Operations with Polynomials and Rewriting Expressions

$$(x^2 + bx - 2)(x + 3) = x^3 + 6x^2 + 7x - 6$$

1. In the equation above, b is a constant. If the equation is true for all values of x, what is the value of b?

A) 2
B) 3
C) 7
D) 9

2. Which of the following is equivalent to $16s^4 - 4t^2$?

A) $4(s^2 - t)(4s^2 + t)$
B) $4(4s^2 - t)(s^2 + t)$
C) $4(2s^2 - t)(2s^2 + t)$
D) $(8s^2 - 2t)(8s^2 + 2t)$

$$y^5 - 2y^4 - cxy + 6x$$

3. In the polynomial above, c is a constant. If the polynomial is divisible by $y - 2$, what is the value of c?

Quadratic Functions and Equations

4. A car is traveling at x feet per second. The driver sees a red light ahead, and after 1.5 seconds reaction time, the driver applies the brake. After the brake is applied, the car takes $\frac{x}{24}$ seconds to stop, during which time the average speed of the car is $\frac{x}{2}$ feet per second. If the car travels 165 feet from the time the driver saw the red light to the time it comes to a complete stop, which of the following equations can be used to find the value of x?

A) $x^2 + 48x - 3{,}960$
B) $x^2 + 48x - 7{,}920$
C) $x^2 + 72x - 3{,}960$
D) $x^2 + 72x - 7{,}920$

5. What are the solutions x of $x^2 - 3 = x$?

A) $\frac{-1 \pm \sqrt{11}}{2}$
B) $\frac{-1 \pm \sqrt{13}}{2}$
C) $\frac{1 \pm \sqrt{11}}{2}$
D) $\frac{1 \pm \sqrt{13}}{2}$

6. If $x > 0$ and $2x^2 + 3x - 2 = 0$, what is the value of x?

7. What is the sum of the solutions of $(2x - 1)^2 = (x + 2)^2$?

Exponential Functions, Equations, and Expressions and Radicals

8. A researcher estimates that the population of a city is declining at an annual rate of 0.6%. If the current population of the city is 80,000, which of the following expressions appropriately models the population of the city t years from now according to the researcher's estimate?

A) $80{,}000(1 - 0.006)^t$
B) $80{,}000(1 - 0.006^t)$
C) $80{,}000 - 1.006^t$
D) $80{,}000(0.006^t)$

9. Which of the following is equivalent to $\left(\frac{1}{\sqrt{x}}\right)^n$?

A) $x^{\frac{n}{2}}$
B) $x^{-\frac{n}{2}}$
C) $x^{n+\frac{1}{2}}$
D) $x^{n-\frac{1}{2}}$

$$x - 12 = \sqrt{x + 44}$$

10. What is the solution set for the above equation?

A) {5}
B) {20}
C) {−5, 20}
D) {5, 20}

Quadratic Functions and Equations

11. When $6x^2 - 5x + 4$ is divided by $3x + 2$, the result is $2x - 3 + \frac{R}{(3x+2)}$, where R is a constant. What is the value of R?

Quadratic Functions and Equations cont.

$$\frac{3}{t+1} = \frac{2}{t+3} + \frac{1}{4}$$

12. If t is a solution to the equation above and $t > 0$, what is the value of t?

System of Equations

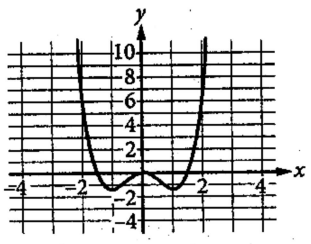
$$3x + y = -3$$
$$(x+1)^2 - 4(x+1) - 6 = y$$

13. If (x, y) is a solution of the system of equations above and $y > 0$, what is the value of y?

Relationships Between Algebraic and Graphical Representations of Functions

14. The graph of which of the following functions in the xy-plane has x-intercepts at -4 and 5?

A) $f(x) = (x+4)(x-5)$
B) $g(x) = (x-4)(x+5)$
C) $h(x) = (x-4)^2 + 5$
D) $k(x) = (x+5)^2 - 4$



15. The function $f(x) = x^4 - 2.4x^2$ is graphed in the xy-plane as shown above. If k is a constant such that the equation $f(x) = k$ has 4 solutions, which of the following could be the value of k?

