Perform arithmetic operations on polynomials, extending beyond the quadratic polynomials (Standards A.APR.1).	
Standard A.APR.1: Understand that all polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.	
Concepts and Skills to Master	
• Add, subtract and multiply polynomials. • Understand closure of polynomials for addition, subtraction, and multiplication (for example, extend properties of arithmetic to polynomial arithmetic).	
Related Standards: Current Course	Related Standards: Future Courses
III.N.CN.8, III.A.SSE.1, III.A.APR.2, III.A.APR.3, III.A.APR.4, III.A.APR.5, III.A.APR.6, III.A.APR.7	P.N.CN.3, P.N.CN.5, P.N.CN.10

Support for Teachers

Critical Background Knowledge
• Performing the mathematical operations of addition, subtraction, and multiplication using quadratics (II.A.APR.1) • Understanding closure of polynomials for addition, subtraction, and multiplication (II.A.APR.1)
Academic Vocabulary
closure
Resources
Curriculum Resources: https://www.uen.org/core/core.do?courseNum=5630#71594

Understand the relationship between zeros and factors of polynomials (Standards A.APR.2-3).	
Standard A.APR.2: Know and apply the Remainder Theorem: For a polynomial *p(x)* and a number *a*, the remainder on division by $x-a$ is $p(a)$, so $p(a)=0$ if and only if $(x-a)$ is a factor of $p(x)$.	
Concepts and Skills to Master	
• Understand that if $p(a) = 0$ then $(x - a)$ is a factor of $p(x)$. • Understand that if $(x - a)$ is a factor of $p(x)$ then $p(a) = 0$ • Use the Remainder Theorem to determine zeros and factors of polynomials. • Explain the relationship between the quotient and the remainder for polynomial division problems.	
Related Standards: Current Course	Related Standards: Future Courses
III.A.APR.1, III.A.APR.3, III.A.APR.6, III.N.CN.9, III.A.SSE.1, III.A.SSE.2, III.A.CED.1, III.F.IF.4, III.F.IF.7, III.F.IF.8	P.F.IF.7

Support for Teachers

Critical Background Knowledge (Access background knowledge)
• Solve quadratic equations (II.N.CN.7, II.N.CN.8, II.N.CN.9) • Factoring a quadratic expression to reveal the zeros of the function it defines (II.A.SSE.3, II.F.IF.8)
Academic Vocabulary
Remainder Theorem
Resources
Curriculum Resources: https://www.uen.org/core/core.do?courseNum=5630#71596

Understand the relationship between zeros and factors of polynomials (Standards A.APR.2-3).	
Standard A.APR.3: Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.	
Concepts and Skills to Master	
• Given a polynomial function in factored form, identify and use the zeros and other key features to make a sketch of the graph of the function. • Recognize that repeated factors indicate multiplicity of roots and understand how they impact the graph.	
Related Standards: Current Course	Related Standards: Future Courses
III.A.APR.2, III.A.SSE.1, III.A.SSE.2, III.A.CED.1, III.N.CN.9, III.F.IF.4, III.F.IF.7.c, III.F.IF.8	P.F.IF.7

Support for Teachers

Critical Background Knowledge
• Graphing quadratic functions by hand, showing intercepts, and maxima or minima (II.F.IF.7)
Academic Vocabulary
Resources
Curriculum Resources: https://www.uen.org/core/core.do?courseNum=5630#71597

Use polynomial identities to solve problems (Standards A.APR.4-5).	
Standard A.APR.4: Prove polynomial identities and use them to describe numerical relationships. *For example, the polynomial identity* $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ *can be used to generate Pythagorean triples.*	
Concepts and Skills to Master	
• Prove polynomial identities that expand or factor polynomials. • Use structure to show the relationship between two related polynomial expressions.	
Related Standards: Current Course	Related Standards: Future Courses
III.A.SSE.1, III.A.SSE.2, III.N.CN.8, III.F.IF.8	P.F.TF.9

Support for Teachers

Critical Background Knowledge
• Use the structure of an expression to rewrite it (II.A.SSE.2, II.A.SSE.3, II.F.IF.8)
Academic Vocabulary
polynomial identity
Resources
Curriculum Resources: https://www.uen.org/core/core.do?courseNum=5630#71599

Use polynomial identities to solve problems (Standards A.APR.4-5).	
Standard A.APR.5: Know and apply the Binomial Theorem for the expansion of $(x+y)^n$ in powers of x and y for a positive integer n, where x and y are any numbers. *For example, with coefficients determined by Pascal's Triangle.*	
Concepts and Skills to Master	
• Find terms for an expanded product using the Binomial Theorem, recognizing how Pascal's Triangle can be useful in the expansion	
Related Standards: Current Course	Related Standards: Future Courses
III.A.SSE.1, III.A.SSE.2, III.F.IF.8	P.S.CP.9

Support for Teachers

Critical Background Knowledge
• Use the structure of an expression to rewrite it (II.A.SSE.2, II.A.SSE.3, II.F.IF.8)
Academic Vocabulary
Binomial Theorem, Pascal's Triangle
Resources
Curriculum Resources: https://www.uen.org/core/core.do?courseNum=5630#71600

Rewrite rational expressions (Standards A.APR.6-7).	
Standard A.APR.6: Rewrite simple rational expressions in different forms; write *a(x)/b(x)* in the form *q(x) + r(x)/b(x)*, where *a(x), b(x), q(x)*, and *r(x)* are polynomials with the degree of *r(x)* less than the degree of *b(x)*, using inspection, long division or, for the more complicated examples, a computer algebra system.	
Concepts and Skills to Master	
• Gain procedural fluency and conceptual understanding of how and why to rewrite rational expressions as quotients and remainders. • Rewrite simple rational expressions using inspection, long division and computer algebra system to divide complicated polynomials.	
Related Standards: Current Course	Related Standards: Future Courses
III.A.SSE.1, III.A.SSE.2, III.A.APR.2, III.A.APR.7, III.F.IF.7d, III.F.IF.8	P.F.IF.7

Support for Teachers

Critical Background Knowledge
• Multiplying/adding/subtracting polynomials (II.A.APR.1) • Find whole number quotients and remainders (4.NBT.6)
Academic Vocabulary
rational expression, computer algebra system
Resources
Curriculum Resources: https://www.uen.org/core/core.do?courseNum=5630#71602

Rewrite rational expressions (Standards A.APR.6-7).	
Standard A.APR.7: Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.	
Concepts and Skills to Master	
• Add, subtract, multiply, and divide rational expressions. • Understand that rational expressions are closed under addition, subtraction, multiplication, and non-zero division. • Relate rational number arithmetic to rational expression arithmetic and become fluent with the latter.	
Related Standards: Current Course	Related Standards: Future Courses
III.A.SSE.1, III.A.SSE.2, III.A.APR.1, III.A.APR.2, III.A.APR.6, III.F.IF.8	

Support for Teachers

Critical Background Knowledge
• Understand operations with rational numbers (7.NS.1, 7.NS.2) and the closure property (II.N.RN.3) • Closure of polynomials (II.A.APR.1)
Academic Vocabulary
rational expression, computer algebra system
Resources
Curriculum Resources: https://www.uen.org/core/core.do?courseNum=5630#71603