

## Section 4: Math Test — Calculator

### QUESTION 1.

**Choice B is correct.** On the graph, a line segment with a positive slope represents an interval over which the target heart rate is strictly increasing as time passes. A horizontal line segment represents an interval over which there is no change in the target heart rate as time passes, and a line segment with a negative slope represents an interval over which the target heart rate is strictly decreasing as time passes. Over the interval between 40 and 60 minutes, the graph consists of a line segment with a positive slope followed by a line segment with a negative slope, with no horizontal line segment in between, indicating that the target heart rate is strictly increasing then strictly decreasing.

Choice A is incorrect because the graph over the interval between 0 and 30 minutes contains a horizontal line segment, indicating a period in which there was no change in the target heart rate. Choice C is incorrect because the graph over the interval between 50 and 65 minutes consists of a line segment with a negative slope followed by a line segment with a positive slope, indicating that the target heart rate is strictly decreasing then strictly increasing. Choice D is incorrect because the graph over the interval between 70 and 90 minutes contains horizontal line segments and no segment with a negative slope.

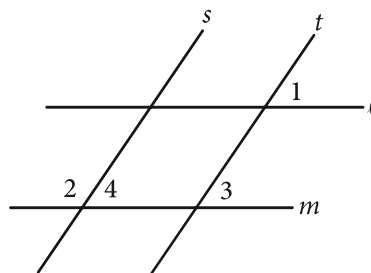
### QUESTION 2.

**Choice C is correct.** Substituting 6 for  $x$  and 24 for  $y$  in  $y = kx$  gives  $24 = (k)(6)$ , which gives  $k = 4$ . Hence,  $y = 4x$ . Therefore, when  $x = 5$ , the value of  $y$  is  $(4)(5) = 20$ . None of the other choices for  $y$  is correct because  $y$  is a function of  $x$ , and so there is only one  $y$ -value for a given  $x$ -value.

Choices A, B, and D are incorrect. Choice A is the result of using 6 for  $y$  and 5 for  $x$  when solving for  $k$ . Choice B results from using a value of 3 for  $k$  when solving for  $y$ . Choice D results from using  $y = k + x$  instead of  $y = kx$ .

### QUESTION 3.

**Choice D is correct.** Consider the measures of  $\angle 3$  and  $\angle 4$  in the figure below.



The measure of  $\angle 3$  is equal to the measure of  $\angle 1$  because they are corresponding angles for the parallel lines  $\ell$  and  $m$  intersected by the transversal line  $t$ . Similarly, the measure of  $\angle 3$  is equal to the measure of  $\angle 4$  because they are corresponding angles for the parallel lines  $s$  and  $t$  intersected by the transversal line  $m$ . Since the measure of  $\angle 1$  is  $35^\circ$ , the measures of  $\angle 3$  and  $\angle 4$  are also  $35^\circ$ . Since  $\angle 4$  and  $\angle 2$  are supplementary, the sum of the measures of these two angles is  $180^\circ$ . Therefore, the measure of  $\angle 2$  is  $180^\circ - 35^\circ = 145^\circ$ .

Choice A is incorrect because  $35^\circ$  is the measure of  $\angle 1$ , and  $\angle 1$  is not congruent to  $\angle 2$ . Choice B is incorrect because it is the measure of the complementary angle of  $\angle 1$ , and  $\angle 1$  and  $\angle 2$  are not complementary angles. Choice C is incorrect because it is double the measure of  $\angle 1$ .

#### QUESTION 4.

**Choice C is correct.** The description “ $16 + 4x$  is 10 more than 14” can be written as the equation  $16 + 4x = 10 + 14$ , which is equivalent to  $16 + 4x = 24$ . Subtracting 16 from each side of  $16 + 4x = 24$  gives  $4x = 8$ . Since  $8x$  is 2 times  $4x$ , multiplying both sides of  $4x = 8$  by 2 gives  $8x = 16$ . Therefore, the value of  $8x$  is 16.

Choice A is incorrect because it is the value of  $x$ , not  $8x$ . Choices B and D are incorrect; those choices may be a result of errors in rewriting  $16 + 4x = 10 + 14$ . For example, choice D could be the result of subtracting 16 from the left side of the equation and adding 16 to the right side of  $16 + 4x = 10 + 14$ , giving  $4x = 40$  and  $8x = 80$ .

