## ARITHMETIC WITH POLYNOMIALS AND RATIONAL EXPRESSIONS A-APR

### Perform arithmetic operations on polynomials

1. Understand that 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.

**8-1**

**Write each polynomial in standard form. Then name each polynomial based on its degree and number of terms.**

**24.** $5y - 2y^2$ **25.** $-2q + 7$ **26.** $x^2 + 4 - 3x$

**27.** $6x^2 - 13x^2 - 4x + 4$ **28.** $c + 8c^3 - 3c^7$ **29.** $3z^4 - 5z - 2z^2$

**8-2**

**Factor each polynomial.**

**21.** $9x - 6$ **22.** $t^2 + 8t$ **23.** $14n^3 - 35n^2 + 28$

**24.** $5k^3 + 20k^2 - 15$ **25.** $14x^3 - 2x^2 + 8x$ **26.** $g^4 + 24g^3 + 12g^2 + 4g$

**8-3**

**Simplify each product using the Distributive Property.**

**8.** $(x + 7)(x + 4)$ **9.** $(y - 3)(y + 8)$ **10.** $(m + 6)(m - 7)$

**11.** $(c - 10)(c - 5)$ **12.** $(2r - 3)(r + 1)$ **13.** $(2x + 7)(3x - 4)$

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## SEEING STRUCTURE IN EXPRESSIONS A-SSE

### Interpret the structure of expressions

1. Interpret expressions that represent a quantity in terms of its context.*
   a. Interpret parts of an expression, such as terms, factors, and coefficients.
   b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret P(1+r)n as the product of P and a factor not depending on P.*

**1-7**

**Write each fraction as a sum or difference.**

**25.** $\frac{2x + 7}{5}$ **26.** $\frac{17 + 5n}{4}$ **27.** $\frac{8 - 9x}{3}$ **28.** $\frac{4y - 12}{2}$

**Simplify each expression.**

**33.** $-(20 + d)$ **34.** $-(-5 - 4y)$ **35.** $-(9 - 7c)$ **36.** $-(-x + 15)$

**8-5**

**Factor each expression. Check your answer.**

**14.** $y^2 + 6y + 5$ **15.** $t^2 + 10t + 16$ **16.** $x^2 + 15x + 56$

**17.** $n^2 - 15n + 56$ **18.** $r^2 - 11r + 24$ **19.** $q^2 - 8q + 12$

**8-6**

**Factor each expression.**

**14.** $5z^2 + 19z - 4$ **15.** $2k^2 - 13k - 24$ **16.** $6t^2 + 7t - 5$

**17.** $3x^2 + 23x - 36$ **18.** $4w^2 - 5w - 6$ **19.** $4d^2 - 4d - 35$

**8-7**

**Factor each expression.**

**24.** $w^2 - 144$ **25.** $a^2 - 49$ **26.** $y^2 - 121$

**27.** $t^2 - 25$ **28.** $k^2 - 64$ **29.** $m^2 - 225$

**8-8**

**Factor each expression.**

**13.** $15q^3 + 40q^2 + 3q + 8$ **14.** $14y^3 + 8y^2 + 7y + 4$ **15.** $14z^3 - 35z^2 + 16z - 40$

**16.** $11w^3 - 9w^2 + 11w - 9$ **17.** $8m^3 + 12m^2 - 2m - 3$ **18.** $12k^3 - 27k^2 - 40k + 90$

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2. Use the structure of an expression to identify ways to rewrite it. *For example, see $x^4 - y^4$ as $(x2)^2 - (y2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.*

**8-7**

**Factor each expression.**

**9.** $h^2 + 8h + 16$ **10.** $v^2 - 10v + 25$ **17.** $9n^2 - 42n + 49$

**Factor each expression.**

**24.** $w^2 - 144$ **31.** $81r^2 - 1$ **35.** $9n^2 - 400$

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## CREATING EQUATIONS* A-CED

### Create equations that describe numbers or relationships

1. Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*

**1-8**

**27. Training** An athlete trains for 115 min each day for as many days as possible. Write an equation that relates the number of days $d$ that the athlete spends training when the athlete trains for 690 min.

