Introductory Algebra
Chapter 4 Review

Objective [4.1a] Tell the meaning of exponential notation.		
Brief Procedure	Example	Practice Exercise
Exponential notation a^n means that the base a is used as a factor n times.	What is the meaning of 2^4? of $(5x)^3$? 2^4 means $2 \cdot 2 \cdot 2 \cdot 2$. $(5x)^3$ means $5x \cdot 5x \cdot 5x$.	1. What is the meaning of y^5? A. $5 \cdot y$ B. $5 \cdot 5 \cdot 5 \cdot 5 \cdot 5$ C. $y \cdot y \cdot y \cdot y \cdot y$ D. $y^5 \cdot y^5 \cdot y^5 \cdot y^5 \cdot y^5$

Objective [4.1b] Evaluate exponential expressions with exponents of 0 and 1.		
Brief Procedure	Example	Practice Exercise
$a^1 = a$, for any number a; $a^0 = 1$, for any nonzero number a.	Evaluate 3^1 and $(-4)^0$. $3^1 = 3; (-4)^0 = 1$	2. Evaluate 2.8^0. A. 0 B. 1 C. 2.8 D. -2.8

Objective [4.1c] Evaluate algebraic expressions containing exponents.		
Brief Procedure	Example	Practice Exercise
Make the substitution indicated and then perform the resulting computation.	Evaluate n^5 for $n = -1$. We substitute -1 for n and then evaluate the power. $n^5 = (-1)^5$ $= (-1) \cdot (-1) \cdot (-1) \cdot (-1) \cdot (-1)$ $= -1$	3. Evaluate $4t^3$ for $t = -2$. A. -256 B. -32 C. -8 D. 32

Objective [4.1d] Use the product rule to multiply exponential expressions with like bases.		
Brief Procedure	Example	Practice Exercise
For any number a and any positive integers m and n, $a^m \cdot a^n = a^{m+n}$. (When multiplying with exponential notation, if the bases are the same, keep the base and add the exponents.)	Multiply and simplify: $y^2 \cdot y^6$. $y^2 \cdot y^6 = y^{2+6} = y^8$	4. Multiply and simplify: $x^3 \cdot x^4$. A. x^7 B. $2x^7$ C. x^{12} D. x^{14}

Objective [4.1e] Use the quotient rule to divide exponential expressions with like bases.		
Brief Procedure	Example	Practice Exercise
For any nonzero number a and any positive integers m and n, $\frac{a^m}{a^n} = a^{m-n}$. (When dividing with exponential notation, if the bases are the same, keep the base and subtract the exponent of the denominator from the exponent of the numerator.)	Divide and simplify: $\frac{a^{10}b^4}{a^2b}$. $\frac{a^{10}b^4}{a^2b} = \frac{a^{10}}{a^2} \cdot \frac{b^4}{b}$ $= a^{10-2}b^{4-1}$ $= a^8b^3$	5. Divide and simplify: $\frac{x^3y^7}{x^2y^4}$. A. y^3 B. xy^3 C. x^5y^{11} D. x^6y^{28}

Objective [4.1f] Express an exponential expression involving negative exponents with positive exponents.		
Brief Procedure	Example	Practice Exercise
For any real number a that is nonzero and any integer n, $a^{-n} = \frac{1}{a}$.	Express using positive exponents. a) $3x^{-8}$ b) $\frac{1}{y^{-2}}$ a) $3x^{-8} = 3 \cdot \frac{1}{x^8} = \frac{3}{x^8}$ b) $\frac{1}{y^{-2}} = y^{-(-2)} = y^2$	6. Express $2n^{-5}$ using positive exponents. A. $\frac{1}{2n^5}$ B. $\frac{2}{n^5}$ C. $\frac{n^5}{2}$ D. $2n^5$

Objective [4.2a] Use the power rule to raise powers to powers.		
Brief Procedure	Example	Practice Exercise
For any real number a and any integers m and n, $(a^m)^n = a^{mn}$. (To raise a power to a power, multiply the exponents.)	Simplify: $(y^{-3})^2$. $(y^{-3})^2 = y^{-3\cdot 2} = y^{-6} = \frac{1}{y^6}$	7. Simplify: $(b^{-4})^{-3}$. A. $\frac{1}{b}$ B. $\frac{1}{b^7}$ C. b^7 D. b^{12}

Objective [4.2b] Raise a product to a power and a quotient to a power.

