Item #	Rationale	
1	Option C is correct	To determine the scaled distance in inches across Texas on the map, the student could have set up and solved a proportion (comparison of two ratios) comparing the distance across the map of Texas in inches to the distance across Texas in miles. In the scale used in the map, 1 inch represents 25 miles. The student could have used the proportion $\frac{1}{25} = \frac{x}{800}$ to find the value of *x*, the distance across Texas on the map in inches. To solve the proportion, the student could have multiplied the number of inches in the scale, 1, by 800, resulting in 800. The student then could have divided 800 by the number of miles in the scale, 25, resulting in 32. Therefore, the distance across Texas on the map is 32 inches. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option A is incorrect	The student likely divided the distance across Texas, 800 miles, by the scale factor, 25, resulting in 32. Then the student likely subtracted that value from 800, resulting in 768. The student needs to focus on understanding how to use part-to-part proportional relationships to solve real-world problems.
	Option B is incorrect	The student likely subtracted the number of miles in the scale factor, 25, from the distance across Texas, 800 miles, resulting 775. The student needs to focus on understanding how to use part-to-part proportional relationships to solve real-world problems.
	Option D is incorrect	The student likely identified the number of miles in the scale factor, 25, as the distance across Texas in inches on the map. The student needs to focus on understanding how to use part-to-part proportional relationships to solve real-world problems.

Item #	Rationale	
2	Option A is correct	To determine the value of the expression $0.45 - \frac{2}{5}$, the student could have first converted the fractional expression $\frac{2}{5}$ to its decimal equivalent, 0.4. Then the student could have subtracted 0.4 from 0.45, resulting in 0.05. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option B is incorrect	The student likely combined the numerator (top number) and the denominator (bottom number) in the fraction $\frac{2}{5}$ to create the decimal 0.25. The student then likely subtracted 0.25 from 0.45, resulting in 0.20. The student needs to focus on converting numbers between fraction and decimal forms.
	Option C is incorrect	The student likely converted the decimal 0.45 to the fraction $\frac{4}{5}$ and then subtracted, resulting in $\frac{4}{5} - \frac{2}{5} = \frac{2}{5}$. The student then likely converted the fraction $\frac{2}{5}$ to the decimal 0.40. The student needs to focus on converting numbers between fraction and decimal forms.
	Option D is incorrect	The student likely converted the fraction $\frac{2}{5}$ to the decimal 0.52 and then subtracted 0.45, resulting in 0.52 – 0.45 = 0.07. The student needs to focus on converting numbers between fraction and decimal forms.

Item #	Rationale	
3	Rational numbers, Whole numbers, Natural numbers	To determine how to represent the relationship among integers, rational numbers, natural numbers, and whole numbers, the student should have understood that the natural numbers (the counting numbers 1, 2, 3, 4, etc.) are a subset of the whole numbers (the counting numbers and zero), the whole numbers are a subset of the integers (all positive and negative numbers with no fractional or decimal parts, and zero), and the integers are a subset of the rational numbers (numbers that can be represented as the ratio of two integers). The student should have recognized that the outermost oval in the Venn diagram should be labeled “Rational numbers” and that the innermost oval should labeled “Natural numbers.” Then the student should have recognized that the remaining oval in the Venn diagram should be labeled “Whole numbers.” This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item #	Rationale	
4	Option B is correct	To determine the volume (amount of three-dimensional space) of the triangular pyramid in cubic inches, the student should have used the formula for the volume of a pyramid: $V = \frac{1}{3}Bh$, where *V* is the volume, *B* is the area (amount of two-dimensional space covered by a surface) of the triangular base, and *h* is the height (vertical distance from top to bottom) of the pyramid. The student should have substituted the values *B* = 60 and *h* = 13 into the volume formula, resulting in $V = \frac{1}{3}(60)(13) = 260$ cubic inches. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option A is incorrect	The student likely used the fraction $\frac{1}{2}$ instead of $\frac{1}{3}$ in the formula for the volume of a pyramid, resulting in $\frac{1}{2}(60)(13) = 390$ cubic inches. The student needs to focus on understanding how to apply formulas to solve problems involving the volume of three-dimensional figures.
	Option C is incorrect	The student likely used the formula for the volume of a prism, *V* = *Bh*, instead of the formula for the volume of a pyramid, $V = \frac{1}{3}Bh$, resulting in *V* = 60(13) = 780 cubic inches. The student needs to focus on understanding how to apply formulas to solve problems involving the volume of three-dimensional figures.
	Option D is incorrect	The student likely misunderstood the area of the triangular base, 60 square inches, to mean the length of the triangle's base, 60 inches. To determine the area of the triangle, the student likely used the formula $A = \frac{1}{2}bh$, where *b* is the length of the triangle's base, and *h* is the height of the triangle. Assuming a height of 1 inch, the result is $A = \frac{1}{2}(60)(1) = 30$ square inches. The student then likely substituted this value into the volume formula, $V = \frac{1}{3}Bh$, resulting in $V = \frac{1}{3}(30)(13) = 130$ cubic inches. The student needs to focus on understanding how to apply formulas to solve problems involving the volume of three-dimensional figures.

Item #	Rationale	
5	Option D is correct	To determine the amount of milk in gallons the family has left after 4 days, the student should have determined the total amount of milk the family used in 4 days and subtracted it from the amount the family started with. Based on the table, the family used $\frac{3}{16}+\frac{3}{8}+\frac{1}{8}+\frac{1}{4}$ gallon of milk. To determine how much milk was used in gallons, the student should have converted these fractions to equivalent forms with a common denominator of 16, resulting in $\frac{3}{16}+\frac{3}{8}\cdot\frac{2}{2}+\frac{1}{8}\cdot\frac{2}{2}+\frac{1}{4}\cdot\frac{4}{4}=\frac{3}{16}+\frac{6}{16}+\frac{2}{16}+\frac{4}{16}=\frac{3+6+2+4}{16}=\frac{15}{16}$. Since the family started with 1 gallon of milk, the amount of milk remaining is $1-\frac{15}{16}=\frac{16}{16}-\frac{15}{16}=\frac{1}{16}$ gallon. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option A is incorrect	The student likely added the amounts of milk used each day to determine the total amount of milk used in gallons for 4 days but did not subtract the result from the starting amount of 1 gallon. The student needs to focus on performing the mathematical operations (+, −, ×, ÷) that are required to solve a problem.
	Option B is incorrect	The student likely added the numerators (top numbers) and the denominators (bottom numbers) of the four fractions together to determine the amount of milk used, resulting in $\frac{3+3+1+1}{16+8+8+4}=\frac{8}{36}=\frac{2}{9}$ gallon. The student needs to focus on adding and subtracting fractions by converting to common denominators and performing the mathematical operations (+, −, ×, ÷) that are required to solve a problem.
	Option C is incorrect	The student likely added the numerators and the denominators of the four fractions together to determine the amount of milk used, resulting in $\frac{3+3+1+1}{16+8+8+4}=\frac{8}{36}=\frac{2}{9}$. The student then likely subtracted 1 from the numerator, resulting in $\frac{2-1}{9}=\frac{1}{9}$ gallon. The student needs to focus on adding and subtracting fractions by converting to common denominators and performing the mathematical operations (+, −, ×, ÷) that are required to solve a problem.

