ACCUPLACER® CollegeBoard

NEXT-GENERATION

Advanced Algebra and Functions

Sample Questions

The College Board

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ACCUPLACER Advanced Algebra and Functions Sample Questions

The Next-Generation Advanced Algebra and Functions placement test is a computer adaptive assessment of test-takers' ability for selected mathematics content. Questions will focus on a range of topics, including a variety of equations and functions, including linear, quadratic, rational, radical, polynomial, and exponential. Questions will also delve into some geometry and trigonometry concepts. In addition, questions may assess a student's math ability via computational or fluency skills, conceptual understanding, or the capacity to apply mathematics presented in a context. All questions are multiple choice in format and appear discretely (stand alone) across the assessment. The following knowledge and skill categories are assessed:

- Linear equations
- Linear applications
- Factoring
- Quadratics
- Functions
- Radical and rational equations
- Polynomial equations
- Exponential and logarithmic equations
- Geometry concepts
- Trigonometry

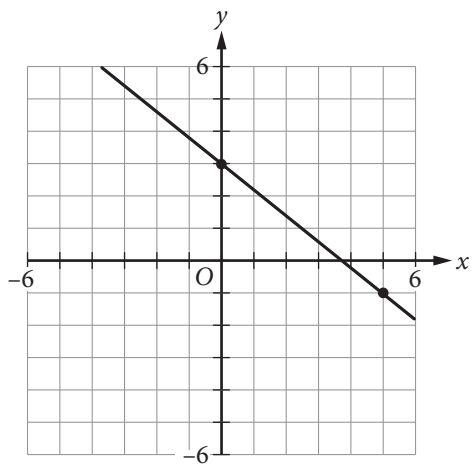
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Sample Questions

Choose the best answer. If necessary, use the paper you were given.

1. Function g is defined by $g(x) = 3(x + 8)$. What is the value of $g(12)$?

   A. -4
   B. 20
   C. 44
   D. 60

2. 

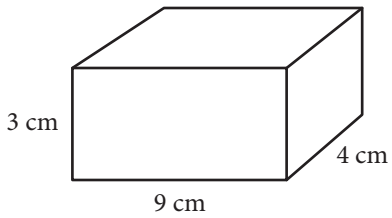
   Which of the following is an equation of the line that passes through the point (0, 0) and is perpendicular to the line shown above?

   A. $y = \frac{5}{4}x$

   B. $y = \frac{5}{4}x + 3$

   C. $y = -\frac{4}{5}x$

   D. $y = -\frac{4}{5}x + 3$

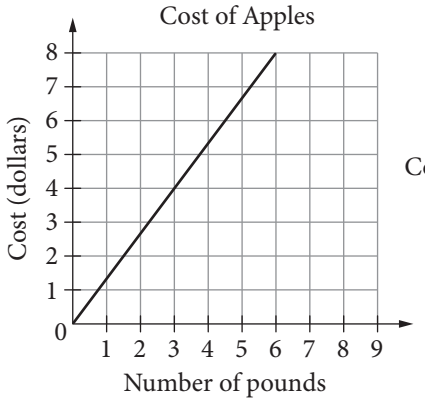
3. 

   The surface area of a right rectangular prism can be found by finding the sum of the area of each of the faces of the prism. What is the surface area of a right rectangular prism with length 4 centimeters (cm), width 9 cm, and height 3 cm? (Area of a rectangle is equal to length times width.)

   A. 75 cm^2
   B. 108 cm^2
   C. 120 cm^2
   D. 150 cm^2

4. Which of the following expressions is equivalent to $(x + 7)(x^2 - 3x + 2)$?

   A. $x^3 - 3x^2 + 2x + 14$
   B. $x^3 + 4x^2 - 19x + 14$
   C. $x^3 - 3x + 14$
   D. $x^2 - 2x + 9$

5. 

   Cost of Pears: $C = \frac{7}{5}p$

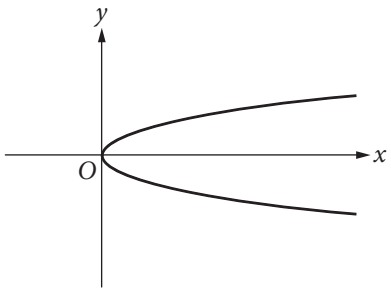
   The graph above shows the cost, in dollars, of apples as a function of the number of pounds of apples purchased at a particular grocery store. The equation above defines the cost C, in dollars, for p pounds of pears at the same store. Which of the following statements accurately compares the cost per pound of apples and the cost per pound of pears at this store?

