

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

Skill/Knowledge: Linear equations in one variable

Testing point: Solving equations with one variable

Key Explanation: Choice B is correct. This question can be solved in two ways. The most efficient way to solve the equation is to factor out the 4 from the left side of the equation yielding $4(x + 4) = 24$. Dividing both sides of the equation

by 4 yields $(x + 4) = \frac{24}{4}$, which equates to

$(x + 4) = 6$, which is **Choice B**.

The second way to solve this equation is to subtract 16 from both sides of the equation. The result is $4x + 16 - 16 = 24 - 16$ which in turn translates to $4x = 8$. Dividing both sides of the equation by 4 gets $x = 2$. However, the question asks for the value of $x + 4$, and not x , which will then be $2 + 4$, or 6.

Distractor Explanation: Choice A is incorrect as this is the value of $4x$ when 16 is subtracted from both sides of the equation. Choice C is incorrect as this is the value of x . Choice D is incorrect as this answer may be the result of a conceptual error or miscalculation.

2. **Level:** Medium | **Domain:** PROBLEM-SOLVING AND DATA ANALYSIS

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

Key Explanation: Choice A is correct. Given that there are 35 teachers in the school, according to the table, there are 16 female teachers. Thus, the number of male teachers in the school is $35 - 16 = 19$. The number of people in the school is found by adding the number of teachers to the number of students as follows: $245 + 35 = 280$. Therefore,

of the 280 people in the school, 19 are male teachers and the probability of selecting a male

teacher is $\frac{19}{280}$.

Distractor Explanation: Choice B is incorrect since it is the probability of choosing a teacher given that he is already male. Choice C is incorrect, since it's the probability of choosing a male given that he is already a teacher. Choice D is incorrect as it is conceptually incorrect because it mixes students and teachers.

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

Skill/Knowledge: Nonlinear equations in one variable and systems of equations in two variables
Testing point: Solving absolute value equations

Key Explanation: Absolute value equations usually have two solutions. The first step would be to remove the parentheses and set up two linear equations as follows:

$$2x - 3 = 11 \text{ and } 2x - 3 = -11$$

To solve for x in the first equation, add 3 to both sides of the equation as follows:

$$2x - 3 + 3 = 11 + 3$$

$$2x = 14$$

$$x = 7$$

To find the second solution solve for x in the second equation by adding 3 to both sides of the equation as follows:

$$2x - 3 + 3 = -11 + 3$$

$$2x = -8$$

$$x = -4$$

Thus, the positive solution for x is 7.

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

Skill/Knowledge: Linear functions | **Testing point:** Perpendicular lines

Key Explanation: Choice C is correct.

Perpendicular lines meet at 90-degree angles and have opposite sign reciprocal slopes. Putting the given equation into slope-intercept form $y = mx + b$ by dividing all terms by 5, yields

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

The m in the slope-intercept form of the equation represents the slope of the line.

Therefore, the slope of the line is $\frac{4}{5}$ and the

opposite reciprocal slope is $-\frac{5}{4}$, which is the slope

of the perpendicular line. This makes **Choice C** the only correct answer.

Distractor Explanation: **Choice A** is incorrect as the line would be parallel to m rather than perpendicular as the lines have the same slope. **Choices B** and **D** are incorrect as they are the negative of the perpendicular slope.

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

Skill/Knowledge: Circles | **Testing point:**

Standard form of the equation of a circle and completing the square

Key Explanation: **Choice C** is correct. To find the center of the circle, first transform the equation to its standard form $(x-h)^2 + (y-k)^2 = r^2$, where (h, k) is the center of the circle and r is its radius. To get the equation in standard form, complete the square. To do this, first, rearrange the terms in the equation to have all the x 's and y 's near each other as follows: $x^2 - 6x + y^2 + 4y = 36$. The standard form of a quadratic equation is $ax^2 + bx + c$. Next,

working with just $x^2 - 6x$, with $a = 1$ and $b = -6$,

add $\left(\frac{b}{2}\right)^2$ or $\left(\frac{-6}{2}\right)^2$ to both sides of the equation

to get $x^2 - 6x + 9 + y^2 + 4y = 36 + 9$. Next, working with just $y^2 + 4y$, with $a = 1$ and $b = 4$,

add $\left(\frac{b}{2}\right)^2$ or $\left(\frac{4}{2}\right)^2$ to both sides of the equation

to get $x^2 - 6x + 9 + y^2 + 4y + 4 = 36 + 9 + 4$ or

49. Next, factoring $x^2 - 6x + 9$ yields $(x-3)^2$,

and factoring $y^2 + 4y + 4$ yields $(y+2)^2$, to get $(x-3)^2 + (y+2)^2 = 49$

Therefore, the center of the circle will be $(3, -2)$.

