Part 5: Math

Bonus Chapter

Chapter 28: Numbers, Arithmetic, and Number Sense

Questions

1. The speed of light is about 186,000 miles per second. A light year is the distance light travels in a year. What is the approximate length of a light year in miles, written in scientific notation?

    (1) 1.63×10^9

    (2) 9.78×10^{10}

    (3) 2.44×10^{11}

    (4) 5.87×10^{12}

    (5) 6.14×10^{13}

2. Which of the following is equal to $(5+2)^2 + 3^2$?

    (1) 10

    (2) 16

    (3) 38

    (4) 55

    (5) 58

3. Kin buys some fruit and vegetables at the grocery store. He buys $\frac{1}{2}$ pound of beans at $1.79 per pound; $\frac{3}{4}$ pounds of broccoli at $1.59 per pound; $1\frac{1}{4}$ pounds of cherries at $2.49 per pound; and a half gallon of milk for $2.89. How much change should he receive if he gives the cashier a $20 bill?

    (1) $7.97

    (2) $8.09

    (3) $8.76

    (4) $11.91

    (5) $20.00 is not enough

4. Michelle plays a carnival game of chance which is won 23 times in every 45 plays. Which of the following best approximates the number of wins in 200 plays?

   (1) 46

   (2) 92

   (3) 102

   (4) 112

   (5) 123

5. A car that gets 22 miles per gallon is driven at an average speed of 55 miles per hour for 3 hours. How many gallons of gasoline does it use on this trip?

   (1) 2½ gallons

   (2) 7½ gallons

   (3) 18⅓ gallons

   (4) 22 gallons

   (5) Need more information

Answers

1. **(4)** Light travels 186,000 miles per second, so multiply by 60 to find out how far it travels in a minute; multiply this answer by 60 again to find out how far it travels in an hour; multiply this answer by 24 to find out how far it travels in a day; and finally multiply this answer by 365 to find out how far it travels in a year: $186,000 \times 60 \times 60 \times 24 \times 365 = 5.865696 \times 10^{12}$, which rounds to answer choice (4). If you key this into the Casio *fx*-260 calculator, the answer will read 5.865696 ^{12}. Answer choice (1) leaves out 60×60, while answer choice (2) only leaves out one 60. Answer choice (3) leaves out 24, and answer choice (5) resulted from a calculation error.

2. **(5)** This question checks understanding of exponents and the order of operations. Answer choice (1) ignores the exponents, while answer choice (2) ignores the first exponent. Answer choice (3) ignores the parentheses, squaring each number and then adding the results. Answer choice (4) multiplies 3×2 instead of squaring 3 as 3×3.

3. **(4)** Multiply the quantity of each item by its cost per unit and add the results: $\frac{1}{2}(1.79) + \frac{3}{4}(1.59) + 1\frac{1}{4}(2.49) + 2.89 = 8.09$. The total cost is $8.09. Subtract this amount from $20 to get $11.91 change. Answer choice (2) is the cost rather than the amount of change. Answer choice (3) just adds the unit prices, disregarding the amount of each product. Answer choices (1) and (5) capture calculation errors.

4. **(3)** This is a proportion problem: $\frac{23}{45} = \frac{x}{200}$. Multiply 23 by 200 and divide the result by 45 to get 102.2. Answer choice (1) simply adds 1 to the number of wins, and answer choice (2) doubles this (because of the 200). Answers (4) and (5) are guesses.

5. **(2)** You know that the car traveled 165 (3 × 55) miles and that it gets 22 miles per gallon. The amount of gasoline it uses is the distance divided by the mileage, or $\frac{165}{22} = 7.5$ gallons. Answer choice (1) is the speed (55) divided by the miles per gallon (22), a meaningless number. Answer choice (3) is the miles per gallon divided by hours, also a meaningless number. Answer choice (4) is the same as the miles per gallon, and answer choice (5) is wrong—there is enough information.