#### QUESTION 5.

**Choice D is correct.** A graph with a strong negative association between  $d$  and  $t$  would have the points on the graph closely aligned with a line that has a negative slope. The more closely the points on a graph are aligned with a line, the stronger the association between  $d$  and  $t$ , and a negative slope indicates a negative association. Of the four graphs, the points on graph D are most closely aligned with a line with a negative slope. Therefore, the graph in choice D has the strongest negative association between  $d$  and  $t$ .

Choice A is incorrect because the points are more scattered than the points in choice D, indicating a weak negative association between  $d$  and  $t$ . Choice B is incorrect because the points are aligned to either a curve or possibly a line with a small positive slope. Choice C is incorrect because the points are aligned to a line with a positive slope, indicating a positive association between  $d$  and  $t$ .

### QUESTION 6.

**Choice D is correct.** Since there are 10 grams in 1 decagram, there are  $2 \times 10 = 20$  grams in 2 decagrams. Since there are 1,000 milligrams in 1 gram, there are  $20 \times 1,000 = 20,000$  milligrams in 20 grams. Therefore, 20,000 1-milligram doses of the medicine can be stored in a 2-decagram container.

Choice A is incorrect; 0.002 is the number of grams in 2 milligrams. Choice B is incorrect; it could result from multiplying by 1,000 and dividing by 10 instead of multiplying by both 1,000 and 10 when converting from decagrams to milligrams. Choice C is incorrect; 2,000 is the number of milligrams in 2 grams, not the number of milligrams in 2 decagrams.

### QUESTION 7.

**Choice C is correct.** Let  $x$  represent the number of installations that each unit on the  $y$ -axis represents. Then  $9x$ ,  $5x$ ,  $6x$ ,  $4x$ , and  $3.5x$  are the number of rooftops with solar panel installations in cities A, B, C, D, and E, respectively. Since the total number of rooftops is 27,500, it follows that  $9x + 5x + 6x + 4x + 3.5x = 27,500$ , which simplifies to  $27.5x = 27,500$ . Thus,  $x = 1,000$ . Therefore, an appropriate label for the  $y$ -axis is “Number of installations (in thousands).”

Choices A, B, and D are incorrect and may result from errors when setting up and calculating the units for the  $y$ -axis.

### QUESTION 8.

**Choice D is correct.** If the value of  $|n - 1| + 1$  is equal to 0, then  $|n - 1| + 1 = 0$ . Subtracting 1 from both sides of this equation gives  $|n - 1| = -1$ . The expression  $|n - 1|$  on the left side of the equation is the absolute value of  $n - 1$ , and the absolute value can never be a negative number. Thus  $|n - 1| = -1$  has no solution. Therefore, there are no values for  $n$  for which the value of  $|n - 1| + 1$  is equal to 0.

Choice A is incorrect because  $|0 - 1| + 1 = 1 + 1 = 2$ , not 0. Choice B is incorrect because  $|1 - 1| + 1 = 0 + 1 = 1$ , not 0. Choice C is incorrect because  $|2 - 1| + 1 = 1 + 1 = 2$ , not 0.

### QUESTION 9.

**Choice A is correct.** Subtracting 1,052 from both sides of the equation  $a = 1,052 + 1.08t$  gives  $a - 1,052 = 1.08t$ . Then dividing both sides of  $a - 1,052 = 1.08t$  by 1.08 gives  $t = \frac{a - 1,052}{1.08}$ .

Choices B, C, and D are incorrect and could arise from errors in rewriting  $a = 1,052 + 1.08t$ . For example, choice B could result if 1,052 is added to the

left side of  $a = 1,052 + 1.08t$  and subtracted from the right side, and then both sides are divided by 1.08.

