

1. **Level:** Medium | **Domain:** ADVANCED MATH
Skill/Knowledge: Equivalent expressions | **Testing point:** Foiling out binomials and combining like terms

Key Explanation: Choice D is correct. To solve the question, first, distribute out the two binomial expressions. The next step is to combine like terms and put the final expression in standard form.

$$\begin{aligned} 3(x^2 + 10x + 25) - 2(x^2 - 10x + 25) + 2x \\ 3x^2 + 30x + 75 - 2x^2 + 20x - 50 + 2x \\ x^2 + 52x + 25 \end{aligned}$$

Distractor Explanation: Choices A and C are incorrect. These answers can be arrived at if the foiling expansion is done incorrectly. Choice B is incorrect. This answer can be arrived at if a math miscalculation is done after the foiling out expansion is completed.

2. **Level:** Medium | **Domain:** ADVANCED MATH
Skill/Knowledge: Equivalent expressions | **Testing point:** Finding the least common denominator with binomial terms and combining

Key Explanation: Choice A is correct. To solve this problem, the fractions need a common denominator to be added. The least common denominator is $(x - 2)(5 - x)$, which multiplies out to a denominator of $-x^2 + 7x - 10$. To get both terms of this expression over the same denominator, the numerator and denominator of the first term each must be multiplied by $(5 - x)$ and the numerator and denominator of the second term each must be multiplied by $(x - 2)$. Since the two terms are now over the same denominator, the numerators can be added as follows:

$$\frac{5 - x + 2x(x - 2)}{(x - 2)(5 - x)},$$

Using the foiling and distributive operations to multiply out and combine like terms, the final

answer is: $\frac{2x^2 - 5x + 5}{-x^2 + 7x - 10}$.

Distractor Explanation: Choices B and C are incorrect. These answers can be arrived at wrongly by adding the two fractions directly, which is a common conceptual error. Choice D is incorrect. This answer may be arrived at by finding the common multiple for the denominator and then just adding the original numerators directly without multiplying them by the binomials needed to get the common multiple for the denominator.

3. **Level:** Easy | **Domain:** ALGEBRA
Skill/Knowledge: Systems of two linear equations in two variables | **Testing point:** Solving simultaneous equations

Key Explanation: Solve for y by using the distributing property and the substitution method as follows:

$$3x - 6 + 5(-2(x - 5)) = 2$$

$$3x - 6 - 10(x - 5) = 2$$

$$3x - 6 - 10x + 50 = 2$$

$$-7x + 44 = 2$$

$$-7x = -42$$

$$x = 6$$

Substitute $x = 6$ into the second equation to find y .

$$y = -2(6 - 5)$$

$$y = -2$$

4. **Level:** Easy | **Domain:** PROBLEM-SOLVING AND DATA ANALYSIS
Skill/Knowledge: Two-variable data: models and scatterplots | **Testing point:** Line of best fit

Key Explanation: Choice A is correct. This question can be solved in several ways. The

equation of the line of best fit can be determined by finding the slope and *y-intercept* from the graph directly and plugging those values into the slope-intercept equation of a line, $y = mx + b$. The elimination method can also be used. The slope and *y-intercept* of the line of best fit are both positive, which eliminates **Choices C and D**. The slope of the line of best fit is not steep so that eliminates **Choice B**.

Distractor Explanation: **Choice B** is incorrect because the slope of the line of best fit is $\frac{1}{4}$ and not 4. **Choice C** is incorrect because the *y-intercept* of the line of best fit is positive, not negative. **Choice D** is incorrect because the line of best fit has a positive slope and not a negative one.

5. **Level:** Medium | **Domain:** GEOMETRY AND TRIGONOMETRY

Skill/Knowledge: Circles | **Testing point:** Arc length of a circle

Key Explanation: **Choice C** is correct. The arc length of the circle can be found by using the equation arc length = $r\theta$, where r is the radius of the circle and θ is the degree in radians of the central angle that subtends the arc length desired.

Therefore the arc length would be

$6\left(\frac{7}{12}\pi\right) = \frac{7}{2}\pi$. The arc length can also be found by converting radians to degrees using the formula $\frac{\theta}{360}2\pi r$. This would still give the answer as $\frac{7}{2}\pi$ cm.

Distractor Explanation: **Choice A** is incorrect. This is the circumference of the whole circle. **Choice B** is incorrect. This is the area of the whole

circle. **Choice D** is incorrect. This is the area of the sector that can be found using the formula $\frac{1}{2}r^2\theta$, where θ is the measure of the central degree in radians.

