1 Advanced Algebra

1. Leroy is training for a marathon race. Each day he runs between 8 miles and 14 miles. Which of the following inequalities shows all possible distances, d, that Leroy might run on any given day?

   (A) $|d - 14| < 8$ **(B)** $|d + 8| < 14$ **(C)** $|d - 11| < 3$ **(D)** $|d - 11| < 8$

2.
$$|x - 4| = 10$$

   Given the absolute value equation, if a and b are the two possible solutions, what is the value of $|a - b|$?

3. Which of the following expressions is equivalent to $(3x^2 - 2x + 5) - (-x^2 + 4x - 3)$?

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

4.
$$\frac{1}{\frac{1}{x+1} + \frac{1}{x+2}}$$

   Which of the following is equivalent to the expression given?

   (A) $\frac{x^2 + 3x + 2}{2x + 3}$ **(B)** $\frac{2x + 3}{x^2 + 3x + 2}$ **(C)** $2x + 3$ **(D)** $x^2 + 3x + 2$

5. Which of the following is equal to $(5 + 3i)(4 - 5i)$? (Note: $i = \sqrt{-1}$)?

   (A) $35 - 13i$ **(B)** $20 - 15i$ **(C)** 5 **(D)** -6

6. The number of miles driven varies directly with the number of gallons of gasoline used. Scott drove his car 297 miles on 9 gallons of gasoline. At this rate, how many miles should he be able to drive using 14 gallons of gasoline?

7. In order to obtain a certain volume, the height of a can will be inversely proportional to the square of the can's radius. A can has a height of 9 inches and a radius of 2 inches. To maintain the same volume, what must the height equal, in inches, when the radius is 3 inches?

8. Annie's Apples is a commercial apple orchard. Within the last 10 years, its largest tree produced as few as 400 apples in one season and as many as 800 apples in one season. Which of the following inequalities correctly identifies the number of apples, a, that could have been produced by this tree in any single season over the last 10 years?

   (A) $|a - 400| \leq 800$ **(B)** $|a - 600| \leq 200$ **(C)** $|a - 800| \leq 400$ **(D)** $|a - 200| \leq 600$

9. What is the sum of complex numbers $4 - 2i$ and $3 + 5i$? (Note: $i = \sqrt{-1}$)

   (A) $12 - 10i$ **(B)** $7 + 3i$ **(C)** $10i$ **(D)** 10

10. Which of the following expressions is equivalent to $(x - 4)^2$?

    (A) $(x - 6)^2 - (x - 5)$ **(B)** $(x - 5)^2 - (x + 9)$ **(C)** $(x - 3)^2 - (2x - 7)$ **(D)** $(x - 2)^2 - (4x - 8)$

11. The time it takes to dig a trench is inversely proportional to the number of people digging. If 6 workers need 5 hours to dig a certain trench, how many hours would it take 4 workers to dig the same trench?

12. If $2x = 8y + 4z$, which of the following correctly identifies y in terms of x and z?

    (A) $\frac{x - 2z}{4}$ **(B)** $\frac{x + 2z}{4}$ **(C)** $2x - 4z$ **(D)** $2x + 4z$

13. If $\frac{8^{3x}}{4^{2y}} = k$ and $9x - 4y = 5$, what is the value of k?

14. If $\frac{9^{3x}}{27^y} = 1$, what is the value of the ratio $\frac{y}{x}$?

15. Which of the following is equivalent to $2^{\frac{5}{4}}$?

(A) $2\sqrt[5]{2}$ (B) $2\sqrt[4]{2}$ (C) $2\sqrt[5]{4}$ (D) $2\sqrt[4]{4}$

16.
$$\sqrt{20} + \sqrt{20} = x\sqrt{y}$$

In the equation above, x and y are integers. Which of the following can be the value of y?

(A) 2 (B) 4 (C) 5 (D) 10

17. What is the set of all real values of x that satisfy the equation $\sqrt{3x + 4} - x = -12$?

(A) $\{7\}$ (B) $\{20\}$ (C) $\{7, 20\}$ (D) There are no real solutions to this equation.

18. A model predicts that the population of Webster was 60,000 in 2015. The model also predicts that each year for the next 7 years, the population p of Webster increased by 3% of the previous year's population. Which equation best represents this model, where y is the number of years after 2015 for $y < 7$?

(A) $p = 0.97(60,000)^y$ (B) $p = 1.03(60,000)^y$
(C) $p = 60,000(0.97)^y$ (D) $p = 60,000(1.03)^y$

19. The function $h(t) = 500(3)^{\frac{t}{150}}$ gives the number of bacteria in a petri dish t minutes after the bacteria were initially placed in the dish. How many minutes does it take for the number of bacterial in the petri dish to triple?

20. If $\frac{27^x}{9^y} = 1$, what is the value of the ratio $\frac{x}{y}$?

21. If $a = 2\sqrt{3}$ and $4a = \sqrt{16b}$, what is the value of b?

22. If $a = \sqrt{a^2}$, which of the following values is NOT a solution to the equation?

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

23. A park ranger estimates that the current population of deer in her state's largest park is 6,000. She further estimates that the deer population in that park will decrease by 10% every 5 years. Which of the following equations models p, the deer population in the park, t years from now?

(A) $p = 6,000(0.9)^{5t}$ (B) $p = 6,000(0.9)^{\frac{t}{5}}$ (C) $p = 6,000(1.1)^{5t}$ (D) $p = 6,000(1.1)^{\frac{t}{5}}$

24.
$$\sqrt{3x + 22} = x - 2$$

Given the equation above, which of the following are solutions for x?