Distractor Explanation: **Choice A** is incorrect because if the standard form of a circle equation is read incorrectly then $(-h, -k)$ would be incorrectly determined to be the center of the circle. **Choice D** is incorrect as the x and y coordinates have been reversed. **Choice B** is incorrect as this is the negative of incorrect **Choice D**.

6. **Level:** Hard | **Domain:** ADVANCED MATH
Skill/Knowledge: Equivalent expressions | **Testing point:** Exponents and matching coefficients

Key Explanation:

$$(8^x)^x \times 4^{2x} = ((2^3)^x)^x \times (2^2)^{2x} = 2^{3x^2} \times 2^{4x}$$

This yields 2^{3x^2+4x} using exponent rules.

$$\frac{2^{ax^2}}{2^{-bx}} = 2^{ax^2+bx} \text{ using exponent rules.}$$

Therefore,

$$3x^2 + 4x = ax^2 + bx$$

$$a = 3$$

7. **Level:** Medium | **Domain:** ALGEBRA
Skill/Knowledge: Linear inequalities in one or two variables | **Testing point:** Solving systems of linear inequalities

Key Explanation: **Choice B** is correct. The most

efficient way to solve the problem is to substitute the given answer choices into the system of inequalities and see which answer makes both inequalities valid. Plugging in **Choice A** into the first inequality yields

$$-6(-2) + 3 < -4$$

$$12 + 3 < -4$$

$15 < -4$, which is false. Plugging in **Choice B** into the first inequality yields $-6(4) + 3 < 7$

$$-24 + 3 < 7$$

$-21 < 7$, which is true. Next, plug **Choice B** into the second inequality which yields

$$7 < 4 + 6$$

$7 < 10$. This is true, making **Choice B** the correct option.

Distractor Explanation: **Choice A** does not work as shown above. Plugging **Choice C** into the first inequality yields

$$-6(-2) + 3 < 1$$

$$12 + 3 < 1$$

$15 < 1$, which is not true. Plugging **Choice D** into the first inequality yields

$$-6(-2) + 3 < -4$$

$$12 + 3 < -4$$

$15 < -4$, which is not true.

8. **Level:** Hard | **Domain:** ADVANCED MATH
Skill/Knowledge: Nonlinear functions | **Testing point:** Transformations of quadratic equations

Key Explanation: **Choice A** is correct. The vertex form of the equation of a parabola is $y = (x - h)^2 + k$, where (h, k) is the vertex of the parabola. Thus, the vertex of the $f(x)$ equation is $(3, 8)$ and the vertex of the $g(x)$ equation is $(5, 5)$. Therefore, the x coordinate moves to the right 2 units from $f(x)$ to $g(x)$, and the y coordinate moves down 3 units.

Distractor Explanation: **Choice B** is incorrect as the x coordinate is moving to the right, not the left. A student may pick this option if he or she assumes that since h has reduced by 2 units it is moving to the left. **Choice C** is incorrect because the y coordinate is moving down not up. **Choice D** is incorrect. This incorrect answer may be selected if the student transformed $g(x)$ onto $f(x)$ instead of the other way around.

9. **Level:** Easy | **Domain:** ADVANCED MATH
Skill/Knowledge: Nonlinear functions | **Testing point:** Identifying the equation of an exponential function from a graph

Key Explanation: **Choice D** is correct. The graph depicts an exponential growth equation, which has its standard equation $y = ab^x$, where if in an exponential equation $b > 1$, then the equation represents exponential growth. The value of a in the equation represents the initial value of the equation when $x = 0$. Using the process of elimination, choices A and C can be ruled out as their b values are less than 1 and thus represent exponential decay, not growth. **Choice A** can also be ruled out as it gives an initial value of 5 whereas the graph shows a smaller initial value. **Choice D** is correct as it is the only equation that shows that the graph is increasing exponentially and has a y -intercept of less than 5.

Distractor Explanation: See the process of elimination answer explanations above.

10. **Level:** Medium | **Domain:** GEOMETRY AND TRIGONOMETRY
Skill/Knowledge: Right triangles and trigonometry | **Testing point:** Similar triangles and use of SOHCAHTOA

Key Explanation: Since triangle DEF and triangle PQR are similar, angles F and R are congruent.

Therefore, $\sin R = \sin F$. Therefore using SOHCAHTOA the $\sin$ of an angle is equal to the length of the opposite side to the angle divided by the length of the hypotenuse of the triangle. Thus,

the $\sin$ of F is $\frac{5}{13}$.