Brief Procedure	Example	Practice Exercises
To raise a product to the nth power, raise each factor to the nth power. That is, for any real numbers a and b and any integer n, $(ab)^n = a^n b^n.$	Simplify: $(3x^{-4}y^2)^3$. $(3x^{-4}y^2)^3 = 3^3(x^{-4})^3(y^2)^3$ $= 27x^{-12}y^6$ $= \frac{27y^6}{x^{12}}$	8. Simplify: $(8a^3b^{-5})^2$. A. $\frac{8a^5}{b^7}$ B. $\frac{16a^6}{b^{10}}$ C. $\frac{64a^3}{b^5}$ D. $\frac{64a^6}{b^{10}}$
To raise a quotient to a power, raise both the numerator and the denominator to the power. That is, for any real numbers a and b, $b \neq 0$, and any integer n, $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}.$	Simplify: $\left(\frac{4}{a^5}\right)^3$. $\left(\frac{4}{a^5}\right)^3 = \frac{4^3}{(a^5)^3} = \frac{64}{a^{15}}$	9. Simplify: $\left(\frac{y^4}{7}\right)^2$. A. $\frac{y^6}{49}$ B. $\frac{y^8}{49}$ C. $\frac{y^{16}}{49}$ D. $\frac{y^8}{7}$

Objective [4.2c] Convert between scientific notation and decimal notation.

Brief Procedure	Example	Practice Exercises
To convert from decimal notation to scientific notation, rewrite the number in the form $M \times 10^n$, where n is an integer, $1 \leq M < 10$, and M is expressed in decimal notation. If the original number is large (greater than 1), then n is positive. If it is a small number (less than 1), then n is negative.	Convert 0.00048 to scientific notation. 0.0004. 8 4 places The number is small, so the exponent is negative. $0.00048 = 4.8 \times 10^{-4}$	10. Convert 567,000 to scientific notation. A. 5.67×10^{-5} B. 5.67×10^3 C. 5.67×10^5 D. 567×10^3
Given a number $M \times 10^n$ in scientific notation, convert to decimal notation by moving the decimal point in M n places to the right or left. If the exponent is positive, the number is large, so the decimal point should be moved to the right. If the exponent is negative, the number is small so the decimal point should be moved to the left.	Convert 4.208×10^6 to decimal notation. The exponent is positive, so the number is large. We move the decimal point 6 places to the right. 4.208000. 6 places $4.208 \times 10^6 = 4,208,000$	11. Convert 3×10^{-4} to decimal notation. A. 0.0003 B. 0.003 C. 3000 D. 30,000

Objective [4.2d] Multiply and divide using scientific notation.		
Brief Procedure	Example	Practice Exercise
Apply the commutative and associative laws and the rules for exponents.	Multiply and express the result in scientific notation: $(4.2 \times 10^8) \cdot (3.1 \times 10^{-3})$. $(4.2 \times 10^8) \cdot (3.1 \times 10^{-3})$ $= (4.2 \cdot 3.1) \times (10^8 \cdot 10^{-3})$ $= 13.02 \times 10^5$ The answer at this stage is 13.02×10^5, but this is not scientific notation, because 13.02 is not a number between 1 and 10. We convert 13.02 to scientific notation and simplify. 13.02×10^5 $= (1.302 \times 10) \times 10^5$ $= 1.302 \times (10 \times 10^5)$ $= 1.302 \times 10^6$	12. Divide and express the result in scientific notation: $\frac{3.3 \times 10^2}{4.4 \times 10^{-10}}$. A. 0.75×10^{-8} B. 0.75×10^{12} C. 7.5×10^{11} D. 7.5×10^{13}