6. **Level:** Easy | **Domain:** ADVANCED MATH
Skill/Knowledge: Nonlinear equations in one variable and systems of equations in two variables
Testing point: Finding the sum of the roots in a quadratic equation

Key Explanation: **Choice A** is correct. The first step is to simplify the equation by dividing out 2, the greatest common factor out of the equation, leaving $x^2 + 3x + 2 = 0$. The equation is in simplified form. The sum of the roots of a quadratic equation is equal to $-\frac{b}{a}$, where $a = 1$, $b = 3$.

Therefore, the sum of the roots of the quadratic equation above would be $-\frac{3}{1} = -3$.

Distractor Explanation: **Choice B** is incorrect and is the negative of the product of the roots and can be arrived at by using $-\frac{c}{a}$. **Choice C** is incorrect. This is the product of the roots given by $\frac{c}{a}$. **Choice D** is incorrect and is the negative value of the sum of roots i.e. $\frac{b}{a}$.

7. **Level:** Medium | **Domain:** GEOMETRY AND TRIGONOMETRY

Skill/Knowledge: Lines, angles, and triangles
Testing point: Finding the sum of angles in a polygon and converting degrees to radians

Key Explanation: The sum of the interior angles in a polygon is $180 \times (n - 2)$, where n is the number of sides in the polygon. A heptagon has 7 sides, so the sum of its interior angles will be $180 \times (7 - 2) = 900^\circ$.

A hexagon has 6 sides, so the sum of its interior angles will be $180 \times (6 - 2) = 720^\circ$. The difference between the total number of degrees of the interior angles of the two shapes is 180° . This number in radians would be π and $a = 1$.

8. **Level:** Medium | **Domain:** ALGEBRA
Skill/Knowledge: Linear functions | **Testing point:** Finding equations of functions

Key Explanation: Choice A is correct. The problem gives two points and asks what the function $f(x)$ is that best describes the points. Using points (3, 2) and (6, -3), the slope of the function, which is the change in the y coordinates over the change in the x coordinates, $\frac{(y_2 - y_1)}{(x_2 - x_1)}$, can be found as follows:

$$\frac{2 - (-3)}{3 - 6} = \frac{5}{-3}$$

The answer choices are in slope-intercept form, $y = mx + b$ where m represents the slope. The only answer choice that has a slope of $-\frac{5}{3}$ is **Choice A**.

Distractor Explanation: Choice B is incorrect most likely due to a conceptual error. Choice C is incorrect and incorrectly states the slope formula as the change in x over the change in y . Choice D is incorrect as this is the equation of the line that is perpendicular to $f(x)$.

9. **Level:** Easy | **Domain:** ALGEBRA
Skill/Knowledge: Linear equations in one variable
Testing point: Solving for x

Key Explanation: Choice D is correct. To solve this problem, first divide both sides of the equation by 2 to get:

$$(x + 4) = \frac{18}{2}$$

$$(x + 4) = 9$$

$$x = 5$$

$$\text{Therefore } (x + 6) = 5 + 6 = 11$$

Distractor Explanation: Choice A is incorrect. This is the value of $(x + 4)$. Choice B is incorrect. This is the value of x only. Choice C is incorrect. It can be the result of a miscalculation.

10. **Level:** Medium | **Domain:** PROBLEM-SOLVING AND DATA ANALYSIS
Skill/Knowledge: Ratios, rates, proportional relationships, and units | **Testing point:** Ratios

Key Explanation: To solve this problem, let x equal the total number of people at the fair. Every group of 5 students and 3.5 parents has a total of 8.5 total people in it. Set up a proportion of ratio students to ratio total people and set it equal to the ratio of the total number of students to the total number of people as follows:

$$\frac{5}{8.5} = \frac{2,000}{x}$$

Cross multiplying gives the equation $5x = 2,000 \times 8.5$. Dividing both sides of the equation by 5 gives $x = 3,400$ students.

11. **Level:** Medium | **Domain:** PROBLEM-SOLVING AND DATA ANALYSIS
Skill/Knowledge: Percentages | **Testing point:** Percent decrease

Key Explanation: Choice D is correct. The percent decrease can be found by using the formula:

$$\frac{\text{difference between actual and predicted values}}{\text{original value}} \times 100.$$

Looking at the graph, the actual y values when $x = 4$ are 6 and 11. The predicted y value at $x = 4$ is 9. Since the question asked for the percent decrease from the actual value to the predicted value, the actual value needs to be higher and thus we would use the y value of 11 and not 6 at $x = 4$. Plugging in the y values of 11 and 9 into the equation yields $\frac{11-9}{11} \times 100 = 18.18\%$

Distractor Explanation: **Choice A** is incorrect as this answer is the percent increase from 9 to 11.