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

Skill/Knowledge: One-variable data: distributions and measures of center and spread | **Testing point:** Finding the mean

Key Explanation: Choice B is correct. To find the average of a set of data, divide the total sum of the values of the data by the number of items. The average of the SAT scores of the 7 students is 1,320. Therefore, the sum of their scores would be $1,320 \times 7 = 9,240$. Adding in the SAT score of the 8th student, the new sum of the SAT scores will be $9,240 + 1,460 = 10,700$. The new average

SAT score will be $\frac{10,700}{8} = 1,337.5$, which is 1,340 rounded to the nearest tens place.

Distractor Explanation: Choice A is incorrect as this is the average of the average SAT scores of the 7 students and the score of the new student

$\frac{(1,320 + 1,460)}{2}$. Choice C is incorrect as this is the

mean score if the new higher score is subtracted from the sum of the current sum of scores and divided by 6. Choice D is incorrect as this answer incorrectly assumes that the new score will be the new average SAT score.

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

Skill/Knowledge: Two-variable data: models and scatterplots | **Testing point:** Exponential function interpretation

Key Explanation: Choice B is correct. The 3 in the exponential equation above represents the growth factor. It indicates a tripling of the bacteria. When $t = 14$ the growth factor in the equation becomes $3^{\frac{14}{14}}$, which is 3, and therefore at $t = 14$ days the amount of bacteria triples. There are 14 days in two weeks which makes Choice B the correct answer.

Distractor Explanation: The equation for an exponential model is $y = ab^x$, where a represents the initial amount of the data. Choice A is incorrect because $a = 2,034$ would represent the amount of bacteria at the beginning of the study and not the given term. Choice C is incorrect because it assumes that the model is linear, however, the model is exponential. Choice D is incorrect as this answer gives $rp(t)$ and not the given term in the equation.

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

Skill/Knowledge: Linear equations in one variable
Testing point: Linear equation with no solutions

Key Explanation: The first step is to use the distributive property to expand out the terms on the left side of the equation as follows:

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

$$5x + 15 - 6 + 3x$$

Combining like terms on the left side of the equation yields $8x + 9$

Therefore, for the equation below to have no solutions, the lines represented by both sides of the equation need to be parallel, and thus have the same slope and different y -intercepts. Since the

equations are in slope–intercept form $y = mx + b$, with different y -intercepts, the slope of the line represented by $8x + 9$ is 8 and thus $p = 8$.

14. **Level:** Hard | **Domain:** ALGEBRA

Skill/Knowledge: Systems of two linear equations in two variables | **Testing point:** Finding the number of solutions in a system of equations

Key Explanation: Choice D is correct. To compare the equations, do math operations to get the equations in the slope–intercept form $y = mx + b$, where m is the slope of the line and b is the y -intercept. First, simplify the second equation by dividing out a 2 from all terms to get: $-3x = -4y + 16$. Adding $4y$ to both sides of the equation and adding $3x$ to both sides of the equation yields $4y = 3x + 16$. Dividing all terms in the equation by 4

to get it into slope–intercept form yields $y = \frac{3}{4}x + 4$.

Adding $-3x$ to both sides of the first equation yields $-4y = -3x + 16$. Dividing all terms in the

equation by -4 yields $y = \frac{3}{4}x - 4$. Looking at the

revised equations the lines have the same slope but different y -intercepts, making the lines parallel. Parallel lines do not intersect, and therefore there is no solution to the system of equations.

Distractor Explanation: Choice A is incorrect because to have one solution, the slopes of both equations should not be equal, and they are.

Choice B is incorrect because linear systems cannot have 2 solutions. Choice C is incorrect because to have infinitely many solutions the equations would need to represent the same line and thus be the same (the slopes and y -intercepts of the two lines would be the same); they are not.

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

Skill/Knowledge: Circles | **Testing point:** Finding the length of a minor arc

Key Explanation: Choice A is correct. The length of the minor arc is found by using the formula

$\frac{\theta}{360}\pi d$, where θ is the measure of the central angle and d is the diameter of the circle. Therefore,

the length of minor arc AB is $\frac{72}{360}\pi(12) = 2.4\pi$,

which is Choice A.

Distractor Explanation: Choice B is incorrect as it gives the area of the minor sector AOB.

Choice C is incorrect as it is the circumference of the whole circle. Choice D is incorrect as it is

$\frac{12\pi}{72} = \frac{\pi}{6}$ and may be due to a calculation error.