Chapter 29: Measurement and Geometry

Questions

1. A rectangular garden is 25 feet long and 30 feet wide. As shown in the figure, a 3-foot walkway surrounds the garden.
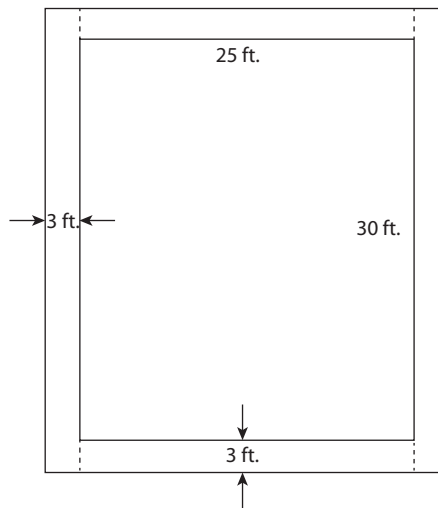
What is the area of the walkway?

(1) 174 ft²

(2) 183 ft²

(3) 225 ft²

(4) 366 ft²

(5) 402 ft²

2. The center of a circle on a coordinate plane is at (2,0). The circle passes through the point (-3,0). At what other point does the circle pass through?

   (1) (7,0)

   (2) (3,0)

   (3) (0,3)

   (4) (0,-3)

   (5) (0,2)

3. The base of a cone-shaped cup has a diameter of 2 inches and a height of 5 inches. How much water will the cup hold?

   (1) 3.3 in^3

   (2) 5.2 in^3

   (3) 10.0 in^3

   (4) 12.6 in^3

   (5) 20.9 in^3

4. Parents' Night at East High School begins at 7 P.M. Mr. Snyder, a teacher, plans to play nine holes of golf and eat dinner before Parents' Night begins. The golf course is 20 minutes away by car, and he can eat dinner in a half an hour. If it takes Mr. Snyder 2½ hours to play nine holes of golf, what is the latest he can leave after school and still get back in time for Parents' Night?

   (1) 3 P.M.

   (2) 3:10 P.M.

   (3) 3:20 P.M.

   (4) 3:30 P.M.

   (5) 3:40 P.M.

5. A tire on an adult bicycle is 26 inches in diameter. A children's bicycle has tires that are 20 inches in diameter. The distance a bicycle travels in one complete rotation of a tire is the tire's circumference. In five rotations, how much further will an adult bicycle travel than a children's bicycle?

   (1) $5 \times \pi$ in

   (2) $6 \times \pi$ in

   (3) $12 \times \pi$ in

   (4) $24 \times \pi$ in

   (5) $30 \times \pi$ in

Answers

1. **(4)** The easiest way to find the area of the walkway is to subtract the area of the garden from the larger area of the garden together with the walkway. Both are rectangles. The dimensions of the garden are 25 feet and 30 feet, so its area is $25 \times 30 = 750$ ft^2. Since there is one width of walkway on each side of the garden, you need to add 6 feet to both the width and length of the garden to get the larger area. So the larger area is $31 \times 36 = 1{,}116$ ft^2. Subtracting 1,116 from 750 gives the answer 366 ft^2. You could also find the area directly. The walkway consists of the four strips formed by the dashed lines in the figure. The two vertical strips each have area $3 \times 36 = 108$ ft^2, for a total of 216 ft^2, and the two horizontal strips each have area $3 \times 25 = 75$ ft^2, for a total of 150 ft^2. Add these totals to get 366 ft^2, or answer choice (4). Answer choice (1) is incorrect because only one walkway width was added to each dimension to find the larger area. Answer (2) attempted to find the area of the walkway directly, but only one width and one length of walkway, instead of two, were added together. Answer choice (3) is an incorrect guess. The length and width of the garden were added, and the result was multiplied by 3. Finally, answer choice (5) was obtained by adding two strips of walkway to both the length and width of the garden, but double-counting the corners.