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

Functions Notation

16. If $g(x) = 2x + 1$ and $f(x) = g(x) + 4$, what is $f(2)$?

Relationships Between Algebraic and Graphical Representations of Functions

17. If an object of mass m is moving at speed v, the object's kinetic energy KE is given by the equation $KE = \frac{1}{2}mv^2$. If the mass of the object is halved and its speed is doubled, how does the kinetic energy change?

A) The kinetic energy is halved.
B) The kinetic energy is unchanged.
C) The kinetic energy is doubled.
D) The kinetic energy is quadrupled (multiplied by a factor of 4).

18. A gas in a container will escape through holes of microscopic size, as long as the holes are larger than the gas molecules. This process is called effusion. If a gas of molar mass M_1 effuses at a rate of r_1 and a gas of molar mass M_2 effuses at a rate of r_2, then the following relationship holds.

$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$$

This is known as Graham's law. Which of the following correctly expresses M_2 in terms of M_1, r_1, and r_2?

A) $M_2 = M_1 \frac{r_1^2}{r_2^2}$
B) $M_2 = M_1 \frac{r_2^2}{r_1^2}$
C) $M_2 = \sqrt{M_1} \frac{r_1}{r_2}$
D) $M_2 = \sqrt{M_1} \frac{r_2}{r_1}$

19. A store manager estimates that if a video game is sold at a price of p dollars, the store will have weekly revenue, in dollars, of $r(p) = -4p^2 + 200p$ from the sale of the video game. Which of the following equivalent forms of $r(p)$ shows, as constants or coefficients, the maximum possible weekly revenue and the price that results in the maximum revenue?

A) $r(p) = 200p - 4p^2$
B) $r(p) = -2(2p^2 - 100p)$
C) $r(p) = -4(p^2 - 50p)$
D) $r(p) = -4(p-25)^2 + 2{,}500$

No Calculator

5

$$(x^2y - 3y^2 + 5xy^2) - (-x^2y + 3xy^2 - 3y^2)$$

Which of the following is equivalent to the expression above?

A) $4x^2y^2$

B) $8xy^2 - 6y^2$

C) $2x^2y + 2xy^2$

D) $2x^2y + 8xy^2 - 6y^2$

7 Also Used as Analysis in History/Social Studies

$$m = \frac{\left(\frac{r}{1{,}200}\right)\left(1 + \frac{r}{1{,}200}\right)^N}{\left(1 + \frac{r}{1{,}200}\right)^N - 1} P$$

The formula above gives the monthly payment m needed to pay off a loan of P dollars at r percent annual interest over N months. Which of the following gives P in terms of m, r, and N ?

A) $P = \frac{\left(\frac{r}{1{,}200}\right)\left(1 + \frac{r}{1{,}200}\right)^N}{\left(1 + \frac{r}{1{,}200}\right)^N - 1} m$

B) $P = \frac{\left(1 + \frac{r}{1{,}200}\right)^N - 1}{\left(\frac{r}{1{,}200}\right)\left(1 + \frac{r}{1{,}200}\right)^N} m$

C) $P = \left(\frac{r}{1{,}200}\right) m$

D) $P = \left(\frac{1{,}200}{r}\right) m$

8

If $\frac{a}{b} = 2$, what is the value of $\frac{4b}{a}$?

A) 0

B) 1

C) 2

D) 4

10

$$g(x) = ax^2 + 24$$

For the function g defined above, a is a constant and $g(4) = 8$. What is the value of $g(-4)$?

A) 8

B) 0

C) −1

D) −8

13

If $x > 3$, which of the following is equivalent to $\frac{1}{\frac{1}{x+2} + \frac{1}{x+3}}$?

A) $\frac{2x+5}{x^2+5x+6}$

B) $\frac{x^2+5x+6}{2x+5}$

C) $2x + 5$

D) $x^2 + 5x + 6$

14

If $3x - y = 12$, what is the value of $\frac{8^x}{2^y}$?

A) 2^{12}

B) 4^4

C) 8^2

D) The value cannot be determined from the information given.

15

If $(ax + 2)(bx + 7) = 15x^2 + cx + 14$ for all values of x, and $a + b = 8$, what are the two possible values for c ?

