

Polynomial Operations Practice

Name: _____

Date: _____

Question 1

Simplify

I. $(x + 1) + (12x + 10)$

II. $(4x - 3) + (-11x + 2)$

III. $\left(\frac{1}{3}x^9 + \frac{1}{5}x^5 - \frac{1}{2}x^2 + 7\right) + \left(\frac{-1}{5}x^9 + \frac{1}{4}x^4 - \frac{3}{5}x^5\right)$

IV. $(3y^6 + 2y^4 - y^3 + 5y) + (-y^6 + 3y^3 - 4y^2 + 7y^4)$

Polynomial Operations Practice

V. $(3x + 1) - (5x + 8)$

VI. $(x^2 - 3x - 2) - (2x^2 - 6x - 2)$

VII. $\left(\frac{1}{3}x^9 + \frac{1}{5}x^5 - \frac{1}{2}x^2 + 7\right) - \left(\frac{-1}{5}x^9 + \frac{1}{4}x^4 - \frac{3}{5}x^5\right)$

VIII. $(3x^5)^7$

IX. $(-y^3)(y^4)$

Polynomial Operations Practice

X. $(-4z^5)(6z^2)(-3z^3)$

$$(-4z^5)(6z^2)(-3z^3) \rightarrow 6 \cdot -3 \cdot -4 \cdot z^5 \cdot z^3 \cdot z^2 \xrightarrow{\text{product rule}} 72z^{5+3+2} \xrightarrow{\text{combine}} 72z^{10}$$

associative/commutative

XI. $\left(\frac{-1}{5}y^3\right)\left(\frac{-1}{3}y\right)$

XII. $18x^2 \cdot 0$

XIII. $5y(4y + 1)$

XIV. $4x(3x^3 - 4x^2 - 5x + 10)$

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XV. $\frac{2}{3}x^4(x^2 - 4x - 6)$

XVI. $\frac{2}{3}y^4\left(6y^5 - 12y^3 - \frac{5}{8}\right)$

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XVII. $(z^2 - z + 3)(z + 1)$

XVIII. $(2x^2 - 5x - 4)\left(3x^2 - x + \frac{1}{2}\right)$

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XIX. $(4x - 5)(5x + 8)$

XX. $(5 - 4x^5)(5 + 4x^5)$

XXI. $(x^5 - 4)^2$

XXII. $(20x^3 - 15x^2 + 30x) \div (5x)$

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XXIII. $(6x^2 + 17x + 8) \div (2x + 5)$

XXIV. $(6x^2 - 2xy + y^2) + (5x^2 - 8xy - 2y^2)$

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XXV. $(2xy + x^2y + 3)(xy + y^2)$

XXVI.
$$\frac{5x^3y + 10x^5y^2 + 15x^2y}{5x^2y}$$

Polynomial Operations Practice

Name: Key

Date: _____

Question 1

Simplify

I. $(x + 1) + (12x + 10)$

$$(x + 1) + (12x + 10) \xrightarrow{\text{combine}} x + 1 + 12x + 10 \xrightarrow{\text{associative/commutative}} 13x + 11$$

II. $(4x - 3) + (-11x + 2)$

$$(4x - 3) + (-11x + 2) \xrightarrow{\text{associative/commutative}} (4x + -3) + (-11x + 2) \xrightarrow{\text{sum form}} 4x + -3 + -11x + 2 \xrightarrow{\text{combine}} -7x + -1$$

III. $\left(\frac{1}{3}x^9 + \frac{1}{5}x^5 - \frac{1}{2}x^2 + 7\right) + \left(\frac{-1}{5}x^9 + \frac{1}{4}x^4 - \frac{3}{5}x^5\right)$

$$\left(\frac{1}{3}x^9 + \frac{1}{5}x^5 - \frac{1}{2}x^2 + 7\right) + \left(\frac{-1}{5}x^9 + \frac{1}{4}x^4 - \frac{3}{5}x^5\right)$$

↓ sum form

$$\left(\frac{1}{3}x^9 + \frac{1}{5}x^5 + \frac{-1}{2}x^2 + 7\right) + \left(\frac{-1}{5}x^9 + \frac{1}{4}x^4 + \frac{-3}{5}x^5\right)$$