<table>
<tr><th>Item #</th><th colspan="2">Rationale</th></tr>
<tr><td>6</td><td>Action, Nonfiction, Fantasy</td><td>To determine which type of book is more than twice as likely to be preferred as another type, the student should have compared the numbers of students who preferred the five types of books and found two numbers such that the greater number was more than 2 times the lesser number. The student should have recognized that 24 and 9 are the only values in the table that fit this requirement since 24 divided by 9 is equal to 2 with remainder of 6. The student should have recognized that 24 and 9 correspond to Action and Nonfiction, respectively, which means that a randomly selected student is more than twice as likely to prefer Action as to prefer Nonfiction.

To determine which other type of book, along with Nonfiction, would be equally likely to be preferred as Action, the student should have identified two values that sum to the number of students who prefer Action, 24. The student should have recognized that 9 and 15, which correspond to Nonfiction and Fantasy, respectively, have a sum of 24. The student then should have concluded that the randomly selected student is equally likely to prefer Action as to prefer Nonfiction or Fantasy. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.</td></tr>
</table>

Item #	Rationale	
7	Option A is correct	To determine the value of *x*, the student should have set up an equation where the measures of all three angles total 180 degrees. The student should have recognized that $m\angle A = x + 4$, $m\angle B = 2(x + 4)$, and $m\angle C = 2(x + 4)$. The student should have then written an equation with the sum of the three angles equal to 180; $x + 4 + 2(x + 4) + 2(x + 4) = 180$. The student should have solved this equation to find the value of *x*; $x + 4 + 2x + 8 + 2x + 8 = 180$; $5x + 20 = 180$; $5x = 160$; $x = 32$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option B is incorrect	The student likely identified the measure of angle C as the same as angle A and wrote the equation as $x + 4 + 2(x + 4) + x + 4 = 180$. The student then likely solved the equation $x + 4 + 2x + 8 + x + 4 = 180$; $4x + 16 = 180$; $4x = 164$, $x = 41$. The student needs to focus on understanding how to write equations using geometric concepts, including triangle angle-sum.
	Option C is incorrect	The student likely inverted the relationship between angles *A* and *B*, interpreting the measure of angle *B* as being equal to half the measure of angle *A*. Since the measure of angle *C* is equal to the measure of angle *B*, the student likely concluded the measure of angle C was also equal to half the measure of angle A. The student then likely wrote and solved the equation $x + 4 + \frac{1}{2}(x + 4) + \frac{1}{2}(x + 4) = 180$; $x + 4 + \frac{1}{2}x + 2 + \frac{1}{2}x + 2 = 180$; $2x + 8 = 180$; $2x = 172$; $x = 86$. The student needs to focus on understanding how to write equations using geometric concepts, including triangle angle-sum.
	Option D is incorrect	The student likely inverted the relationship between angles *A* and *B*, interpreting that the measure of angle *B* is equal to half the measure of angle *A*. Then the student likely interpreted the measure of angle *C* as equal to measure of angle *A*. The student then likely wrote and solved the equation $x + 4 + \frac{1}{2}(x + 4) + x + 4 = 180$; $x + 4 + \frac{1}{2}x + 2 + x + 4 = 180$; $2\frac{1}{2}x + 10 = 180$; $2\frac{1}{2}x = 170$; $x = 68$. The student needs to focus on understanding how to write equations using geometric concepts, including triangle angle-sum.

Item #	Rationale	
8	Option D is correct	To determine the constant of proportionality that relates *y* to *x*, the student should have used the formula for the constant of proportionality: $k = \frac{y}{x}$, where *k* represents the constant of proportionality, *x* represents the value of the independent variable, and *y* represents the corresponding (paired) value of the dependent variable. The student could have used the given information, *y* = 96 feet when *x* = 6 minutes, and substituted those values into the formula, resulting in $k = \frac{96}{6} = 16$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option A is incorrect	The student likely calculated the ratio of two different values of the dependent variable instead of calculating the constant of proportionality. The student likely set up the calculation as $k = \frac{96}{64} = \frac{3}{2}$. The student needs to focus on substituting the correct values in the equation to determine the constant of proportionality.
	Option B is incorrect	The student likely inverted the order of *x* and *y* when calculating the constant of proportionality, resulting in $k = \frac{4}{64} = \frac{1}{16}$. The student needs to focus on substituting the correct values in the equation to determine the constant of proportionality.
	Option C is incorrect	The student likely used a *y*-value that did not correspond to the appropriate *x*-value when calculating the constant of proportionality. The student likely set up the calculation as $k = \frac{96}{4} = 24$. The student needs to focus on substituting the correct values in the equation to determine the constant of proportionality.

Item #	Rationale	
9	Option A is correct	To determine the measurement closest to the height of the building in meters, the student could have set up and solved the proportion (comparison of two ratios) $\frac{x}{15} = \frac{1}{3.28}$, which compares the ratio of the height of the building in meters, *x*, to the height of the building in feet, 15, and the conversion factor where 1 meter is approximately equal to 3.28 feet. To solve the proportion, the student could have multiplied by each denominator (the bottom number of a fraction) on both sides of the equation, resulting in $x(3.28) = 15(1)$ or $3.28x = 15$. Finally, the student could have divided both sides of the equation by 3.28, resulting in $x \approx 4.573$. The student could have concluded that the measurement closest to the height of the building is 4.57 meters. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option B is incorrect	The student likely subtracted the approximate number of feet in 1 meter, 3.28, from the height of the building in feet, 15, resulting in 11.72 meters. The student needs to focus on understanding how to convert values expressed in one unit of measurement into equivalent values in a different unit of measurement.
	Option C is incorrect	The student likely multiplied the approximate number of feet in 1 meter, 3.28, by the height of the building in feet, 15, resulting in 49.20 meters. The student needs to focus on understanding how to convert values expressed in one unit of measurement into equivalent values in a different unit of measurement.
	Option D is incorrect	The student likely added the approximate number of feet in 1 meter, 3.28, to the height of the building in feet, 15, resulting in 18.28 meters. The student needs to focus on understanding how to convert values expressed in one unit of measurement into equivalent values in a different unit of measurement.

