



Day 1: Heart of Algebra and Passport to Advanced Mathematics

Solving Linear Equations:

Example:

$$3(2n - 2) - 1 = 9/4$$

Given the equation above, what is the value of $2n - 2$?

- A) $5/12$
- B) $13/12$
- C) $7/4$
- D) $13/4$

Practice:

1.)

$$-3(m - 2n - 4) = -9$$

Given the equation above, what is the value of $m - 2n$?

- A) 7
- B) 4
- C) 3
- D) 6

2.)

$$6 = 2(y + 2)$$

What is the value of y ?

- A) 2
- B) -1
- C) 1
- D) 0

Linear Equation Word Problems:

Example:

A meteorologist estimates that on a sunny day, the air temperature decreases by about 4 F degrees for every 1,000 feet (ft) of elevation gain. On a certain day, the air temperature outside an airplane flying above Seattle is -58 F degrees and the ground level temperature in Seattle is 70 F degrees. If x is the height above Seattle, in feet, at which the plane is flying, which of the following best models the situation?

A) $70 = -(4/1000)x - 58$

B) $70 = (4/1000)x - 58$

C) $-58 = -(4/1000)x + 70$

D) $-58 = 4x + 70$

Practice:

A barber offers two options at his barbershop: a \$15.00 regular haircut and a \$20.00 deluxe haircut. On a certain day, the barber gave r regular haircuts and 3 fewer deluxe haircuts than regular haircuts. He earned \$500.00 total from the two types of haircuts. Which of the following equations best models this situation?

A) $15.00r + 20.00(r - 3) = 500.00$

B) $15.00r + 20.00(r + 3) = 500.00$

C) $15.00(r - 3) + 20.00r = 500.00$

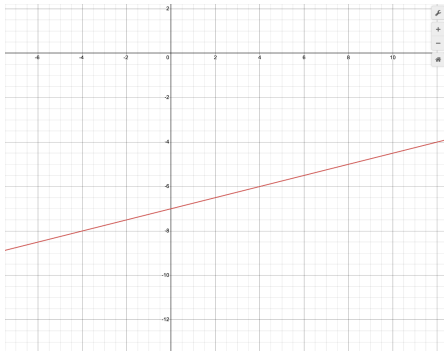
D) $15.00(r + 3) + 20.00r = 500.00$

Graphing Linear Equations:

Example:

Which of the following is an equation of the line in the xy -plane that passes through the point $(-2, 0)$ and is perpendicular to the line with equation $y = (1/4)x - 7$?

- A) $y = -(1/4)x + 8$
- B) $y = (1/4)x - 8$
- C) $y = -4x + 8$
- D) $y = -4x - 8$



Practice:

Which of the following is an equation of the line in the xy -plane that passes through the point $(-1/2, 2)$ and is parallel to the line with equation $y = -8x + 3$?

- A) $y = (1/8)x + 4$
- B) $y = (1/8)x + 1$
- C) $y = -8x - 2$
- D) $y = -8x + 2$

Systems of Linear Equations:

Example:

Find the solution to the system of equations:

$$2x+3y=5$$

$$4x-6y=10$$

- A) $x=0, y=2$
- B) $x=3/2, y=1$
- C) $x=5/2, y=0$
- D) $x=0, y=5/2$

Practice:

1.)

Find the solution to the system of equations:

$$4x+2y=3$$

$$8x-4y=6$$

- A) $x=3/4, y=0$
- B) $x=3/2, y=2$
- C) $x=7/2, y=5/2$
- D) $x=1, y=1/2$

2.)

Find the solution to the system of equations:

$$3x+5y=27$$

$$6x+9y=51$$

- A) $x = 9, y = 0$
- B) $x = 4, y = 3$
- C) $x = 7, y = 1$
- D) $x = 5/3, y = 2$

Linear Equations Word Problems:

Example:

A piece of glass with an initial temperature of 99°C is cooled at a rate of 3.5°C per minute. At the same time, a piece of copper with an initial temperature of 0°C is heated at 2.5°C per minute. Which of the following systems of equations can be used to solve for the temperature, T , in degrees Celsius, and the time, m , in minutes, when the glass and copper reach the same temperatures?

