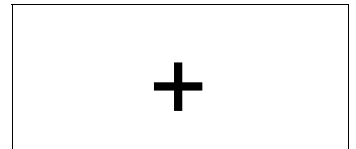| Rule: $2x + 1$	
x	**Answer**
0	1
1	3
3	?
-1	-1
-2	?
3	?

Notice that the x's are not in order and that an x may be given more than once. To find the answer, you substitute the x in the rule expression and evaluate it as we did in the chapter on EXPRESSIONS:

For $x = 3$:

$$2x + 1 = 2(3) + 1$$
$$= 6 + 1$$
$$= 7$$

For $x = {}^-1$:

$$2x + 1 \;=\; 2(^-1) + 1$$
$$=\; ^-2 + 1$$
$$=\; ^-1$$

+

Here is another game. The rule is $10 - x$.
To find the missing answers, we evaluate the rule for each value of x:

Rule: $10 - x$	
x	Answer
0	10
1	9
2	8
-1	11
5	?
-2	?

For $x \;=\; 5$:

$$10 - x \;=\; 10 - (5)$$
$$=\; 5$$

For $x \;=\; ^-2$:

$$10 - x \;=\; 10 - (^-2)$$
$$=\; 10 + 2$$
$$=\; 12$$

Be careful to substitute the exact value for x (positive *or* negative) wherever x occurs in the rule.
Here is one more game with a more complicated rule. Can you calculate the missing answers for $^-3$, 1, 0, and 4?
The answers are 11, 7, 2, and 46.
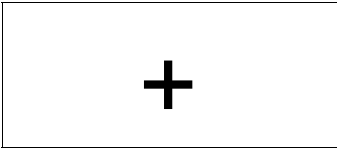
The tables shown above illustrate the idea of a **function.** A function is a

Rule: $2x^2 + 3x + 2$

x	Answer
0	2
2	16
-3	?
1	?
0	?
4	?

group of number pairs where each pair contains x and a matching answer. These functions have a rule which tells us how to calculate the answer. The rule is based only on x; the order that x's are given has no effect on the answer for any specific x. The answer for a specific x is always the same.

Guess the Rule

In the previous examples, we were given the rule and were asked to guess the answer. Now we will attempt to guess the rule when only x's and answers are given:

How did you guess the rule? The best method is to make a guess and try it for each x. Is the rule to add to x? Subtract? Multiply? Add and multiply? In
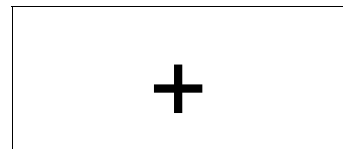
Rule: ?

x	Answer
0	3
1	4
-3	0
-1	2
2	5

the case above, the rule was to add 3 to x. We write this as $x + 3$.

Here is another example. Guess the rule:
In this game, the rule involved two operations—adding and multiplying. Each x was doubled and then 3 was added. This is written as **$2x + 3$**.
Try one more game and guess the rule:

Rule: ?

x	Answer
0	3
1	5
-3	-3
-1	1
2	7

As you probably discovered, this rule used squaring and adding. Each x was raised to the second power and then 1 was added: **$x^2 + 1$**.

Rule: ?

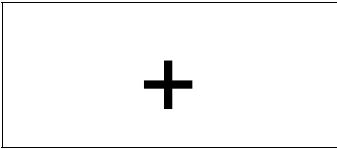| x	Answer
0	1
1	2
-3	10
-1	2
2	5

Guess the x

Our third and final game requires us to guess the x when we are given the rule and the answer. To solve the problem, we must look at the answer in each pair and guess which number would have given us that answer. Look at the table on the next page:

How can you discover the missing x's? One way is to think of the answer as the result of tripling an unknown number and adding one. To work backwards, we subtract one and divide by three:
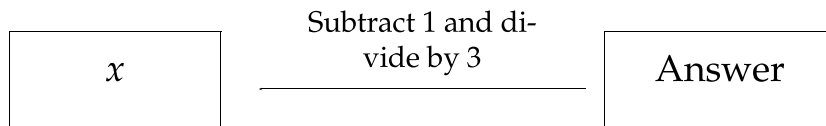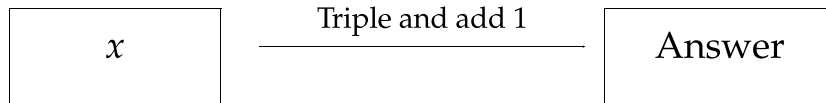
We can also find the x more formally by setting the rule expression equal to

Rule: $3x + 1$

x	Answer
?	16
?	-2
?	10
?	7

the answer:

For 16:

x	Triple and add 1	Answer

x	Subtract 1 and divide by 3	Answer

$$3x + 1 \ = \ 16$$
$$3x \ = \ 15$$
$$x \ = \ 5$$

For -2:

$$3x + 1 \ = \ {}^-2$$
$$3x \ = \ {}^-3$$
$$x \ = \ {}^-1$$

Can you solve for x when the answer is 10?
Here is another example. Determine the missing x's by working backwards or by solving the appropriate equation:
Using the equation method:

For $x \ = \ 5$:

$$2x - 1 = 5$$
$$2x = 6$$

Rule: $2x - 1$

x	Answer
?	5
?	-1
?	11
?	7

$$x = 3$$

For $x = {}^{-}1$:
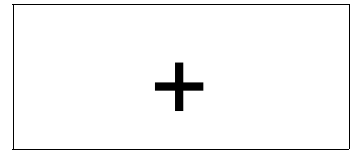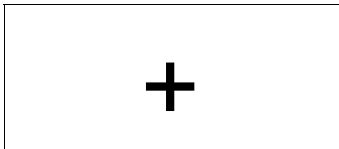
$$2x - 1 = {}^{-}1$$
$$2x = 0$$
$$x = 0$$

The other missing answers are shown below in the completed table:
Finally, the next page shows a game with a more complicated rule. If you work backwards or solve the equation, how will you "undo" all of these operations?

Here is how to solve for x when the answer is 13:

Rule: $2x - 1$

x	Answer
3	5
0	-1
6	11
4	7

Rule: $\dfrac{7x+5}{2}$

x	Answer
?	13
?	-1
?	20
?	6

$$\frac{7x+5}{2} = 13$$

$$2\left(\frac{7x+5}{2}\right) = 2(13)$$

$$7x+5 = 26$$

$$7x = 21$$

$$\frac{7x}{7} = \frac{21}{7}$$

$$x = 3$$

The completed table is shown below:

This version of the Function Game is really just the Equation Game in another form.
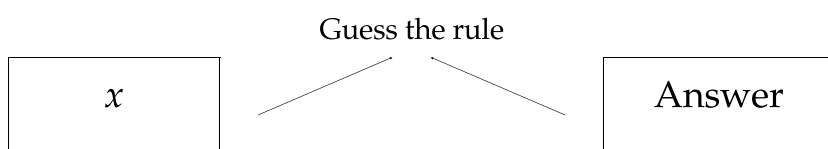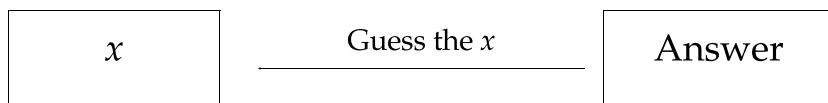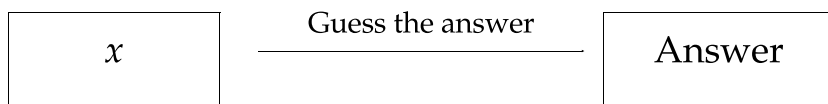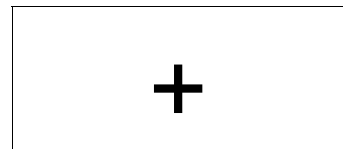
Rule: $\dfrac{7x+5}{2}$

x	Answer
3	13
-1	-1
5	20
1	6

The three games we have played are useful to help you understand the idea of a function:

Exercises

x — Guess the answer — **Answer**

x — Guess the x — **Answer**

x — Guess the rule — **Answer**

Guess the answer:

1. Rule: $7x - 4$

x	Answer
1	3
2	?
3	?
0	?

2. Rule: $x^2 + 3x + 1$

x	Answer
1	5
2	?
-1	?
-3	?

3. Rule: $^-5 - x$

x	Answer
5	?
⁻5	?
5	?
13	?

Guess the rule:

4. Rule: ?

x	Answer
1	5
2	10
3	15
0	0

5. Rule: ?

x	Answer
1	17
2	18
⁻1	15
⁻3	13

6. Rule: ?

x	Answer
5	24
⁻5	24
3	8
13	168

Guess the missing x's:
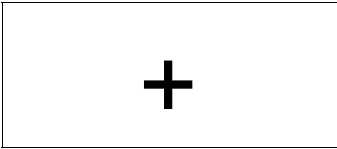
7. Rule: $x - 4$

x	Answer
-5	-9
?	13
?	-5
?	0

8. Rule: $3x - 5$

x	Answer
?	-5
?	7
?	-4
?	-3

9. Rule: $\dfrac{x + 3}{4}$

x	Answer
?	1
?	0
?	2
?	-1

Discover the rule and fill in the missing x's and answers:

10. Rule: ?

x	Answer
-5	19
1	13
19	-5
3	?
12	?
?	0

11. Rule: ?

x	Answer
-1	-7
0	0
1	7
3	?
2	?
?	21

12. Rule: ?

x	Answer
6	6
4	5
0	3
2	?
3	?
?	$\frac{7}{2}$