### QUESTION 10.

**Choice B is correct.** Substituting 1,000 for  $a$  in the equation  $a = 1,052 + 1.08t$  gives  $1,000 = 1,052 + 1.08t$ , and thus  $t = \frac{-52}{1.08} \approx -48.15$ . Of the choices given,  $-48^\circ\text{F}$  is closest to  $-48.15^\circ\text{F}$ . Since the equation  $a = 1,052 + 1.08t$  is linear, it follows that of the choices given,  $-48^\circ\text{F}$  is the air temperature when the speed of a sound wave is closest to 1,000 feet per second.

Choices A, C, and D are incorrect, and might arise from errors in calculating  $\frac{-52}{1.08}$  or in rounding the result to the nearest integer. For example, choice C could be the result of rounding  $-48.15$  to  $-49$  instead of  $-48$ .

### QUESTION 11.

**Choice A is correct.** Subtracting  $3x$  and adding 3 to both sides of  $3x - 5 \geq 4x - 3$  gives  $-2 \geq x$ . Therefore,  $x$  is a solution to  $3x - 5 \geq 4x - 3$  if and only if  $x$  is less than or equal to  $-2$  and  $x$  is NOT a solution to  $3x - 5 \geq 4x - 3$  if and only if  $x$  is greater than  $-2$ . Of the choices given, only  $-1$  is greater than  $-2$  and, therefore, cannot be a value of  $x$ .

Choices B, C, and D are incorrect because each is a value of  $x$  that is less than or equal to  $-2$  and, therefore, could be a solution to the inequality.

### QUESTION 12.

**Choice C is correct.** The average number of seeds per apple is the total number of seeds in the 12 apples divided by the number of apples, which is 12. On the graph, the horizontal axis is the number of seeds per apple and the height of each bar is the number of apples with the corresponding number of seeds. The first bar on the left indicates that 2 apples have 3 seeds each, the second bar indicates that 4 apples have 5 seeds each, the third bar indicates that 1 apple has 6 seeds, the fourth bar indicates that 2 apples have 7 seeds each, and the fifth bar indicates that 3 apples have 9 seeds each. Thus, the total number of seeds for the 12 apples is  $(2 \times 3) + (4 \times 5) + (1 \times 6) + (2 \times 7) + (3 \times 9) = 73$ , and the average number of seeds per apple is  $\frac{73}{12} = 6.08$ . Of the choices given, 6 is closest to 6.08.

Choice A is incorrect; it is the number of apples represented by the tallest bar but is not the average number of seeds for the 12 apples. Choice B is incorrect; it is the number of seeds per apple corresponding to the tallest bar, but is not the average number of seeds for the 12 apples. Choice D is incorrect; a student might choose this by correctly calculating the average number of seeds, 6.08, but incorrectly rounding up to 7.

### QUESTION 13.

**Choice C is correct.** From the table, there was a total of 310 survey respondents, and 19% of all survey respondents is equivalent to  $\frac{19}{100} \times 310 = 58.9$  respondents. Of the choices given, 59, the number of males taking geometry, is closest to 58.9 respondents.

Choices A, B, and D are incorrect because the number of males taking geometry is closer to 58.9 than the number of respondents in each of these categories.

### QUESTION 14.

**Choice C is correct.** The range of the 21 fish is  $24 - 8 = 16$  inches, and the range of the 20 fish after the 24-inch measurement is removed is  $16 - 8 = 8$  inches. The change in range, 8 inches, is much greater than the change in the mean or median.

Choice A is incorrect. Let  $m$  be the mean of the lengths, in inches, of the 21 fish. Then the sum of the lengths, in inches, of the 21 fish is  $21m$ . After the 24-inch measurement is removed, the sum of the lengths, in inches, of the remaining 20 fish is  $21m - 24$ , and the mean length, in inches, of these 20 fish is  $\frac{21m - 24}{20}$ , which is a change of  $\frac{24 - m}{20}$  inches. Since  $m$  must be between the smallest and largest measurements of the 21 fish, it follows that  $8 < m < 24$ , from which it can be seen that the change in the mean, in inches, is between  $\frac{24 - 24}{20} = 0$  and  $\frac{24 - 8}{20} = \frac{4}{5}$ , and so must be less than the change in the range, 8 inches. Choice B is incorrect because the median length of the 21 fish is the length of the 11th fish, 12 inches. After removing the 24-inch measurement, the median of the remaining 20 lengths is the average of the 10th and 11th fish, which would be unchanged at 12 inches. Choice D is incorrect because the changes in the mean, median, and range of the measurements are different.

