

1. **Level:** Easy | **Domain:** ADVANCED MATH
Skill/Knowledge: Nonlinear equations in one variable and system of equations in two variables |
Testing point: Solving absolute value equations

Key Explanation: Choice C is correct. To calculate the two solutions (p & q), equate the contents of the absolute value symbol to both the positive and negative values of the number on the other side of the equation. To obtain the first solution (p), solve for x in the equation $3x - 1 = 2$. Adding 1 to both sides of the equation yields $3x = 3$. Dividing 3 from both sides of the equation yields $x = 1$. Thus, $p = 1$. To obtain the second solution (q), solve for x in the equation $3x - 1 = -2$. Adding 1 to both sides of the equation yields $3x = -1$. Dividing 3 from both sides of the equation yields $x = -\frac{1}{3}$. Thus, $q = -\frac{1}{3}$. Adding 1 and $-\frac{1}{3}$ yields $\frac{2}{3}$. Therefore, $p + q = \frac{2}{3}$.

Distractor Explanation: Choice A is incorrect and may result from multiplying the second solution (q) by -1 . Choice B and Choice D are incorrect as these are the two solutions to the equation.

2. **Level:** Medium | **Domain:** GEOMETRY AND TRIGONOMETRY
Skill/Knowledge: Circles | **Testing point:** Using equation of a circle

Key Explanation: Choice C is correct. To solve this question, plug each point into the equation of the circle. A coordinate that lies on the circle means that the equation will be equal on both ends. Plugging the point $(-3, 4)$, the equation becomes $(-3 - 3)^2 + 4^2 + 8(4) = 84$. Simplifying the equation, this yields $84 = 84$. Therefore, point $(-3, 4)$ lies on the circle.

Distractor Explanation: Choice A is incorrect. Plugging the point $(1, 7)$ into the equation yields $109 = 84$. Therefore, it lies outside the circle.

Choice B is incorrect. Plugging the point $(-2, 5)$ into the equation yields $90 = 84$. Therefore, it lies outside the circle. Choice D is incorrect. Plugging the point $(3, -6)$ into the equation yields $-12 = 84$. Therefore, it does not lie on the circle.

3. **Level:** Easy | **Domain:** GEOMETRY AND TRIGONOMETRY
Skill/Knowledge: Right triangles and trigonometry | **Testing point:** Using trigonometry identities

Key Explanation: $\sin x = \cos(90 - x)$. So, if $\sin C$ and $\cos 63$ are equal, then the angles would add up to 90° . Therefore, $63^\circ + C = 90^\circ$. Subtracting 63° from both sides of the equation yields $C = 27^\circ$.

4. **Level:** Hard | **Domain:** ADVANCED MATH
Skill/Knowledge: Equivalent expressions |
Testing point: Working with complex numbers

Key Explanation: Choice A is correct. Rationalize the denominator of $\frac{2-2i}{3+4i}$ by multiplying the

fraction by the denominator's conjugate which is

$\frac{3-4i}{3-4i}$. This yields $\frac{6-6i-8i+8i^2}{9-16i^2}$. Substituting -1

to i^2 yields $-\frac{2}{25} - \frac{14}{25}i$. Matching the coefficients

yields $a = -\frac{2}{25}$ and $b = -\frac{14}{25}$.

Distractor Explanations: Choice B is incorrect as this would be the value of b . Choice C and Choice D are incorrect and may result from miscalculation or conceptual errors.

5. **Level:** Medium | **Domain:** ADVANCED MATH
Skill/Knowledge: Nonlinear equations in one variable and systems of equations in two variables
Testing point: Solving system of linear and quadratic equations

Key Explanation: Choice C is correct. To solve for x , we can equate the two equations.

This yields $2x - 2 = 2x^2 - 9x + 7$.

Subtracting $2x$ and adding 2 to both sides of the equation yields $2x^2 - 9x + 7 - 2x + 2 = 0$.

Combining like terms yields $2x^2 - 11x + 9 = 0$. To solve the quadratic equation use either the factor method or the quadratic formula. Using the factor method, get the two factors of $18x^2$ whose sum is $-11x$.

The two factors are $-2x$ and $-9x$ which makes the equation $2x^2 - 2x - 9x + 9 = 0$.