Item #	Rationale	
10	$x > -3$, $x > 9$	To determine the solution set for each inequality, the student could have used inverse operations to isolate the variable (symbol used to represent an unknown number) x on one side of the inequality. For the first inequality, $-3x + 9 < 18$, the student first could have subtracted 9 from both sides of the inequality, yielding the equivalent inequality $-3x < 9$. Then the student could have divided both sides of the inequality by −3, which would change the direction of the inequality, yielding $x > -3$. For the second inequality, $4x - 24 > 12$, the student first could have added 24 to both sides of the inequality, yielding the equivalent inequality $4x > 36$. Then the student could have divided both sides of the inequality by 4, yielding $x > 9$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item #	Rationale	
11	Option C is correct	To determine how many more people use a car than ride a bicycle to get to work, the student could have determined how many people use a car and how many people ride a bicycle and then subtracted the number of bicycle riders from the number of car users to find the difference. To determine how many people use a car, the student could have multiplied the percentage of car users shown in the circle graph, 38%, by the number of people surveyed, 150. This results in (38%)(150) = (0.38)(150) = 57, so there are 57 car users. To determine how many people ride a bicycle, the student could have determined the percentage of bicycle riders by adding up the percentages in the other categories and subtracting from 100%, resulting in a value of 100% – (20% + 32% + 28%) = 100% – 90% = 10%. Then the student could have multiplied the percent of bicycle riders by the number of people who were surveyed, 150. This results in (10%)(150) = (0.10)(150) = 15, so there are 15 bicycle riders. Subtracting these values yields 57 – 15 = 42, so the student should have concluded that there are 42 more car users than bicycle riders. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option A is incorrect	The student likely determined the total number of bicycle riders instead of the difference between the numbers of bicycle riders and car users. To find the percentage of bicycle riders, the student likely added up the percentages from the other categories and subtracted from 100%, resulting in 100% – (20% + 32% + 28%) = 100% – 90% = 10%. Then to find the total number of bicycle riders, the student likely multiplied the percentage of bicycle riders, 10%, by the number of people in the survey, 150, resulting in (10%)(150) = (0.10)(150) = 15. The student needs to focus on answering the question that is asked in a multistep scenario.
	Option B is incorrect	The student likely determined the difference between the percentages of car users and bicycle riders instead of the difference between the total numbers of car users and bicycle riders. To find the percentage of bicycle riders, the student likely added up the percentages from the other categories and subtracted from 100%, resulting in 100% – (20% + 32% + 28%) = 100% – 90% = 10%. The student then likely subtracted this value from the percentage of car users, resulting in 38% – 10% = 28%. The student needs to focus on understanding the part-to-whole relationship between percentage and sample size.
	Option D is incorrect	The student likely determined the total number of people who use a car to get to work instead of finding how many more people use a car than ride a bicycle. The student likely multiplied the percentage of car users, 38%, by the number of people surveyed, 150, to determine the number of car users, resulting in (38%)(150) = (0.38)(150) = 57. The student needs to focus on answering the question that is asked in a multistep scenario.

Item #	Rationale	
12	7,800 and any equivalent values are correct	To determine the area (amount of space covered by a surface) of the top of the table in square inches, the student could have calculated the sum of the areas of the shapes that make up the figure. The student could have divided the figure into 2 congruent trapezoids that each have a height of 30 inches and bases (lengths of the parallel sides of the trapezoid) of 130 inches and 100 inches, and 1 square with a side length of 30 inches. The student could have calculated the area of 1 trapezoid by substituting $b_1 = 130$, $b_2 = 100$, and $h = 30$ into the formula for the area of a trapezoid: $A = \frac{1}{2}(b_1 + b_2)h$, where b_1 and b_2 represent the bases of the trapezoid and h represents the height. This results in $A = \frac{1}{2}(130 + 100)(30) = 3{,}450$ square inches. Next, the student could have calculated the area of the square by using the formula $A = bh$, where b represents the base of the square and h represents the height of the square, resulting in $A = 30 \times 30 = 900$ square inches. Last, the student could have added the areas of the 2 trapezoids and the 1 square to determine the total area of the top of the table, resulting in $2(3{,}450) + 900 = 7{,}800$ square inches. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item #	Rationale	
13	Option B is correct	To determine the probability (how likely it is that an event will occur) that Spinner X will land on 2 and Spinner Y will land on blue, the student could have first found the probability of each event. The probability of Spinner X landing on 2 is $\frac{1}{4}$ because 1 of 4 equal sections of the spinner is labeled 2. The probability of Spinner Y landing on blue is $\frac{1}{3}$ because 1 of 3 equal sections of the spinner is labeled blue. Next, the student could have recognized that since each event is independent (not affected by the outcome) of the other, the product rule of probability (the probability of any combination of independent events occurring together can be calculated by multiplying the probabilities of each event occurring alone) applies, resulting in a probability of $\left(\frac{1}{4}\right)\left(\frac{1}{3}\right) = \frac{1}{12}$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option A is incorrect	The student likely added the total numbers of sections on the two spinners to determine the numerator (the top number in a fraction) and then multiplied the total numbers of spaces on the two spinners to determine the denominator (the bottom number in a fraction), resulting in $\frac{3+4}{3 \cdot 4} = \frac{7}{12}$. The student needs to focus on understanding how to determine the probability of a compound event.
	Option C is incorrect	The student likely divided 2, the number of events described (landing on 2 and landing on blue) by 7, the total number of sections on the two spinners combined. The student needs to focus on understanding how to determine the probability of a compound event.
	Option D is incorrect	The student likely calculated the probability that either Spinner X will land on 2 or Spinner Y will land on blue by listing the total number of outcomes, 12, and identifying those outcomes that are successful, meaning that either landing on 2, landing on blue, or both occurred. The list could have resembled the following, where the underlined outcomes are successful: 1-Red, 1-Green, <u>1-Blue</u>, <u>2-Red</u>, <u>2-Green</u>, <u>2-Blue</u>, 3-Red, 3-Green, <u>3-Blue</u>, 4-Red, 4-Green, <u>4-Blue</u>. There are 6 successful outcomes out of 12 total outcomes, so the student calculated the probability of either Spinner X landing on 2 or Spinner Y landing on blue as $\frac{6}{12} = \frac{1}{2}$. The student needs to focus on understanding how to determine the probability of a compound event.

Item #	Rationale	
14	Option A is correct	To determine the measurement that is closest to the radius of a circle with an area of approximately 28.26 square centimeters, the student could have applied the formula for the area of a circle: $A = \pi r^2$, where A is the area of the circle and r is the radius (distance from the center of the circle to a point on the circle). Substituting the approximate value of the area and $\pi \approx 3.14$ into the formula, the student could have determined that $28.26 \approx 3.14r^2$. The student then could have divided both sides by 3.14 to find that $9 \approx r^2$, so $r \approx 3$ centimeters. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option B is incorrect	The student likely calculated the radius of the circle as $r \approx 3$ but doubled the value, finding the diameter (length of a line segment that goes through the center of the circle and connects two points on the circle) instead of the radius. The student needs to focus on understanding how to accurately perform calculations when applying the formula for the area of a circle.
	Option C is incorrect	The student likely applied the circumference formula ($C = 2\pi r$, where C is the circumference of the circle and r is the radius of the circle) instead of the area formula to find the length of the radius, resulting in $28.26 \approx 2(3.14)r$ or $28.26 \approx 6.28r$. After dividing both sides by 6.28, the student likely concluded that $r \approx 4.5$ centimeters. The student then likely rounded the result to the nearest whole number, 5. The student needs to focus on applying the appropriate formula when solving problems involving the area or circumference of circles.
	Option D is incorrect	The student likely applied the formula for the area of a circle, $A = \pi r^2$, to find the radius but solved the equation for r^2 instead of r, resulting in $28.26 \approx 3.14r^2$ or $9 \approx r^2$. The student needs to focus on understanding how to accurately perform calculations when applying the formula for the area of a circle.

