

Math: Question 1

Abigail can read 200 words in one minute. If she were to read at this rate for 30 minutes each day, how many days would Abigail take to read 30,000 words of a book?

- A. 4
- B. 5
- C. 6
- D. 7

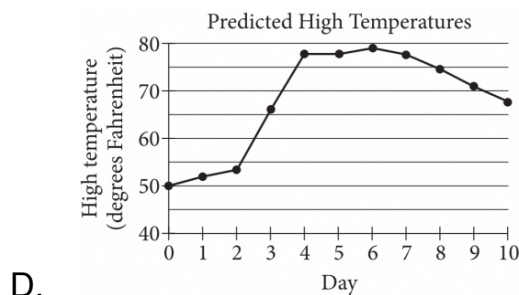
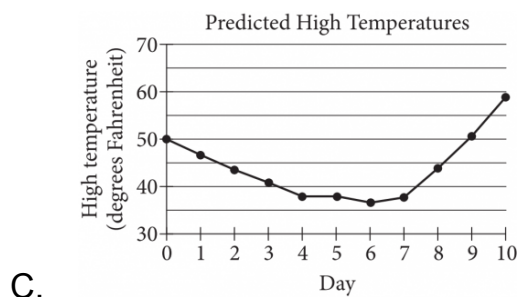
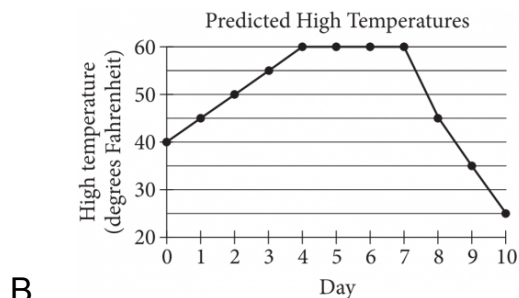
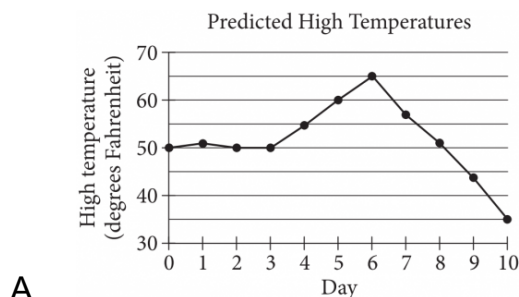
Choice B is correct. Abigail can read 200 words in one minute. If she were to read at this rate for 30 minutes each day, in 1 day she would read $(200)(30) = 6,000$ words. Therefore, at this rate she can read 30,000 words of a book in $\frac{30,000}{6,000} = 5$ days.

Choice A is incorrect. At the rate described, in 4 days Abigail would read $(200)(30)(4) = 24,000$ words. Choice C is incorrect. At the rate described, in 6 days Abigail would read $(200)(30)(6) = 36,000$ words. Choice D is incorrect. At the rate described, in 7 days Abigail would read $(200)(30)(7) = 42,000$ words.

Question Difficulty: Easy

Math: Question 2

A meteorologist predicted the high temperatures, in degrees Fahrenheit, for the next 10 days. The meteorologist predicted that the high temperatures will increase at a constant rate from today's high temperature for 4 days, remain about the same for the following 3 days, and then decrease rapidly for the final 3 days. Which graph best represents this trend in the high temperatures for the next 10 days, where today is Day 0 ?



Choice B is correct. The graph shows the predicted high temperature increasing at a constant rate of 5°F per day, from 40°F on Day 0 to 60°F on Day 4. For the next 3 days, from Day 4 to Day 7, the predicted high temperature remains unchanged at 60°F . For the final 3 days, the graph shows the predicted high temperature decreasing rapidly from 60°F on Day 7 to 25°F on Day 10. This represents the trend in the high temperatures, in degrees Fahrenheit, for the 10-day period predicted by the meteorologist.

Choices A, C, and D are incorrect. The predicted high temperatures shown in these graphs do

not correspond to the trend predicted by the meteorologist. For example, the graphs given in choices A, C, and D do not show the predicted high temperature increasing at a constant rate from Day 0 to Day 4.

Question Difficulty: Easy

Math: Question 3

A journalist earns \$50 for an article that appears in an online publication, plus \$0.08 per word in the article. If the journalist earned a total of \$70 for the article, how many words were in the article?