Grouping the first two terms together and the last two terms together yields $(2x^2 - 2x) - (9x - 9) = 0$

Factoring out the greatest common factor yields $2x(x - 1) - 9(x - 1) = 0$.

Factoring out the common binomial yields $(x - 1)(2x - 9) = 0$. Equating both factors to 0 yields the

two solutions, which are $x = 1$ and $x = \frac{9}{2}$ or 4.5

Distractor Explanation: Choice A is incorrect and may result from adding the two solutions.

Choice B is incorrect as it is the negative of one of the solutions. Choice D is incorrect and may result from getting the difference between the solutions.

6. **Level:** Hard | **Domain:** ADVANCED MATH
Skill/Knowledge: Nonlinear equations in one variable and systems of equations in two variables
Testing point: Solving absolute equation

Key Explanation: To obtain the solutions, first simplify the equation by factorization. Factoring out 2 from $|6x - 4|$ yields $2|3x - 2|$. Factoring out $|3x - 2|$ from $3|3x - 2| - 2|3x - 2| = 7$ yields

$(3 - 2)|3x - 2| = 7$ or $|3x - 2| = 7$. Then, equate the contents of the absolute value symbol to both the positive and negative values of the number on the other side of the equation. To obtain the first solution, solve for x in the equation $3x - 2 = 7$. Adding 2 to both sides of the equation yields $3x = 9$. Dividing 3 from both sides of the equation yields $x = 3$. To obtain the second solution, solve for x in the equation $3x - 2 = -7$. Adding 2 to both sides of the equation yields $3x = -5$. Dividing 3 from both sides of the equation yields $x = \frac{-5}{3}$.

Therefore, the positive solution to the equation is 3.

7. **Level:** Easy | **Domain:** ALGEBRA
Skill/Knowledge: Linear functions | **Testing point:** Creating equations from graphs

Key Explanation: Choice C is correct.

Calculating the slope of the given line using the points $(-5, 0)$ and $(3, 0)$ yields $\frac{5}{3}$. A slope of a

line perpendicular to this will be the negative reciprocal of the slope of the given line.

Therefore, a line perpendicular to this should have

a slope of $\left(\frac{-3}{5}\right)$.

To get the slope of a line from the equation, convert the equation to slope-intercept form. Dividing both sides of the equation by 5, Choice

C becomes $y = -\left(\frac{3}{5}\right)x + 3$.

Since the coefficient of x is $-\left(\frac{3}{5}\right)$, then this line is perpendicular to the given line.

Distractor Explanation: Choice A is incorrect as this is the equation of the line in the graph.

Choice B is incorrect as this is the equation of a line that has a slope of $\frac{3}{5}$. **Choice D** is incorrect as this is the equation of a line that has a slope of $\frac{5}{3}$ making it parallel to the given line.

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

Skill/Knowledge: Circles | **Testing point:** Finding the circumference of a circle given its equation

Key Explanation: **Choice D** is correct. To find the circumference of a circle, first, find the radius of the circle or the diameter. Rewrite the given equation into the standard form for the equation of a circle, by completing the squares. This yields $x^2 + 6x + 9 + y^2 - 4y + 4 = 51 + 9 + 4$. Simplifying the equation yields $(x + 3)^2 + (y - 2)^2 = 64$. Since the equation is now in standard form, then $r^2 = 64$. Solving for r yields 8 as the radius. Using the formula of the circumference which is $2\pi r$ yields 16π .

Distractor Explanation: **Choice A** is incorrect and may result from solving for the area of the circle instead of the circumference. **Choice B** is incorrect and may result from using πr instead of $2\pi r$ to solve for the circumference. **Choice C** is incorrect and may result from using $\sqrt{51}$ as the radius of the circle.

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

Skill/Knowledge: Lines, angles and triangles | **Testing point:** Using the exterior angle theorem

Key Explanation: According to the Exterior Angle Theorem, the exterior angle of a triangle is equal to the sum of the opposite and non-adjacent interior angles.

Therefore, $\angle ABC + \angle BAC = \angle ACD$.

The equation will now become $2x - 2 + x + 3 = 118$.

Combining like terms yields $3x + 1 = 118$.

Subtracting 1 from both sides of the equation yields $3x = 117$.

Dividing 3 from both sides of the equation yields $x = 39$.