Objective [4.2e] Solve applied problems using scientific notation.		
Brief Procedure	Example	Practice Exercise
Express the numbers involved in scientific notation and carry out the indicated calculation.	In the summer about 1.3088×10^8 L of water spills over the Canadian side of Niagara Falls in 1 min. How much water spills over the falls in 1 sec? Express the answer in scientific notation. We divide 1.3088×10^8 by 60, expressing 60 in scientific notation as 6×10. $\frac{1.3088 \times 10^8}{6 \times 10}$ $= \frac{1.3088}{6} \times \frac{10^8}{10}$ $\approx 0.218 \times 10^7$ $\approx (2.18 \times 10^{-1}) \times 10^7$ $\approx 2.18 \times (10^{-1} \times 10^7)$ $\approx 2.18 \times 10^6$ About 2.18×10^6 L of water spills over the falls in 1 sec.	13. Using the information given in the example at the left, find the amount of water that spills over the falls in 1 hr. Express the answer in scientific notation. A. 7.8528×10^6 L B. 7.8528×10^8 L C. 7.8528×10^9 L D. 78.528×10^8 L

Objective [4.3a] Evaluate a polynomial for a given value of the variable.		
Brief Procedure	Example	Practice Exercise
Substitute the given value for the variable and perform the calculations indicated using the rules for order of operations.	Evaluate $3x^2 - 5x + 7$ for $x = -2$. $$\begin{aligned} 3x^2 - 5x + 7 &= 3(-2)^2 - 5(-2) + 7 \\ &= 3 \cdot 4 - 5(-2) + 7 \\ &= 12 + 10 + 7 \\ &= 22 + 7 \\ &= 29 \end{aligned}$$	14. Evaluate $-x^2 + 3x - 4$ for $x = -1$. A. -8 B. -6 C. -2 D. 0

Objective [4.3b] Identify the terms of a polynomial.		
Brief Procedure	Example	Practice Exercise
Rewrite the subtractions in the polynomial as additions. Then each monomial being added is a term of the polynomial.	Identify the terms of the polynomial $3y^3 - 2y^2 - 5y + 1$. $3y^3 - 2y^2 - 5y + 1 = 3y^3 + (-2y^2) + (-5y) + 1$ Then the terms are $3y^3,\ -2y^2,\ -5y$, and 1.	15. Identify the terms of the polynomial $-5y^4 + 3y^2 - 2$. A. $5y^4,\ 3y^2,\ 2$ B. $5y^4,\ 3y^2$ C. $-5y^4,\ 3y^2$ D. $-5y^4,\ 3y^2,\ -2$

Objective [4.3c] Identify the like terms of a polynomial.		
Brief Procedure	Example	Practice Exercise
Identify the terms that have the same variable raised to the same power.	Identify the like terms in the polynomial $3x^2 - 4x + 5 - 6x^2 - 2x + 7$. $3x^2$ and $-6x^2$ have the same variable raised to the same power, so they are like terms. $-4x$ and $-2x$ have the same variable raised to the same power, so they are like terms. The constant terms 5 and 7 are also like terms, because they can be thought of as $5x^0$ and $7x^0$, respectively.	16. Identify all the like terms of the polynomial $4y^5 - 7 - 3y^5 + 4$. A. $4y^5$ and $-3y^5$ B. -7 and 4 C. $4y^5$ and 4 D. $4y^5$ and $-3y^5$; -7 and 4

Objective [4.3d] Identify the coefficients of a polynomial.		
Brief Procedure	Example	Practice Exercise
The coefficient of a term of a polynomial is the number by which the variable is multiplied.	Identify the coefficients of each term of the polynomial $5y^6 - 10y^2 + 4$. The coefficient of $5y^6$ is 5. The coefficient of $-10y^2$ is -10. The coefficient of 4 is 4.	17. Identify the coefficients of each term of the polynomial $-8x^3 + 4x^2 - 7$. A. $-8,\ 4$ B. $-8,\ 4,\ -7$ C. 3, 2 D. 3, 2, 0

Objective [4.3e] Collect the like terms of a polynomial.