Item #	Rationale	
15	Option C is correct	To determine which graph represents a line where each value of *y* is 3 more than $\frac{1}{2}$ the value of *x*, the student could have identified two points on the coordinate plane that satisfy the equation $y = \frac{1}{2}x + 3$. The student could have evaluated *y* when *x* = 0 and when *x* = 2, resulting in the values $y = \frac{1}{2}(0) + 3 = 3$ and $y = \frac{1}{2}(2) + 3 = 4$, which correspond to the ordered pairs (locations of points on a coordinate grid) (0, 3) and (2, 4). The student could have chosen the graph that contains the points (0, 3) and (2, 4). This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option A is incorrect	The student likely identified two points on the graph of the line where each value of *y* is $\frac{1}{2}$ the value of *x* but ignored the condition that *y* should be 3 more than that, interpreting the equation of the line as $y = \frac{1}{2}x$. If the student chose *x* = 2 and *x* = 4, the resulting *y*-values would be $y = \frac{1}{2}(2) = 1$ and $y = \frac{1}{2}(4) = 2$, which correspond to the points (2, 1) and (4, 2) on the graph. The student needs to focus on understanding how to represent verbal descriptions of linear functions graphically.
	Option B is incorrect	The student likely evaluated *y* for two different values of *x* but doubled the value of *x* instead of halving it and added 3 to the resulting value, interpreting the equation of the line as *y* = 2*x* + 3. If the student chose *x* = 0 and *x* = 1, the resulting *y*-values would be *y* = 2(0) + 3 = 3 and *y* = 2(1) + 3 = 5, which correspond to the points (0, 3) and (1, 5) on the graph. The student needs to focus on understanding how to represent verbal descriptions of linear functions graphically.
	Option D is incorrect	The student likely evaluated *y* for two different values of *x* but subtracted the halved value of *x* from 3 instead of adding it to 3, interpreting the equation of the line as $y = 3 - \frac{1}{2}x$. If the student chose *x* = 0 and *x* = 2, the resulting *y*-values would be $y = 3 - \frac{1}{2}(0) = 3$ and $y = 3 - \frac{1}{2}(2) = 2$, which correspond to the points (0, 3) and (2, 2) on the graph. The student needs to focus on understanding how to represent verbal descriptions of linear functions graphically.

Item #	Rationale	
16	Option A is correct	To determine which graph best represents the unit rate of \$0.12 per kilowatt-hour as the average cost of electricity, the student could have recognized that the graph must contain the point (0, 0), which indicates that the cost of 0 kilowatt-hours of electricity is \$0.00. Then the student could have determined that the graph should contain the point (10, 1.2), representing that the cost of 10 kilowatt-hours is \$1.20. Therefore, the student would have selected the graph that contains those points. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option B is incorrect	The student likely selected a graph with a rate of change (ratio of the change in *y*-values to the change in *x*-values) of $\frac{1}{12}$, believing $\frac{1}{12}$ to be equivalent to the unit rate of 0.12. The student needs to focus on understanding how to represent real-world situations graphically.
	Option C is incorrect	The student likely made a calculation error, determining that the cost of 10 kilowatt-hours is \$12.00 instead of \$1.20. The student likely then selected the graph that contains the point (10, 12). The student needs to focus on understanding how to represent real-world situations graphically.
	Option D is incorrect	The student likely identified the unit rate as 12 cents per kilowatt-hour and selected a graph with a rate of change of 12, ignoring the fact that the values on the *y*-axis are represented in dollars. The student needs to focus on understanding how to represent real-world situations graphically.

Item #	Rationale	
17	Option B is correct	To determine which statement is best supported by the information in the box plots, the student should have calculated the interquartile range (the difference between the third quartile and the first quartile) for each box plot. To do this, the student should have found the difference in dollars between the first quartile (the value represented by the left side of the rectangle in a box plot) and the third quartile (the value represented by the right side of the rectangle in a box plot) in dollars for each set of data. The interquartile range for Sales Team X is 90 – 75 = 15. The interquartile range for Sales Team Y is 105 – 75 = 30. The student then should have recognized that $15 = \frac{1}{2}(30)$ and concluded that the interquartile range for Sales Team X is half the interquartile range for Sales Team Y. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option A is incorrect	The student likely calculated the range (the difference between the maximum and minimum values of a set of numbers) in dollars for each box plot. The student likely identified the range for Sales Team X as 125 – 70 = 55 and the range for Sales Team Y as 130 – 65 = 65. The student then likely recognized that there is $10 difference in the ranges but reversed the order of Sales Team X and Sales Team Y in the comparison. The student needs to focus on comparing statistics between two sets of data.
	Option C is incorrect	The student likely confused the median (the value represented by the vertical line within the rectangle in a box plot) with the mean (the average value of a data set). While the median for Sales Team X ($85) is $5 less than the median of Sales Team Y ($90), there is no way to determine the mean for either group since the data values are not given. The student needs to focus on understanding which statistics are presented in a box plot.
	Option D is incorrect	The student likely calculated the interquartile range for Sales Team X as $15 and the interquartile range for Sales Team Y as $30. The student then likely recognized that $30 is twice $15 but reversed the order of Sales Team X and Sales Team Y in the comparison. The student needs to focus on comparing statistics between two sets of data.

Item #	Rationale	
18	The topmost table, the rightmost equation, the leftmost graph	To determine which representations show the relationship between the total number of miles Carson covers in a day, y, and the number of hours he walks, x, the student could have recognized that the statement “walking at a rate of 4 miles per hour” means that the rate of change (ratio of the change in y-values to the change in x-values) for this situation is 4, since the number of miles covered increases by 4 for each hour walked. The student could have then understood that the statement “He starts the day by running 2 miles” means that 2 miles represents the y-value before Carson starts walking, or the initial value. Since the number of hours spent walking is represented by x, the student could have recognized that relationship between the total number of miles he covers and the number of miles he walks can be represented by the equation $y = 4x + 2$. The student then could have identified the table that represents this equation by substituting 1, 1.5, 2 and 2.5 for x and calculating the corresponding y-values, resulting in $4(1) + 2 = 6$, $4(1.5) + 2 = 8$, $4(2) + 2 = 10$, and $4(2.5) + 2 = 12$. Finally, the student could have identified the graph that represents this equation by identifying an initial value (starting value) of 2 and a rate of change of 4. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item #	Rationale	
19	Option D is correct	To determine the length of side *RU* in centimeters, the student could have recognized that since triangles *KLM* and *RTU* are similar (two figures with corresponding angle measures equal and corresponding side lengths proportional), sides *KM* and *RU* are corresponding, and sides *ML* and *UT* are corresponding. Therefore, the side lengths *KM* and *RU* must be in the same proportion as *ML* and *UT*, or $\frac{KM}{RU} = \frac{ML}{UT}$. Substituting the known side lengths into the proportion results in $\frac{14}{x} = \frac{12}{3}$, where *x* is the unknown length of side *RU*. To solve the proportion, the student could have multiplied by each denominator (the bottom number of a fraction) on both sides of the equation, resulting in 3(14) = 12(*x*), or 42 = 12*x*. Then the student could have divided both sides of the equation by 12, resulting in $x = 3\frac{1}{2}$ centimeters. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option A is incorrect	The student likely used sides that do not correspond to set up and solve a proportion to determine the length of side *RU*. The student likely set up the proportion $\frac{MK}{RU} = \frac{ML}{RT}$ and substituted known side lengths into the equation to determine *x*, the length of side *RU*: $\frac{14}{x} = \frac{12}{2\frac{1}{2}}$. To solve the proportion, the student likely multiplied by each denominator on both sides of the equation, resulting in $\left(2\frac{1}{2}\right)(14) = x(12)$, or 35 = 12*x*. The student then likely divided both sides by 12, resulting in $x = \frac{35}{12} = 2\frac{11}{12}$ centimeters. The student needs to focus on understanding how to solve problems involving similar figures.
	Option B is incorrect	The student likely multiplied the side length of *MK* by the ratio between sides *RT* and *TU* to find the length of *RU,* resulting in $\frac{2\frac{1}{2}}{3}(14) = \frac{5}{6}(14) = \frac{70}{6} = \frac{35}{3} = 11\frac{2}{3}$ centimeters. The student needs to focus on understanding how to solve problems involving similar figures.
	Option C is incorrect	The student likely identified two sets of corresponding sides, *KL* and *RT* and *MK* and *RU*, and used an additive relationship between the pairs of sides instead of a proportional relationship. The student likely determined that *RT* is $10 - 2\frac{1}{2} = 7\frac{1}{2}$ centimeters shorter than *KL* and assumed that *RU* is also $7\frac{1}{2}$ centimeters shorter than *KM*, resulting in $RU = 14 - 7\frac{1}{2} = 6\frac{1}{2}$ centimeters. The student needs to focus on understanding how to solve problems involving similar figures.