### QUESTION 15.

**Choice A is correct.** The total cost  $C$  of renting a boat is the sum of the initial cost to rent the boat plus the product of the cost per hour and the number of hours,  $h$ , that the boat is rented. The  $C$ -intercept is the point on the  $C$ -axis where  $h$ , the number of hours the boat is rented, is 0. Therefore, the  $C$ -intercept is the initial cost of renting the boat.

Choice B is incorrect because the graph represents the cost of renting only one boat. Choice C is incorrect because the total number of hours of rental is represented by  $h$ -values, each of which corresponds to the first coordinate of a point on the graph. Choice D is incorrect because the increase in cost for each additional hour is given by the slope of the line, not by the  $C$ -intercept.

**QUESTION 16.**

**Choice C is correct.** The relationship between  $h$  and  $C$  is represented by any equation of the given line. The  $C$ -intercept of the line is 5. Since the points  $(0, 5)$  and  $(1, 8)$  lie on the line, the slope of the line is  $\frac{8-5}{1-0} = \frac{3}{1} = 3$ . Therefore, the relationship between  $h$  and  $C$  can be represented by  $C = 3h + 5$ , the slope-intercept equation of the line.

Choices A and D are incorrect because each uses the wrong values for both the slope and intercept. Choice B is incorrect; this choice would result from computing the slope by counting the number of grid lines instead of using the values represented by the axes.

**QUESTION 17.**

**Choice B is correct.** The minimum value of the function corresponds to the  $y$ -coordinate of the point on the graph that is the lowest along the vertical or  $y$ -axis. Since the grid lines are spaced 1 unit apart on each axis, the lowest point along the  $y$ -axis has coordinates  $(-3, -2)$ . Therefore, the value of  $x$  at the minimum of  $f(x)$  is  $-3$ .

Choice A is incorrect;  $-5$  is the smallest value for an  $x$ -coordinate of a point on the graph of  $f$ , not the lowest point on the graph of  $f$ . Choice C is incorrect; it is the minimum value of  $f$ , not the value of  $x$  that corresponds to the minimum of  $f$ . Choice D is incorrect; it is the value of  $x$  at the maximum value of  $f$ , not at the minimum value of  $f$ .

**QUESTION 18.**

**Choice A is correct.** Since  $(0, 0)$  is a solution to the system of inequalities, substituting 0 for  $x$  and 0 for  $y$  in the given system must result in two true inequalities. After this substitution,  $y < -x + a$  becomes  $0 < a$ , and  $y > x + b$  becomes  $0 > b$ . Hence,  $a$  is positive and  $b$  is negative. Therefore,  $a > b$ .

Choice B is incorrect because  $b > a$  cannot be true if  $b$  is negative and  $a$  is positive. Choice C is incorrect because it is possible to find an example where  $(0, 0)$  is a solution to the system, but  $|a| < |b|$ ; for example, if  $a = 6$  and  $b = -7$ . Choice D is incorrect because the equation  $a = -b$  could be true, but doesn't have to be true; for example, if  $a = 1$  and  $b = -2$ .

**QUESTION 19.**

**Choice B is correct.** To determine the number of salads sold, write and solve a system of two equations. Let  $x$  equal the number of salads sold and let  $y$  equal the number of drinks sold. Since the number of salads plus the number of drinks sold equals 209, the equation  $x + y = 209$  must hold. Since each

salad cost \$6.50, each soda cost \$2.00, and the total revenue was \$836.50, the equation  $6.50x + 2.00y = 836.50$  must also hold. The equation  $x + y = 209$  is equivalent to  $2x + 2y = 418$ , and subtracting each side of  $2x + 2y = 418$  from the respective side of  $6.50x + 2.00y = 836.50$  gives  $4.5x = 418.50$ . Therefore, the number of salads sold,  $x$ , was  $x = \frac{418.50}{4.50} = 93$ .