Brief Procedure	Example	Practice Exercise
The distributive laws allow us to collect like terms by adding or subtracting their coefficients.	Collect like terms: $5x^4 - 6x^2 - 3x^4 + 1$. $5x^4 - 6x^2 - 3x^4 + 1$ $= (5-3)x^4 - 6x^2 + 1$ $= 2x^4 - 6x^2 + 1$	18. Collect like terms: $4x^3 - 2x^2 + 3x^2 - 5$. A. $7x^3 - 2x^2 - 5$ B. $4x^3 + x^2 - 5$ C. $5x^2 - 5$ D. x^2

Objective [4.3f] Arrange a polynomial in descending order, or collect the like terms and then arrange in descending order.

Brief Procedure	Example	Practice Exercise
Collect the like terms by adding or subtracting their coefficients. Then arrange the terms so that the exponents decrease from left to right.	Collect like terms and then arrange in descending order: $8 + 3x^2 - 4x - x^2 - 4 + 5x$. $8 + 3x^2 - 4x - x^2 - 4 + 5x$ $= 4 + 2x^2 + x$ $= 2x^2 + x + 4$	19. Collect like terms and then arrange in descending order: $x - x^2 + 6 + 7x - 9 - 2x^2$. A. $8x - 3x^2 - 3$ B. $-3 + 8x - 3x^2$ C. $-3 - 3x^2 + 8x$ D. $-3x^2 + 8x - 3$

Objective [4.3g] Identify the degree of each term of a polynomial and the degree of the polynomial.

Brief Procedure	Example	Practice Exercise
The degree of a term is the exponent of the variable. The degree of a polynomial is the largest of the degrees of the terms. The only exception is the polynomial 0 which has no degree either as a term or as a polynomial.	Identify the degree of each term and the degree of the polynomial: $2x^4 - 6x^3 + x - 4$. The degree of $2x^4$ is the exponent of the variable, 4. The degree of $-6x^3$ is the exponent of the variable, 3. The degree of x is the exponent of the variable, 1, since $x = x^1$. The degree of -4 is the exponent of the variable, 0, since $-4 = -4x^0$. The largest of the degrees of the terms is 4, so the degree of the polynomial is 4.	20. Identify the degree of the polynomial: $-5x - x^3 + 8x^2 + 7$. A. 2 B. 3 C. 7 D. 8

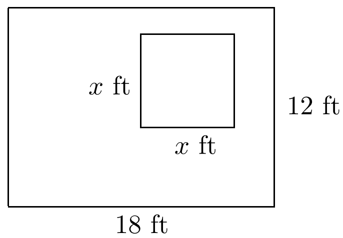
Objective [4.3h] Identify the missing terms of a polynomial.		
Brief Procedure	Example	Practice Exercise
A term of a polynomial with a 0 coefficient is a missing term. We consider only terms of lower degree than the degree of the polynomial to be missing.	Identify the missing terms in the polynomial $4x^3 - x$. There are no terms with degree 2 or 0. (A term with degree 0 is a constant term.) Thus the x^2- and x^0-terms are missing.	21. Identify the missing terms in the polynomial $6x^4 - x^2 + 7$. A. x B. x^3 C. $x^3,\ x$ D. $x^5,\ x^3,\ x$

Objective [4.3i] Classify a polynomial as a monomial, binomial, trinomial, or none of these.		
Brief Procedure	Example	Practice Exercise
A polynomial with just one term is a monomial. A polynomial with just two terms is a binomial. A polynomial with just three terms is a trinomial. Those with more than three terms do not generally have a specific name.	Classify each of the following as a monomial, binomial, trinomial, or none of these. a) $x^2 - 7$ b) $2x^3 - x^2 + 5x + 6$ a) This polynomial has just two terms, so it is a binomial. b) This polynomial has more than three terms, so it is none of these.	22. Classify $-6x^7$ as a monomial, binomial, trinomial, or none of these. A. Monomial B. Binomial C. Trinomial D. None of these