- A. 250
- B. 625
- C. 875
- D. 925

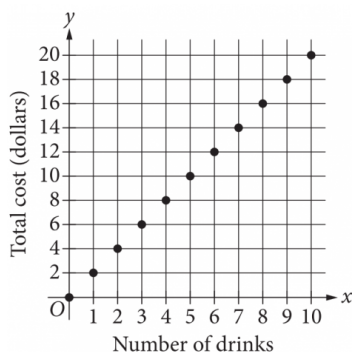
Choice A is correct. For an article that appears in the publication, the journalist earns \$50 plus \$0.08 per word in the article. Therefore, for an article that has x words, the journalist will earn $0.08x + 50$ dollars. If the journalist earned a total of \$70 for an article, it follows that $70 = 0.08x + 50$. Solving for x by first subtracting 50 from both sides of the equation and then dividing both sides of the equation by 0.08 yields $x = 250$. Therefore, there were 250 words in the article.

Choice B is incorrect and results from solving the equation $50 = 0.08x$, where x is the number of words in the article. However, this equation represents a situation where the journalist earned \$0.08 per word for a total of \$50. Choice C is incorrect and results from solving the equation $70 = 0.08x$, where x is the number of words in the article. However, this equation does not account for the \$50 the journalist earned for the article in addition to the \$0.08 per word in the article. Choice D is incorrect and results from errors made when representing the situation algebraically or solving the equation for the variable that represents the number of words in the article.

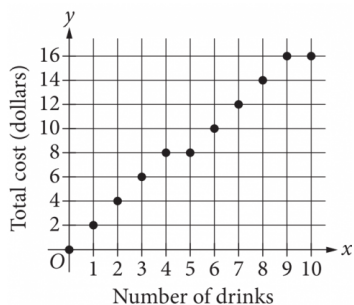
Question Difficulty: Easy

Math: Question 4

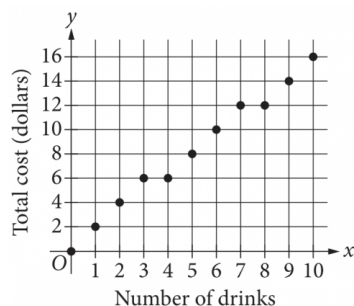
A coffee shop has a customer loyalty program. For every 4 drinks a customer orders for \$2 each, the next drink the customer orders is free. Which of the following graphs represents the relationship between x , the number of drinks a customer orders, and y , the total cost, in dollars, of the drinks, for $x \leq 10$?



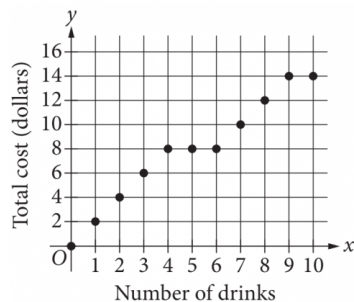
A.



B.



C.



D.

Choice B is correct. For every 4 drinks a customer orders for \$2, the next drink is free. Therefore, when the number of drinks ordered is between 0 and 4, the total cost, in dollars, increases at a constant rate of \$2 per drink, as this graph shows. The total cost of 5 drinks is the same as the total cost of 4 drinks because the fifth drink ordered is free. This trend repeats for the next 5 drinks ordered and so on.

Choice A is incorrect. This graph represents a situation where each drink ordered is \$2 and no drinks are free. Choice C is incorrect. This graph represents a situation where for every 3 drinks a customer orders for \$2, the next drink is free. Choice D is incorrect. This graph represents a situation where a customer orders 4 drinks for \$2 each and the next 2 drinks are free; then the customer orders 3 more drinks for \$2 each and the next drink is free.

Question Difficulty: Medium

Math: Question 5

$$\frac{5}{9}(d - 12) = 10$$

A linear equation is shown above. Which of the following values of d is a solution to the equation?

- A. 16
- B. 18
- C. 30
- D. The equation has no solution.

Choice C is correct. The value of d can be found by first multiplying both sides of the equation by 9. This yields $5(d - 12) = 90$. Dividing both sides of the equation by 5 further yields $d - 12 = 18$. Finally, adding 12 to both sides of the equation gives the solution $d = 30$.

Choice A is incorrect. Substituting 6 for d in the equation yields $\frac{5}{9}(6 - 12) = 10$, or

$-3\frac{1}{3} = 10$, which is not true. Choice B is incorrect. Substituting 18 for d in the equation yields

$\frac{5}{9}(18 - 12) = 10$, or $3\frac{1}{3} = 10$, which is not true. Choice D is incorrect. Every linear equation

in one variable can be rewritten in the form $ax = b$, where a and b are constants. An equation in this form has no solution only when $a = 0$ and $b \neq 0$. The given equation can be rewritten as $5d = 150$. Therefore, the equation has a solution.

Question Difficulty: Medium

Math: Question 6

Which of the following situations exhibits exponential growth over time?