Item #	Rationale	
20	Option B is correct	To determine the final cost of groceries after the 25%-off coupon was applied, the student could have subtracted the discounted amount from the cost of the groceries. The student could have multiplied the cost of the groceries, \$210.00, by the coupon amount, 25%, to determine the discounted amount, resulting in (25%)(210) = 0.25(210) = 52.50. The student then could have subtracted this amount from the original cost, resulting in 210 – 52.50 = 157.50. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option A is incorrect	The student likely determined the discounted amount from the coupon instead of the final cost of the groceries after the coupon, resulting in (25%)(210) = 0.25(210) = 52.50. The student needs to focus on understanding how to use percentage change relationships to solve real-world problems.
	Option C is incorrect	The student likely interpreted the 25% off coupon as a discounted amount of \$25, resulting in 210 – 25 = 185. The student needs to focus on understanding how to use percentage change relationships to solve real-world problems.
	Option D is incorrect	The student likely determined the discounted amount from the coupon, (25%)(210) = 0.25(210) = 52.50, but added the value to the cost of groceries instead of subtracting, resulting in 210 + 52.50 = 262.50. The student needs to focus on understanding how to distinguish between real-world situations where a percentage change represents a decrease from or an increase to the initial value.

Item #	Rationale	
21	Option B is correct	To determine which statement is best supported by the data in the dot plot (graph that uses dots to display data), the student could have first recognized that the total number of turns represented on the dot plot is 30 and then divided the number of turns for each point value by the total number of turns. Since 5 turns were 5 points, the student could have concluded that $\frac{5}{30}$, or $\frac{1}{6}$, of the turns were 5 points. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option E is correct	To determine which statement is best supported by the data in the dot plot, the student could have first recognized that the total number of turns represented on the dot plot is 30 and then divided the number of turns for each point value by the total number of turns. Since 15 turns were 2 or 3 points, the student could have concluded that $\frac{15}{30}$, or 50%, of the turns were 2 or 3 points. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option A is incorrect	The student likely determined that 9 turns were 2 points and converted 9 to 9% instead of dividing by the total number of turns. The student needs to focus on understanding the part-to-whole relationship when calculating a percentage.
	Option C is incorrect	The student likely counted 3 possible point values that are 3 or more and 6 possible point values in total and then divided. Since $\frac{3}{6} = \frac{1}{2}$, the student then likely concluded that exactly half of the turns were 3 or more points. The student needs to focus on understanding and interpreting data presented in a dot plot.
	Option D is incorrect	The student likely counted the number of turns that were exactly 1 point, 3, instead of counting the number of turns that were worth 1 point or fewer, 7, and then determined that $\frac{3}{30} = \frac{1}{10}$ of the turns were worth 1 point or fewer. The student needs to focus on understanding and interpreting data presented in a dot plot.

Item #	Rationale	
22	Option D is correct	To determine which equation can be used to find *x*, the maximum number of games Maggie can purchase, the student should have first recognized that the value of the gift card, \$50, is a fixed amount. Next, the student should have recognized that the expression $1.99x - 5$ represents the cost of *x* games at a unit rate of \$1.99 with a \$5 discount when the coupon code is applied. Last, the student should have set the fixed amount (50) equal to the expression representing Maggie's spending ($1.99x - 5$) to create the equation $50 = 1.99x - 5$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option A is incorrect	The student likely used the discount, \$5, as the unit rate instead of the cost of each game, \$1.99, resulting in the equation $50 = 1.99 - 5x$. The student needs to focus on understanding how to write equations based on real-world problems.
	Option B is incorrect	The student likely used the discount, \$5, as the unit rate instead of the cost of each game, \$1.99, and added the discount instead of subtracting it, resulting in the equation $50 = 1.99 + 5x$. The student needs to focus on understanding how to write equations based on real-world problems.
	Option C is incorrect	The student likely added the discount, \$5, instead of subtracting it, resulting in the equation $50 = 1.99x + 5$. The student needs to focus on understanding how to write equations based on real-world problems.

Item #	Rationale	
23	Option A is correct	To determine the value of Mr. Russo’s savings account, the student could have added the values of the rest of his assets (items with a positive value) and liabilities (items with a negative value) and calculated the difference between the subtotal and his net worth (the sum value of all assets and liabilities), resulting in $48{,}700 - (95{,}000 - 64{,}600 + 8{,}500 - 5{,}700 + 7{,}400) = 8{,}100$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option B is incorrect	The student likely added Mr. Russo’s net worth to the total value of his other assets and liabilities (not including his savings account), resulting in $(95{,}000 - 64{,}600 + 8{,}500 - 5{,}700 + 7{,}400) + 48{,}700 = 89{,}300$. The student needs to attend to the details of the question in problems that require students to find the value of assets or liabilities.
	Option C is incorrect	The student likely added the total value of Mr. Russo’s liabilities (mortgage and auto loan) to his net worth and assumed that he would need an equivalent amount in the savings account. Since $-64{,}600 - 5{,}700 + 48{,}700 = -21{,}600$, he would need $21,600 in the savings account. The student needs to attend to the details of the question in problems that require students to find the value of assets or liabilities.
	Option D is incorrect	The student likely added the values of Mr. Russo’s assets and liabilities that were listed in the table, resulting in $95{,}000 - 64{,}600 + 8{,}500 - 5{,}700 + 7{,}400 = 40{,}600$. The student needs to attend to the details of the question in problems that require students to find the value of assets or liabilities.