Objective [4.4a] Add polynomials.		
Brief Procedure	Example	Practice Exercise
To add two polynomials, write a plus sign between them and then collect like terms. The polynomials can also be written with like terms in columns and then added.	Add: $(5x^3 + x - 7) + (2x^3 - 4x^2 + 3)$. $(5x^3 + x - 7) + (2x^3 - 4x^2 + 3)$ $= (5 + 2)x^3 - 4x^2 + x + (-7 + 3)$ $= 7x^3 - 4x^2 + x - 4$	23. Add: $(6x^4 - 5x^2 - 1) +$ $(x^3 - 3x^2 + 4)$. A. $7x^4 - 8x^2 + 3$ B. $7x^4 - 8x^3 + 3$ C. $6x^4 + x^3 - 8x^2 + 3$ D. $6x^4 + x^3 - 2x^2 + 3$

Objective [4.4b] Find the opposite of a polynomial.		
Brief Procedure	Example	Practice Exercise
Replace each term of the polynomial with its opposite. That is, change the sign of each term.	Simplify $-(10x^2 - 5x + 2)$. We change the sign of each term. $-(10x^2 - 5x + 2) = -10x^2 + 5x - 2$	24. Simplify $-(-x^3 + 3x - 4)$. A. $x^3 + 3x - 4$ B. $x^3 - 3x + 4$ C. $-x^3 - 3x - 4$ D. $-x^3 - 3x + 4$

Objective [4.4c] Subtract polynomials.		
Brief Procedure	Example	Practice Exercise
Add the opposite of the polynomial being subtracted. In other words, change the sign of each term of the polynomial being subtracted and then collect like terms.	Subtract: $(4x^2 - x + 3) - (6x^2 - 4x - 1)$. $(4x^2 - x + 3) - (6x^2 - 4x - 1)$ $= 4x^2 - x + 3 - 6x^2 + 4x + 1)$ $= -2x^2 + 3x + 4$	25. Subtract: $(x^3 - x + 2) - (5x^3 + x^2 - 8)$. A. $-4x^3 + 10$ B. $-4x^3 + x^2 - x - 6$ C. $-4x^3 - x^2 - x - 6$ D. $-4x^3 - x^2 - x + 10$

Objective [4.4d] Use polynomials to represent perimeter and area.		
Brief Procedure	Example	Practice Exercise
Use formulas from geometry for perimeter and area, and use addition and subtraction of polynomials.	A square sandbox that is x ft on a side is placed on a lawn that is 12 ft by 18 ft. Find a polynomial for the area of the lawn not covered by the sandbox. First we make a drawing.  Then we reword the problem and find the polynomial. $\underbrace{\text{Area of lawn}}_{\downarrow} - \underbrace{\text{Area of sandbox}}_{\downarrow} = \underbrace{\text{Area left over}}_{\downarrow}$ $18 \cdot 12 - x \cdot x = \text{Area left over}$ Then $216 - x^2 =$ Area left over.	26. One rectangle has length $3y$ and width $2y$. Another has length $5y$ and width y. Find a polynomial for the sum of the perimeters of the rectangles. A. $11y$ B. $22y$ C. $11y^2$ D. $30y^4$

Objective [4.5a] Multiply monomials.		
Brief Procedure	Example	Practice Exercise
Multiply the coefficients, and then multiply the variables using the product rule for exponents.	Multiply: $(-3y^2)(6y^5)$. $(-3y^2)(6y^5) = (-3 \cdot 6)(y^2 \cdot y^5)$ $= -18y^{2+5}$ $= -18y^7$	27. Multiply: $(5n^4)(-2n^2)$. A. $-7n^6$ B. $-10n^2$ C. $-10n^6$ D. $-10n^8$

Objective [4.5b] Multiply a monomial and any polynomial.		
Brief Procedure	Example	Practice Exercise
Multiply each term of the polynomial by the monomial.	Multiply: $3x(2x^3 - x)$. $3x(2x^3 - x) = (3x)(2x^3) - (3x)(x)$ $= 6x^4 - 3x^2$	28. Multiply: $2x^2(x^2 - 3x - 5)$. A. $3x^2 - 3x - 5$ B. $2x^4 - 3x - 5$ C. $2x^4 - 6x^3 - 5$ D. $2x^4 - 6x^3 - 10x^2$

Objective [4.5c] Multiply two binomials.