Choices A, C, and D are incorrect and could result from errors in writing the equations and solving the system of equations. For example, choice C could have been obtained by dividing the total revenue, \$836.50, by the total price of a salad and a soda, \$8.50, and then rounding up.

### QUESTION 20.

**Choice D is correct.** Let  $x$  be the original price of the computer, in dollars. The discounted price is 20 percent off the original price, so  $x - 0.2x = 0.8x$  is the discounted price, in dollars. The tax is 8 percent of the discounted price, so  $0.08(0.8x)$  is the tax on the purchase, in dollars. The price  $p$ , in dollars, that Alma paid the cashiers is the sum of the discounted price and the tax:  $p = 0.8x + (0.08)(0.8x)$  which can be rewritten as  $p = 1.08(0.8x)$ . Therefore, the original price,  $x$ , of the computer, in dollars, can be written as  $\frac{p}{(0.8)(1.08)}$  in terms of  $p$ .

Choices A, B, and C are incorrect; each choice either switches the roles of the original price and the amount Alma paid, or incorrectly combines the results of the discount and the tax as  $0.8 + 0.08 = 0.88$  instead of as  $(0.8)(1.08)$ .

### QUESTION 21.

**Choice C is correct.** The probability that a person from Group Y who recalled at least 1 dream was chosen from the group of all people who recalled at least 1 dream is equal to the number of people in Group Y who recalled at least 1 dream divided by the total number of people in the two groups who recalled at least 1 dream. The number of people in Group Y who recalled at least 1 dream is the sum of the 11 people in Group Y who recalled 1 to 4 dreams and the 68 people in Group Y who recalled 5 or more dreams:  $11 + 68 = 79$ . The total number of people who recalled at least 1 dream is the sum of the 79 people in Group Y who recalled at least 1 dream, the 28 people in Group X who recalled 1 to 4 dreams, and the 57 people in Group X who recalled 5 or more dreams:  $79 + 28 + 57 = 164$ . Therefore, the probability is  $\frac{79}{164}$ .

Choice A is incorrect; it is the number of people in Group Y who recalled 5 or more dreams divided by the total number of people in Group Y. Choice B is incorrect; it uses the total number of people in Group Y as the denominator of the probability. Choice D is incorrect; it is the total number of people in the two groups who recalled at least 1 dream divided by the total number of people in the two groups.

**QUESTION 22.**

**Choice B is correct.** The average rate of change in the annual budget for agriculture/natural resources from 2008 to 2010 is the total change from 2008 to 2010 divided by the number of years, which is 2. The total change in the annual budget for agriculture/natural resources from 2008 to 2010 is  $488,106 - 358,708 = 129,398$ , in thousands of dollars, so the average change in the annual budget for agriculture/natural resources from 2008 to 2010 is  $\frac{\$129,398,000}{2} = \$64,699,000$  per year. Of the options given, this average rate of change is closest to \$65,000,000 per year.

Choices A and C are incorrect; they could result from errors in setting up or calculating the average rate of change. Choice D is incorrect; \$130,000,000 is the approximate total change from 2008 to 2010, not the average change from 2008 to 2010.

**QUESTION 23.**

**Choice B is correct.** The human resources budget in 2007 was 4,051,050 thousand dollars, and the human resources budget in 2010 was 5,921,379 thousand dollars. Therefore, the ratio of the 2007 budget to the 2010 budget is slightly greater than  $\frac{4}{6} = \frac{2}{3}$ . Similar estimates for agriculture/natural resources give a ratio of the 2007 budget to the 2010 budget of slightly greater than  $\frac{3}{4}$ ; for education, a ratio of slightly greater than  $\frac{2}{3}$ ; for highways and transportation, a ratio of slightly less than  $\frac{5}{6}$ ; and for public safety, a ratio of slightly greater than  $\frac{5}{9}$ . Therefore, of the given choices, education's ratio of the 2007 budget to the 2010 budget is closest to that of human resources.

Choices A, C, and D are incorrect because the 2007 budget to 2010 budget ratio for each of these programs in these choices is further from the corresponding ratio for human resources than the ratio for education.

