Simplify. Express each answer with positive exponents.

1. $6^7 \div 6^2$ [A] 6^5 [B] 36^5 [C] 6^9 [D] 6^{14}

2. $\left(\frac{a^2}{b^3}\right)^6$ [A] $\frac{a^8}{b^9}$ [B] $\frac{a^{12}}{b^3}$ [C] $a^{12}+b^{18}$ [D] $\frac{a^{12}}{b^{18}}$

3. Simplify. $\frac{\sqrt{150}}{\sqrt{10}}$ [A] $2\sqrt{8}$ [B] $\sqrt{15}$ [C] $15\sqrt{2}$ [D] 15

4. Given $t_n = (-2)^n - 9$, find t_1 and t_3.

   [A] $t_1 = -7,\ t_3 = -41$ [B] $t_1 = -7,\ t_3 = -17$

   [C] $t_1 = -11,\ t_3 = -15$ [D] $t_1 = -11,\ t_3 = -17$

5. The number of roses a large nursery can sell each day after April 1, is modelled by a sequence whose general term is $t_n = 1200 - 70n$, where n is the number of days after April 1. Find the numbers of roses that can be sold on April 4, 5, and 6.

   [A] 990, 920, 850 [B] 920, 850, 780 [C] 1130, 1060, 990 [D] 1060, 990, 920

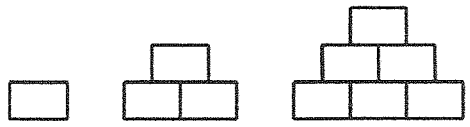
6. Find the values of a and d for the arithmetic sequence –7, 2, 11, …

   [A] $a = 1,\ d = -\frac{2}{7}$ [B] $a = -7,\ d = -9$ [C] $a = 1,\ d = \frac{2}{7}$ [D] $a = -7,\ d = 9$

7. Find t_{22} for the arithmetic sequence $-9,\ -12,\ -15,\ -18,\ -21,\ \ldots$

   [A] –75 [B] –72 [C] 13 [D] –66

8. If the pattern shown is continued, what would be the total number of rectangles in the fifth stage of the pattern?



1 $1 + 2 = 3$ $1 + 2 + 3 = 6$

   [A] 15 [B] 28 [C] 21 [D] 10

9. Determine whether the sequence is arithmetic, geometric, or neither. 4, 5, 6, 7, …

   [A] arithmetic [B] geometric [C] neither

10. Given the first term and the last term, find the sum of the arithmetic series.
$a = 3,\ t_{10} = -42$

[A] −390 [B] −195 [C] 195 [D] none of these

11. A 30-row theatre has 20 seats in the front row. The second row has 21 seats. If each row has one more seat than the row in front of it, how many seats are there in the theatre?

[A] 2100 [B] 2070 [C] 1050 [D] 1035

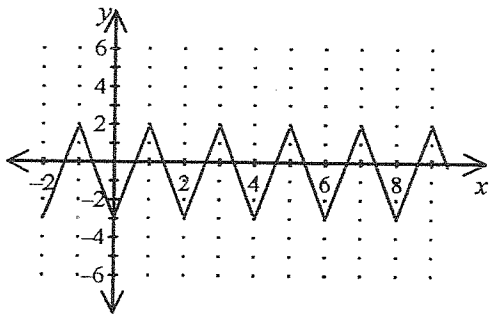
12. At a local grocery store, cans of mushrooms are stacked in a triangular formation for display. Each new row has 3 fewer cans than the row beneath it. If there are 12 rows, and the top row contains one can, how many cans of mushrooms are in the display?