   A. Apples cost approximately \$0.07 less per pound than pears do.
   B. Apples cost approximately \$0.04 less per pound than pears do.
   C. Apples cost approximately \$0.73 less per pound than pears do.
   D. Apples cost approximately \$0.62 more per pound than pears do.

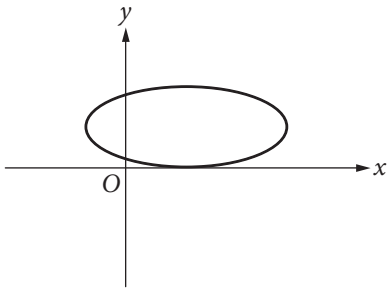
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6. Which of the following is the graph of a function where $y = f(x)$?

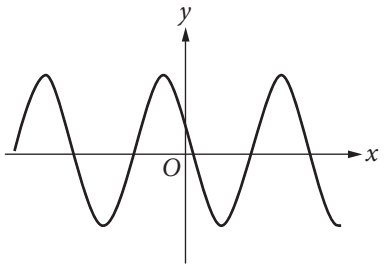
A.



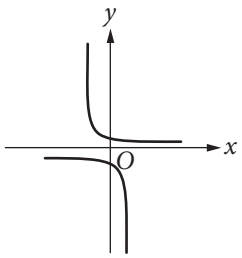
B.



C.



D.



7. Which of the following expressions is equivalent to $3x^2 + 6x - 24$?

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

8. A biologist puts an initial population of 500 bacteria into a growth plate. The population is expected to double every 4 hours. Which of the following equations gives the expected number of bacteria, n, after x days? (24 hours = 1 day)

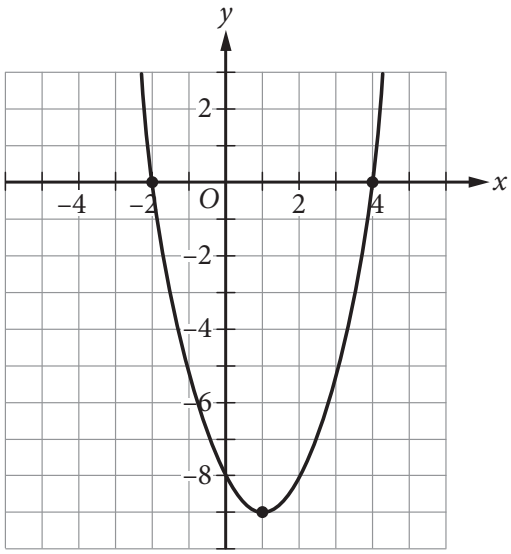
A. $n = 500(2)^x$
B. $n = 500(2)^{6x}$
C. $n = 500(6)^x$
D. $n = 500(6)^{2x}$

9. $x^2 + 5x - 9 = 5$

Which of the following values of x satisfies the equation above?

A. 7
B. 3
C. –2
D. –7

10. The graph of $y = f(x)$ is shown in the xy-plane below.



Which of the following equations could define $f(x)$?

A. $f(x) = x^2 - 2x - 8$
B. $f(x) = -x^2 + 2x - 8$
C. $f(x) = (x - 2)(x + 4)$
D. $f(x) = -(x - 1)^2 - 9$

11. Which of the following best describes the range of $y = -2x^4 + 7$?

A. $y \leq -2$
B. $y \geq 7$
C. $y \leq 7$
D. All real numbers

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12. For which of the following equations is $x = 6$ the only solution?

A. $(6x)^2 = 0$
B. $(x - 6)^2 = 0$
C. $(x + 6)^2 = 0$
D. $(x - 6)(x + 6) = 0$

13. If $f(x) = x^2 + 3x + 1$, what is $f(x + 2)$?

A. $x^2 + 3x + 3$
B. $(x + 2)^2 + 3(x + 2) + 1$
C. $(x + 2)(x^2 + 3x + 1)$
D. $x^2 + 3x + 9$

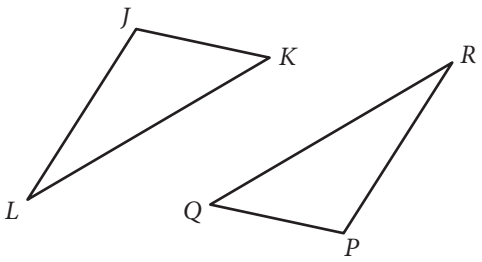
14. What, if any, is a real solution to $\sqrt{5x + 1} + 9 = 3$?