2. **(1)** The center is at (2,0) and the circle passes through (-3,0). The radius of the circle is the distance between these two points, 5. Therefore the circle passes through the point (7,0), which is 5 units on the other side of (2,0).

3. **(2)** The amount of water that the cone will hold is the volume of the cone. Use the formula from the formula sheet, where 3.14 is used to approximate π:

   $V = (\frac{1}{3}) \times 3.14 \times (1)^2 \times 5$

   $V = 5.2$ in^3

   Answer choice (1) is $\frac{1}{3} \times$ diameter $\times$ height, and answer choice (3) is the diameter times the height. Neither of these is the formula for the volume of a cone. Answer choice (4) is 4×3.14. This answer uses the diameter of the base instead of its radius and fails to multiply by the height 5 and by $\frac{1}{3}$. Answer choice (5) used the diameter instead of the radius in the formula.

4. **(3)** Add the times it takes to drive, play golf, and eat dinner: 40 minutes + 150 minutes + 30 minutes = 220 minutes, or 3 hours and 40 minutes. Three hours and 40 minutes before 7 P.M. is 3:20. The other answer choices may be attractive to guessers.

5. **(5)** A tire has the shape of a circle. The circumference of a circle is its diameter $\times \pi$. In five revolutions, the tire on an adult bicycle travels $5 \times 26 \times \pi$ inches, while the tire on a children's bike travels $5 \times 20 \times \pi$ inches. The difference is $5 \times 6 \times \pi$, or 30π inches.

Chapter 30: Data Analysis, Statistics, and Probability

Questions

1. Which conclusion can you draw from the following table?

Brand Loyalty: Percent Owning Each Brand Who Would Buy That Brand Again

Brand A	28%
Brand B	75%
Brand C	82%
Brand D	76%
Brand E	91%
Brand F	38%

(1) More people like Brand C than Brand B.

(2) Brand D has the fourth-highest loyalty.

(3) Loyalty to brands B and D are about the same.

(4) Brand A is the least popular brand.

(5) The number of people owning Brand C is greater than the number who own Brand F.

2. Juan commutes every day to work by car. The following graph shows the distance he traveled during the first 20 minutes of his commute on Monday morning.
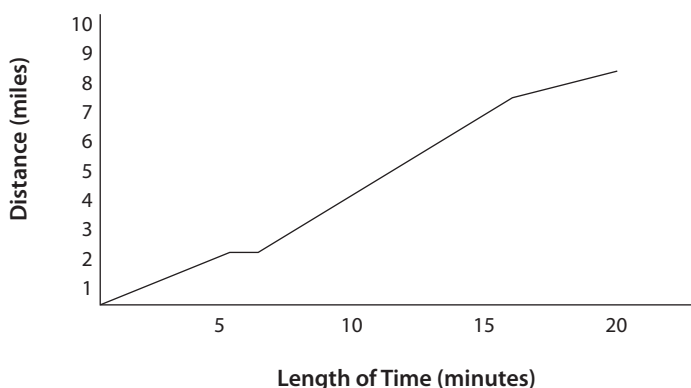
During which period of time was he traveling at the greatest average speed?

(1) the first 5 minutes

(2) between the fifth and sixth minutes

(3) between the sixth and sixteenth minutes

(4) between the sixteenth and twentieth minutes

(5) between the first and fifteenth minutes

3. Chin's test grades for the year in his math class were 86, 92, 79, 58, 98, and 85. What was his mean grade for the year?

4. What is the mode of the data set below?

1	2	3	4	5
√√√√	√√	√	√√√√	√√√
√√	√√√			

(1) 1

(2) 2

(3) 3

(4) 4

(5) 5

5. Ms. Sanchez' math class has 15 boys and 17 girls. What is the probability that a randomly chosen student from this class is a boy?