[A] 210 [B] 212 [C] 34 [D] 36

13. Find S_8, if $a = -25$ and $r = -4$.

[A] −13 107 [B] 241 389 [C] 409 600 [D] 327 675

14. Calculate the period and amplitude of the relation.



[A] period: 2.5, amplitude: 2 [B] period: 2, amplitude: 5

[C] period: 5, amplitude: 2 [D] period: 2, amplitude: 2.5

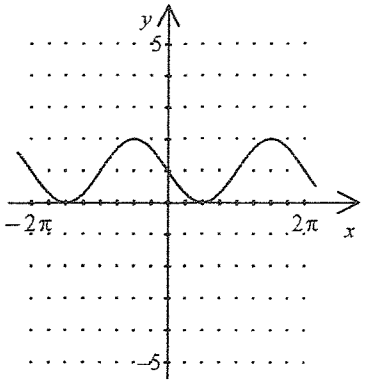
15. Which equation represents the cosine function with amplitude 3 and period 8π?

[A] $y = 3\cos\frac{1}{4}x$ [B] $y = \frac{1}{3}\cos\frac{1}{8}x$ [C] $y = -3\cos\frac{1}{8}x$ [D] $y = -\frac{1}{3}\cos\frac{1}{4}x$

16. A water wave is created in a wave tank. It has an amplitude of 4 and a period of $\frac{2\pi}{5}$. Find the equation of this wave as a sine function.

[A] $y = \frac{2\pi}{5}\sin\frac{x}{4}$ [B] $y = \frac{1}{4}\sin\frac{2\pi x}{5}$ [C] $y = 4\sin 5x$ [D] $y = 5\sin 4x$

17. Match the graph with the correct equation.



[A] $y = \sin\left(x + \frac{\pi}{2}\right) + 1$

[B] $y = \cos\left(x + \frac{\pi}{2}\right) + 1$

[C] $y = \sin\left(x - \frac{\pi}{2}\right) + 1$

[D] $y = \cos\left(x - \frac{\pi}{2}\right) + 1$

18. Suppose the depth of the tide in a certain harbour can be modelled by $y = 9 - 2\cos\left(\frac{\pi t}{6}\right)$, where y is the water depth in metres and t is the time in hours. Consider a day in which $t = 0$ represents 00:00. For that day, when are high and low tides, and what is the depth of each?

[A] high tide at 06:00 and 18:00, depth 11 m
low tide at 00:00 and 12:00, depth 7 m

[B] high tide at 00:00 and 12:00, depth 11 m
low tide at 06:00 and 18:00, depth 7 m

[C] high tide at 00:00 and 12:00, depth 9 m
low tide at 06:00 and 18:00, depth 2 m

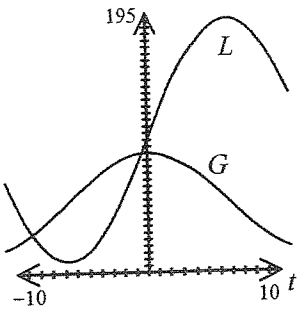
[D] high tide at 06:00 and 18:00, depth 9 m
low tide at 00:00 and 12:00, depth 2 m

19. An object attached to a coiled spring is pulled down a distance, a, from its rest position, and then released. Assuming the motion is simple harmonic with period, b, write an equation that describes the distance, d, of the object from its rest position at time, t. Assume that the positive direction of motion is down.
$a = 5,\ b = \pi$

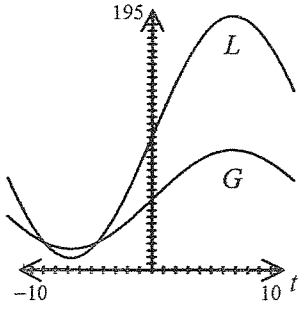
[A] $d = 2\cos 5t$ [B] $d = 5\cos t + 2$ [C] $d = -5\cos 2t$ [D] $d = 5\cos 2t$

20. In a remote area, the population of gazelles, G, is modelled by $G = 53 + 37\cos\frac{2\pi t}{27}$. The population of lions, L, is modelled by $L = 100 + 91\sin\frac{2\pi t}{27}$. Which of the following graphs models the functions?