I. -2

II. 9

(A) Neither of the above   (B) I only   (C) II only   (D) I and II

25.
$$\sqrt{a + 5} - 10 = -2$$

What is the value of a in the equation above?

26. The temperature of Fargo, ND hit a high of 72° F on a day when a storm blew in, and the low temperature that same day was 10° F. Which of the following inequalities indicates the range of temperatures, t, in Fargo that day?

(A) $|t - 10| \leq 72$ (B) $|t - 41| \leq 31$ (C) $|t - 72| \leq 10$ (D) $|t - 46| \leq 26$

27. Which of the following is equal to $(6 + 3i)(6 - 3i)$? (Note: $i = \sqrt{-1}$)

(A) 27 (B) 45 (C) $36 - 9i$ (D) $36 + 9i$

28. If $c = b^{-3}$, what is b in terms of c?

(A) $c^{\frac{1}{3}}$ (B) c^3 (C) $\frac{1}{c^3}$ (D) $\frac{1}{\sqrt[3]{c}}$

29. In physics, Boyle's law states that pressure on a gas varies inversely with the volume of the gas. The volume of air inside a tube is 5.2 cubic inches at a pressure of 15.5 psi. If the volume decreases to 2.6 cubic inches, what is the new pressure on the compressed air?

(A) 7.75psi   (B) 15.6psi   (C) 23.25psi   (D)31psi

30.

$$x^{\frac{y}{2}} = 64$$

For positive integers x and y, what is one possible value of y in the equation above?

31. The integer y represents the value of $3x$ in the equation $\sqrt{84} + \sqrt{525} = x\sqrt{y}$. What is the value of y?

32. Which of the following expressions is equivalent to $(9x^2 + 10x - 4) - (3x^2 - 2x + 6)$?

(A) $6x^2 + 12x - 10$ (B) $6x^2 + 8x + 2$ (C) $12x^2 + 12x - 10$ (D) $12x^2 + 8x + 2$

33. Tara invests $200 in a bank account that accrues 2.5% interest each year. Which of the following equations gives the amount of money, a, that Tara will have in this account after 5 years?

(A) $a = 0.025(200)^5$ (B) $a = 1.025(200)^5$ (C) $a = 200(0.025)^5$ (D) $a = 200(1.025)^5$

34. If y and z are teh two solutions to the absolute value equation $|x + 9| = 11$, what is the value of $y + z$?

35. Which of the following expresisons is equivalent to $\frac{5^{10}}{5^3}$?

(A) 5^{-7} (B) 5^5 (C) 5^7 (D) 5^{13}

36. If x and y are inversely related and $x = 6$ when $y = 3$, what is the value of x when $y = 9$?

37. Jubilee invests $500 into a bank account that earns 2% interest annually. What will be the total amount a, in Jubilee's account after 3 years, assuming that she does not withdraw or deposit any other money into the account?

(A) $a = 500(0.98)^3$ (B) $a = 500(1.02)^3$ (C) $a = 0.98(500)^3$ (D) $a = 1.02(500)^3$

38. If $\sqrt{17 - x} + 5 = x$, what is the set of all real solutions for x?

(A) $\{1\}$ (B) $\{8\}$ (C) $\{1, 8\}$ (D) There are no real solutions to this equation.

39. Which of the following expressions is equivalent to $25y^2 - 9$?

(A) $(5y - 3)^2$ (B) $(y - 9)(25y + 1)$ (C) $(5y + 3)^2$ (D)$(5y - 3)(5y + 3)$

40. The height of an object varies directly with the square of its instability coefficient. An object that measures 160 ft. in height has an instability coefficient of 0.4. If the object has an instability coefficient of 0.5, what is its height, in ft.?

41. If the complex number $\frac{6 + 6i}{3 - 3i}$ is expressed in $a + bi$ form, what is the value of a? (Note: $i = \sqrt{-1}$)

42. A bungee cord is attached to a platform that is 50 feet above a pool. When a person jumps from the platform the cord will take them to within 5 feet of the water's surface and back up to within 3 feet of the platform. Which of the following inequalities shows all possible distances, d, that the person is away from the platfrom at any given moment once the person has reached the lowest point?

(A) $|d - 24| \leq 21$ (B) $|d - 21| \leq 24$ (C) $|d - 25| \leq 25$ (D) $|d - 5| \leq 45$

43. If $\left(\frac{a^3 b^{-5}}{a^4 b^{-6}} \right)^{-2} = \left(a^{\frac{x-2}{3}} \right) \left(b^{\frac{x-y}{2}} \right)$, what is the value of $\frac{x}{y}$?

44. Which of the following is equivalent to $\frac{2x^2 + 3x}{2x - 1}$?

(A) $x + 2$ (B) $x + 3$ (C) $x + 2 + \frac{2}{2x-1}$ (D) $x + 2 + \frac{4}{2x-1}$

Solutions

1. C
2. 20
3. D
4. A
5. A
6. 462
7. 4
8. B
9. B
10. C
11. 7.5
12. A
13. 5
14. 2
15. B
16. C
17. B
18. D
19. 150
20. 2/3
21. 12
22. A
23. B
24. D
25. 59
26. B
27. B
28. D
29. D
30. 4, 6, 12
31. 21
32. A
33. D
34. -18
35. C

36. 2

37. B

38. B

39. D

40. 250

41. 0

42. A

43. 2/3

44. C