(1) $\dfrac{15}{32}$

(2) $\dfrac{17}{32}$

(3) $\dfrac{15}{17}$

(4) $\dfrac{17}{15}$

(5) 15

Answers

1. **(3)** Choice (1) is incorrect because the table provides no information about the number of people who like each brand. Brand A has the third-highest loyalty, so choice (2) is incorrect. Choice (4) is wrong because the data represent brand loyalty, not brand popularity, and choice (5) would result from a misreading of the problem.

2. **(3)** The average speed is greatest when the distance covered per unit of time is largest. In the figure, this is represented by the segment with the steepest slope. Between the sixth and sixteenth minutes, Juan covered 6 miles, and 6 miles in 10 minutes is 36 miles per hour.

3. To find the mean test score, add the six scores and divide by 6: $\dfrac{86+92+79+58+98+85}{6} = 83$.

4. **(4)** The mode is the most frequently occurring value.

5. **(1)** The probability of an event is the likelihood that the event occurs. There are 15+17=32 in the class, and 15 are boys, so the probability of choosing a boy is $\frac{15}{32}$. Answer choice (2) represents the probability of choosing a girl. Answer choices (3) and (4) represent ratios of boys to girls and girls to boys, while answer choice (5) is the number of boys rather than the probability of a boy.

Chapter 31: Algebra, Functions, and Patterns

Questions

1. Sharon pays x dollars for a new coat. The sales tax where Sharon lives is 7%. Which expression represents the total cost of the coat?

   (1) .07x

   (2) x + .07x

   (3) x − .07x

   (4) x + .7x

   (5) x − .7x

2. What is the y-intercept of the equation $y = 3x − 1$?

3. The variables x and y are related by the equation $y = a^x$, where a is a constant. Which word or phrase best describes this relationship?

   (1) linear

   (2) quadratic

   (3) direct variation

   (4) exponential

   (5) constant

4. Gina wants to go to an amusement park. It costs $5 to park a car and there is an entry fee of $10. Each ride costs $2. Which expression represents Gina's total cost if she goes on x rides?

   (1) $2x + 15$

   (2) $5x + 2$

   (3) $10x + 2$

   (4) $10x + 5$

   (5) $15x + 2$

5. At what point does the graph of $y = -2x + 6$ pass through the x axis?

    (1) (-3,0)

    (2) (-2,0)

    (3) (0,3)

    (4) (0,-3)

    (5) (3,0)

Answers

1. **(2)** Percent means out of 100, and 7 out of 100 is .07. Therefore, the total cost of the coat is its price x plus the tax .07x. Answer choice (3) would be correct if the question said there was a 7% discount. Answers (4) and (5) use .7 instead of .07 as the tax/discount rate, and answer choice (1) gives only the amount of tax.

2. The y-intercept is the value of y when $x = 0$ in the equation. In other words, the y-intercept is $y = 3(0) - 1 = -1$.

3. **(4)** The relationship is exponential because the variable x is in an exponent. Answer choice (1) would have applied if the equation had been $y = ax + b$, where b is also constant. Answer choice (2) would have applied if the equation included a term with x^2 in it. Answer choice (3) would have applied if the equation had been $y = ax$, and answer choice (5) would have applied if the equation had been $y =$ any number.

4. **(1)** Since each ride costs $2, the cost (in $) of x rides is 2 times x. Add $15 for parking and admission. Other answer choices would result from misreading the problem or poor guesses.

5. **(5)** The point where the line crosses the x axis is called the x-intercept and has a y coordinate of 0. Substitute 0 in the equation for y and solve:

$y = -2x + 6$

$0 = -2x + 6$

$2x = 6$

$x = 3$

Therefore, the desired point is (3,0). Answer choice (1) results from solving the equation incorrectly. Answer choice (2) uses the slope -2 as the x-intercept. The x coordinate, instead of the y coordinate, is zero in both answer choices (3) and (4).