Choice B is incorrect as this answer is the percent decrease from 9 to 6.

Choice C is incorrect as this describes the percent increase from 6 to 9.

12. **Level:** Easy | **Domain:** ALGEBRA

Skill/Knowledge: Linear inequalities in one or two variables | **Testing point:** Systems of linear inequalities

Key Explanation: **Choice B** is correct. To solve the question, the fastest method would be to substitute the x and y coordinates of the answer choices into the system of inequalities and see which coordinate pair satisfies both inequalities. Plugging in the x and y values for **Choice B** makes both inequalities valid as follows:

$$\text{Inequality 1: } 4 > -3(1) + 5$$

$$4 > -3 + 5$$

$$4 > 2$$

$$\text{Inequality 2: } 4 > 2(1)$$

$$4 > 2$$

Distractor Explanation: **Choice A** is incorrect. Plugging in this coordinate pair into the second inequality yields $4 > 4$, which is false. **Choice C** is incorrect. Plugging this coordinate pair into the second inequality yields $4 > 2(3) = 4 > 6$, which

is false. **Choice D** is incorrect. Plugging this coordinate pair into the second inequality yields $1 > 2(2) = 1 > 4$, which is false.

13. **Level:** Medium | **Domain:** ADVANCED MATH
Skill/Knowledge: Nonlinear equations in one variable and systems of equations in two variables
Testing point: Finding solutions for an absolute value equation

Key Explanation: To solve this absolute value equation, first divide both sides of the equation by 3 to get: $|x - 4| = 2$. Then remove the absolute value and set up and solve the following 2 equations:

$$x - 4 = 2 \text{ and } x - 4 = -2$$

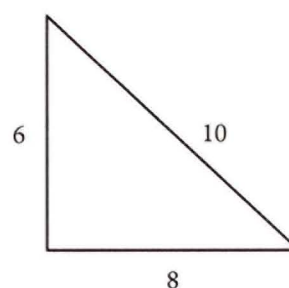
$$x = 6 \text{ and } x = 2$$

14. **Level:** Easy | **Domain:** GEOMETRY AND TRIGONOMETRY

Skill/Knowledge: Area and volume | **Testing point:** Area of a trapezoid

Key Explanation: **Choice A** is correct. Since segment AD is parallel to segment BC and $AB = DC$ the shape is an isosceles trapezoid. To find the area of a trapezoid the formula $\frac{h}{2}(a+b)$, is used where h is the height of the trapezoid and a and b are the lengths of the two bases of the trapezoid.

The height of the trapezoid can be found by using the Pythagorean theorem $a^2 + b^2 = c^2$, where a and b are the legs of the right triangle and c is its hypotenuse.



Using the pythagorean theorem $a^2 + 8^2 = 10^2$ or $a^2 = 36$, yielding $a = 6$. Thus the height of the trapezoid is 6. Plugging in the values for a , b , and h into the area of a trapezoid formula, yields

$$\frac{6}{2}(12 + 28) = 120$$

Therefore the area of the trapezoid would be 120.

Distractor Explanation: Choice B is incorrect.

This answer is the perimeter of the trapezoid.

Choice C is incorrect. This answer can be

determined if the shape is divided into a rectangle and two triangles. This answer is the area of the rectangle plus one triangle. **Choice D** is incorrect.

It is the value of the area of the two triangles alone.

15. **Level:** Easy | **Domain:** ADVANCED MATH

Skill/Knowledge: Nonlinear equations in one variable and systems of equations in two variables

Testing point: Absolute values

Key Explanation: Choice C is correct. The first step is to combine the two absolute value terms into $|x + 3| = -2$. The next step is to divide both sides by -1 to get: $|x + 3| = 2$. The absolute value is equal to a positive number and therefore it has 2 solutions.

Distractor Explanation: Choice A is incorrect.

To have 0 solutions in an absolute value equation, the absolute equation value has to be equal to a negative number. **Choice B** is incorrect. For an absolute value equation to have 1 solution it has to be equal to 0. **Choice D** is incorrect. There is sufficient information to answer the question.

16. **Level:** Medium | **Domain:** ALGEBRA

Skill/Knowledge: Linear equations in two

variables | **Testing point:** Perpendicular lines

Key Explanation: The slope is found by putting the equation of the line into slope-intercept form of $y = mx + b$ as follows:

$$5x - 6y + 30 = 0$$

$$-6y = -5x - 30$$

$$y = \frac{5}{6}x + 5. \text{ The slope is then } \frac{5}{6}, \text{ a line}$$

perpendicular to this will have the negative

inverse of this slope which is $-\frac{6}{5}$.