- A.
The amount of money in a retirement account that is decreasing in value by 4% each year
- B.
The salary of an employee who receives a \$2,000 increase in salary at the end of each year
- C.
The amount of rent for an apartment when the landlord raises the rent by \$125 every 12 months
- D.
The amount of money in a savings account that earns 1% annual interest compounded monthly

Choice D is correct. When a quantity grows exponentially over time, the amount added is proportional to the amount already present. As the quantity gets larger, the amount of increase gets proportionally larger. For example, when the amount of money in a savings account grows by 1% annual interest that is compounded monthly, each month $\left(\frac{1}{12}\right)\%$ of the amount in the account is added to the account. Each subsequent month the amount added is larger, since the total amount in the account grows each month and the amount added is proportional to the amount already present.

Choices A, B, and C are incorrect because none of these situations exhibits exponential growth over time. The situation in choice A describes an amount that is decreasing exponentially over time. For the situations described in choices B and C, the amount added is fixed and not proportional to the amount already present. Therefore, these situations do not exhibit exponential growth.

Question Difficulty: Medium

Math: Question 7

At a factory, there were 60 defective items produced in 2012. From 2012 to 2013, this number decreased by 10 percent. How many defective items were produced at the factory in 2013 ?

- A. 50
- B. 54
- C. 55
- D. 66

Choice B is correct. The number of defective items produced at the factory decreased by 10% from 2012 to 2013. This means that the number of defective items produced at the factory in 2013 was 90% of the number of defective items produced at the factory in 2012. Since 60 defective items were produced in 2012, the number of defective items produced in 2013 was $(0.90)(60)$, or 54.

Choice A is incorrect and may result from decreasing the number of defective items produced at the factory in 2012 by 10 items. However, in the given situation, a decrease by 10% is not equivalent to a decrease by 10 items. Choice C is incorrect and may result from thinking that the number of defective items in 2012 was a 10% increase from the number of defective items in 2013. Choice D is incorrect and may result from increasing the number of defective items produced at the factory in 2012 by 10%.

Question Difficulty: Medium

Math: Question 8

Record Monthly Temperatures for
New York City, in Degrees Fahrenheit

Month	Record low (°F)	Record high (°F)
January	-6	72
February	-15	75
March	3	86
April	12	96
May	28	99
June	44	101
July	52	106
August	50	104
September	39	102
October	28	94
November	7	84
December	-13	75

The table above gives the record-low and record-high monthly temperatures for New York City.

To the nearest percent, what percent of the record-high monthly temperatures in New York City were at least 100 degrees Fahrenheit?

- A. 4%
- B. 17%
- C. 25%
- D. 33%

Choice D is correct. According to the table, the record-high temperature in New York City (NYC) was at least 100°F in 4 of 12 months, June, July, August, and September. That is $\frac{1}{3}$, or

$33\frac{1}{3}\%$, of all the record-high monthly temperatures shown. Therefore, to the nearest percent,

33% of the record-high monthly temperatures in NYC were at least 100°F.

Choice A is incorrect. The record-high temperatures in NYC reached at least 100°F in 4 months, which is not 4% of that 12-month period. Choice B is incorrect because 17% of the 12-month period would be 2 months of record-high temperatures that were at least 100°F, not 4 months. Choice C is incorrect because 25% of the 12-month period would be 3 months of record-high temperatures that were at least 100°F, not 4 months.

Question Difficulty: Medium

Math: Question 9

Record Monthly Temperatures for
New York City, in Degrees Fahrenheit

Month	Record low (°F)	Record high (°F)
January	-6	72
February	-15	75
March	3	86
April	12	96
May	28	99
June	44	101
July	52	106
August	50	104
September	39	102
October	28	94
November	7	84
December	-13	75

The table above gives the record-low and record-high monthly temperatures for New York City.

What is the median of the record-low monthly temperatures for New York City for November, December, January, February, and March?

- A. -15°F
- B. -6°F
- C. 3°F
- D. 39°F

Choice B is correct. The median of a data set is the middle value when the data are sorted in order and there is an odd number of data. The record-low temperatures for NYC for November, December, January, February, and March, ordered from least to greatest, are -15°F , -13°F , -6°F , 3°F , and 7°F . The middle value of the 5 ordered temperatures is -6°F .

Choice A is incorrect. The temperature of -15°F is the lowest, not the median, of the record-low temperatures for NYC. Choices C and D are incorrect and may result from misunderstanding the median of a data set.

Question Difficulty: Easy

Math: Question 10

A company surveyed 73 employees selected at random to determine if they opposed additional security at the office entrance. The survey showed that 64 were opposed to the additional security. Based on the results of the survey, how many of the 657 employees who work in the office would be estimated to not be opposed to the additional security?