**QUESTION 24.**

**Choice A is correct.** The equation of a circle can be written as  $(x - h)^2 + (y - k)^2 = r^2$  where  $(h, k)$  are the coordinates of the center of the circle and  $r$  is the radius of the circle. Since the coordinates of the center of the circle are  $(0, 4)$ , the equation is  $x^2 + (y - 4)^2 = r^2$ , where  $r$  is the radius. The radius of the circle is the distance from the center,  $(0, 4)$ , to the given endpoint of a radius,  $(\frac{4}{3}, 5)$ . By the distance formula,  $r^2 = \left(\frac{4}{3} - 0\right)^2 + (5 - 4)^2 = \frac{25}{9}$ . Therefore, an equation of the given circle is  $x^2 + (y - 4)^2 = \frac{25}{9}$ .

Choice B is incorrect; it results from the incorrect equation  $(x + h)^2 + (y + k)^2 = r^2$ . Choice C is incorrect; it results from using  $r$  instead of  $r^2$  in the equation for the circle. Choice D is incorrect; it results from using the incorrect equation  $(x + h)^2 + (y + k)^2 = \frac{1}{r}$ .



**QUESTION 25.**

**Choice D is correct.** When the ball hits the ground, its height is 0 meters. Substituting 0 for  $h$  in  $h = -4.9t^2 + 25t$  gives  $0 = -4.9t^2 + 25t$ , which can be rewritten as  $0 = t(-4.9t + 25)$ . Thus, the possible values of  $t$  are  $t = 0$  and  $t = \frac{25}{4.9} \approx 5.1$ . The time  $t = 0$  seconds corresponds to the time the ball is launched from the ground, and the time  $t \approx 5.1$  seconds corresponds to the time after launch that the ball hits the ground. Of the given choices, 5.0 seconds is closest to 5.1 seconds, so the ball returns to the ground approximately 5.0 seconds after it is launched.

Choice A, B, and C are incorrect and could arise from conceptual or computation errors while solving  $0 = -4.9t^2 + 25t$  for  $t$ .

**QUESTION 26.**

**Choice B is correct.** Let  $x$  represent the number of pears produced by the Type B trees. Then the Type A trees produce 20 percent more pears than  $x$ , which is  $x + 0.20x = 1.20x$  pears. Since Type A trees produce 144 pears, the equation  $1.20x = 144$  holds. Thus  $x = \frac{144}{1.20} = 120$ . Therefore, the Type B trees produced 120 pears.

Choice A is incorrect because while 144 is reduced by approximately 20 percent, increasing 115 by 20 percent gives 138, not 144. Choice C is incorrect; it results from subtracting 20 from the number of pears produced by the Type A trees. Choice D is incorrect; it results from adding 20 percent of the number of pears produced by Type A trees to the number of pears produced by Type A trees.

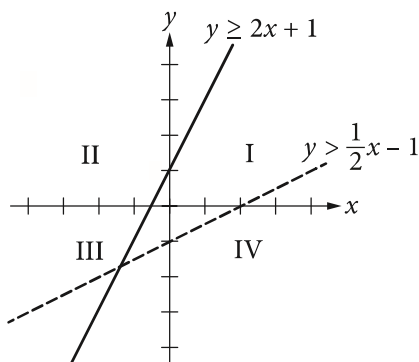
**QUESTION 27.**

**Choice C is correct.** The area of the field is 100 square meters. Each 1-meter-by-1-meter square has an area of 1 square meter. Thus, on average, the earthworm counts to a depth of 5 centimeters for each of the regions investigated by the students should be about  $\frac{1}{100}$  of the total number of earthworms to a depth of 5 centimeters in the entire field. Since the counts for the smaller regions are from 107 to 176, the estimate for the entire field should be between 10,700 and 17,600. Therefore, of the given choices, 15,000 is a reasonable estimate for the number of earthworms to a depth of 5 centimeters in the entire field.

Choice A is incorrect; 150 is the approximate number of earthworms in 1 square meter. Choice B is incorrect; it results from using 10 square meters as the area of the field. Choice D is incorrect; it results from using 1,000 square meters as the area of the field.