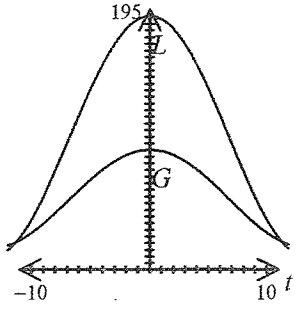
[A]



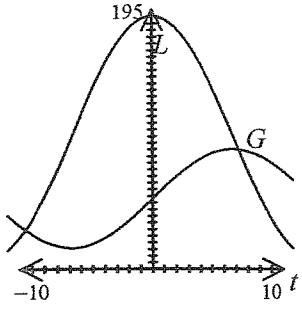
[B]



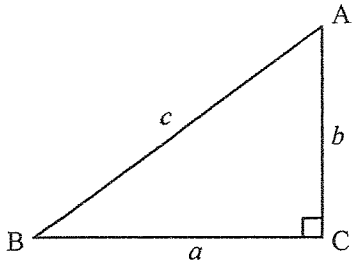
[C]



[D]



21. In ΔABC, $\angle A = 65°$ and $a = 10$ m. Find $\angle B$, b, and c.



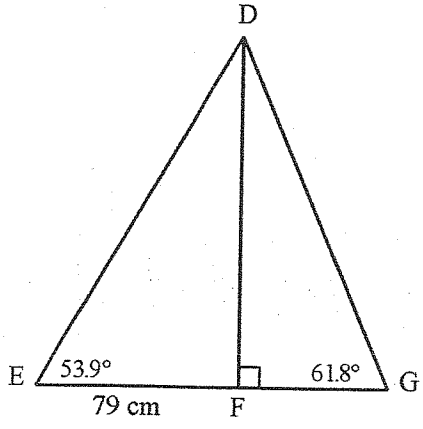
[A] $\angle B = 20°$, $b = 11.0$, $c = 4.7$

[B] $\angle B = 25°$, $b = 11.0$, $c = 4.7$

[C] $\angle B = 20°$, $b = 4.7$, $c = 11.0$

[D] $\angle B = 25°$, $b = 4.7$, $c = 11.0$

22. What is the length of FG?



[A] 58.1 cm

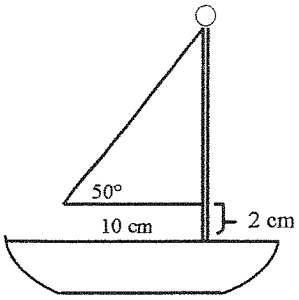
[B] 52.8 cm

[C] 59.2 cm

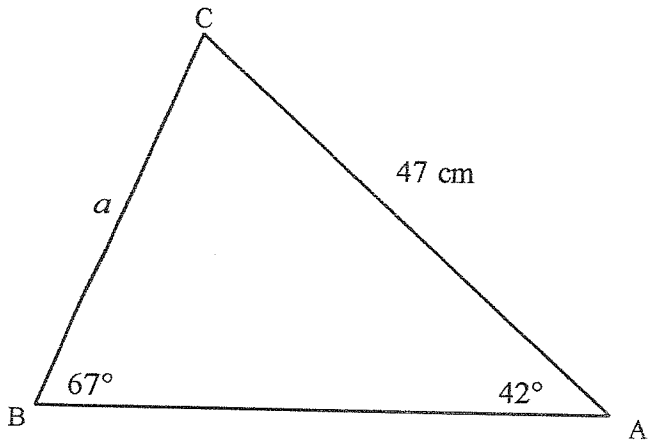
[D] 72.4 cm

23. **Application** You are building a model sailboat. The plans show that the base of the main sail is 10 cm, the bottom acute angle in the sail is $50°$, and the distance between the base of the sail and the deck is 2 cm. What is the height of the mast, to the nearest tenth of a centimetre?