A. $-\frac{1}{5}$
B. 7
C. $\frac{143}{5}$
D. There is no real solution.

15. If $x \neq -2$ and $x \neq -\frac{3}{2}$, what is the solution to $\frac{5}{x + 2} = \frac{x}{2x - 3}$?

A. 3 and 5
B. 2 and $-\frac{3}{2}$
C. –2 and $\frac{3}{2}$
D. –3 and –5

16.



Triangle JKL and triangle PQR are shown above. If $\angle J$ is congruent to $\angle P$, which of the following must be true in order to prove that triangles JKL and PQR are congruent?

A. $\angle L \cong \angle R$ and $JL = PR$
B. $KL = QR$ and $PR = JL$
C. $JK = PQ$ and $KL = QR$
D. $\angle K \cong \angle Q$ and $\angle L \cong \angle R$

17. In the function $f(x) = a(x + 2)(x - 3)^b$, a and b are both integer constants and b is positive. If the end behavior of the graph of $y = f(x)$ is positive for both very large negative values of x and very large positive values of x, what is true about a and b?

A. a is negative, and b is even.
B. a is positive, and b is even.
C. a is negative, and b is odd.
D. a is positive, and b is odd.

18. Which of the following equations is equivalent to $2^{5x} = 7$?

A. $x = \log_2\left(\frac{7}{5}\right)$
B. $x = \frac{\log_2 7}{5}$
C. $x = \frac{\log_7 2}{5}$
D. $x = \frac{\log_7 5}{2}$

19. If $x > 0$ and $y > 0$, which of the following expressions is equivalent to $\frac{x - y}{\sqrt{x} - \sqrt{y}}$?

A. $\frac{x - y}{\sqrt{x - y}}$
B. $\sqrt{x - y}$
C. $\sqrt{x} + \sqrt{y}$
D. $x\sqrt{x} + y\sqrt{y}$

20. In triangle ABC, angle C is a right angle. If $\cos A = \frac{5}{8}$, what is the value of $\cos B$?

A. $\frac{3}{8}$
B. $\frac{5}{8}$
C. $\frac{\sqrt{39}}{8}$
D. $\frac{\sqrt{89}}{8}$

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Answer Key

1. D

2. A

3. D

4. B

5. A

6. C

7. B

8. B

9. D

10. A

11. C

12. B

13. B

14. D

15. A

16. A

17. D

18. B

19. C

20. C

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Rationales

1. **Choice D is correct.** The value of $g(12)$ can be found by substituting 12 for x in the equation for $g(x)$. This yields $g(12) = 3(12 + 8)$, which is equivalent to $3(20)$ or 60. Choice A is incorrect. This answer represents the value of x in the equation $12 = 3(x + 8)$. Choice B is incorrect. This answer represents the value of the expression in parentheses. Choice C is incorrect. This answer is a result of incorrectly distributing the 3 through the expression in parentheses: $g(12) = 3(12) + 8$.

2. **Choice A is correct.** The slopes of perpendicular lines are negative reciprocals of each other. The slope of the line in the graph is $-\frac{4}{5}$. The negative reciprocal of $-\frac{4}{5}$ is $\frac{5}{4}$. A line that passes through the point $(0, 0)$ has a y-intercept of 0. Therefore, the equation $y = \frac{5}{4}x + 0$, or $y = \frac{5}{4}x$, is correct. Choice B is incorrect because it is an equation of a line that is perpendicular to the line shown, but it does not pass through the origin. Choice C is incorrect because this equation is parallel to the line shown, not perpendicular. Choice D is incorrect because it is the equation of the line shown in the graph.

3. **Choice D is correct.** The surface area of the rectangular prism is the total area of each of the faces of the prism and can be written as $2(\text{length} \times \text{width}) + 2(\text{height} \times \text{width}) + 2(\text{length} \times \text{height})$, which is $2(4 \text{ cm} \times 9 \text{ cm}) + 2(3 \text{ cm} \times 9 \text{ cm}) + 2(4 \text{ cm} \times 3 \text{ cm})$, or 150 cm^2. Choice A is incorrect because it is half the surface area of the prism. Choice B is incorrect because it is the volume of the prism. Choice C is incorrect because it is 30 units less than the surface area of the prism described.