A) $T = 99 + 3.5m$

$$T = 2.5m$$

B) $T = 99 - 3.5m$

$$T = 2.5m$$

C) $T = 99 + 2.5m$

$$T = 3.5m$$

D) $T = 99 - 2.5m$

$$T = 3.5m$$

Practice:

Ethan sells e candy bars for $\$2.50$ apiece and Chloe sells c candy bars for $\$2.00$ apiece to raise money for a school trip. Ethan sold 15 fewer candy bars than Chloe, but he also got a $\$6.00$ donation. If Chloe and Ethan raised the same amount of money, which of the following systems could be used to find how many candy bars each sold?

A) $2c = 2.5e + 6$

$$c = e - 15$$

B) $2c = 2.5e + 6$

$$e = c - 15$$

C) $2c + 6 = 2.5e$

$$c = e - 15$$

D) $2c + 6 = 2.5e$

$$e = c - 15$$

Interpreting Linear Functions:

Example:

$$P=0.7c$$

A store is having a sale on every item purchased. Irina decides to take advantage of the sale and purchases a sweater. The equation that gives the after-sale price, P , or Irina's sweater with an original cost, c , is shown above. What percent of the original cost did Irina save?

- A) 3%
- B) 7%
- C) 30%
- D) 70%

Practice:

1.)

$$L=1.1J$$

Jacob and Liam purchased the same camera from two different stores that charged different amounts. The equation above gives the price that Liam, L , paid compared to the amount Jacob, J paid. What does the 1.1 mean in the equation?

- A) Jacob paid 10% more than Liam paid
- B) Liam paid 10% more than Jacob paid
- C) Jacob paid \$1.10 more than Liam paid
- D) Liam paid \$1.10 more than Jacob paid

2.)

$$V = -2.6 + d/3$$

The electric potential, V , in volts, between two metal plates a distance of d millimeters from the left plate is given by the equation above when $0 \leq d \leq 15$. By how many millimeters does the distance from the left plate increase for the potential to increase by 1 volt?

Free Response:

Linear Function Word Problems:

Example:

John's seafood restaurant is trying to estimate its profits. John has found that on average, each meal served costs the restaurant \$14.56 and earns \$17.12. John has also found that on average, each beverage served costs the restaurant \$1.20 and earns \$5.40. If c customers order a meal, and half of those customers order a beverage, which of the following functions models the restaurant's total profit?

- A) $f(c) = 17.12c - 14.56c + 5.40(1/2 c) - 1.20(1/2 c)$
- B) $f(c) = 17.12c - 14.56c + 5.40c - 1.20c$
- C) $f(c) = 14.56c - 17.12c + 1.20c - 5.40c$
- D) $f(c) = 14.56c - 17.12c + 1.20(1/2 c) - 5.40(1/2 c)$

Practice:

Dalia makes a cranberry apple punch that contains 20% real juice by mixing x gallons of a cranberry drink with y gallons of an apple drink. The cranberry drink contains 40% real juice and the apple drink contains 10% real juice. Which of the following equations represents the relationship between x and y ?

- A) $0.4x + 0.1y = 20$
- B) $0.4x + 0.1y = x + y$
- C) $0.20(x + y) = x + y$
- D) $0.2(x + y) = 0.4x + 0.1y$

Linear Inequality Word Problems:

Example:

Underwater pressure consists of atmospheric pressure, which is 101 kilopascals (kPa), plus 101 kPa of hydrostatic pressure for every 10 meters (m) of depth under water. Which inequality best represents the depth, d , in meters, that is permitted for a scuba diver who is advised not to exceed 220 kPa of underwater pressure?

- A) $101 + 101d \leq 220$
- B) $101 + 10.1d \leq 220$
- C) $101 + 10.1d > 220$
- D) $101 + 101d > 220$

Practice:

A local cafe has startup costs of \$4,500. The owner estimates quarterly costs (every three months) at the constant rate of \$10,200 per quarter. The owner operates for m months without earning a profit. If the owner does not want costs to exceed \$12,500, which of the following inequalities best represents this situation?