Brief Procedure	Example	Practice Exercise
Use the distributive law and collect like terms, if possible.	Multiply: $(x-3)(x+2)$. $\begin{aligned}(x-3)(x+2) &= x(x+2)-3(x+2)\\ &= x^2+2x-3x-6\\ &= x^2-x-6\end{aligned}$	29. Multiply: $(2x-7)(x+1)$. A. $2x^2-7x$ B. $2x^2-7x-7$ C. $2x^2-5x-7$ D. $2x^2+2x-7$

Objective [4.5d] Multiply any two polynomials.

Brief Procedure	Example	Practice Exercise
Multiply each term of one polynomial by every term of the other and collect like terms, if possible. It is often convenient to write the multiplication in columns.	Multiply: $(x^2-2x+3)(x-1)$. We use columns. First we multiply the top row by -1 and then by x, placing like terms of the product in the same column. Finally we collect like terms. $\begin{array}{rrrr} & x^2 & -\,2x & +\,3 \\ & & x & -\,1 \\ \hline & -\,x^2 & +\,2x & -\,3 \\ x^3 & -\,2x^2 & +\,3x & \\ \hline x^3 & -\,3x^2 & +\,5x & -\,3 \end{array}$	30. Multiply: $(x^3-3x+1)(x^2+4)$. A. $x^5-3x^3+x^2$ B. $x^5-12x+1$ C. $x^5+x^3-11x^2+4$ D. $x^5+x^3+x^2-12x+4$

Objective [4.6a] Multiply two binomials mentally using the FOIL method.

Brief Procedure	Example	Practice Exercise
To multiply two binomials, $A+B$ and $C+D$, multiply the **F**irst terms AC, the **O**utside terms AD, the **I**nside terms BC, and then the **L**ast terms BD. Then collect like terms, if possible. $(A+B)(C+D) = AC+AD+BC+BD$	Multiply: $(2x+3)(x-4)$. $(2x+3)(x-4)$ F O I L $= 2x\cdot x+2x\cdot(-4)+3\cdot x+3\cdot(-4)$ $= 2x^2-8x+3x-12$ $= 2x^2-5x-12$	31. Multiply: $(y+2)(3y-5)$. A. $3y^2+y-10$ B. $3y^2-5y-10$ C. $3y^2+6y-10$ D. $3y^2-11y-10$

Objective [4.6b] Multiply the sum and difference of two terms mentally.

Brief Procedure	Example	Practice Exercise
The product of the sum and the difference of the same two terms is the square of the first term minus the square of the second term: $(A+B)(A-B) = A^2-B^2$	Multiply: $(2x+1)(2x-1)$. $\begin{aligned}(2x+1)(2x-1) &= (2x)^2-1^2\\ &= 4x^2-1\end{aligned}$	32. Multiply: $(x+6)(x-6)$. A. $x^2+12x-36$ B. $x^2-12x-36$ C. x^2+36 D. x^2-36

Objective [4.6c] Square a binomial mentally.		
Brief Procedure	Example	Practice Exercise
The square of a sum or a difference of two terms is the square of the first term, plus or minus twice the product of the two terms, plus the square of the last term: $(A+B)^2 = A^2 + 2AB + B^2$; $(A-B)^2 = A^2 - 2AB + B^2$.	Multiply: $(3x-4)^2$. $(3x-4)^2$ $= (3x)^2 - 2 \cdot 3x \cdot 4 + 4^2$ $= 9x^2 - 24x + 16$	33. Multiply: $(2x+1)^2$. A. $4x^2+1$ B. $2x^2+4x+1$ C. $4x^2+2x+1$ D. $4x^2+4x+1$

Objective [4.6d] Find special products when polynomial products are mixed together.		
Brief Procedure	Example	Practice Exercise
1. Use the rule for the square of a binomial or for the product of the sum and difference of the same two terms, if applicable. 2. To find the product of two binomials when the rules above do not apply, use FOIL. 3. To find the product of a monomial and a polynomial, multiply each term of the polynomial by the monomial. 4. To find the product of two polynomials other than those above, multiply each term of one by every term of the other.	Multiply: $(n-4)(n+3)$. This is the product of two binomials, but it is not the square of a binomial nor the product of the sum and difference of the same two terms. We use FOIL. $(n-4)(n+3) = n^2 + 3n - 4n - 12$ $= n^2 - n - 12$	34. Multiply: $(3y+1)^2$. A. $9y^2+1$ B. $3y^2+3y+1$ C. $9y^2+3y+1$ D. $9y^2+6y+1$