Item #	Rationale	
24	Option C is correct	To determine the number of days that it snowed, the student could have subtracted the total number of sunny days and rainy days from 90. The student could have multiplied the proportion of sunny days by the total number of days to determine that there were $\frac{1}{2}(90) = 45$ sunny days. Next, the student could have multiplied the proportion of rainy days by the total number of days to determine that there were $\frac{1}{3}(90) = 30$ rainy days. It snowed during remaining days, so by subtracting the total number of sunny days and rainy days from 90, the student could have determined there were 90 – (45 + 30) = 15 days that it snowed. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option A is incorrect	The student likely determined the number of sunny days instead of the number days that it snowed: $\frac{1}{2}(90) = 45$ days. The student needs to focus on performing the mathematical operations (+, −, ×, ÷) that are required to solve a problem.
	Option B is incorrect	The student likely divided the total number of days, 90, by the number of weather categories, 3, to determine that there were 90 ÷ 3 = 30 days that it snowed. The student needs to focus on performing the mathematical operations (+, −, ×, ÷) that are required to solve a problem.
	Option D is incorrect	The student likely found the total number of days that were either sunny or rainy, $\frac{1}{2}(90) + \frac{1}{3}(90) = 45 + 30 = 75$, and failed to subtract that number from 90 to find the number days that it snowed. The student needs to focus on performing the mathematical operations (+, −, ×, ÷) that are required to solve a problem.

Item #	Rationale	
25	Option D is correct	To determine which measurement is closest to the area (amount of space covered by a surface) in square feet of the circular part of the lawn that is watered by the sprinkler, the student should have used the formula for the area of a circle: $A = \pi r^2$, where A is the area of the circle and r is the radius (distance from the center of the circle to a point on the circle). The student should have recognized that the radius of the circle is half the labeled diameter (length of a line segment that goes through the center of a circle and connects two points on the circle) of 14 feet, resulting in $14 \div 2 = 7$ feet. The student should then have substituted $r = 7$ into the formula for the area of a circle, resulting in $A = \pi(7^2)$, $A \approx 3.14(49)$, and $A \approx 154$ square feet. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option A is incorrect	The student likely combined the formulas for the area of a circle, $A = \pi r^2$, and the circumference (distance around the circle) of a circle, $C = 2\pi r$, into $A = 2\pi r^2$ and substituted the value of the diameter for the value of the radius, resulting in $A = 2\pi(14)^2$, or $A \approx 6.28(196) \approx 1{,}231$ square feet. The student needs to focus on understanding which formula to apply in calculations involving circles and on correctly applying the formula.
	Option B is incorrect	The student likely used the formula for the circumference (distance around the circle) of a circle ($C = \pi d$, where C is the circumference and d is the diameter), resulting in $C = \pi(14)$, or $C \approx 3.14(14) \approx 44$ square feet. The student needs to focus on understanding which formula to apply in calculations involving circles.
	Option C is incorrect	The student likely used the formula for the area of a circle, $A = \pi r^2$, but substituted the value of the diameter for the radius, resulting in $A = \pi(14)^2$, or $A \approx 3.14(196) \approx 615$ square feet. The student needs to focus on understanding how to correctly apply the formula for the area of a circle.

Item #	Rationale	
26	32; 8	To determine the rates in pages per minute for black-and-white and color printing, the student could have divided the number of each type of page printed by the number of minutes that elapsed while printing. The printer prints 48 black-and-white pages in 1.5 minutes, so the student could have calculated the unit rate as 48 ÷ 1.5 = 32 pages per minute. The printer prints 20 color pages in 2.5 minutes, so the student could have calculated the unit rate as 20 ÷ 2.5 = 8 pages per minute. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item #	Rationale	
27	Option A is correct	To determine the total surface area (amount of space covered by all faces of a three-dimensional figure) of the rectangular prism, the student could have calculated the area of the net (two-dimensional view of a three-dimensional figure). Since the net has 3 pairs of congruent rectangles, the student could have found the area of each type of rectangle, multiplied each area by 2, and added the results together to determine the total surface area. The student could have recognized that the dimensions of the three types of rectangles are 8 centimeters by 6 centimeters, 8 centimeters by 4 centimeters, and 6 centimeters by 4 centimeters. Therefore, the student could have calculated the area of the net to be 2(8)(6) + 2(8)(4) + 2(6)(4) = 96 + 64 + 48 = 208 square centimeters. Since the area of the net is equal to the surface area of the rectangular prism, the student could have concluded that the surface area is 208 square centimeters. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option B is incorrect	The student likely recognized that the net would form a rectangular prism with a height of 4 centimeters and a rectangular base with a length of 8 centimeters and a width of 6 centimeters. The student then likely multiplied the length, width, and height together and determined that the surface area is 4(6)(8) = 192 square centimeters. The student needs to focus on understanding the steps and formulas needed to determine the surface area of a prism from a net.
	Option C is incorrect	The student likely found the lateral surface area (total amount of space covered by the surfaces, not including the bases) of the rectangular prism after deciding that the rectangles with a length of 8 centimeters and a width of 4 centimeters are the bases. The student likely calculated the total area of all the rectangles except the two bases, resulting in 2(8)(6) + 2(6)(4) = 96 + 48 = 144 square centimeters. The student needs to focus on understanding the steps and formulas needed to determine the surface area of a prism from a net.
	Option D is incorrect	The student likely tried to find the area of the net by finding the area of each rectangle and adding the areas together but omitted one of the rectangles with a length of 8 centimeters and a width of 6 centimeters, resulting in 4(6) + 8(6) + 4(8) + 4(8) + 4(6) = 24 + 48 + 32 + 32 + 24 = 160 square centimeters. The student needs to focus on understanding the steps and formulas needed to determine the surface area of a prism from a net.

Item #	Rationale	
28	Not True; True; True; Not True	To determine which equations are true when $m = -5$, the student could have substituted -5 for m to determine whether it makes a true statement. When -5 is substituted for m in the first equation, $4m - 6 = 14$, the result is $4(-5) - 6 = 14$, or $-26 = 14$, which is not a true statement. When -5 is substituted for m in the second equation, $-2m + 7 = 17$, the result is $-2(-5) + 7 = 17$, or $17 = 17$, which is a true statement. When -5 is substituted for m in the third equation, $4m - 6 = -26$, the result is $4(-5) - 6 = -26$, or $-26 = -26$, which is a true statement. When -5 is substituted for m in the fourth equation, $-2m + 7 = -3$, the result is $-2(-5) + 7 = -3$, or $17 = -3$, which is not a true statement. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item #	Rationale	
29	Option D is correct	To determine which statement about a randomly selected student is true based on the results in the table, the student should have compared the number of students who prefer dogs to the total number of students who prefer all other types of pets. Since the total number of students who prefer rabbits, cats, and fish (10 + 65 + 15 = 90) is less than the number who prefer dogs (110), the student should have concluded that the statement "The student is more likely to prefer a dog than to prefer any other type of pet" is true. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option A is incorrect	The student likely ignored the number of students who prefer each type of pet and assumed that each type of pet would be equally likely to be chosen. The student needs to focus on understanding how to compare probabilities of different outcomes to each other.
	Option B is incorrect	The student likely recognized that 5 more students prefer fish than prefer rabbits and concluded that a randomly selected student would be 5 times as likely to prefer fish than to prefer a rabbit. The student needs to focus on understanding how to compare probabilities of different outcomes to each other.
	Option C is incorrect	The student likely noticed that fish was listed last in the table and assumed that fish was the least popular type of pet. The student needs to focus on understanding how to compare probabilities of different outcomes to each other.