A) 3 and 5

B) 6 and 35

C) 10 and 21

D) 31 and 41

16

If $t > 0$ and $t^2 - 4 = 0$, what is the value of t ?

20

If $a = 5\sqrt{2}$ and $2a = \sqrt{2x}$, what is the value of x ?

$$a = 1{,}052 + 1.08t$$

The speed of a sound wave in air depends on the air temperature. The formula above shows the relationship between a, the speed of a sound wave, in feet per second, and t, the air temperature, in degrees Fahrenheit (°F).

9 Also Used as Analysis in Science

Which of the following expresses the air temperature in terms of the speed of a sound wave?

A) $t = \dfrac{a - 1{,}052}{1.08}$

B) $t = \dfrac{a + 1{,}052}{1.08}$

C) $t = \dfrac{1{,}052 - a}{1.08}$

D) $t = \dfrac{1.08}{a + 1{,}052}$

25 Also Used as Analysis in Science

$$h = -4.9t^2 + 25t$$

The equation above expresses the approximate height h, in meters, of a ball t seconds after it is launched vertically upward from the ground with an initial velocity of 25 meters per second. After approximately how many seconds will the ball hit the ground?

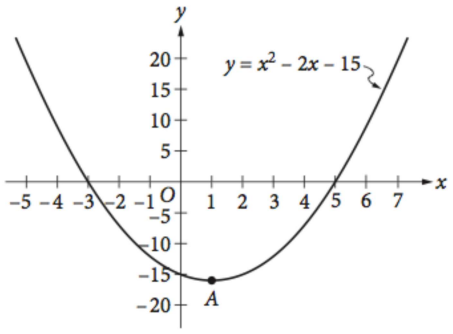
A) 3.5
B) 4.0
C) 4.5
D) 5.0

29

For a polynomial $p(x)$, the value of $p(3)$ is -2. Which of the following must be true about $p(x)$?

A) $x - 5$ is a factor of $p(x)$.
B) $x - 2$ is a factor of $p(x)$.
C) $x + 2$ is a factor of $p(x)$.
D) The remainder when $p(x)$ is divided by $x - 3$ is -2.

30



Which of the following is an equivalent form of the equation of the graph shown in the xy-plane above, from which the coordinates of vertex A can be identified as constants in the equation?

A) $y = (x + 3)(x - 5)$
B) $y = (x - 3)(x + 5)$
C) $y = x(x - 2) - 15$
D) $y = (x - 1)^2 - 16$

36

$$h(x) = \frac{1}{(x-5)^2 + 4(x-5) + 4}$$

For what value of x is the function h above undefined?

Questions 37 and 38 refer to the following information.

Jessica opened a bank account that earns 2 percent interest compounded annually. Her initial deposit was \$100, and she uses the expression $\$100(x)^t$ to find the value of the account after t years.

37 Also Used as Analysis in History/Social Studies

What is the value of x in the expression?

38 Also Used as Analysis in History/Social Studies

Jessica's friend Tyshaun found an account that earns 2.5 percent interest compounded annually. Tyshaun made an initial deposit of \$100 into this account at the same time Jessica made a deposit of \$100 into her account. After 10 years, how much more money will Tyshaun's initial deposit have earned than Jessica's initial deposit? (Round your answer to the nearest cent and ignore the dollar sign when gridding your response.)

No Calculator

4

$$9a^4 + 12a^2b^2 + 4b^4$$

Which of the following is equivalent to the expression shown above?

A) $(3a^2 + 2b^2)^2$

B) $(3a + 2b)^4$

C) $(9a^2 + 4b^2)^2$

D) $(9a + 4b)^4$

5

$$\sqrt{2k^2 + 17} - x = 0$$

If $k > 0$ and $x = 7$ in the equation above, what is the value of k ?

A) 2

B) 3

C) 4

D) 5

7

If $\frac{x^{a^2}}{x^{b^2}} = x^{16}$, $x > 1$, and $a + b = 2$, what is the value of $a - b$?

A) 8

B) 14

C) 16

D) 18

10

Which of the following equations has a graph in the xy-plane for which y is always greater than or equal to -1 ?