- A) $4,500 + 2,500m \leq 12,500$
- B) $10,200 + 2,500m \leq 12,500$
- C) $4,500 + 3,400m \leq 12,500$
- D) $4,500 + 3,400m > 12,500$

Systems of Linear Inequalities Word Problems

Example:

In order to bring his business to the next level, Christov wants to gain at least 2,000 followers on a popular social media platform. From his own personal account, he knows that each original post gains him approximately 3 new followers and every 5 reposts gains about 1. Which of the following inequalities represents the numbers of posts, P , and reposts, R , Christov needs to reach his goal of gaining at least 2,000 followers?

A) $3P + 0.2R \geq 2,000$

B) $3P + 5R \leq 2,000$

C) $1P + 5R \geq 2,000$

D) $0.2P + 5R \leq 2,000$

Practice:

Joe is buying apples and persimmons at the grocery store. Each apple costs \$0.99 and each persimmon costs \$0.79. If Joe has \$10 which of the following inequalities describes x , the number of apples and y , the number of persimmons that he can buy?

A) $0.79x + 0.99y \geq 10$

B) $0.99x + 0.79y \geq 10$

C) $0.79x + 0.99y \leq 10$

D) $0.99x + 0.79y \leq 10$

Solving Quadratic Equations:

Example:

$$72 = 2x^2$$

What are the solutions to the equation above?

- A) $x = 6$ only
- B) $x = -6$ and $x = 6$
- C) $x = -2 + 6\sqrt{2}$
- D) $x = -2 - 6\sqrt{2}$ and $x = -2 + 6\sqrt{2}$

Quadratic Formula:

Practice:

1.)

$$2x^2 - (11/2)x - (3/2) = 0$$

What are the solutions to the equation above?

- A) $x = -(1/4)$ and $x = 2$
- B) $x = -(1/4)$ and $x = 3$
- C) $x = 2$ and $x = 3$
- D) $x = -(1/4)$, $x = 2$ and $x = 3$

2.)

$$(1/2)x^2 - (1/6)x - (1/3) = 0$$

What are the solutions to the equation above?

- A) $x = 1$ and $x = -(2/3)$
- B) $x = 1/6$ and $x = 3$
- C) $x = 2$ and $x = 3$
- D) $x = -(2/3)$, $x = 2$ and $x = 3$

Interpreting Nonlinear Expressions:

Example:

$$p(m) = 100\left(\frac{1}{2}\right)^{\frac{m}{27}}$$

Bismuth-199 is a radioactive isotope that decays over time. The half-life of a radioactive isotope is the amount of time it takes for 1/2 of the isotopes in a sample to decay. The function above models the percent of bismuth-199 remaining in a sample after m minutes. What is the meaning of the number 27 in the function?

- A) The amount of bismuth-199 in the sample decreases by 27% every $\frac{1}{2}$ minute.
- B) The sample is initially composed of 27% bismuth-199
- C) The half-life of bismuth-199 is 13.5 minutes
- D) The half-life of bismuth-199 is 27 minutes

Practice:

The following equation shows the number of possible distinct passwords, p , of length L is increased by 3 characters?

$$p = n^L$$

How does the number, p , of possible distinct passwords change if the length is increased by 3 characters?

- A) p is multiplied by n^3
- B) p is multiplied by $3n$
- C) p is cubed
- D) p is multiplied by 3

Quadratic and Exponential Word Problems:

Example:

Calculator OK

$$p(x) = (x - 0.95)(500 - 100x)$$

The equation above models p , the daily profit, in dollars, a food truck makes by selling their signature tacos at a price of x dollars each. What is the daily profit if the tacos are sold at \$3 each?