[A] 14.8 cm [B] 11.9 cm [C] 13.9 cm [D] 16.4 cm



24. Use the sine law to find a.



[A] 33.2 cm [B] 36.2 cm

[C] 34.2 cm [D] 35.2 cm

25. In ΔXYZ, $\angle X = 134°$, $y = 9$ m, and $z = 10$ m. Find x.

[A] 17.5 m [B] 15.6 m [C] 7.5 m [D] 7.8 m

26. In ΔABC, $\angle A = 49°$, $\angle B = 44°$, and $b = 71$ m. Solve the triangle.

[A] $\angle C = 87°$, $a = 65.4$ m, $c = 93.9$ m [B] $\angle C = 267°$, $a = 65.4$ m, $c = 93.9$ m

[C] $\angle C = 267°$, $a = 77.1$ m, $c = 102.1$ m [D] $\angle C = 87°$, $a = 77.1$ m, $c = 102.1$ m

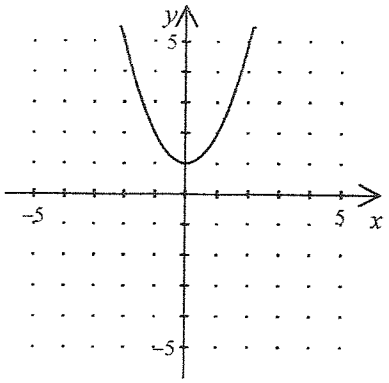
27. In ΔBCD, $\angle D = 56.2°$, $d = 10.4$ cm, and $b = 10.4$ cm. Find $\angle B$ and $\angle C$.

[A] $\angle B = 54.2°$ and $\angle C = 69.6°$, or $\angle B = 45.2°$ and $\angle C = 78.6°$

[B] $\angle B = 62.2°$ and $\angle C = 61.6°$, or $\angle B = 54.2°$ and $\angle C = 69.6°$

[C] $\angle B = 117.8°$ and $\angle C = 6°$ [D] $\angle B = 56.2°$ and $\angle C = 67.6°$

28. Find the domain and range of each relation.



[A] domain: the set of real numbers, range: the set of real numbers

[B] domain: the set of real numbers, range: $y > 1$

[C] domain: the set of real numbers, range: $y \geq 1$

[D] domain: the set of real numbers, range: $y < 1$

29. The function $y = f(x)$ has been transformed 4 units upward and 3 units to the right. Identify the function corresponding to the transformation.

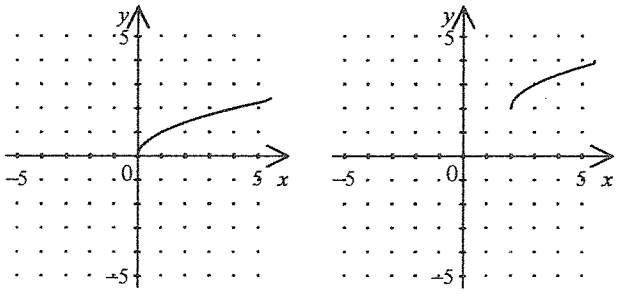
[A] $y = f(x-3)-4$

[B] $y = f(x+3)+4$

[C] $y = f(x-3)+4$

[D] $y = f(x+3)-4$

30. The graph of the function $f(x) = \sqrt{x}$ is shown on the left below. The graph on the right is the same graph translated two units to the right and two units upward. Write the equation of the graph on the right.



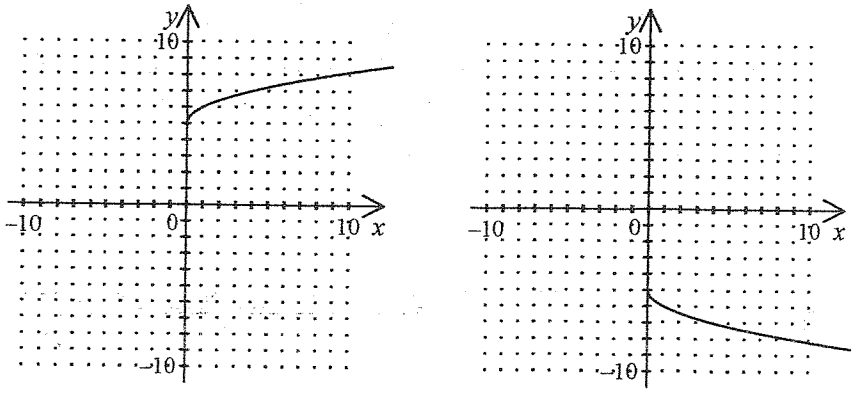
[A] $y = \sqrt{-x+2}-2$

[B] $y = \sqrt{-x+2}+2$

[C] $y = -\sqrt{x+2}-2$

[D] $y = \sqrt{x-2}+2$

31. The graph of the function $f(x) = \sqrt{x}+5$ is shown on the left below. The graph on the right is the graph of $f(x) = \sqrt{x}+5$ reflected in the x-axis. Write the equation of the graph on the right.



