Polynomial Operations Practice

Name: _____   Date: _____

Question 1

Simplify

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

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

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

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

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

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

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

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

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

Polynomial Operations Practice

Name: **Key**   Date: _____

Question 1
Simplify

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

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

associative/commutative

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

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

sum form

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

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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

$\downarrow$

$-2x + -7$

combine

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

opposite and add

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

$\downarrow$

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

sum form

$\downarrow$

$-1x^2 + 3x$ combine

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

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

$\downarrow$ opposite and add

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

$\downarrow$ sum form

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

$\downarrow$ associative/commutative

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

prepare fractions

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

combine $\uparrow$

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

prepare fractions $\uparrow$

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

combine $\uparrow$

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

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

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

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

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

XII. $18x^2 \cdot 0$

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

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

$5y(4y + 1) \rightarrow \underset{\text{distributive law}}{(5y)(4y) + (5y)(1)} \rightarrow 5 \cdot 4 \cdot y \cdot y + 5 \cdot 1 \cdot y \underset{\text{product rule}}{\rightarrow} 20y^{1+1} + 5y \underset{\text{combine}}{\rightarrow} 20y^2 + 5y$

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

$4x(3x^3 - 4x^2 - 5x + 10) \rightarrow \underset{\text{sum form}}{4x(3x^3 + -4x^2 + -5x + 10)} \rightarrow \underset{\text{distributive law}}{(4x)(3x^3) + (4x)(-4x^2) + (4x)(-5x) + (4x)(10)}$

$\underset{\text{product rule}}{12x^{3+1} + -16x^{2+1} + -20x^{1+1} + 40x} \leftarrow \underset{\text{associative/commutative}}{4 \cdot 3 \cdot x^3 \cdot x + 4 \cdot -4x^2 \cdot x + 4 \cdot -5 \cdot x \cdot x + 4 \cdot 10 \cdot x}$

$\underset{\text{combine}}{12x^4 + -16x^3 + -20x^2 + 40x}$

Polynomial Operations Practice

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

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

distributive law

sum form

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

product rule

associative/commutative

$\downarrow$

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

combine

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

sum form

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

$\downarrow$

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

distributive law

$\downarrow$

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

associative/commutative

$\downarrow$

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

product rule

$\downarrow$

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

combine

Polynomial Operations Practice

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

$(z^2 - z + 3)(z + 1) \longrightarrow (z^2 + \text{-}z + 3)(z + 1) \longrightarrow (z^2 + \text{-}z + 3)(z) + (z^2 + \text{-}z + 3)(1)$

sum form $\qquad\qquad\qquad\qquad$ distributive law

$\downarrow$

$(z^2)(z) + (\text{-}z)(z) + (3)(z) + (z^2)(1) + (\text{-}z)(1) + (3)(1)$

distributive law

$\downarrow$

$z^{2+1} + \text{-}1z^{1+1} + 3z + z^2 + \text{-}1z + 3 \quad \longleftarrow \quad z^2 \cdot z + \text{-}1 \cdot z \cdot z + 3 \cdot z + 1 \cdot z^2 + \text{-}1 \cdot 1 \cdot z + 3 \cdot 1$

product rule $\qquad\qquad\qquad\qquad$ associative/commutative

$\downarrow$

$z^3 + \text{-}1z^2 + 3z + z^2 + \text{-}1z + 3 \longrightarrow z^3 + 2z + 3$

combine

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

$(2x^2 - 5x - 4)\left(3x^2 - x + \dfrac{1}{2}\right) \longrightarrow (2x^2 + \text{-}5x + \text{-}4)\left(3x^2 + \text{-}x + \dfrac{1}{2}\right)$

sum form

$\downarrow$

$(2x^2 + \text{-}5x + \text{-}4)(3x^2) + (2x^2 + \text{-}5x + \text{-}4)(\text{-}x) + (2x^2 + \text{-}5x + \text{-}4)\left(\dfrac{1}{2}\right)$

distributive law

$\downarrow$

$(2x^2)(3x^2) + (\text{-}5x)(3x^2) + (\text{-}4)(3x^2) + (2x^2)(\text{-}x) + (\text{-}5x)(\text{-}x) + (\text{-}4)(\text{-}x) + (2x^2)\left(\dfrac{1}{2}\right) + (\text{-}5x)\left(\dfrac{1}{2}\right) + (\text{-}4)\left(\dfrac{1}{2}\right)$

