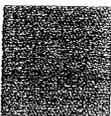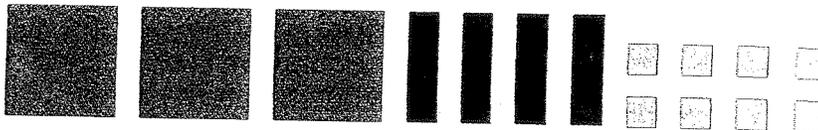# Subtracting Polynomials

Objective: To subtract polynomials.

EXPLORATION

Let the tile ⬛ represent n^2, the tile ▮ represent n, and the tile ☐ represent 1.

The tiles below represent the polynomial $3n^2 + 4n + 8$.

1. Copy the diagram or use algebra tiles. Remove 2 tiles representing n^2, one tile representing n, and five tiles representing 1.
2. What polynomial is represented by the tiles that you removed?
3. What polynomial is represented by the tiles that are left?
4. Complete: $(3n^2 + 4n + 8) - (2n^2 + n + 5) = \underline{\quad?\quad}$

In the Exploration you removed tiles to represent the polynomial that was being subtracted. Recall that subtraction may also be thought of as addition of the opposite. To subtract a rational number, you add the opposite of that number. To subtract a polynomial, you use a similar procedure.

> **Generalization:** *Subtracting Polynomials*
>
> To subtract a polynomial, add the opposite of each term of the polynomial.

Example 1

Subtract: $(3n^2 + 4n + 8) - (2n^2 + n + 5)$

Solution

$(3n^2 + 4n + 8) - (2n^2 + n + 5)$
$= (3n^2 + 4n + 8) + (-2n^2 - n - 5)$
$= (3n^2 - 2n^2) + (4n - n) + (8 - 5)$
$= n^2 + 3n + 3$

The opposite of $2n^2$ is $-2n^2$.
The opposite of n is $-n$.
The opposite of 5 is -5.

Check Your Understanding

1. In Example 1, why was the polynomial $-2n^2 - n - 5$ added to the polynomial $3n^2 + 4n + 8$?

As with addition, you may have to subtract polynomials that have terms missing for some powers.

Example 2 Subtract: $(7a^3 + 3a^2 - 10) - (9a^3 + 4a^2 - 6a - 9)$

Solution 1 Line up like terms. Insert zero terms as needed. Add the opposite.

$$
\begin{array}{r}
7a^3 + 3a^2 + 0a - 10 \\
9a^3 + 4a^2 - 6a - 9 \\
\hline
\end{array}
\quad\longrightarrow\quad
\begin{array}{r}
7a^3 + 3a^2 + 0a - 10 \\
-9a^3 - 4a^2 + 6a + 9 \\
\hline
-2a^3 - a^2 + 6a - 1
\end{array}
$$

Solution 2
$(7a^3 + 3a^2 - 10) - (9a^3 + 4a^2 - 6a - 9)$
$= (7a^3 + 3a^2 - 10) + (-9a^3 - 4a^2 + 6a + 9)$
$= (7a^3 - 9a^3) + (3a^2 - 4a^2) + 6a + (-10 + 9)$
$= -2a^3 - a^2 + 6a - 1$

☑ Check Your Understanding

2. In Solution 1, why was the term $0a$ inserted in $7a^3 + 3a^2 - 10$?

Guided Practice

COMMUNICATION «*Reading*

Replace each __?__ with the correct word.

« 1. To subtract a number, you add its __?__.

« 2. To subtract a polynomial, you add the opposite of each __?__.

Write the opposite of each term of each polynomial.

3. $2a^2 + 5a + 6$

4. $-6x^3 - 3x^2 - x - 7$

5. $4x^4 - 6x^3 + 9x^2 + 4x - 9$

6. $-m^4 + 2m^3 - 8m^2 - m - 8$

Subtract.

7. $\begin{array}{r} -4a + 7 \\ 2a - 3 \\ \hline \end{array}$

8. $\begin{array}{r} 2n^2 - 5n - 1 \\ 3n^2 - n + 6 \\ \hline \end{array}$

9. $\begin{array}{r} 7b^3 + 9b^2 \quad\; - 12 \\ 2b^3 + 9b^2 - 2b + 10 \\ \hline \end{array}$

10. $\begin{array}{r} 9n^3 - 6n^2 - n - 3 \\ -7n^3 + 4n^2 + n - 1 \\ \hline \end{array}$

11. $(5a^2 + 7a + 8) - (3a^2 + 4a + 2)$

12. $(v^3 + 8v^2 - 13v + 2) - (v^3 + 5v^2 + 9)$

13. $(15z^3 - 3z^2 + 6z + 13) - (-8z^3 + 7z^2 - 8z - 4)$

14. $(3w^3 - 5w^2 - 8) - (6w^3 + 2w - 18)$