# 1 Non-Linear Equations and Functions

**1.** If $x^2 - y^2 = 322$ and $x + y = 23$, what is the value of $x - y$?

**2.**

$$2x^2 + 5x + 1 = 0$$

In the equation above, what is the largest possible value of $x$?

**(A)** $\frac{-5-\sqrt{17}}{4}$ **(B)** $\frac{-2+\sqrt{17}}{5}$ **(C)** $\frac{-2-\sqrt{17}}{5}$ **(D)** $\frac{-5+\sqrt{17}}{4}$

**3.** If the equation $y = (x-3)(x-7)$ is graphed on the $xy$-plane, which of the following is an equivalent form that identifies the $x$-coordinate of the parabola's vertex as a constant?

**(A)** $y = (x-5)^2 - 4$ **(B)** $y = (x+5)^2 - 4$ **(C)** $y = (x-5)^2 + 21$ **(D)** $y = (x+5)^2 + 21$

**4.** How many real solutions exist for the equation $4x^2 + 16x + 16 = 0$?

**5.** The function $f$ is defined as $f(x) = x^3 - 2x^2 + 4x + d$. If $(3, 0)$ is a solution, what is the value of $d$?

**6.** If $m + n = 12$ and $m^2 - n^2 = 48$, what does $m - n$ equal?

**7.** What is the sum of the solutions to the equation $8x^2 - 24x + 100 = 0$?

**8.** In the $xy$-plane, the graph of $y = x^3 - x^2 - kx - 24$ has the solutions $(e, 0)$, $(f, 0)$, and $(6, 0)$. What is the value of $k$?

**9.** If $x^2 - 6x - 27 = 0$ and $x > 0$, what is the value of $x$?

**10.** If $f(x) = 3x^2 - 5x + 2$, which of the following is equal to $f(-2)$?

**(A)** $0$ **(B)** $4$ **(C)** $12$ **(D)** $24$

**11.** The function $f$ is defined as $f(x) = 10\sqrt{x}$. For what value of $x$ does $f(x) = 60$?

**12.** When the function $f$ is graphed in the $xy$-plane, the point $(3, 8)$ lies on the graph. The function $g$ is defined as $g(x) = -f(x+2) - 3$. Which of the following points must lie on the graph of $g$ in the $xy$-plane?

**(A)** $(-3, 9)$ **(B)** $(-1, -5)$ **(C)** $(1, -11)$ **(D)** $(1, 5)$

**13.**

$$-6x + y = 14$$
$$2x^2 = y + 6$$

The graphs of the equations in the given system of equations intersect at the point $(x, y)$ in the $xy$-plane. What is one possible value of $x$?

**(A)** $-6$ **(B)** $-2$ **(C)** $4$ **(D)** $8$

**14.** The function $f$ is defined as $f(x) = 6x^2$. Which of the following is a possible value of $a$ for which $f(a) = 54$?

**(A)** $-5$ **(B)** $-3$ **(C)** $2$ **(D)** $9$

**15.** The function $f$ is defined as $f(x) = 2x - 5$ and the function $g$ is defined as $g(x) = -f(x) + 3$. What is the value of $g(-4)$?

**16.**

$$x^2 + y^2 = 333$$
$$-6x = y$$

What is a possible value of $y$ in the system of equations above?

**(A)** $-9$ **(B)** $-3$ **(C)** $3$ **(D)** $18$

**17.** The function $f$ is defined as $f(x) = 10x - 15$. What is the value of $f(4)$?

**18.** If the quadratic equation $x^2 - kx = 24$ has only integer solutions, which of the following cannot be a possible value of $k$?

**(A)** $11$ **(B)** $10$ **(C)** $5$ **(D)** $2$

**19.** How many real solutions exist for the equation $2x^2 - 10x + 5 = 0$?

**20.** If $a + b = 12$ and $a - b = 8$, what is the value of $a^2 - b^2$?

**21.** The equation of a parabola graphed in the $xy$-plane is given as $y = x^2 - 8x + 12$. Which of the following is an equivalent form that displays the solutions as constants or coefficients?

**(A)** $y = (x - 2)(x - 6)$ **(B)** $y = (x + 2)(x + 6)$ **(C)** $y = (x - 4)^2 - 4$ **(D)** $y = (x - 4)^2 + 12$

**22.** In the $xy$-plane, the point $(1, 5)$ lies on the graph of $f(x) = x^3 + 3x^2 + cx - 12$. What is the value of $c$?

**23.** If the solutions to the equation $2x^2 - 13x + 15 = 0$ are represented as $c$ and $d$, what is the value of $c + d$?

**24.** The equation of a parabola in the $xy$-plane is given as $y = (x - 6)^2 + 4$. If this parabola is transformed left 4 units and up 4 units, what are the coordinates of the vertex of the transformed parabola?

**(A)** $(-10, 0)$ **(B)** $(2, 8)$ **(C)** $(6, 4)$ **(D)** $(10, 8)$

**25.** Given the system of equations $y = x^2$ and $y = 9x - 20$, which of the following is a possible solution for $x$?

**(A)** $2$ **(B)** $4$ **(C)** $6$ **(D)** $8$

**26.** Which of the following shows the solutions for the equation $n^2 - 10n - 24 = 0$?

**(A)** $-12$ and $2$ **(B)** $-6$ and $4$ **(C)** $12$ and $-2$ **(D)** $6$ and $-4$

**27.** How many real solutions does the function $k(x)$ have if $k(x) = 11x^2 + 22x + 11$?

**28.** If $x^2 - px - 14 = 0$ for all values of $x$ and the sum of the roots is 5, what is the value of $p$?

**29.** For $x > 0$, what is one possible solution to the equation $x^3 - x^2 - 9x + 9 = 0$?

**30.** The function $f$ 9s defined as $f(x) = 3x - 5$. The function $g$ is defined as $g(x) = 2f(x - 2) + 6$. The function $h$ is defined as $h(x) = -g(x) + 3$. What is the value of $h(8)$?

**31.** The XYZ company produces widgets. The company uses the formula $p = -3w^2 + kw + 1200$ to model its profit, $p$, in dollars versus the number of widgets, $w$, sold. If XYZ Company makes \$1800 on sales of 10 widgets and $k$ is a constant, what is the maximum profit that XYZ Company can make for a given number of widgets sold?

## Solutions

**1.** 14

**2.** D

**3.** A

**4.** 1

**5.** -21
**6.** 4
**7.** 3
**8.** 26
**9.** 9
**10.** D
**11.** 36
**12.** D
**13.** B
**14.** B
**15.** 16
**16.** D
**17.** 25
**18.** A
**19.** 2
**20.** 96
**21.** A
**22.** 13
**23.** 6.5
**24.** B
**25.** B
**26.** C
**27.** 1
**28.** 5
**29.** 1, 3
**30.** -29
**31.** 1875