4. **Choice B is correct.** Using the distribution property, the given expression can be rewritten as $x(x^2) + x(-3x) + x(2) + 7(x^2) + 7(-3x) + 7(2)$. Further simplifying results in $x^3 - 3x^2 + 2x + 7x^2 - 21x + 14$. Finally, adding like terms yields $x^3 + 4x^2 - 19x + 14$. Choices A, C, and D are incorrect because they each result from errors made when performing the necessary distribution and adding like terms.

5. **Choice A is correct.** The cost per pound of apples can be determined by the slope of the graph as about $\$1.33$ per pound. The cost per pound of pears can be determined by the slope of the line defined by the equation $C = \frac{7}{5}p$. The slope of the line defined by C is $\frac{7}{5}$, so the cost per pound of pears is $\$1.40$. Therefore, the apples cost approximately $\$0.07$ less per pound than pears do. Choice B is incorrect. This is the result of misreading the cost per pound of apples as $\$0.67$ and the cost per pound of pears as $\$0.71$ and then finding the difference between the two values. Choice C is incorrect. This is the result of misreading the cost per pound of apples from the graph as $\$0.67$ and then subtracting the cost per pound of pears, $\$1.40$. Choice D is incorrect. This is the result of misreading the cost per pound of pears as $\$0.71$ and then subtracting this value from the cost per pound of apples, $\$1.33$.

6. **Choice C is correct.** A function has one output for each input. Each x-value on this graph corresponds to only one y-value. Choices A, B, and D are incorrect because each has x-values that correspond to more than one y-value.

7. **Choice B is correct.** The expression $3(x - 2)(x + 4)$ can be expanded by first multiplying $(x - 2)$ by 3 to get $(3x - 6)$ and then multiplying $(3x - 6)$ by $(x + 4)$ to get $3x^2 + 6x - 24$. Choice A is incorrect because it is equivalent to $3x^2 - 6x - 24$. Choice C is incorrect because it is equivalent to $x^2 - 6x - 72$. Choice D is incorrect because it is equivalent to $x^2 + 6x - 72$.

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8. **Choice B is correct.** An exponential function can be written in the form $y = ab^t$ where a is the initial amount, b is the growth factor, and t is the time. In the scenario described, the variable y can be substituted with n, the total number of bacteria, and the initial amount is given as 500, which yields $n = 500b^t$. The growth factor is 2 because the population is described as being expected to double, which gives the equation $n = 500(2)^t$. The population is expected to double every 4 hours, so for the time to be x days, x must be multiplied by 6 (the number of 4-hour periods in 1 day). This gives the final equation $n = 500(2)^{6x}$. Choices A, C, and D are incorrect. Choice A does not account for the six 4-hour periods per day, choice C uses the number of time periods per day as the growth rate, and choice D uses the number of time periods per day as the growth rate and multiplies the exponent by the actual growth rate.

9. **Choice D is correct.** Subtracting 5 from both sides of the equation gives $x^2 + 5x - 14 = 0$. The left-hand side of the equation can be factored, giving $(x + 7)(x - 2) = 0$. Therefore, the solutions to the quadratic equation are $x = -7$ and $x = 2$. Choice A is incorrect because $7^2 + 5(7) - 9$ is not equal to 5. Choice B is incorrect because $3^2 + 5(3) - 9$ is not equal to 5. Choice C is incorrect because $(-2)^2 + 5(-2) - 9$ is not equal to 5.