A) $y = |x| - 2$

B) $y = x^2 - 2$

C) $y = (x - 2)^2$

D) $y = x^3 - 2$

12

$$R = \frac{F}{N + F}$$

A website uses the formula above to calculate a seller's rating, R, based on the number of favorable reviews, F, and unfavorable reviews, N. Which of the following expresses the number of favorable reviews in terms of the other variables?

A) $F = \frac{RN}{R - 1}$

B) $F = \frac{RN}{1 - R}$

C) $F = \frac{N}{1 - R}$

D) $F = \frac{N}{R - 1}$

13

What is the sum of all values of m that satisfy $2m^2 - 16m + 8 = 0$?

A) -8

B) $-4\sqrt{3}$

C) $4\sqrt{3}$

D) 8

14 Also Used as Analysis in Science

A radioactive substance decays at an annual rate of 13 percent. If the initial amount of the substance is 325 grams, which of the following functions f models the remaining amount of the substance, in grams, t years later?

A) $f(t) = 325(0.87)^t$

B) $f(t) = 325(0.13)^t$

C) $f(t) = 0.87(325)^t$

D) $f(t) = 0.13(325)^t$

15

The expression $\frac{5x - 2}{x + 3}$ is equivalent to which of the following?

A) $\frac{5 - 2}{3}$

B) $5 - \frac{2}{3}$

C) $5 - \frac{2}{x + 3}$

D) $5 - \frac{17}{x + 3}$

17

$$2x(3x + 5) + 3(3x + 5) = ax^2 + bx + c$$

In the equation above, a, b, and c are constants. If the equation is true for all values of x, what is the value of b ?

7

$$y = x^2 - 6x + 8$$

The equation above represents a parabola in the xy-plane. Which of the following equivalent forms of the equation displays the x-intercepts of the parabola as constants or coefficients?

A) $y - 8 = x^2 - 6x$

B) $y + 1 = (x - 3)^2$

C) $y = x(x - 6) + 8$

D) $y = (x - 2)(x - 4)$

10

A function f satisfies $f(2) = 3$ and $f(3) = 5$. A function g satisfies $g(3) = 2$ and $g(5) = 6$. What is the value of $f(g(3))$?

A) 2

B) 3

C) 5

D) 6

Questions 22 and 23 refer to the following information.

$$I = \frac{P}{4\pi r^2}$$

At a large distance r from a radio antenna, the intensity of the radio signal I is related to the power of the signal P by the formula above.

22 Also Used as Analysis in Science

Which of the following expresses the square of the distance from the radio antenna in terms of the intensity of the radio signal and the power of the signal?

A) $r^2 = \frac{IP}{4\pi}$

B) $r^2 = \frac{P}{4\pi I}$

C) $r^2 = \frac{4\pi I}{P}$

D) $r^2 = \frac{I}{4\pi P}$

23 Also Used as Analysis in Science

For the same signal emitted by a radio antenna, Observer A measures its intensity to be 16 times the intensity measured by Observer B. The distance of Observer A from the radio antenna is what fraction of the distance of Observer B from the radio antenna?

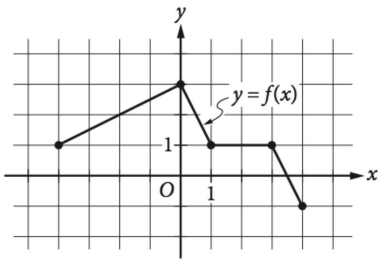
A) $\frac{1}{4}$

B) $\frac{1}{16}$

C) $\frac{1}{64}$

D) $\frac{1}{256}$

26



The complete graph of the function f is shown in the xy-plane above. Which of the following are equal to 1 ?

I. $f(-4)$

II. $f\left(\frac{3}{2}\right)$

III. $f(3)$

A) III only

B) I and III only

C) II and III only

D) I, II, and III

29

$$y = 3$$
$$y = ax^2 + b$$

In the system of equations above, a and b are constants. For which of the following values of a and b does the system of equations have exactly two real solutions?

A) $a = -2,\ b = 2$

B) $a = -2,\ b = 4$

C) $a = 2,\ b = 4$

D) $a = 4,\ b = 3$

33

In the xy-plane, the point $(3, 6)$ lies on the graph of the function $f(x) = 3x^2 - bx + 12$. What is the value of b ?