- A) \$410
- B) \$600
- C) \$820
- D) \$2,460

Practice:

Calculator OK

$$f(x) = 0.145x^2$$

The function above models f , the kinetic energy, in joules, of a baseball traveling at a speed of x meters per second. Based on the function, what is the kinetic energy, in joules, of a baseball traveling at a speed of 40 meters per second?

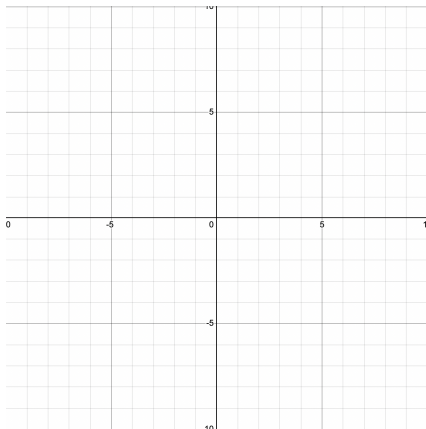
- A) 5.8
- B) 58
- C) 232
- D) 2,320

Manipulating Quadratic and Exponential Expressions

Example:

$y = (x + 2)(x + 8)$ is graphed in the xy -plane, which of the following characteristics of the graph is displayed as a constant in the equation?

- A) x -intercept(s)
- B) y -intercept
- C) x -coordinate of the vertex
- D) Minimum y -value



Practice:

If $y = -(x - 1)^2 + 3$ is graphed in the xy -plane, which of the following characteristics of the graph is displayed as a constant or coefficient in the equation?

- A) y -intercept
- B) x -intercept(s)
- C) Minimum y -value
- D) x -coordinate of the line of symmetry

Radical and Rational Exponents:

$$\left(\frac{1}{2}\right)^{-2} + 3^0$$

What is the value of the expression above?

- A) $\frac{3}{4}$
- B) $\frac{5}{4}$
- C) 4
- D) 5

Exponent Rules:

Practice:

$$(a^3)^3 \cdot a^{-9}$$

Which of the following expressions is equivalent to the expression above for all $a \neq 0$?

- A) 0
- B) 1
- C) a^3
- D) a^{18}

Radical and Rational Equations:

Example:

$$\sqrt{4x + 20} = x + 2$$

What is the sum of the solutions to the above equation? (Free Response)

Practice:

1.)

$$\sqrt{3p + 13} = p + 3$$

What is the sum of the solutions to the above equation? (Free Response)

2.)

$$n + 2 = \sqrt{a - n}$$

In the equation above, a is a constant. If $n = 1$ is a solution to the equation, what is the value of a ? (Free Response)

Operations with Rational Expressions:

Example:

$$\frac{7}{x-5} + \frac{4}{5-x}$$

Which expression is equivalent to the above sum for all $x \neq 5$?

A) $\frac{11}{x-5}$

B) $\frac{11}{5-x}$

C) $\frac{3}{x-5}$

D) $\frac{3}{5-x}$

Practice:

$$\frac{3}{14y} + \frac{y}{14}$$

Which of the following expressions is equivalent to the expression above sum for all $y \neq 0$?

A) $\frac{3y+y}{14y}$

B) $\frac{3+y^2}{14y^2}$

C) $\frac{3+y^2}{14y}$

D) $\frac{9+y^2}{14y}$

Operations with Polynomials:

Example:

$$(x - 4)(x - 8)$$

Which of the following is equivalent to the expression above?

- A) $x^2 - 12x + 32$
- B) $2x^2 + 4x + 32$
- C) $x^2 + 4x - 12$
- D) $2x^2 - 12x + 32$

Practice:

1.)

$$(x + 4)(x - 3)$$

Which of the following is equivalent to the expression above?

- A) $x^2 + x + 1$
- B) $x^2 + x - 12$
- C) $2x^2 + x - 12$
- D) $2x^2 + 7x + 1$

2.)

$$7n - (4n - 3)$$

Which of the following is equivalent to the expression above?