distributive law

$\downarrow$

$2 \cdot 3 \cdot x^2 \cdot x^2 + \text{-}5 \cdot 3 \cdot x^2 \cdot x + \text{-}4 \cdot 3 \cdot x^2 + 2 \cdot \text{-}1 \cdot x^2 \cdot x + \text{-}5 \cdot \text{-}1 \cdot x \cdot x + \text{-}4 \cdot \text{-}1 \cdot x + 2 \cdot \dfrac{1}{2} \cdot x^2 + \text{-}5 \cdot \dfrac{1}{2} \cdot x + \text{-}4 \cdot \dfrac{1}{2}$

associative/commutative

$\downarrow$

$6x^{2+2} + \text{-}15x^{2+1} + \text{-}12x^2 + \text{-}2x^{2+1} + 5x^{1+1} + 4x + 1x^2 + \dfrac{\text{-}5}{2}x + \text{-}2$

product rule

$\downarrow$

$6x^4 + \text{-}15x^3 + \text{-}12x^2 + \text{-}2x^3 + 5x^2 + 4x + 1x^2 + \dfrac{\text{-}5}{2}x + \text{-}2$

combine

$\downarrow$

$6x^4 + \text{-}17x^3 + \text{-}6x^2 + \dfrac{3x}{2} + \text{-}2$

combine

Polynomial Operations Practice

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

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

<p style="text-align:center">sum form   combine</p>

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

$(5 - 4x^5)(5 + 4x^5) \rightarrow (5)^2 - (4x^5)^2 \xrightarrow{\text{raising a product to a power}} 25 - 16x^{10} \rightarrow 25 + \text{-}16x^{10} \xrightarrow{\text{descending order}} \text{-}16x^{10} + 25$

<p style="text-align:center">product of s&d   sum form</p>

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

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

<p style="text-align:center">sum form   power rule</p>

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

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

<p style="text-align:center">sum form</p>

$$\downarrow$$

$$4x^2 + \text{-}3x + 6 \leftarrow 4x^{3-1} + \text{-}3x^{2-1} + 6x^{1-1}$$

<p style="text-align:center">combine   quotient rule</p>

Polynomial Operations Practice

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

$2x + 5\ |\ \overline{6x^2 + 17x + 8}$ $\rightarrow$ $\dfrac{6x^2}{2x} = 3x$ $\rightarrow$ $3x(2x + 5) = 6x^2 + 15x$

quotient rule   distributive law

$3x$

$2x + 5\ |\ \overline{6x^2 + 17x + 8}$

$1(2x + 5) = 2x + 5$ $\leftarrow$ $\dfrac{2x}{2x} = 1$ $\leftarrow$ $-\ \underline{6x^2 + 15x}$ long division

distributive law   quotient rule $2x + 8$

$3x + 1$

$2x + 5\ |\ \overline{6x^2 + 17x + 8}$

$-\ \underline{6x^2 + 15x}$ long division

$2x + 8$ $\rightarrow$ $3x + 1 + \dfrac{3}{2x + 5}$

$-\ \underline{2x + 5}$

3 remainder

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

$(6x^2 - 2xy + y^2) + (5x^2 - 8xy - 2y^2)$ $\rightarrow$ $(6x^2 + -2xy + y^2) + (5x^2 + -8xy + -2y^2)$

sum form

$11x^2 + -10xy + -1y^2$ $\leftarrow$ $6x^2 + 5x^2 + -2xy + -8xy + y^2 + -2y^2$

combine   associative/commutative

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

$\downarrow$

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

distributive law

$\downarrow$

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

associative/commutative

$\downarrow$

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

product rule

$\downarrow$

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

combine

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

$\dfrac{5x^3y + 10x^5y^2 + 15x^2y}{5x^2y} \rightarrow \dfrac{5x^3y}{5x^2y} + \dfrac{10x^5y^2}{5x^2y} + \dfrac{15x^2y}{5x^2y} \rightarrow$

quotient rule

$1x^{3-2}y^{1-1} + 2x^{5-2}y^{2-1} + 3x^{2-2}y^{1-1}$

split the fraction

$\downarrow$

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

combine