### QUESTION 28.

**Choice C is correct.** To determine which quadrant does not contain any solutions to the system of inequalities, graph the inequalities. Graph the inequality  $y \geq 2x + 1$  by drawing a line through the  $y$ -intercept  $(0, 1)$  and the point  $(1, 3)$ , and graph the inequality  $y > \frac{1}{2}x - 1$  by drawing a dashed line through the  $y$ -intercept  $(0, -1)$  and the point  $(2, 0)$ , as shown in the figure below.



The solution to the system of inequalities is the intersection of the shaded regions above the graphs of both lines. It can be seen that the solutions only include points in quadrants I, II, and III and do not include any points in quadrant IV.

Choices A and B are incorrect because quadrants II and III contain solutions to the system of inequalities, as shown in the figure above. Choice D is incorrect because there are no solutions in quadrant IV.

### QUESTION 29.

**Choice D is correct.** If the polynomial  $p(x)$  is divided by  $x - 3$ , the result can be written as  $\frac{p(x)}{x - 3} = q(x) + \frac{r}{x - 3}$ , where  $q(x)$  is a polynomial and  $r$  is the remainder. Since  $x - 3$  is a degree 1 polynomial, the remainder is a real number. Hence,  $p(x)$  can be written as  $p(x) = (x - 3)q(x) + r$ , where  $r$  is a real number. It is given that  $p(3) = -2$  so it must be true that  $-2 = p(3) = (3 - 3)q(3) + r = (0)q(3) + r = r$ . Therefore, the remainder when  $p(x)$  is divided by  $x - 3$  is  $-2$ .

Choice A is incorrect because  $p(3) = -2$  does not imply that  $p(5) = 0$ . Choices B and C are incorrect because the remainder  $-2$  or its negative,  $2$ , need not be a root of  $p(x)$ .

### QUESTION 30.

**Choice D is correct.** Any quadratic function  $q$  can be written in the form  $q(x) = a(x - h)^2 + k$ , where  $a$ ,  $h$ , and  $k$  are constants and  $(h, k)$  is the vertex of the parabola when  $q$  is graphed in the coordinate plane. (Depending on the

sign of  $a$ , the constant  $k$  must be the minimum or maximum value of  $q$ , and  $h$  is the value of  $x$  for which  $a(x - h)^2 = 0$  and  $q(x)$  has value  $k$ .) This form can be reached by completing the square in the expression that defines  $q$ . The given equation is  $y = x^2 - 2x - 15$ , and since the coefficient of  $x$  is  $-2$ , the equation can be written in terms of  $(x - 1)^2 = x^2 - 2x + 1$  as follows:  $y = x^2 - 2x - 15 = (x^2 - 2x + 1) - 16 = (x - 1)^2 - 16$ . From this form of the equation, the coefficients of the vertex can be read as  $(1, -16)$

Choices A and C are incorrect because the coordinates of the vertex A do not appear as constants in these equations. Choice B is incorrect because it is not equivalent to the given equation.

### QUESTION 31.

**The correct answer is any number between 4 and 6, inclusive.** Since Wyatt can husk at least 12 dozen ears of corn per hour, it will take him no more than  $\frac{72}{12} = 6$  hours to husk 72 dozen ears of corn. On the other hand, since Wyatt can husk at most 18 dozen ears of corn per hour, it will take him at least  $\frac{72}{18} = 4$  hours to husk 72 dozen ears of corn. Therefore, the possible times it could take Wyatt to husk 72 dozen ears of corn are 4 hours to 6 hours, inclusive. Any number between 4 and 6, inclusive, can be gridded as the correct answer.

### QUESTION 32.

**The correct answer is 107.** Since the weight of the empty truck and its driver is 4500 pounds and each box weighs 14 pounds, the weight, in pounds, of the delivery truck, its driver, and  $x$  boxes is  $4500 + 14x$ . This weight is below the bridge's posted weight limit of 6000 pounds if  $4500 + 14x < 6000$ . That inequality is equivalent to  $14x \leq 1500$  or  $x < \frac{1500}{14} = 107\frac{1}{7}$ . Since the number of packages must be an integer, the maximum possible value for  $x$  that will keep the combined weight of the truck, its driver, and the  $x$  identical boxes below the bridge's posted weight limit is 107.