↓ associative/commutative

$$\frac{1}{3}x^9 + \frac{-1}{5}x^9 + \frac{1}{5}x^5 + \frac{-3}{5}x^5 + \frac{1}{4}x^4 + \frac{-1}{2}x^2 + 7 \longrightarrow \frac{5}{15}x^9 + \frac{-3}{15}x^9 + \frac{1}{5}x^5 + \frac{-3}{5}x^5 + \frac{1}{4}x^4 + \frac{-1}{2}x^2 + 7$$

prepare fractions

$$\frac{8x^9 + -24x^5 + 15x^4 + -30x^2 + 420}{60}$$

combine ↑

$$\frac{8x^9}{60} + \frac{-24x^5}{60} + \frac{15x^4}{60} + \frac{-30x^2}{60} + \frac{420}{60}$$

prepare fractions ↑

$$\frac{2}{15}x^9 + \frac{-2}{5}x^5 + \frac{1}{4}x^4 + \frac{-1}{2}x^2 + 7$$

combine ↑

IV. $(3y^6 + 2y^4 - y^3 + 5y) + (-y^6 + 3y^3 - 4y^2 + 7y^4)$

$$(3y^6 + 2y^4 - y^3 + 5y) + (-y^6 + 3y^3 - 4y^2 + 7y^4)$$

↓ sum form

$$(3y^6 + 2y^4 + -y^3 + 5y) + (-y^6 + 3y^3 + -4y^2 + 7y^4)$$

↓ associative/commutative

$$3y^6 + 2y^4 + -y^3 + 5y + -y^6 + 3y^3 + -4y^2 + 7y^4 \longrightarrow 2y^6 + 9y^4 + 2y^3 + -4y^2 + 5y$$

combine

Polynomial Operations Practice

V. $(3x + 1) - (5x + 8)$

associative/commutative

$$(3x + 1) - (5x + 8) \rightarrow (3x + 1) + (-5x - 8) \rightarrow 3x + 1 - 5x - 8 \rightarrow 3x + 1 - 5x - 8$$

opposite and add

sum form

↓

$$-2x + -7$$

combine

VI. $(x^2 - 3x - 2) - (2x^2 - 6x - 2)$

opposite and add

$$(x^2 - 3x - 2) - (2x^2 - 6x - 2) \rightarrow (x^2 - 3x - 2) + (-2x^2 + 6x + 2)$$

↓

sum form

$$\text{associative/commutative } x^2 - 3x - 2 + -2x^2 + 6x + 2 \rightarrow x^2 + -3x + -2 + -2x^2 + 6x + 2$$

↓

$$-1x^2 + 3x \text{ combine}$$

VII. $\left(\frac{1}{3}x^9 + \frac{1}{5}x^5 - \frac{1}{2}x^2 + 7\right) - \left(\frac{-1}{5}x^9 + \frac{1}{4}x^4 - \frac{3}{5}x^5\right)$

$$\left(\frac{1}{3}x^9 + \frac{1}{5}x^5 - \frac{1}{2}x^2 + 7\right) - \left(\frac{-1}{5}x^9 + \frac{1}{4}x^4 - \frac{3}{5}x^5\right)$$

↓ opposite and add

$$\left(\frac{1}{3}x^9 + \frac{1}{5}x^5 - \frac{1}{2}x^2 + 7\right) + \left(\frac{1}{5}x^9 - \frac{1}{4}x^4 + \frac{3}{5}x^5\right)$$

↓ sum form

$$\left(\frac{1}{3}x^9 + \frac{1}{5}x^5 + \frac{-1}{2}x^2 + 7\right) + \left(\frac{1}{5}x^9 + \frac{-1}{4}x^4 + \frac{3}{5}x^5\right)$$

↓ associative/commutative

$$\frac{1}{3}x^9 + \frac{1}{5}x^9 + \frac{1}{5}x^5 + \frac{3}{5}x^5 + \frac{-1}{4}x^4 + \frac{-1}{2}x^2 + 7 \rightarrow \frac{5}{15}x^9 + \frac{3}{15}x^9 + \frac{1}{5}x^5 + \frac{3}{5}x^5 + \frac{-1}{4}x^4 + \frac{-1}{2}x^2 + 7$$

prepare fractions

$$\frac{32x^9 + 48x^5 - 15x^4 - 30x^2 + 420}{60}$$

combine ↑

$$\frac{32x^9}{60} + \frac{48x^5}{60} + \frac{-15x^4}{60} + \frac{-30x^2}{60} + \frac{420}{60}$$