10. **Choice A is correct.** The graph of $y = f(x)$ crosses the x-axis at $x = -2$ and $x = 4$, crosses the y-axis at $y = 8$, and has its vertex at the point $(1, -9)$. Therefore, the ordered pairs $(-2, 0)$, $(4, 0)$, $(0, -8)$, and $(1, -9)$ must satisfy the equation for $f(x)$. Furthermore, because the graph opens upward, the equation defining $f(x)$ must have a positive leading coefficient. All of these conditions are met by the equation $f(x) = x^2 - 2x - 8$. Choice B is incorrect. The points $(-2, 0)$, $(4, 0)$, $(0, -8)$, and $(1, -9)$, which are easily identified on the graph of $y = f(x)$, do not all satisfy the equation $f(x) = -x^2 + 2x - 8$; only $(0, -8)$ does. Therefore $f(x) = -x^2 + 2x - 8$ cannot define the function graphed. Furthermore, because the graph opens upward, the equation defining $y = f(x)$ must have a positive leading coefficient, which $f(x) = -x^2 + 2x - 8$ does not. Choice C is incorrect. The points $(-2, 0)$, $(4, 0)$, $(0, -8)$, and $(1, -9)$, which are easily identified on the graph of $y = f(x)$, do not all satisfy the equation $f(x) = (x - 2)(x + 4)$; only $(0, -8)$ does. Therefore, $f(x) = (x - 2)(x + 4)$ cannot define the function graphed. Choice D is incorrect. Though the vertex $(1, -9)$ does satisfy the equation $f(x) = -(x - 1)^2 - 9$, the points $(-2, 0)$, $(4, 0)$, and $(0, -8)$ do not. Therefore, $f(x) = -(x - 1)^2 - 9$ cannot define the function graphed. Furthermore, because the graph opens upward, the equation defining $y = f(x)$ must have a positive leading coefficient, which $f(x) = -(x - 1)^2 - 9$ does not.

11. **Choice C is correct.** The range of a function describes the set of all outputs, y, that satisfy the equation defining the function. In the xy-plane, the graph of $y = -2x^4 + 7$ is a U-shaped graph that opens downward with its vertex at $(0, 7)$. Because the graph opens downward, the vertex indicates that the maximum value of y is 7. Therefore, the range of the function defined by $y = -2x^4 + 7$ is the set of y-values less than or equal to 7. Choices A, B, and D are incorrect in that choice A doesn't cover the entire range, while choices B and D include values that aren't part of the range.

12. **Choice B is correct.** The only value of x that satisfies the equation $(x - 6)^2 = 0$ is 6. Choice A is incorrect because $x = 0$ is the only solution to the equation $(6x)^2 = 0$. Choice C is incorrect because $x = -6$ is the only solution to the equation $(x + 6)^2 = 0$. Choice D is incorrect because although $x = 6$ is a solution to the equation $(x - 6)(x + 6) = 0$, $x = -6$ is another solution to the equation.

13. **Choice B is correct.** Substituting $x + 2$ for x in the original function gives $f(x + 2) = (x + 2)^2 + 3(x + 2) + 1$. Choice A is incorrect. This is $f(x) + 2$. Choice C is incorrect. This is $(x + 2)f(x)$. Choice D is incorrect. This is $f(x) + 2^3$.

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14. Choice D is correct. Subtracting 9 from both sides of the equation yields $\sqrt{5x+1} = -6$, and there are no real values of x that result in the square root of a number being negative, so the equation has no real solution. Choices A and C are incorrect due to computational errors in solving for x and not checking the solution in the original equation. Choice B is incorrect because it is the extraneous solution to the equation.

15. Choice A is correct. To solve the equation for x, cross multiply to yield $x(x+2) = 5(2x-3)$. Simplifying both sides of the new equation results in $x^2 + 2x = 10x - 15$. Next, subtract $10x$ from both sides of the equation and add 15 to both sides of the equation to yield $x^2 - 8x + 15 = 0$. By factoring the left-hand side, the equation can be rewritten in the form $(x-3)(x-5) = 0$. It follows, therefore, that $x = 3$ and $x = 5$. Choices B, C, and D are possible results from mathematical errors when solving the equation for x.

16. Choice A is correct. If two angles and the included side of one triangle are congruent to corresponding parts of another triangle, the triangles are congruent. Since angles J and L are congruent to angles P and R, respectively, and the side lengths between each pair of angles, JL and PR, are also equal, then it can be proven that triangles JKL and PQR are congruent. Choices B and C are incorrect because only when two sides and the included angle of one triangle are congruent to corresponding parts of another triangle can the triangles be proven to be congruent, and angles J and P are not included within the corresponding pairs of sides given. Further, side-side-angle congruence works only for right triangles, and it is not given that triangles JKL and PQR are right triangles. Choice D is incorrect because the triangles can only be proven to be similar (not congruent) if all three sets of corresponding angles are congruent.