[A] $f(x) = -\sqrt{x}+5$

[B] $f(x) = \sqrt{-x}-5$

[C] $f(x) = -\sqrt{x}-5$

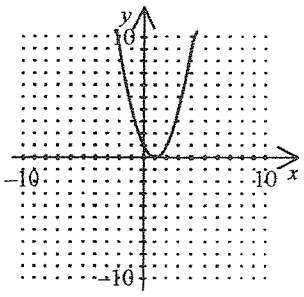
[D] $f(x) = \sqrt{-x}+5$

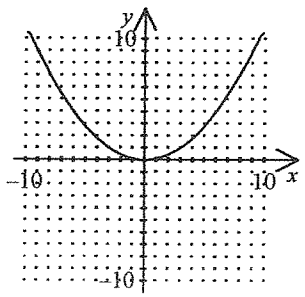
32. Find the inverse of the function $f(x) = \{(-9, 6), (6, -9), (-6, 4)\}$.

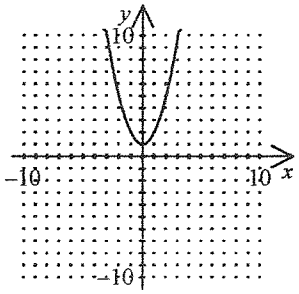
[A] $\{(6, -9), (-9, 6), (4, -6)\}$ [B] $\{(-9, 6), (6, -9), (-6, 4)\}$

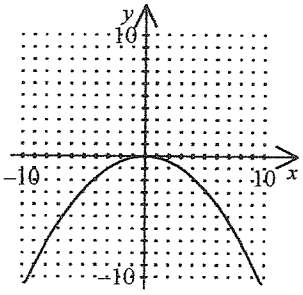
[C] $\{(6, -9), (-9, 4), (4, -6)\}$ [D] $\{(6, -9), (-9, -6), (4, -6)\}$

33. Sketch the graph of the equation $y = \frac{1}{9}x^2$.

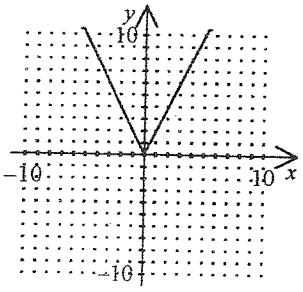
[A] 

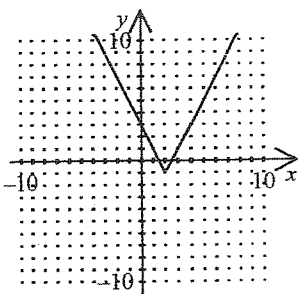
[B] 

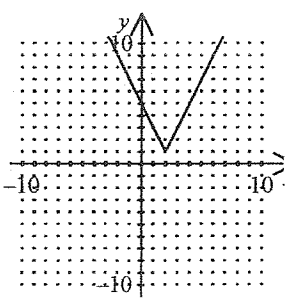
[C] 

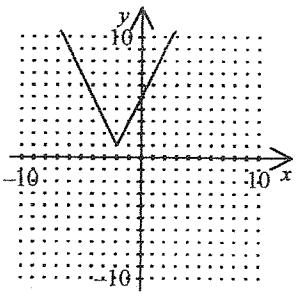
[D] 

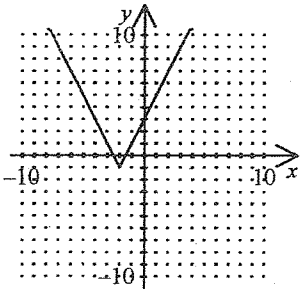
34. The graph of $y = f(x)$ is shown below. Identify the graph of $y = f(x-2) - 1$.



