1.4 In the Chips
Using a Chip Model

When business records were kept by hand, accountants used red ink for expenses and black ink for income. If your income was greater than your expenses, you were "in the black." If your expenses were greater than your income, you were "in the red." You wanted to be "in the black."

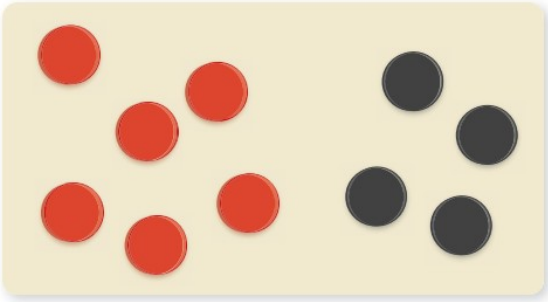
Julia has this problem to solve:

> Tate owes his sister \$6 for helping him cut the lawn. He earns \$4 delivering papers. Is Tate "in the red" or "in the black"?

To solve this problem, Julia uses red and black chips to model income and expenses. Each black chip represents $^{+}1$ dollar of income. Each red chip represents $^{-}1$ dollar of income (expenses).

Julia puts chips on the board to represent the situation.

Julia's Chip Board



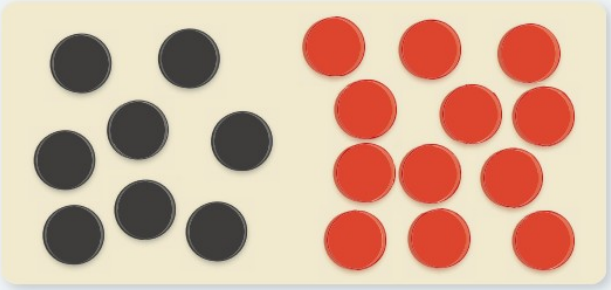
She decides that Tate is "in the red" 2 dollars, or has $^{-}2$ dollars. She writes

$$^{-}6 + {}^{+}4 = {}^{-}2$$

- Why do you think Julia concludes that $^{-}6 + {}^{+}4 = {}^{-}2$?
- What is another way to show a total value of $^{-}2$ on the chip board?
- What are some ways to show a total value of zero?
- Julia changes the board by adding one red chip and one black chip. By how much has Julia changed the total value?
- What groups of red and black chips can you add to the board that will not change the total value on the board?

Problem 1.4

A Use this chip board as the starting value for each part.



Write a number sentence to show the total value on the chip board for each move.

1. original chip board
2. add 5 black chips
3. remove 5 red chips
4. remove 3 black chips
5. add 3 red chips
6. What patterns do you see?

B Start with the original chip board from Question A.

1. Describe three ways to get a total value of $^{-}2$.
2. Describe three ways to get a total value of 0.
3. Describe three ways to get a total value of $^{-}4$.

C Give three combinations of red and black chips (using at least one of each color) that will equal each value.

1. 0
2. $^{+}12$
3. $^{-}7$
4. $^{-}125$

Problem 1.4 continued

D Find the missing part for each chip problem. Write a number sentence for each problem.

	Start With	Rule	End With	Number Sentence
1.	● ● ●	Add 5 ●	■	■
2.	● ● ●	Subtract 3 ●	■	■
3.	● ● ● ● ● ●	■	● ●	■
4.	■	Subtract 3 ●	● ● ● ●	■

E Describe a chip board display that matches each number sentence. Find the missing value in each case.

1. $^{+}3 - {}^{+}2 = \square$
2. $^{-}4 - {}^{+}2 = \square$
3. $^{-}4 - {}^{-}2 = \square$
4. $^{+}7 + \square = {}^{+}1$
5. $^{-}3 - {}^{+}5 = \square$
6. $\square - {}^{-}2 = {}^{+}6$

F Nadie has a chip board with 4 red chips. She needs to subtract 2 black chips, but there are no black chips on the board. Nadie says, "It is impossible to subtract 2 black chips. There are none on the board!" What can Nadie do to the chip board so that she can subtract 2 black chips? Explain your reasoning.

ACE Homework starts on page 20.