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

Skill/Knowledge: Ratio, rates, proportional relationships, and units | **Testing point:** Creating and solving rate equation

Key Explanation: **Choice B** is correct. The question presents an inverse proportion problem where the number of carpenters (x) is inversely proportional to the number of days it requires to build a bed (y). Using the formula $xy = k$ and the given data $x = 4$ and $y = 3$ yields 12 as the value of k . Thus, the inverse proportion equation becomes $xy = 12$. To solve for the corresponding number of carpenters, substitute 2 with y which then yields $2x = 12$. Solving for x yields 6 as the number of carpenters needed to build the bed in 2 days.

Distractor Explanation: **Choice A** is incorrect as this represents the value of the constant k .

Choice C is incorrect as this is the product of four carpenters and 2 days. **Choice D** is incorrect as this is a miscalculation or conceptual error.

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

Skill/Knowledge: Equivalent expressions | **Testing point:** Using the FOILing method to multiply expressions

Key Explanation: **Choice C** is correct. Using distributive property yields, $5xy(x - 2y) + 3x(x - 2y)$. Simplifying the expression yields $5x^2y + 3x^2 - 10xy^2 - 6xy$.

Distractor Explanation: Choice A and Choice D are incorrect and may result from applying the distributive property incorrectly. Choice B is incorrect and may result from a miscalculation error in multiplying $5xy$ and $-2y$.

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

Skill/Knowledge: Systems of two linear equations in two variables | **Testing point:** Solving for a variable in a system of linear equations

Key Explanation: To solve for y , use the elimination method. Multiplying 2 to the second equation yields $10x + 4y = 16$. Adding the first and second equations yields $7x + 10x - 4y + 4y = 1 + 16$. Combining like terms yield $17x = 17$. Dividing 17 from both sides of the equation yields $x = 1$. Substituting the value of x to the first equation yields $7(1) - 4y = 1$ or $7 - 4y = 1$. Subtracting 7 from both sides of the equation yields $-4y = -6$. Dividing -4 from both sides of the equation yields

$$y = \frac{3}{2} \text{ or } 1.5.$$

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

Skill/Knowledge: Linear inequalities in one or two variables | **Testing point:** Solving for x in an inequality

Key Explanation: Choice B is correct. Adding x to both sides of the equation yields $-2x + x \leq 8 - x + x$ or $-x \leq 8$.

Dividing both sides of the equation by -1 yields $x \geq -8$. Therefore, x is greater than or equal to -8 . And -10 is the only option that is less than -8 .

Distractor Explanation: Choices A, C, and D are incorrect. These values will make the inequality true and are considered solutions.

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

Skill/Knowledge: Probability and conditional probability | **Testing point:** Finding the probability of an event

Key Explanation: Choice D is correct. The unfair coin is tossed 20 times and 14 of these land on heads making the probability of the unfair

coin landing on heads $\frac{14}{20} = 0.7$. Therefore the

probability of the coin landing on heads the 21st time will be 0.7.

Distractor Explanation: Choice A is incorrect as this is the probability of landing on heads on a fair coin. Choice B is incorrect and may result from a miscalculation or conceptual error. Choice C is incorrect as it gives the probability of the unfair coin landing on tails.

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

Skill/Knowledge: Systems of two linear equations in two variables | **Testing point:** Solving for x and y in a system of linear equations

Key Explanation: Choice D is correct. Solve for x and y either by substitution or by elimination. Using the elimination method, multiply 3 by both sides of the second equation. This yields $(5x + y = -6) 3$ or $15x + 3y = -18$. Subtracting the second equation from the first equation yields $-17x = 34$. Dividing both sides of the equation by -17 yields $x = -2$. Substituting the value of x to the second equation yields $5(-2) + y = -6$. Simplifying the equation yields $y = 4$. Subtracting y from x yields $-2, -4, \text{ or } -6$.

Distractor Explanation: Choice A is incorrect and may result from subtracting x from y . Choice B is incorrect because it is the value of y . Choice C is incorrect as it is the value of x .