prepare fractions ↑

$$\frac{8}{15}x^9 + \frac{4}{5}x^5 + \frac{-1}{4}x^4 + \frac{-1}{2}x^2 + 7$$

combine ↑

VIII. $(3x^5)7$

combine

$$(3x^5)7 \rightarrow 3 \cdot 7 \cdot x^5 \rightarrow 21x^5$$

associative/commutative

IX. $(-y^3)(y^4)$

product rule

$$(-y^3)(y^4) \rightarrow 1 \cdot -1 \cdot y^3 \cdot y^4 \rightarrow -1y^{3+4} \rightarrow -1y^7$$

associative/commutative

combine

Polynomial Operations Practice

X. $(-4z^5)(6z^2)(-3z^3)$

$$(-4z^5)(6z^2)(-3z^3) \rightarrow \underset{\text{associative/commutative}}{6 \cdot -3 \cdot -4 \cdot z^5 \cdot z^3 \cdot z^2} \xrightarrow{\text{product rule}} 72z^{5+3+2} \xrightarrow{\text{combine}} 72z^{10}$$

XI. $\left(\frac{-1}{5}y^3\right)\left(\frac{-1}{3}y\right)$

$$\left(\frac{-1}{5}y^3\right)\left(\frac{-1}{3}y\right) \xrightarrow{\text{associative/commutative}} \frac{-1}{5} \cdot \frac{-1}{3} \cdot y^3 \cdot y \xrightarrow{\text{product rule}} \frac{1}{15}y^{3+1} \xrightarrow{\text{combine}} \frac{1}{15}y^4 \xrightarrow{\text{combine}} \frac{y^4}{15}$$

XII. $18x^2 \cdot 0$

$$18x^2 \cdot 0 \xrightarrow{\text{combine}} 0$$

XIII. $5y(4y + 1)$

$$5y(4y + 1) \xrightarrow{\text{distributive law}} (5y)(4y) + (5y)(1) \xrightarrow{\text{associative/commutative}} 5 \cdot 4 \cdot y \cdot y + 5 \cdot 1 \cdot y \xrightarrow{\text{product rule}} 20y^{1+1} + 5y \xrightarrow{\text{combine}} 20y^2 + 5y$$

XIV. $4x(3x^3 - 4x^2 - 5x + 10)$

$$4x(3x^3 - 4x^2 - 5x + 10) \xrightarrow{\text{sum form}} 4x(3x^3 + -4x^2 + -5x + 10) \xrightarrow{\text{distributive law}} (4x)(3x^3) + (4x)(-4x^2) + (4x)(-5x) + (4x)(10) \xrightarrow{\text{product rule}} 12x^{3+1} + -16x^{2+1} + -20x^{1+1} + 40x \xrightarrow{\text{associative/commutative}} 4 \cdot 3 \cdot x^3 \cdot x + 4 \cdot -4x^2 \cdot x + 4 \cdot -5 \cdot x \cdot x + 4 \cdot 10 \cdot x \xrightarrow{\text{combine}} 12x^4 + -16x^3 + -20x^2 + 40x$$

Polynomial Operations Practice

XV. $\frac{2}{3}x^4(x^2 - 4x - 6)$

distributive law

$$\frac{2}{3}x^4(x^2 - 4x - 6) \rightarrow \frac{2}{3}x^4(x^2 + -4x + -6) \rightarrow \left(\frac{2}{3}x^4\right)(x^2) + \left(\frac{2}{3}x^4\right)(-4x) + \left(\frac{2}{3}x^4\right)(-6)$$

sum form

$$\frac{2}{3}x^{4+2} + \frac{-8}{3}x^{4+1} + \frac{-4}{1}x^4 \leftarrow \frac{2}{3} \cdot x^4 \cdot x^2 + \frac{2}{3} \cdot -4 \cdot x^4 \cdot x + \frac{2}{3} \cdot -6 \cdot x^4$$

product rule

associative/commutative

$$\frac{2x^6}{3} + \frac{-8x^5}{3} + -4x^4$$

combine

XVI. $\frac{2}{3}y^4(6y^5 - 12y^3 - \frac{5}{8})$

sum form

$$\frac{2}{3}y^4(6y^5 - 12y^3 - \frac{5}{8}) \rightarrow \frac{2}{3}y^4(6y^5 + -12y^3 + \frac{-5}{8})$$