Item #	Rationale	
30	Selected 2 points on the line $y = \frac{3}{2}x$, such as (0, 0) and (2, 3). Any other points on the line $y = \frac{3}{2}x$ are correct.	To determine two points on the graph that represents *y*, the number of cups of nuts required for *x* cups of dried fruit in the trail mix recipe, the student could have recognized that the rate of change (ratio of the change in *y*-values to the change in *x*-values) for this situation is $\frac{3}{2}$, since the recipe uses $1\frac{1}{2}$ cups of nuts for every cup of dried fruit. The student should have also recognized that the amount of nuts used is represented by *y*, and the amount of dried fruit used is represented by *x*. The student then could have graphed ordered pairs in which each *y*-value is the result of multiplying the corresponding *x*-value by $\frac{3}{2}$, satisfying the equation $y = \frac{3}{2}x$. The graph contains the points (0, 0), $\left(1, 1\frac{1}{2}\right)$, (2, 3), $\left(3, 4\frac{1}{2}\right)$, and (4, 6). This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item #	Rationale	
31	Option C is correct	To determine the experimental probability (how likely it is that an event will occur based on the results of an experiment) that the next card drawn is red or orange, the student should have recognized that, during the experiment, the frequency of red occurring was 9, and the frequency of orange occurring was 13. The student then should have added these two values and divided the sum by 40, the total number of times a card was drawn, resulting in $\frac{22}{40} = \frac{11}{20}$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option A is incorrect	The student likely calculated the experimental probability of drawing only an orange card, by determining the number of times an orange card was drawn, 13, and dividing by 40, the total number of times a card was drawn, resulting in $\frac{13}{40}$. The student needs to focus on understanding how to determine the probability of a simple event from an experiment.
	Option B is incorrect	The student likely ignored the frequency column and divided the number of colors that were asked about, 2 (red and orange), by the total number of colors in the table, 4, resulting in $\frac{2}{4} = \frac{1}{2}$. The student needs to focus on understanding how to determine the probability of a simple event from an experiment.
	Option D is incorrect	The student likely calculated the experimental probability of drawing only a red card by determining the number of times a red card was drawn, 9, and dividing by 40, the total number of times a card was drawn, resulting in $\frac{9}{40}$. The student needs to focus on understanding how to determine the probability of a simple event from an experiment.

Item #	Rationale	
32	Option B is correct	To determine which statement is best supported by the information in the dot plots (a graphical way of showing the frequency of an event by placing a dot or dots above the value on a number line), the student should have determined whether the distribution of the data for in each dot plot is symmetric (data to the right of the middle are approximately the same shape as the data to the left of the middle) or asymmetric (data to the right of the middle are shaped differently from the data to the left of the middle). The student should have looked at the shapes of both dot plots and determined that the left and right sides of the dot plot for women's shoes are not reflections of each other, but the left and right sides of the dot plot for men's shoes" are reflections of each other. Therefore, the student should have concluded that the distribution of the data for the men's shoes is symmetric, but the distribution for the women's shoes is not.
	Option A is incorrect	The student likely recognized that the data on the right sides of both dot plots are steadily decreasing and interpreted this to mean that both distributions are symmetric. The student needs to focus on understanding how to classify the symmetry of data presented in comparative dot plots.
	Option C is incorrect	The student likely recognized that the data set for the women's shoes has a single mode (most frequent response in a set of data), 7.5, and that the data set for the men's shoes has three modes, 10, 10.5, and 11. The student likely confused symmetric with unimodal (having exactly one mode), and identified the distribution of the data for the women's shoes as symmetric instead of unimodal and the distribution of the data set for the men's shoes as not symmetric instead of multimodal (having more than one mode). The student needs to focus on understanding how to classify the symmetry of data presented in comparative dot plots.
	Option D is incorrect	The student likely concluded that, since neither the data set for women's shoes nor the data set for men's shoes has a center in the middle of the number line (between 9 and 9.5), neither distribution is symmetric. The student needs to focus on understanding how to classify the symmetry of data presented in comparative dot plots.

Item #	Rationale	
33	Option C is correct	To determine which expression best represents the value of π, the student should have understood that π is the ratio of the circumference (distance around a circle) to the diameter (length of a line segment that goes through the center of the circle and connects two points on the circle). Since the radius (distance from the center to a point on the circle), 10 inches, is half the length of the diameter, the diameter is 20 inches. The circumference is *c* inches, so π, which is defined as the ratio of the circumference to the diameter, can be represented by $\frac{c}{20}$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option A is incorrect	The student likely confused the radius with the diameter and multiplied the values of the circumference and the radius instead of writing a ratio. The student needs to focus on understanding that π is the ratio of the circumference of a circle to its diameter.
	Option B is incorrect	The student likely confused the radius with the diameter when determining the ratio. The student needs to focus on understanding that π is the ratio of the circumference of a circle to its diameter.
	Option D is incorrect	The student likely multiplied the values of the circumference and the diameter instead of writing a ratio. The student needs to focus on understanding that π is the ratio of the circumference of a circle to its diameter.

Item #	Rationale	
34	Option D is correct	To determine the solution to the equation $4 + \frac{1}{2}x - 8 = 12$, the student could have first combined the terms 4 and −8 on the left side of the equation, resulting in $\frac{1}{2}x - 4 = 12$. Then the student could have added 4 to both sides of the equation, resulting in $\frac{1}{2}x - 4 + 4 = 12 + 4$, or $\frac{1}{2}x = 16$. Finally, the student could have multiplied both sides of the equation by 2, resulting in $2\left(\frac{1}{2}x\right) = 2(16)$, or $x = 32$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option A is incorrect	The student likely combined the terms 4 and −8 on the left side of the equation to obtain $\frac{1}{2}x - 4 = 12$ but subtracted 4 from the right side of the equation instead of adding 4, resulting in $\frac{1}{2}x = 12 - 4$, or $\frac{1}{2}x = 8$. The student then likely multiplied the right side of the equation by $\frac{1}{2}$ instead of multiplying by 2, resulting in $x = \frac{1}{2}(8)$, or $x = 4$. The student needs to focus on understanding how to solve a two-step linear equation.
	Option B is incorrect	The student likely combined the terms 4 and −8 on the left side of the equation to obtain $\frac{1}{2}x - 4 = 12$ and then added 4 to both sides of the equation, resulting in $\frac{1}{2}x = 16$. The student then likely multiplied the right side of the equation by $\frac{1}{2}$ instead of multiplying by 2, resulting in $x = \frac{1}{2}(16)$, or $x = 8$. The student needs to focus on understanding how to solve a two-step linear equation.
	Option C is incorrect	The student likely combined the terms 4 and −8 on the left side of the equation to obtain $\frac{1}{2}x - 4 = 12$ but then subtracted 4 from the right side of the equation instead of adding 4, resulting in $\frac{1}{2}x = 12 - 4$, or $\frac{1}{2}x = 8$. The student then likely multiplied both sides of the equation by 2, resulting in $2\left(\frac{1}{2}x\right) = 2(8)$, or $x = 16$. The student needs to focus on understanding how to solve a two-step linear equation.