[A] 

[B] 

[C] 

[D] 

35. The graph of $f(x) = x^2$ is expanded vertically by a factor of 3, translated 5 units to the left, and translated 6 units upward. Which is the equation of the transformed function, $g(x)$?

[A] $g(x) = -\frac{1}{3}(x-5)^2 + 6$ [B] $g(x) = 3(x-5)^2 - 6$

[C] $g(x) = 3(x+5)^2 + 6$ [D] $g(x) = -\frac{1}{6}(x+5)^2 + 3$

36. Simplify. $\sqrt{30} \times 3\sqrt{36}$ [A] $18\sqrt{30}$ [B] $9\sqrt{20}$ [C] $3\sqrt{120}$ [D] $36\sqrt{30}$

37. Find the maximum or minimum value of the function and the value of x when it occurs.
$y = 2x^2 + 8x + 5$

[A] minimum of -3 at $x = 3$ [B] maximum of 3 at $x = -2$

[C] minimum of -3 at $x = -2$ [D] maximum of -2 at $x = -3$

38. **Application** Upco Manufacturing estimates that its profit P, in hundreds of dollars, after producing x thousand units, can be expressed as $P = -4x^2 + 32x + 2$. How many units must be produced to obtain the maximum profit?

[A] 32 units [B] 4000 units [C] 3200 units [D] none of these

39. Solve by completing the square. Express solutions in simplest radical form. $9x = 3x^2 - 2$

[A] $\frac{17+\sqrt{105}}{6}, \frac{17-\sqrt{105}}{6}$ [B] $\frac{9+\sqrt{105}}{5}, \frac{9-\sqrt{105}}{5}$

[C] $\frac{9+\sqrt{105}}{6}, \frac{9-\sqrt{105}}{6}$ [D] $\frac{17+\sqrt{105}}{5}, \frac{17-\sqrt{105}}{5}$

Solve by factoring.

40. $12x^2 - 35x + 25 = 0$ [A] $\frac{5}{3}, -\frac{5}{4}$ [B] $-\frac{5}{3}, -\frac{5}{4}$ [C] $-\frac{5}{3}, \frac{5}{4}$ [D] $\frac{5}{3}, \frac{5}{4}$

41. $\frac{x^2}{2} + \frac{7x}{4} = -\frac{3}{2}$

[A] $x = -\frac{2}{3}, -\frac{1}{2}$ [B] $x = \frac{3}{2}, 2$ [C] $x = \frac{2}{3}, \frac{1}{2}$ [D] none of these

42. Solve using the quadratic formula. Round solutions to the nearest hundredth.
$4x^2 - 2x - 3 = 0$

[A] 2.05, –1.55 [B] 0.65, –1.15 [C] 1.55, –2.05 [D] 1.15, –0.65

43. **Application** A rocket is launched from atop a 81-m cliff with an initial velocity of 92 m/s. The height of the rocket t seconds after launch is given by the equation $h = -16t^2 + 92t + 81$. How long after the rocket is launched will it hit the ground? (Hint: The rocket will strike the ground when its height h is 0.) Round to the nearest hundredth of a second.

[A] –0.78 s [B] 4.66 s [C] 0.78 s [D] 6.53 s

Simplify.

44. $6\sqrt{3} - 8\sqrt{3} - 4\sqrt{3}$ [A] -6 [B] $\sqrt{3}$ [C] $-6\sqrt{3}$ [D] $\sqrt{-3}$

45. $\sqrt{112}+\sqrt{28}$ [A] 56 [B] $6\sqrt{7}$ [C] $\sqrt{140}$ [D] 18

46. $\frac{11}{\sqrt{7}}$ [A] $\frac{11\sqrt{7}}{7}$ [B] $11\sqrt{7}$ [C] $\frac{\sqrt{11}}{7}$ [D] $\frac{11\sqrt{7}}{49}$