Objective [4.7a] Evaluate a polynomial in several variables for given values of the variables.		
Brief Procedure	Example	Practice Exercise
Make the substitutions indicated and then perform the resulting computation.	Evaluate the polynomial $x^2y^2 - 3xy + 2xy^3$ for $x = 2$ and $y = -1$. We replace x with 2 and y with -1. $x^2y^2 - 3xy + 2xy^3$ $= 2^2(-1)^2 - 3(2)(-1) + 2(2)(-1)^3$ $= 4(1) - 3(2)(-1) + 2(2)(-1)$ $= 4 + 6 - 4$ $= 6$	35. Evaluate the polynomial $2xy^2 - 4x^3y + 5$ for $x = -1$ and $y = 3$. A. -25 B. -1 C. 35 D. 119

<table>
<tr><td colspan="3">Objective [4.7b] For a polynomial in several variables, identify the coefficients and the degrees of the terms and the degree of the polynomial.</td></tr>
<tr><th>Brief Procedure</th><th>Example</th><th>Practice Exercise</th></tr>
<tr><td>The coefficient of a term is the number by which the variables are multiplied. The degree of a term is the sum of the exponents of the variables. The degree of a polynomial is the degree of the term of highest degree.</td><td>Identify the coefficient and the degree of each term and the degree of the polynomial $8xy^3 - 7x^2y^4 + 5xy - 4$.
Term | Coefficient | Degree
$8xy^3$ | 8 | 4
$-7x^2y^4$ | -7 | 6
$5xy$ | 5 | 2
-4 | -4 | 0
The degree of the term of highest degree is 6, so the degree of the polynomial is 6.</td><td>36. Identify the degree of the polynomial $2x^2y - 8x^3y^4 + 9x + 6x^2y^3 - 1$.
A. 3
B. 5
C. 7
D. 9</td></tr>
<tr><td colspan="3">Objective [4.7c] Collect like terms of a polynomial (in several variables).</td></tr>
<tr><th>Brief Procedure</th><th>Example</th><th>Practice Exercise</th></tr>
<tr><td>Like terms have exactly the same variables with exactly the same exponents. The distributive laws allow us to collect like terms by adding or subtracting their coefficients.</td><td>Collect like terms:
$7ab - ab^2 - 2ab + 5a^2b + 4ab^2$.
$7ab - ab^2 - 2ab + 5a^2b + 4ab^2$
$= (7-2)ab + (-1+4)ab^2 + 5a^2b$
$= 5ab + 3ab^2 + 5a^2b$</td><td>37. Collect like terms:
$5xy^2 - 4x^2y + 3 + 2x^2y + 7 - xy^2$.
A. $3xy^2 - 5x^2y + 10$
B. $xy^2 + 10 + x^2y$
C. $4xy^2 - 2x^2y + 10$
D. $7xy^2 - 5x^2y + 10$</td></tr>
<tr><td colspan="3">Objective [4.7d] Add polynomials (in several variables).</td></tr>
<tr><th>Brief Procedure</th><th>Example</th><th>Practice Exercise</th></tr>
<tr><td>To add two polynomials in several variables, write a plus sign between them and then collect like terms.</td><td>Add: $(3x^3 - 2xy + 4) + (x^3 - xy^2 + 5)$.
$(3x^3 - 2xy + 4) + (x^3 - xy^2 + 5)$
$= (3+1)x^3 - 2xy - xy^2 + (4+5)$
$= 4x^3 - 2xy - xy^2 + 9$</td><td>38. Add:$(2x^3y^2 - 3x^2y + xy^2) +$
$(5x^2y^2 + 4x^2y - 8xy^2)$.
A. $7x^3y^2 + x^2y - 7xy^2$
B. $7x^3y^2 - 7x^2y - 7xy^2$
C. $2x^3y^2 - 7x^2y + 5x^2y^2 - 7xy^2$
D. $2x^3y^2 + x^2y + 5x^2y^2 - 7xy^2$</td></tr>
<tr><td colspan="3">Objective [4.7e] Subtract polynomials (in several variables).</td></tr>
<tr><th>Brief Procedure</th><th>Example</th><th>Practice Exercise</th></tr>
<tr><td>Add the opposite of the polynomial being subtracted.</td><td>Subtract: $(m^4n + 2m^3n^2 - m^2n^3) -$
$(3m^4n + 2m^3n^2 - 4m^2n^2)$.
$(m^4n + 2m^3n^2 - m^2n^3) -$
$(3m^4n + 2m^3n^2 - 4m^2n^2)$
$= m^4n + 2m^3n^2 - m^2n^3 -$
$3m^4n - 2m^3n^2 + 4m^2n^2$
$= -2m^4n - m^2n^3 + 4m^2n^2$</td><td>39. Subtract: $(a^3b^2 - 5a^2b + 2ab) -$
$(3a^3b^2 - ab^2 + 4ab)$.
A. $-2a^3b^2 - 5a^2b + 6ab - ab^2$
B. $-2a^3b^2 - 5a^2b - 2ab + ab^2$
C. $-2a^3b^2 - 4a^2b + 6ab$
D. $4a^3b^2 - 5a^2b - 2ab + ab^2$</td></tr>
</table>