Item #	Rationale	
35	music; physical education	To determine which inference (a conclusion based on evidence) about the preferred nonacademic subjects of sixth graders at lunch is best supported by the information in the comparative bar graph, the student should have identified the numbers of sixth graders who chose art (9), physical education (9), and music (12) and concluded that more sixth graders would choose music than would choose either one of the other two subjects. To determine which inference about the preferred nonacademic subjects of seventh graders at lunch is best supported by the information in the comparative bar graph, the student should have identified the numbers of seventh graders who chose art (10), physical education (14), and music (6) and concluded that more seventh graders would choose physical education than would choose either one of the other two subjects. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item #	Rationale	
36	Option C is correct	To determine the area (amount of space covered by a surface) of the side wall of the barn in square feet, the student should have calculated the areas of the shapes that make up the figure. The student could have calculated the area of the bottom rectangle by multiplying the length and the width: (11)(15) = 165 square feet. The student could have calculated the area of the trapezoid on top by using the formula $A = \frac{1}{2}(b_1 + b_2)h$, where A is the area, b_1 and b_2 are the lengths of the two bases of the trapezoid, and h is the height of the trapezoid. The top base of the trapezoid is 15 feet, and the bottom base is 3 feet longer than the top base on each side, or 15 + 3(2) = 21 feet. Substituting the bases and the height, 4 feet, into the formula results in $A = \frac{1}{2}(15 + 21)(4) = 72$ square feet. The student then could have added the areas of the rectangle and trapezoid to find the total area of the side wall of the barn: 165 + 72 = 237 square feet. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option A is incorrect	The student likely calculated the area of the side wall of the barn by finding the areas of the rectangle and the trapezoid but made an error when determining the length of the trapezoid's bottom base, resulting in 3 + 15 = 18 feet instead of 2(3) + 15 = 21 feet. The student likely substituted b_2 = 18, b_1 = 15, and h = 4 into $A = \frac{1}{2}(b_1 + b_2)h$, resulting in $A = \frac{1}{2}(15 + 18)(4) = 66$ square feet. Then the student likely added this area to the area of the rectangle, resulting in 165 + 66 = 231 square feet. The student needs to focus on understanding how to determine the area of a composite figure.
	Option B is incorrect	The student likely calculated the area of the side wall of the barn by finding the total area of the two rectangles but ignored the area of the two right triangles, resulting in 15(11 + 4) = 15(15) = 225 square feet. The student needs to focus on understanding how to determine the area of a composite figure.
	Option D is incorrect	The student likely calculated the area of the side wall of the barn by finding the areas of the square and the two right triangles but made an error when calculating the area of the triangles. The student likely did not multiply by $\frac{1}{2}$ when calculating the area of each of the right triangles, resulting in (3)(4) = 12 square feet instead of 6 square feet. The student then likely added the areas, resulting in 225 + 2(12) = 249 square feet. The student needs to focus on understanding how to determine the area of a composite figure.

Item #	Rationale	
37	32; 64	To determine the number of blue gumballs in the gumball machine, the student could have isolated the ratio of blue to yellow gumballs, 4:3. Given there are 24 yellow gumballs, the student could have then set up and solved a proportion (comparison of two ratios) comparing the number of blue gumballs to the number of yellow gumballs. The student could have used the proportion $\frac{4}{3} = \frac{x}{24}$ to find the value of *x*, the number of blue gumballs. To solve the proportion, the student could have multiplied both sides of the equation by 24, resulting in $24\left(\frac{4}{3}\right) = 24\left(\frac{x}{24}\right)$, or *x* = 32. The student could have concluded that there are 32 blue gumballs in the machine. To determine the total number of gumballs in the machine, the student could have recognized the need to determine the number of green gumballs in the machine. The student could have used the ratio of green to yellow gumballs, 1:3. The student could have then set up and solved a proportion comparing the number of yellow gumballs to the number of green gumballs. The student could have used the proportion $\frac{1}{3} = \frac{y}{24}$ to find the value of *y*, the number of green gumballs. To solve the proportion, the student could have multiplied both sides of the equation by 24, resulting in $24\left(\frac{1}{3}\right) = 24\left(\frac{y}{24}\right)$, or *y* = 8. The student could have concluded that there are 8 green gumballs in the machine. Then the student could have added the total numbers of blue, yellow, and green gumballs together to determine that there are 32 + 24 + 8 = 64 gumballs in the machine. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item #	Rationale	
38	Option C is correct	To determine which inference (a conclusion based on evidence) about the number of sandwiches in each order that will be placed next Monday is best supported by the information in the dot plot (a graphical way of showing the frequency of an event by placing a dot or dots above the value on a number line), the student should have compared the total number of orders for 1 or 2 sandwiches to the total number of orders for 9 or 10 sandwiches. The student should have recognized there were 7 orders for 1 sandwich, 6 orders for 2 sandwiches, 0 orders for 9 sandwiches, and 5 orders for 10 sandwiches. The student then should have determined that the total number of orders for 1 or 2 sandwiches is 7 + 6 = 13, which is more than the total number of orders for 9 or 10 sandwiches, 0 + 5 = 5. Therefore, the student should have concluded that the information in the dot plot supports the inference that more orders will be for 1 or 2 sandwiches than for 9 or 10 sandwiches.
	Option A is incorrect	The student likely multiplied the number of sandwiches in each order by the number of orders to find the total number of sandwiches ordered for each order size. It is true that 50 sandwiches (5 orders for 10 sandwiches, or 5(10) = 50) is the greatest number of sandwiches for any order size; however, the question asks the student to compare the numbers of orders for the different order sizes, rather than the total numbers of sandwiches ordered for the different order sizes. The student made an incorrect comparison, since the number of orders for 10 sandwiches is 5, which is less than or equal to the number of orders for several of the other order sizes. The student needs to focus on attending to the details of the answer options in problems that require the student to make an inference from a data set.
	Option B is incorrect	The student likely determined the total number of sandwiches rather than the number of orders. To find the total number of sandwiches ordered for each order size, the student would have multiplied the number of sandwiches in an order by the number of orders. The total number of sandwiches ordered in orders for 1 to 5 sandwiches is 69. The total number of sandwiches ordered in orders for 6 to 10 sandwiches is 114. The ratio of the total number of sandwiches that were ordered in orders for 1 to 5 sandwiches to the total number of sandwiches ordered is $\frac{69}{69+114}=\frac{69}{183}<\frac{1}{2}$. The student then likely concluded that less than 50% (half) of the total number of sandwiches ordered were in orders for 1 to 5 sandwiches. The student needs to focus on attending to the details of the answer options in problems that require the student to make an inference from a data set.
	Option D is incorrect	The student likely determined the total number of sandwiches rather than the number of orders. To find the total number of sandwiches ordered for each order size, the student would have multiplied the number of sandwiches in an order by the number of orders. The total number of sandwiches ordered in orders for 6 to 10 sandwiches is 114. The total number of sandwiches ordered in orders for 1 to 5 sandwiches is 69. The ratio of the total number of sandwiches that were ordered in orders for 6 to 10 sandwiches to the total number of sandwiches ordered is $\frac{114}{69+114}=\frac{114}{183}>\frac{1}{2}$. The student then likely concluded that more than 50% (half) of the total number of sandwiches were ordered in orders for 6 to 10 sandwiches. The student needs to focus on

		attending to the details of the answer options in problems that require the student to make an inference from a data set.