17. Choice D is correct. A polynomial function of even degree with a positive leading coefficient will have positive end behavior for both very large negative values of x and very large positive values of x. For a polynomial function in the form $f(x) = a(x+2)(x-3)^b$ to be of even degree with a positive leading coefficient, a must be positive and b must be odd. Choice A is incorrect. If a is negative and b is even, the polynomial function will be of odd degree, with a negative leading coefficient. This results in positive end behavior for very large negative values of x and negative end behavior for very large positive values of x. Choice B is incorrect. If a is positive and b is even, the polynomial function will be of odd degree with a positive leading coefficient. This results in negative end behavior for very large negative values of x and positive end behavior for very large positive values of x. Choice C is incorrect. If a is negative and b is odd, the polynomial function will be of even degree with a negative leading coefficient. This results in negative end behavior on both sides of the function.

18. Choice B is correct. By definition, if $(b)^x = y$, where $b > 0$ and $b \neq 1$, then $x = \log_b y$. Therefore, the given equation $2^{5x} = 7$ can be rewritten in the form $\log_2 7 = 5x$. Next, solving for x by dividing both sides of the equation by 5 yields $\frac{\log_2 7}{5} = x$. Choices A, C, and D are incorrect because they are the result of misapplying the identity, which states that if $(b)^x = y$, where $b > 0$ and $b \neq 1$, then $x = \log_b y$.

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19. Choice C is correct. Since $x > 0$ and $y > 0$, x can be rewritten as $(\sqrt{x})^2$ and y can be rewritten as $(\sqrt{y})^2$. It follows, then, that $\frac{x-y}{\sqrt{x}-\sqrt{y}}$ can be rewritten as $\frac{(\sqrt{x})^2-(\sqrt{y})^2}{\sqrt{x}-\sqrt{y}}$.

Because the numerator is a difference of two squares, it can be factored as $\frac{(\sqrt{x}+\sqrt{y})(\sqrt{x}-\sqrt{y})}{(\sqrt{x}-\sqrt{y})}$. Finally, dividing the common factors of $(\sqrt{x}-\sqrt{y})$ in the numerator and denominator yields $\sqrt{x}+\sqrt{y}$. Alternatively, if $\frac{x-y}{\sqrt{x}-\sqrt{y}}$ is multiplied by $\frac{\sqrt{x}+\sqrt{y}}{\sqrt{x}+\sqrt{y}}$, which is equal to 1, and therefore does not change the value of the original expression, the result is $\frac{(x-y)(\sqrt{x}+\sqrt{y})}{(\sqrt{x}-\sqrt{y})(\sqrt{x}+\sqrt{y})}$, which is equivalent to $\frac{x\sqrt{x}+x\sqrt{y}-y\sqrt{x}-y\sqrt{y}}{x-\sqrt{xy}+\sqrt{xy}-y}$. This can be rewritten as $\frac{(x-y)(\sqrt{x}+\sqrt{y})}{(x-y)}$, which can be simplified to $\sqrt{x}+\sqrt{y}$. Choice A is incorrect and may be the result of incorrectly combining $\sqrt{x}-\sqrt{y}$. Choice B is incorrect because it is equivalent to $\frac{x-y}{\sqrt{x-y}}$. Choice D is incorrect and may be the result of misusing the conjugate strategy. Instead of multiplying the numerator and denominator by the quantity $(\sqrt{x}+\sqrt{y})$, they may have been multiplied by $(\sqrt{x}-\sqrt{y})$ and then improperly distributed.

20. Choice C is correct. If triangle ABC is defined as a right triangle, where angle C is the right angle, then the cosine of angle A $(\cos A)$ is defined as the ratio $\frac{\text{the length of the side adjacent to angle } A}{\text{the length of the hypotenuse}}$. Since this ratio is defined as $\frac{5}{8}$, then the length of the side opposite angle A, which is also the side adjacent to angle B, can be derived from the Pythagorean theorem: $a^2 + 5^2 = 8^2$, where a represents the length of the side opposite angle A. Solving for a yields $a^2 = 64 - 25 = 39$, so $a = \sqrt{39}$. Then, to determine the cosine of angle B, use the same ratio in relation to angle B: $\cos B = \frac{\text{the length of the side adjacent to angle } B}{\text{the length of the hypotenuse}} = \frac{\sqrt{39}}{8}$. Choice A and D are incorrect and likely results from an error in finding the length of side $\overline{CB}$. Choice B is incorrect and is the value of cos A and sin B.

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