16. **Level:** Easy | **Domain:** ADVANCED MATH
Skill/Knowledge: Nonlinear functions |
Testing point: Converting the unit on exponential functions

Key Explanation: Since the equations are still equal, then $1,200(1.03)^m = 1,200(1.03)^{ad}$. Dividing both sides of the equation by 1,200 yields $(1.03)^m = (1.03)^{ad}$. Since the bases are equal, equate the exponents which yield $m = ad$. Since 1 month = 30 days, then $1 = a(30)$. Dividing 30 from both sides of the equation yields $\frac{1}{30} = a$.

17. **Level:** Easy | **Domain:** GEOMETRY AND TRIGONOMETRY
Skill/Knowledge: Area and volume | **Testing point:** Finding the volume of a cylinder

Key Explanation: Choice A is correct. The volume of a cylinder is given by the formula $\pi r^2 h$. Using the given data, $h = 2r$. Therefore, $h = 2(6) = 12$. Therefore, the volume will be $\pi(6)^2(12) = 432\pi$.

Distractor Explanation: Choice B is incorrect and may result from interchanging the values of r and h . Choice C is incorrect and may result from calculating the surface area of the cylinder instead of volume. Choice D is incorrect and may result from conceptual or calculation errors.

18. **Level:** Easy | **Domain:** GEOMETRY AND TRIGONOMETRY
Skill/Knowledge: Circles | **Testing point:** Using circle theorems

Key Explanation: Choice A is correct. An angle subtended at any point of the circle is half the angle subtended at the center. This means that $\angle DOE = 2 \angle DRE$. Therefore, $\angle DOE = 2(35^\circ) = 70^\circ$.

Distractor Explanation: Choice B is incorrect because it implies that the angles are equal. Choice C and D are incorrect and this may be due to conceptual or calculation errors

19. **Level:** Easy | **Domain:** ADVANCED MATH
Skill/Knowledge: Equivalent expressions |
Testing point: Factoring using the difference of two squares

Key Explanation: Choice A is correct. This question can be solved using factorization. Using the difference of squares, $x^2 - a^2$ becomes $(x + a)(x - a)$. Transforming the numerator of $4x^2 - 3$ to the format $x^2 - a^2$ yields $(2x)^2 - (\sqrt{3})^2$. Factoring the expression yields $(2x + \sqrt{3})(2x - \sqrt{3})$.

This would result to $\frac{(2x + \sqrt{3})(2x - \sqrt{3})}{(2x + \sqrt{3})}$.

Canceling out the binomial $2x + \sqrt{3}$ from both numerator and denominator yields $2x - \sqrt{3}$.

Distractor Explanation: Choice B is incorrect and would result if the student mistook the denominator for a minus sign. Choice C and Choice D are incorrect and may result from conceptual or calculation errors.

20. **Level:** Hard | **Domain:** ALGEBRA
Skill/Knowledge : Systems of two linear equations in two variables | **Testing point:** Working with systems of equations with Infinite solutions

Key Explanation: Equations that have infinite solutions are equations that are the same line just written differently. They have the same slope and the same y -intercept. In the above equation, neither are similar. To

make them similar, multiply the top equation by -2 which yields $-18x + 28y = 6$.

Comparing the coefficients of the first and second equations yields $a = -18$ and $b = -28$.

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

Skill/Knowledge: Linear equations in two variables | **Testing point:** Matching coefficients

Key Explanation: Choice D is correct. To find the value of a , we have to first group like terms together.

Adding $4x$ to both sides of the equation yields $3x + 5y + 4x = ax - 4x - by + 4x$
or simply $7x + 5y = ax - by$. This makes $a = 7$ and $b = -5$

Distractor Explanation: Choice A is incorrect because this would be the value of a if the $-4x$ had been ignored

Choice B is incorrect and may result from conceptual or calculation error.

Choice C is incorrect because this would be the value of b instead.

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

Skill/Knowledge: Linear inequalities in one or two variables | **Testing point:** Solving for x in an inequality

Key Explanation: Choice D is correct. Using the distributive property yields $3x + 2 < -5x - 30$. Adding $5x$ and subtracting 2 from both sides of the equation yields $3x + 5x < -30 - 2$ or $8x < -32$. Dividing 8 from both sides of the equation yields $x < -4$. Since -5 is less than -4 , then it is a solution to the inequality.

Distractor Explanation: Choice A and Choice B are incorrect because they are both greater than -4 . **Choice C** is incorrect because the value of x must be less than and not equal to -4 .