Objective [4.7f] Multiply polynomials (in several variables).

Brief Procedure	Example	Practice Exercise
Multiply each term of one polynomial by every term of the other. Use the rules for special products where appropriate.	Multiply: $(xy^2 - 3x)(xy + y^2)$. We use FOIL. $(xy^2 - 3x)(xy + y^2)$ F O I L $= x^2y^3 + xy^4 - 3x^2y - 3xy^2$	40. Multiply: $(2x + 5y)^2$. A. $4x^2 + 25y^2$ B. $4x^2 + 10xy + 25y^2$ C. $4x^2 + 20xy + 25y^2$ D. $4x^2 - 20xy + 25y^2$

Objective [4.8a] Divide a polynomial by a monomial.

Brief Procedure	Example	Practice Exercise
Divide the coefficients and then divide the variables using the quotient rule for exponents.	Divide: $(6x^3 - 8x^2 + 15x) \div (3x)$. $\frac{6x^3 - 8x^2 + 15x}{3x}$ $= \frac{6x^3}{3x} - \frac{8x^2}{3x} + \frac{15x}{3x}$ $= \frac{6}{3}x^{3-1} - \frac{8}{3}x^{2-1} + \frac{15}{3}$ $= 2x^2 - \frac{8}{3}x + 5$	41. Divide: $(4y^2 - 5y + 12) \div 4$. A. $y^2 - 5y + 12$ B. $y^2 - \frac{5}{4}y + 12$ C. $y^2 - \frac{5}{4}y + 3$ D. $4y^2 - 5y + 3$

Objective [4.8b] Divide a polynomial by a divisor that is not a monomial.

Brief Procedure	Example	Practice Exercise
Use long division by repeating the following procedure until the degree of the remainder is less than the degree of the divisor. 1. Divide, 2. Multiply, 3. Subtract, and 4. Bring down the next term.	Divide $x^2 - 3x + 7$ by $x + 1$. $\begin{array}{r\|l} & x - 4 \\ x+1 & x^2 - 3x + 7 \\ & \underline{x^2 + x} \\ & \quad -4x + 7 \\ & \quad \underline{-4x - 4} \\ & \qquad\quad 11 \end{array}$ The answer is $x - 4 + \frac{11}{x+1}$.	42. Divide: $(x^2 - 8x + 5) \div (x - 2)$. A. $x - 10 + \frac{25}{x-2}$ B. $x - 10 + \frac{-15}{x-2}$ C. $x - 6 + \frac{-17}{x-2}$ D. $x - 6 + \frac{-7}{x-2}$