### QUESTION 33.

**The correct answer is  $\frac{5}{8}$  or .625.** Based on the line graph, the number of portable media players sold in 2008 was 100 million, and the number of portable media players sold in 2011 was 160 million. Therefore, the number of portable media players sold in 2008 is  $\frac{100 \text{ million}}{160 \text{ million}}$  of the portable media players sold in 2011. This fraction reduces to  $\frac{5}{8}$ . Either  $\frac{5}{8}$  or its decimal equivalent, .625, may be gridded as the correct answer.

### QUESTION 34.

**The correct answer is 96.** Since each day has a total of 24 hours of time slots available for the station to sell, there is a total of 48 hours of time slots

available to sell on Tuesday and Wednesday. Each time slot is a 30-minute interval, which is equal to a  $\frac{1}{2}$ -hour interval. Therefore, there are a total of  $\frac{48 \text{ hours}}{\frac{1}{2} \text{ hours/time slot}} = 96$  time slots of 30 minutes for the station to sell on

Tuesday and Wednesday.

### QUESTION 35.

**The correct answer is 6.** The volume of a cylinder is  $\pi r^2 h$ , where  $r$  is the radius of the base of the cylinder and  $h$  is the height of the cylinder. Since the storage silo is a cylinder with volume  $72\pi$  cubic yards and height 8 yards, it is true that  $72\pi = \pi r^2(8)$ , where  $r$  is the radius of the base of the cylinder, in yards. Dividing both sides of  $72\pi = \pi r^2(8)$  by  $8\pi$  gives  $r^2 = 9$ , and so the radius of base of the cylinder is 3 yards. Therefore, the diameter of the base of the cylinder is 6 yards.

### QUESTION 36.

**The correct answer is 3.** The function  $h(x)$  is undefined when the denominator of  $\frac{1}{(x-5)^2 + 4(x-5) + 4}$  is equal to zero. The expression  $(x-5)^2 + 4(x-5) + 4$  is a perfect square:  $(x-5)^2 + 4(x-5) + 4 = ((x-5) + 2)^2$ , which can be rewritten as  $(x-3)^2$ . The expression  $(x-3)^2$  is equal to zero if and only if  $x = 3$ . Therefore, the value of  $x$  for which  $h(x)$  is undefined is 3.

### QUESTION 37.

**The correct answer is 1.02.** The initial deposit earns 2 percent interest compounded annually. Thus at the end of 1 year, the new value of the account is the initial deposit of \$100 plus 2 percent of the initial deposit:  $\$100 + \frac{2}{100}(\$100) = \$100(1.02)$ . Since the interest is compounded annually, the value at the end of each succeeding year is the sum of the previous year's value plus 2 percent of the previous year's value. This is again equivalent to multiplying the previous year's value by 1.02. Thus, after 2 years, the value will be  $\$100(1.02)(1.02) = \$100(1.02)^2$ ; after 3 years, the value will be  $\$100(1.02)^3$ ; and after  $t$  years, the value will be  $\$100(1.02)^t$ . Therefore, in the formula for the value for Jessica's account after  $t$  years,  $\$100(x)^t$ , the value of  $x$  must be 1.02.

### QUESTION 38.

**The correct answer is 6.11.** Jessica made an initial deposit of \$100 into her account. The interest on her account is 2 percent compounded annually, so after 10 years, the value of her initial deposit has been multiplied 10 times by the factor  $1 + 0.02 = 1.02$ . Hence, after 10 years, Jessica's deposit is worth  $\$100(1.02)^{10} = \$121.899$  to the nearest tenth of a cent. Tyshaun made an initial deposit of \$100 into his account. The interest on his account is 2.5 percent compounded annually, so after 10 years, the value of his initial deposit

has been multiplied 10 times by the factor  $1 + 0.025 = 1.025$ . Hence, after 10 years, Tyshaun's deposit is worth  $\$100(1.025)^{10} = \$128.008$  to the nearest tenth of a cent. Hence, Jessica's initial deposit earned  $\$21.899$  and Tyshaun's initial deposit earned  $\$28.008$ . Therefore, to the nearest cent, Tyshaun's initial deposit earned  $\$6.11$  more than Jessica's initial deposit.