↓

$$\left(\frac{2}{3}y^4\right)(6y^5) + \left(\frac{2}{3}y^4\right)(-12y^3) + \left(\frac{2}{3}y^4\right)\left(\frac{-5}{8}\right)$$

distributive law

↓

$$\frac{2}{3} \cdot 6 \cdot y^5 \cdot y^4 + \frac{2}{3} \cdot -12 \cdot y^4 \cdot y^3 + \frac{2}{3} \cdot \frac{-5}{8} \cdot y^4$$

associative/commutative

↓

$$4y^{5+4} + -8y^{4+3} + \frac{-5}{12}y^4$$

product rule

↓

$$4y^9 + -8y^7 + \frac{-5y^4}{12}$$

combine

Polynomial Operations Practice

XVII. $(z^2 - z + 3)(z + 1)$

$$\begin{aligned}
 (z^2 - z + 3)(z + 1) &\rightarrow (z^2 + -z + 3)(z + 1) \rightarrow (z^2 + -z + 3)(z) + (z^2 + -z + 3)(1) \\
 &\quad \text{sum form} \qquad \qquad \qquad \text{distributive law} \\
 &\quad \downarrow \\
 &(z^2)(z) + (-z)(z) + (3)(z) + (z^2)(1) + (-z)(1) + (3)(1) \\
 &\quad \text{distributive law} \\
 &\quad \downarrow \\
 z^{2+1} + -1z^{1+1} + 3z + z^2 + -1z + 3 &\leftarrow z^2 \cdot z + -1 \cdot z \cdot z + 3 \cdot z + 1 \cdot z^2 + -1 \cdot 1 \cdot z + 3 \cdot 1 \\
 &\quad \text{product rule} \qquad \qquad \qquad \text{associative/commutative} \\
 &\quad \downarrow \\
 z^3 + -1z^2 + 3z + z^2 + -1z + 3 &\rightarrow z^3 + 2z + 3 \\
 &\quad \text{combine}
 \end{aligned}$$

XVIII. $(2x^2 - 5x - 4)\left(3x^2 - x + \frac{1}{2}\right)$

$$\begin{aligned}
 (2x^2 - 5x - 4)\left(3x^2 - x + \frac{1}{2}\right) &\rightarrow (2x^2 + -5x + -4)\left(3x^2 + -x + \frac{1}{2}\right) \\
 &\quad \text{sum form} \\
 &\quad \downarrow \\
 &(2x^2 + -5x + -4)(3x^2) + (2x^2 + -5x + -4)(-x) + (2x^2 + -5x + -4)\left(\frac{1}{2}\right) \\
 &\quad \text{distributive law} \\
 &\quad \downarrow \\
 (2x^2)(3x^2) + (-5x)(3x^2) + (-4)(3x^2) + (2x^2)(-x) + (-5x)(-x) + (-4)(-x) + (2x^2)\left(\frac{1}{2}\right) + (-5x)\left(\frac{1}{2}\right) + (-4)\left(\frac{1}{2}\right) \\
 &\quad \text{distributive law} \\
 &\quad \downarrow \\
 2 \cdot 3 \cdot x^2 \cdot x^2 + -5 \cdot 3 \cdot x^2 \cdot x + -4 \cdot 3 \cdot x^2 + 2 \cdot -1 \cdot x^2 \cdot x + -5 \cdot -1 \cdot x \cdot x + -4 \cdot -1 \cdot x + 2 \cdot \frac{1}{2} \cdot x^2 + -5 \cdot \frac{1}{2} \cdot x + -4 \cdot \frac{1}{2} \\
 &\quad \text{associative/commutative} \\
 &\quad \downarrow \\
 6x^{2+2} + -15x^{2+1} + -12x^2 + -2x^{2+1} + 5x^{1+1} + 4x + 1x^2 + \frac{-5}{2}x + -2 \\
 &\quad \text{product rule} \\
 &\quad \downarrow \\
 6x^4 + -15x^3 + -12x^2 + -2x^3 + 5x^2 + 4x + 1x^2 + \frac{-5}{2}x + -2 \\
 &\quad \text{combine} \\
 &\quad \downarrow \\
 6x^4 + -17x^3 + -6x^2 + \frac{3x}{2} + -2 \\
 &\quad \text{combine}
 \end{aligned}$$

Polynomial Operations Practice

XIX. $(4x - 5)(5x + 8)$

$$(4x - 5)(5x + 8) \xrightarrow{\text{FOIL}} (4x + -5)(5x + 8) \xrightarrow{\text{sum form}} 20x^2 + 32x + -25x + -40 \xrightarrow{\text{combine}} 20x^2 + 7x + -40$$

XX. $(5 - 4x^5)(5 + 4x^5)$

$$(5 - 4x^5)(5 + 4x^5) \xrightarrow{\text{product of s\&d}} (5)^2 - (4x^5)^2 \xrightarrow{\text{raising a product to a power}} 25 - 16x^{10} \xrightarrow{\text{sum form}} 25 + -16x^{10} \xrightarrow{\text{descending order}} -16x^{10} + 25$$