**2-1**

**Solve each equation using multiplication or division. Check your answer.**

**26.** $-8n = -64$ **27.** $-7y = 28$ **28.** $5b = 145$ **29.** $6a = 0.96$

**34.** $\frac{m}{7} = 12$ **35.** $35 = \frac{j}{5}$ **36.** $\frac{k}{7} = 13$ **37.** $-39 = \frac{q}{3}$

**2-3**

**Solve each equation. Check your answer.**

**1.** $7p + 8p - 12 = 59$ **2.** $-2(3x + 9) = 24$

**3.** $\frac{2m}{7} + \frac{3m}{14} = 1$ **4.** $1.2 = 2.4 - 0.6x$

**2-4**

**Solve each equation. Check your answer.**

**21.** $3(q - 5) = 2(q + 5)$ **22.** $8 - (3 + b) = b - 9$

**23.** $7(6 - 2a) = 5(-3a + 1)$ **24.** $(g + 4) - 3g = 1 + g$

**3-3**

**Solve each inequality. Justify each step.**

**50.** $-4.5 > 9p$ **51.** $-1 \geq \frac{t}{3}$ **52.** $\frac{3}{4}n < 4$ **53.** $0.5 \leq \frac{1}{2}c$

**3-7**

**Solve each equation. If there is no solution, write *no solution*.**

**17.** $|r - 8| = 5$ **18.** $|c + 4| = 6$ **19.** $2 = |g + 3|$

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2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

**5-2**

**Determine whether each equation represents a direct variation. If it does, find the constant of variation.**

**9.** $2y = 5x + 1$ **10.** $8x + 9y = 10$ **11.** $-12x = 6y$

**5-5**

**Find the $x$- and $y$-intercepts of the graph of each equation.**

**8.** $x + y = 9$ **9.** $x - 2y = 2$ **10.** $-3x + 3y = 7$

**11.** $3x - 5y = -20$ **12.** $7x - y = 21$ **13.** $-5x + 3y = -7.5$

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3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*

**6-4**

**7. Business** A bicycle store costs $2400 per month to operate. The store pays an average of $60 per bike. The average selling price of each bicycle is $120. How many bicycles must the store sell each month to break even?

**11. Airports** A traveler is walking on a moving walkway in an airport. The traveler must walk back on the walkway to get a bag he forgot. The traveler's groundspeed is 2 ft/s against the walkway and 6 ft/s with the walkway. What is the traveler's speed off the walkway? What is the speed of the moving walkway?

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4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law $V = IR$ to highlight resistance $R$.*

**2-5**

**Solve each equation for $x$.**

**19.** $mx + nx = p$ **20.** $ax - x = c$ **21.** $\frac{rx + sx}{t} = 1$

**22.** $y = \frac{x - v}{b}$ **23.** $S = C + xC$ **24.** $\frac{x}{a} = \frac{y}{b}$

## REASONING WITH EQUATIONS AND INEQUALITIES A-REI

### Understand solving equations as a process of reasoning and explain the reasoning

1. Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

### Solve equations and inequalities in one variable

3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

**2-2**

**Solve each equation. Check your answer.**

**11.** $2 + \frac{a}{4} = -1$ **12.** $3n - 4 = 11$ **13.** $-1 = 7 + 8x$ **14.** $\frac{y}{5} + 2 = -8$

**2-7**

**Solve each proportion using any method.**

**30.** $\frac{7}{k-2} = \frac{5}{8}$ **31.** $\frac{3}{3b+4} = \frac{2}{b-4}$ **32.** $\frac{q+2}{5} = \frac{2q-11}{7}$ **33.** $\frac{c+1}{c-2} = \frac{4}{7}$

**34. Gardening** A gardener is transplanting flowers into a flowerbed. She has been working for an hour and has transplanted 14 flowers. She has 35 more flowers to transplant. If she works at the same rate, how many more hours will it take her?

**3-4**

**Solve each inequality. Check your solutions.**

**9.** $5f + 7 \leq 22$ **10.** $6n - 3 > -18$ **11.** $-5y - 2 < 8$

**15. Family Trip** On a trip from Buffalo, New York, to St. Augustine, Florida, a family wants to travel at least 250 mi in the first 5 h of driving. What should their average speed be in order to meet this goal?

**3-6**

**Solve each compound inequality. Graph your solutions.**

**11.** $-4 < k + 3 < 8$ **12.** $5 \leq y + 2 \leq 11$ **13.** $3 < 4p - 5 \leq 15$

**14.** $15 \leq \frac{20 + 11 + k}{3} \leq 19$ **15.** $\frac{1}{4} < \frac{2x - 7}{2} < 5$ **16.** $-3 \leq \frac{6 - q}{9} \leq 3$

4. Solve quadratic equations in one variable.

   a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.

   b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers $a$ and $b$.