47. Evaluate. $256^{-\frac{1}{4}}$ [A] $\frac{1}{4}$ [B] $\frac{1}{16}$ [C] 4 [D] 16

48. Solve. $2^x = 8$ [A] $-\frac{1}{3}$ [B] $\frac{1}{3}$ [C] -3 [D] 3

49. Expand and simplify. $(2x+3y)^2$

[A] $4x^2+10xy+9y^2$ [B] $4x^2+6xy+9y^2$ [C] $4x^2+12xy+9y^2$ [D] $4x^2+9y^2$

Simplify. State any restriction(s) on the variables.

50. $\frac{-3x+3x^2}{-18x+18}$

[A] $\frac{x-x^2}{6x-6}, x\neq 6$ [B] $-\frac{x}{6}, x\neq 1$ [C] $\frac{x^2}{12}, x\neq 6$ [D] $\frac{1-x}{12}, x\neq 1$

Simplify. State any restriction(s) on the variables.

51. $\frac{12x^2+4x-8}{12x^2-12}$

[A] $\frac{3x-2}{3(x-1)}, x\neq\pm 1$ [B] $\frac{3x+2}{3(x+1)}, x\neq -1$

[C] $\frac{3x-2}{3(x+1)}, x\neq -3$ [D] $\frac{3x+1}{3(x-1)}, x\neq\pm 3$

52. $\frac{x^2+8x+15}{x^2-9}\div\frac{x+5}{x-5}$

[A] $\frac{x+3}{x-5}, x\neq\pm 3, \pm 5$ [B] $\frac{8x+5}{3}, x\neq 3$

[C] $\frac{x+3}{x-3}, x\neq 3$ [D] $\frac{x-5}{x-3}, x\neq\pm 3, \pm 5$

53. $\frac{-2x+7}{-3x}+\frac{3x-7}{-3x}$

[A] $-\frac{2}{3}, x\neq 0$ [B] $\frac{-2x+3x}{-3x}, x\neq 0$ [C] $-\frac{1}{3}, x\neq 0$ [D] $-\frac{x}{3}, x\neq 0$

54. $\dfrac{2x-5}{x^2-25}-\dfrac{3x-10}{x^2-25}$

[A] $-\dfrac{1}{x+5},\ x\neq\pm5$

[B] $\dfrac{-x-15}{x^2-25},\ x\neq\pm5$

[C] $-\dfrac{1}{x-5},\ x\neq5$

[D] $\dfrac{1}{x+5},\ x\neq-5$

Simplify. State any restriction(s) on the variables.

55. $\dfrac{x+5}{x^2+2x-3}+\dfrac{x+2}{x^2-1}$

[A] $\dfrac{2x^2+11x+11}{(x-1)(x+1)(x+3)},\ x\neq\pm1,-3$

[B] $\dfrac{2x^2+9x+11}{(x-1)(x+1)(x+3)},\ x\neq\pm1,-3$

[C] $\dfrac{2x^2+11x+1}{(x-1)(x+1)(x+3)},\ x\neq\pm1,-3$

[D] $\dfrac{2x^2+9x+1}{(x-1)(x+1)(x+3)},\ x\neq\pm1,-3$

Answers

[1] [A] [15] [A] [29] [C] [43] [D]

[2] [D] [16] [C] [30] [D] [44] [C]

[3] [B] [17] [B] [31] [C] [45] [B]

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[5] [A] [19] [D] [33] [B] [47] [A]

[6] [D] [20] [A] [34] [A] [48] [D]

[7] [B] [21] [D] [35] [C] [49] [C]

[8] [A] [22] [A] [36] [A] [50] [B]

[9] [A] [23] [C] [37] [C] [51] [A]

[10] [B] [24] [C] [38] [B] [52] [D]

[11] [D] [25] [A] [39] [C] [53] [C]

[12] [A] [26] [D] [40] [D] [54] [A]

[13] [D] [27] [D] [41] [D] [55] [A]

[14] [D] [28] [C] [42] [D]