- A) $3n + 3$
- B) $3n - 3$
- C) $11n + 3$
- D) $11n - 3$

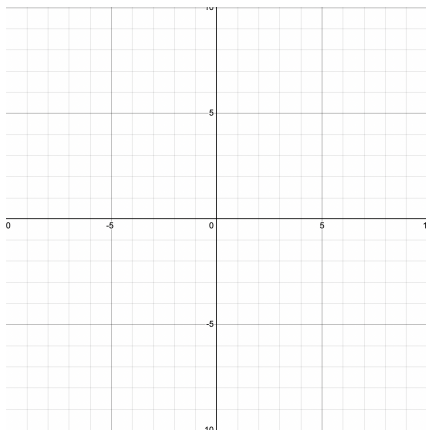
Polynomial Factors and Graphs:

Example:

$$(x - 7)(x + 5)(2x - 3)$$

Given the polynomial above, what are its zeros?

- A) $\{-7, 5, -3\}$
- B) $\{7, -5, 3\}$
- C) $\{-7, 5, -3/2\}$
- D) $\{7, -5, 3/2\}$



Practice:

A polynomial function f is defined as $f(x) = 3(5x + 3)(x + 2)(7x - 1)$. Which of the following is a zero of function f ?

- A) -3
- B) -2
- C) 2
- D) 3

Nonlinear Equation Graphs:

Example:

The equation $y = 2x^2 - 7x + 1$ is graphed in the xy -plane. What is the y -intercept of the graph?

- A) -1
- B) 1
- C) 2
- D) 7

Practice:

1.)

$$y = (x - 3)(x + 9)$$

The equation is graphed in the xy -plane. Which of the following are x -intercepts of the graph?

- A) -3 and -9
- B) -3 and 9
- C) 3 and -9
- D) 3 and 9

2.)

$$f(x) = (x - 3)^2 - 4$$

The graph of the function above is a parabola. What are the coordinates of the vertex of the parabola?

- A) $(-3, -4)$
- B) $(-3, 4)$
- C) $(3, -4)$
- D) $(3, 4)$

Structure in Expressions:

Example:

$$x^2 + 11x + 24$$

Which of the following is equivalent to the expression above?

- A) $(x + 2)(x + 12)$
- B) $(x + 3)(x + 8)$
- C) $(x + 4)(x + 6)$
- D) $(x + 5)(x + 6)$

Practice:

1.)

Which of the following is equivalent to the expression $x^2 - 5x - 14$?

- A) $(x - 14)(x + 1)$
- B) $(x - 7)(x + 2)$
- C) $(x - 2)(x + 7)$
- D) $(x - 1)(x + 14)$

2.)

Which of the following is equivalent to the expression $x^2 + 3x - 10$?

- A) $(x - 2)(x - 5)$
- B) $(x - 2)(x + 5)$
- C) $(x + 2)(x - 5)$
- D) $(x + 2)(x + 5)$

Isolating Quantities:

Example:

$$f = 12gh + 15g$$

The equation above gives the quantity f in terms of the quantities g and h . Which of the following equations correctly expresses g in terms of f and h ?

A) $g = \frac{f}{12h + 15}$

B) $g = \frac{f}{12h - 15}$

C) $g = \frac{f - 15}{12h}$

D) $g = \frac{f}{27h}$

Practice:

$$j = \frac{m}{c} \cdot 78$$

Which of the following equations correctly expresses c in terms of j and m ?

A) $c = \frac{m}{j} \cdot 78$

B) $c = \frac{m}{78 \cdot j}$

C) $c = \frac{j}{m} \cdot 78$

D) $c = \frac{j}{78 \cdot m}$

Function Notation:

Example:

If $f(x) = 4x - 5$ and $g(x) = -2x - 3$, what is the value of $g(f(3))$?

- A) 12
- B) -17
- C) -5
- D) -11

Practice:

1.)

If $f(x) = -5x + 6$ and $g(x) = -x - 2$, what is the value of $f(g(3))$?

- A) 31
- B) 27
- C) -18
- D) -19

2.)

If $f(x) = 3x - 1$ and $g(x) = x^2 + 1$, what is the value of $g(f(3))$?

- A) 8
- B) 10
- C) 29
- D) 65