**9-3**

**Solve each equation**

**8.** $x^2 - 9 = 0$ **9.** $x^2 + 7 = 0$ **10.** $3x^2 = 0$

**9-4**

**Solve by factoring.**

**14.** $x^2 + 11x + 10 = 0$ **15.** $g^2 + 4g - 32 = 0$ **16.** $s^2 - 14s + 45 = 0$

**9-5**

**Find the value of $c$ such that each expression is a perfect-square trinomial.**

**7.** $x^2 + 18x + c$ **8.** $z^2 + 22z + c$ **9.** $p^2 - 30p + c$

**Solve each equation by completing the square. If necessary, round to the nearest hundredth.**

**13.** $g^2 + 7g = 144$ **14.** $r^2 - 4r = 30$ **15.** $m^2 + 16m = -59$

**9-6**

**Use the quadratic formula to solve each equation.**

**7.** $2x^2 + 5x + 3 = 0$ **8.** $5x^2 + 16x - 84 = 0$

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## Represent and solve equations and inequalities graphically

10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

**1-9**

**Tell whether the given equation has the ordered pair as a solution.**

**8.** $y = x + 6; (0, 6)$ **9.** $y = 1 - x; (2, 1)$ **10.** $y = -x + 3; (4, 1)$

**4-2**

**For each table, determine whether the relationship is a linear function. Then represent the relationship using words, an equation, and a graph.**

8.

| x | y |
|---|---|
| 0 | 5 |
| 1 | 8 |
| 2 | 11 |
| 3 | 14 |

9.

| x | y |
|---|---|
| 0 | −3 |
| 1 | 2 |
| 2 | 7 |
| 3 | 12 |

10.

| x | y |
|---|---|
| 0 | 43 |
| 1 | 32 |
| 2 | 21 |
| 3 | 10 |

**4-3**

**Graph the function shown by each table. Tell whether the function is *linear* or *nonlinear*.**

8.

| x | y |
|---|---|
| 0 | 5 |
| 1 | 5 |
| 2 | 5 |
| 3 | 5 |

9.

| x | y |
|---|---|
| 0 | −4 |
| 1 | −3 |
| 2 | 0 |
| 3 | 5 |

10.

| x | y |
|---|---|
| 0 | 0 |
| 1 | 1 |
| 2 | −5 |
| 3 | 8 |

11.

| x | y |
|---|---|
| 0 | 0 |
| 1 | 3 |
| 2 | 6 |
| 3 | 9 |

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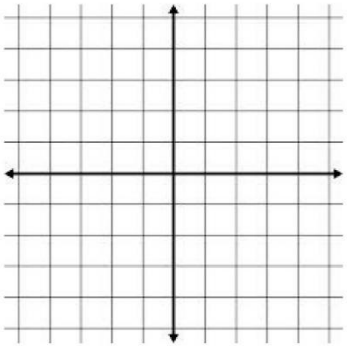
11. Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.

**6-1**

At what point does f(x) = g(x)?

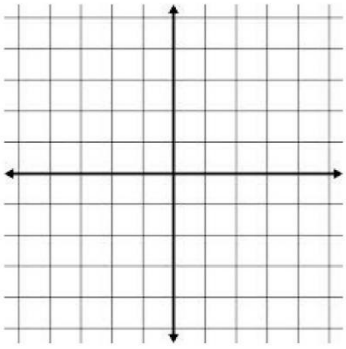
1. f(x) = $^1/_2$x + 2

   g(x) = -$^1/_2$x



2. f(x) = x – 4

   g(x) = -x



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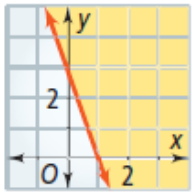
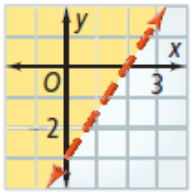
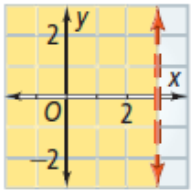
12. Graph the solutions to a linear inequality in two variables as a half- plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

**6-5**

**Write a linear inequality that represents each graph.**

32. 


33. 


34. 


**6-6**

**Determine whether the ordered pair is a solution of the given system.**

**7.** $(2, 12)$;
$y > 2x + 4$
$y < 3x + 7$

**8.** $(8, 2)$;
$3x - 2y \leq 17$
$0.3x + 4y > 9$

**9.** $(-3, 17)$;
$y > -5x + 2$
$y \geq -3x + 7$

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## INTERPRETING FUNCTIONS F-IF

### Understand the concept of a function and use function notation

1. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and *x* is an element of its domain, then *f(x)* denotes the output of *f* corresponding to the input *x*. The graph of *f* is the graph of the equation *y* = *f(x)*.