XXI. $(x^5 - 4)^2$

$$(x^5 - 4)^2 \xrightarrow{\text{sum form}} (x^5 + -4)^2 \xrightarrow{\text{squaring binomials}} (x^5)^2 + -8x^5 + (-4)^2 \xrightarrow{\text{power rule}} x^{10} + -8x^5 + 16$$

XXII. $(20x^3 - 15x^2 + 30x) \div (5x)$

$$\frac{20x^3 - 15x^2 + 30x}{5x} \xrightarrow{\text{sum form}} \frac{20x^3 + -15x^2 + 30x}{5x} \xrightarrow{\text{split the fraction}} \frac{20x^3}{5x} + \frac{-15x^2}{5x} + \frac{30x}{5x}$$

$$\downarrow$$

$$4x^2 + -3x + 6 \xleftarrow{\text{combine}} 4x^{3-1} + -3x^{2-1} + 6x^{1-1} \xleftarrow{\text{quotient rule}}$$

Polynomial Operations Practice

XXIII. $(6x^2 + 17x + 8) \div (2x + 5)$

$$\begin{array}{l}
 2x + 5 \overline{) 6x^2 + 17x + 8} \rightarrow \frac{6x^2}{2x} = 3x \rightarrow 3x(2x + 5) = 6x^2 + 15x \\
 \text{quotient rule} \qquad \qquad \qquad \text{distributive law} \\
 \downarrow \\
 1(2x + 5) = 2x + 5 \leftarrow \frac{2x}{2x} = 1 \leftarrow 2x + 5 \overline{) 6x^2 + 17x + 8} \\
 \text{distributive law} \qquad \qquad \text{quotient rule} \qquad \qquad \text{long division} \\
 \downarrow \\
 \begin{array}{r}
 3x + 1 \\
 2x + 5 \overline{) 6x^2 + 17x + 8} \\
 - 6x^2 + 15x \\
 \hline
 2x + 8 \\
 - 2x + 5 \\
 \hline
 3 \text{ remainder}
 \end{array}
 \end{array}$$

$$\rightarrow 3x + 1 + \frac{3}{2x + 5}$$

XXIV. $(6x^2 - 2xy + y^2) + (5x^2 - 8xy - 2y^2)$

$$\begin{array}{l}
 (6x^2 - 2xy + y^2) + (5x^2 - 8xy - 2y^2) \rightarrow (6x^2 + -2xy + y^2) + (5x^2 + -8xy + -2y^2) \\
 \text{sum form} \\
 \downarrow \\
 11x^2 + -10xy + -1y^2 \leftarrow 6x^2 + 5x^2 + -2xy + -8xy + y^2 + -2y^2 \\
 \text{combine} \qquad \qquad \qquad \text{associative/commutative}
 \end{array}$$

Polynomial Operations Practice

XXV. $(2xy + x^2y + 3)(xy + y^2)$

$$(2xy + x^2y + 3)(xy + y^2) \rightarrow (2xy)(xy + y^2) + (x^2y)(xy + y^2) + (3)(xy + y^2)$$

distributive law



$$(2xy)(xy) + (2xy)(y^2) + (x^2y)(xy) + (x^2y)(y^2) + (3)(xy) + (3)(y^2)$$

distributive law



$$2 \cdot x \cdot x \cdot y \cdot y + 2 \cdot x \cdot y^2 \cdot y + x^2 \cdot x \cdot y \cdot y + x^2 \cdot y^2 \cdot y + 3 \cdot x \cdot y + 3 \cdot y^2$$

associative/commutative



$$2x^{1+1}y^{1+1} + 2xy^{2+1} + x^{2+1}y^{1+1} + x^2y^{2+1} + 3xy + 3y^2$$

product rule



$$2x^2y^2 + 2xy^3 + x^3y^2 + x^2y^3 + 3xy + 3y^2$$

combine

XXVI. $\frac{5x^3y + 10x^5y^2 + 15x^2y}{5x^2y}$

$$\frac{5x^3y + 10x^5y^2 + 15x^2y}{5x^2y} \rightarrow \frac{5x^3y}{5x^2y} + \frac{10x^5y^2}{5x^2y} + \frac{15x^2y}{5x^2y} \rightarrow 1x^{3-2}y^{1-1} + 2x^{5-2}y^{2-1} + 3x^{2-2}y^{1-1}$$

quotient rule



$$1x + 2x^3y + 3$$

combine