17. **Level:** Easy | **Domain:** GEOMETRY AND TRIGONOMETRY

Skill/Knowledge: Right triangles and trigonometry

Testing point: Trigonometric identities

Key Explanation: Choice C is correct.

$\sin x = \cos(90^\circ - x)$ and vice versa, therefore $\cos 72^\circ = \sin(90^\circ - 72^\circ)$ This equates to $\sin 18^\circ$.

Distractor Explanation: Choice A is incorrect.

This choice may be selected due to a conceptual error. **Choice B** is incorrect as $\sin 72^\circ$ is equal to $\cos 18^\circ$. **Choice D** is incorrect. $\cos 18^\circ$ is equal to $\sin 72^\circ$.

18. **Level:** Easy | **Domain:** PROBLEM-SOLVING AND DATA ANALYSIS

Skill/Knowledge: Probability and conditional probability | **Testing point:** Probability Complement

Key Explanation: Choice B is correct. The sum of the probabilities of an event and its complement must add up to 1. Therefore, if the probability that it will rain is 0.26, the probability of no rain is $1 - 0.26 = 0.74$.

Distractor Explanation: Choices A and C are incorrect and can be due to a miscalculation or conceptual error. **Choice D** is incorrect as a probability of 1 means that it is certain that it will not rain.

19. **Level:** Easy | **Domain:** ADVANCED MATH

Skill/Knowledge: Nonlinear functions | **Testing point:** Vertex form of a quadratic and minimum/maximum point

Key Explanation: The maximum t value of a concave down parabola for the quadratic equation $ax^2 + bx + c$ can be found using the formula $t =$

$\frac{-b}{2a}$, which finds the x coordinate of the vertex of

the parabola. In the equation above, a is 3 and $b = 9$ yielding,

$$t = \left(\frac{-9}{2(-3)} \right) = \frac{-9}{-6} = \frac{3}{2}$$

20. **Level:** Hard | **Domain:** GEOMETRY AND TRIGONOMETRY

Skill/Knowledge: Right triangles and trigonometry | **Testing point:** Special triangles

Key Explanation: The triangle PQR is a special triangle. **Choice D** is correct. Triangle PQR is inscribed in a semicircle where the hypotenuse of triangle PQR is the diameter of the circle. This makes angle P a right angle. A triangle has 180 degrees and that would make angle R equal to 30 degrees. Therefore triangle PQR is a special triangle, more specifically a 30 – 60 – 90 special triangle. Since the radius of the circle is 7cm, this makes the diameter 14cm. The hypotenuse of triangle PQR is the diameter of the circle. In a 30 – 60 – 90 special triangle, the length of the side opposite the right angle, the hypotenuse, is two times the length of the side opposite the 30-degree angle. This makes side $PQ = 7$ cm. The side opposite the 60-degree angle in this special triangle is the length of the side opposite the 30-degree angle times $\sqrt{3}$. Therefore the length of PR is equal to $7\sqrt{3}$.

Distractor Explanation: **Choice A** is incorrect.

This is the diameter of the circle and the value of the length of RQ .

Choice B is incorrect as it is the length of PR .

Choice C is incorrect. This answer is due to a conceptual error confusing the ratios in sides of the 30 – 60 – 90 triangle with the 45 – 45 – 90 special triangle.

21. **Level:** Medium | **Domain:** ALGEBRA

Skill/Knowledge: Linear inequalities in one or two variables | **Testing point:** Absolute value linear inequalities

Key Explanation: **Choice B** is correct. For the above inequality either $x + 3 > 4$ or $x + 3 < -4$. Solving $x + 3 > 4$ yields $x > 1$. Solving $x + 3 < -4$ yields $x < -7$. **Choice B** is the correct choice as it has the only value in the domain of the range of solutions to the inequality.

Distractor Explanation: **Choices A, C, and D** are incorrect as they are not part of the range of solutions to the inequality.

22. **Level:** Easy | **Domain:** ALGEBRA

Skill/Knowledge: Systems of two linear equations in two variables | **Testing point:** Systems of equations

Key Explanation: **Choice A** is correct. To solve this problem, subtract the two equations.

$$3x + 4y = 31 - (2x + 3y = 22)$$

$$= x + y = 9, \text{ which is } \mathbf{Choice A}.$$

Distractor Explanation: **Choice B** is incorrect. This answer is the value of x . **Choice C** is incorrect. This answer is the value of y . **Choice D** is incorrect. It is due to conceptual or miscalculation errors.