**4-6**

**Find the range of each function for the given domain.**

**18.** $f(x) = 2x - 7; \{-2, -1, 0, 1, 2\}$

**19.** $g(x) = -4x + 1; \{-5, -1, 0, 2, 10\}$

**Find a reasonable domain and range for each function. Then graph the function.**

**22. Fuel** A car can travel 32 mi for each gallon of gasoline. The function $d(x) = 32x$ represents the distance $d(x)$, in miles, that the car can travel with $x$ gallons of gasoline. The car's fuel tank holds 17 gal.

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2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

**(See previous 4-6 questions)**

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3. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. *For example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≥ 1.*

**4-7**

**Write a recursive formula for each sequence.**

**30.** 1.1, 1.9, 2.7, 3.5, . . .

**31.** 99, 88, 77, 66, . . .

**32.** 23, 38, 53, 68, . . .

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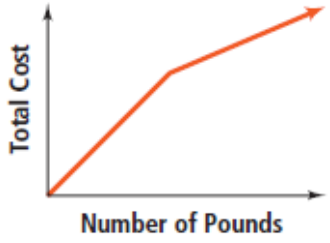
## Interpret functions that arise in applications in terms of the context

4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.**

**4-1**

**What are the variables in each graph? Describe how the variables are related at various points on the graph.**

**5.**

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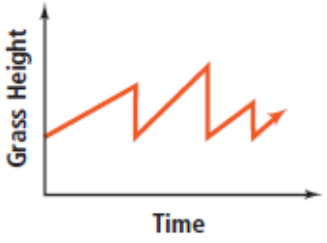


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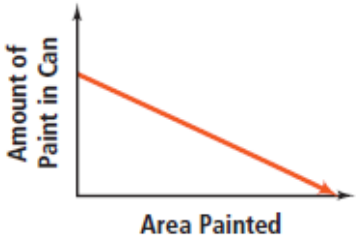


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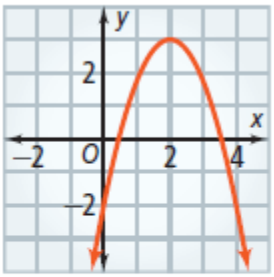
5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.**

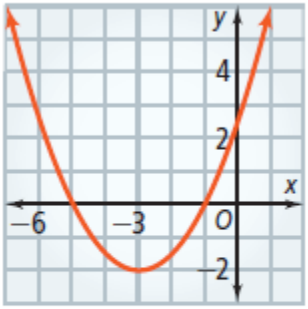
**9-1**

**Identify the vertex of each parabola. Tell whether it is a minimum or a maximum.**

**7.**




**8.**




**9.**

| x | y |
|---|---|
| 0 | 8 |
| 1 | 2 |
| 2 | 0 |
| 3 | 2 |
| 4 | 8 |

**Graph each function. Then identify the domain and range of the function.**

**10.** $y = -4x^2$ **11.** $f(x) = 1.5x^2$ **12.** $f(x) = 3x^2$

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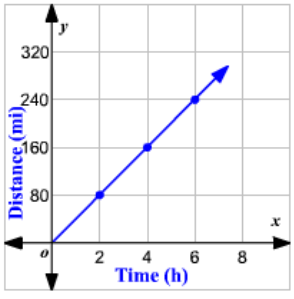
6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.*

**5-1**

1. Use the graph to find the rate of change.




2. Use the table to find the rate of change.

| *Ticket Price (dollars)* | *Profit (Millions of Dollars)* |
|---|---|
| 200 | 3.08 |
| 250 | 3.52 |
| 300 | 3.76 |
| 350 | 3.82 |
| 400 | 3.70 |
| 450 | 3.38 |

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# INTERPRETING CATEGORICAL AND QUANTITATIVE DATA S-ID

## Interpret linear models

7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
8. Compute (using technology) and interpret the correlation coefficient of a linear fit.
9. Distinguish between correlation and causation.

**5-7**

**Use the table.**

| Average Maximum Daily Temperature in January for Northern Latitudes | | | | | | | |
|---|---|---|---|---|---|---|---|
| Latitude (° N) | 35 | 33 | 30 | 25 | 43 | 40 | 39 |
| Temperature (°F) | 46 | 52 | 67 | 76 | 32 | 37 | 44 |

SOURCE: U.S. Department of Commerce

1. Make a scatter plot of the data. What type of relationship does the scatter plot show?
2. Draw a trend line and write its equation.
3. Predict the average maximum daily temperature in January at a latitude of 50° N.

**In each situation, tell whether a correlation is likely. If it is, tell whether the correlation reflects a causal relationship. Explain your reasoning.**

12. the amount of time you study for a test and the score you receive
13. a person's height and the number of letters in the person's name
14. the shoe size and the salary of a teacher