16. **Level:** Medium | **Domain:** ADVANCED MATH

Skill/Knowledge: Equivalent expressions | **Testing point:** Matching coefficients

Key Explanation: $(x + 3)^2$ is equal to $(x + 3) \times (x + 3)$. Using the foiling method to multiply out the terms, yields $x^2 + 3x + 3x + 9$, or $x^2 + 6x + 9$. Using the distributive property, $-2(x^2 + 6x + 9) + 6 = -2x^2 - 12x - 18 + 6$, which is equivalent to $-2x^2 - 12x - 12 = ax^2 + bx + c$. Therefore, $c = -12$.

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

Skill/Knowledge: Lines, angles, and triangles | **Testing point:** Midpoint between two points on a line

Key Explanation: Choice C is correct. To find the midpoint between two points on a line (x_1, y_1)

and (x_2, y_2) , use the midpoint coordinates formula

$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

Therefore the coordinates of the midpoint of line segment AB can be found from the following

equations: $\frac{6 + x_2}{2} = 8$ and $\frac{11 + y_2}{2} = 10$. Using

cross products, solve $x_2 + 6 = 16$, or $x_2 = 10$, and $y_2 + 11 = 20$, or $y_2 = 9$. Therefore, the coordinates of point B are $(10, 9)$.

Distractor Explanation: **Choice A** is incorrect and is found when the midpoint formula is used incorrectly with $(8, 10)$ and $(6, 11)$ as the points. **Choice B** is incorrect and is found by subtracting in the midpoint formula instead of adding. **Choice D** is incorrect and may be arrived at through a conceptual error.

18. **Level:** Easy | **Domain:** ADVANCED MATH
Skill/Knowledge: Nonlinear functions | **Testing point:** Finding the number of solutions to an absolute value equation

Key Explanation: **Choice A** is correct. Since the absolute value is equal to zero, the only value that makes the absolute value equation equal to zero is $x = -3$. Thus, there is only one solution.

Distractor Explanation: **Choice B** is incorrect as to have two solutions the absolute value must be equal to a positive number. Zero is not a positive number. **Choice C** is incorrect because for an absolute value to have 0 solutions, it must be equal to a negative number and zero is not a negative number. **Choice D** is incorrect as there is enough information to answer the question.

19. **Level:** Easy | **Domain:** ADVANCED MATH
Skill/Knowledge: Nonlinear functions | **Testing point:** Absolute value and value of a function

Key Explanation: **Choice A** is correct. To find $f(2)$, substitute 2 for all values of x in the equation as follows:

$$(2)^2 - 20(2) + 9 = -27.$$

To find $|f(2)|$ take the absolute value of -27 which is 27, or **Choice A**.

Distractor Explanation: **Choice B** is incorrect as the question requires the absolute value of the function value and not the function value itself. **Choices C** and **D** are incorrect and can be arrived at through miscalculations.

20. **Level:** Easy | **Domain:** PROBLEM-SOLVING AND DATA ANALYSIS
Skill/Knowledge: Percentages | **Testing point:** Percentage increase and decrease

Key Explanation: Assume that the initial price of the oil was x . The price of oil after the 20% increase would be $1.2x$. This price is then decreased by 14%. Thus, 86% of the oil price remains and thus $0.86 \times 1.2x = 1.032x$. This shows that after the two changes, the price of oil has increased overall by 3.2%.

21. **Level:** Easy | **Domain:** GEOMETRY AND TRIGONOMETRY
Skill/Knowledge: Circles | **Testing point:** Area of a circle inscribed in a square

Key Explanation: **Choice C** is correct. The length of a side of the square is equal to the diameter of the circle. The area of a circle can be found using the formula πr^2 , where r is the radius of the circle.

The radius of a circle is half of its diameter, so the radius of the circle is $\frac{4\sqrt{2}}{2}$ or $2\sqrt{2}$. Therefore, the

area of the circle is $(2\sqrt{2})^2 \times \pi$ or 8π .

Therefore, $p = 8$.

Distractor Explanation: Choice A is incorrect.

This is the value of the area of the square and not the circle. **Choice B** is incorrect. This is the value of two times the diameter of the circle. **Choice D** is incorrect. This is the value of the area of the circle if the radius is equal to 8.

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

Skill/Knowledge: Linear inequalities in one or two variables | **Testing point:** Solving a linear inequality

Key Explanation: Choice B is correct. To solve, first add x to both sides of the equation to get: $-2x + 6 \leq 2$. Next, subtract 6 from both sides of the equation to get: $-2x \leq -4$. Finally, divide both sides by -2 which flips the inequality sign yielding $x \geq 2$. x is, therefore, greater than or equal to 2. Only Choice B is not in the domain of the equation.

Distractor Explanation: Choices A, C, and D are incorrect. These answer choices are solutions to the inequality and answer the opposite of what the question is asking.