- A. 244
- B. 178
- C. 81
- D. 75

Choice C is correct. It is given that 64 of the 73 employees selected at random were opposed to additional security. So the remaining 9 employees of those surveyed were not opposed to additional security. Since the 73 employees were selected at random from all the employees who work in the office, the proportion of all 657 employees who are not opposed to additional security is expected to be the same as the proportion of those 73 employees surveyed who were not opposed to additional security. So if x is the estimated number of employees who work in the office and are expected to not be opposed to additional security, then $\frac{x}{657} = \frac{9}{73}$.

Solving this proportion for x gives $x = \frac{657 \times 9}{73}$, or $x = 81$.

Choices A, B, and D are incorrect and may be the result of calculation errors or incorrect setup of the proportion.

Question Difficulty: Medium

Math: Question 11

A farmer will plant 120 acres of land, some with corn and some with soybeans. This year, corn is estimated to yield 158.8 bushels per acre planted and soybeans are estimated to yield 43.3 bushels per acre planted. The farmer expects to harvest 12,126 bushels of corn and soybeans. Which of the following systems of equations describes this situation, where C is the number of acres of corn planted and S is the number of acres of soybeans planted?

A.
$$\begin{cases} C + S = 120 \\ 158.8C + 43.3S = 12,126 \end{cases}$$

B.
$$\begin{cases} C + S = 12,126 \\ 158.8C + 43.3S = 120 \end{cases}$$

C.
$$\begin{cases} 60C = 158.8 \\ 60S = 43.3 \end{cases}$$

D.
$$\begin{cases} C + S = 120 \\ 60C + 60S = 12,126 \end{cases}$$

Choice A is correct. The farmer will plant C acres with corn and S acres with soybeans. Since he will plant a total of 120 acres, $C + S = 120$. Corn is estimated to yield 158.8 bushels per acre planted, and soybeans are estimated to yield 43.3 bushels per acre planted. So the expression $158.8C + 43.3S$ gives the estimated number of bushels of corn and soybeans expected to be harvested from the 120 acres of land. Since the farmer expects to harvest 12,126 bushels of corn and soybeans, it follows that $158.8C + 43.3S = 12,126$.

Choice B is incorrect. The total number of acres planted and the total number of bushels expected to be harvested in this system of equations are transposed. Choice C is incorrect and may result from an incorrect interpretation of the bushels per acre harvested. Choice D is incorrect. The second equation of the system incorrectly assumes that the numbers of bushels harvested per acre planted are the same for both corn and soybeans.

Question Difficulty: Medium

Math: Question 12

Marco randomly sampled 100 students from his high school to determine whether they were in favor of a new school dress code. Of the 100 students surveyed, 65% were not in favor of the policy, 28% were in favor of the policy, and the rest did not respond. Marco estimated that 210 students in the school were in favor of the new dress code. What additional information did Marco need to reach this conclusion?

- A. The number of teachers in the high school
- B. The number of students in the high school
- C. The ages of the 100 students in his sample
- D. The number of students who did not respond

Choice B is correct. To estimate the number of students in the school who were in favor of the new dress code, Marco used the data from the survey. Since students surveyed were randomly sampled, it can be assumed that the proportion of students who were in favor of the new dress code in the school is the same as the proportion of students who were in favor of the new dress code in the sample of students surveyed. Therefore, Marco needed the number of students in the high school to estimate that 210 students in the school were in favor of the new dress code.

Choices A, C, and D are incorrect because the information in each of these choices does not help to estimate the number of students in the school who were in favor of the new dress code.

Question Difficulty: Medium

Math: Question 13

A certain county has a population of 83,952 residents and a land area of 954 square miles. A demographer determines that there is one housing unit for every 2.75 residents of the county. On average, how many housing units per square mile does the county have?

- A. 32
- B. 88
- C. 242
- D. 347

Choice A is correct. Since the county has a population of 83,952 residents and there is one housing unit for every 2.75 residents in the county, there are a total of $\frac{83,952}{2.75} = 30,528$

housing units in the county. It is given that the county has a land area of 954 square miles. It follows that the county has, on average, $\frac{30,528}{954} = 32$ housing units per square mile.

Choice B is incorrect. It gives the average number of residents, not housing units, per square mile $\left(\frac{83,952}{954} = 88\right)$. Choices C and D are incorrect and may be the result of errors when calculating the number of housing units per square mile in the county.

Question Difficulty: Medium

Math: Question 14

A concert hall representative surveyed a group of audience members selected at random to determine which type of musical performances they would like to see at the concert hall. The table below displays the results of the survey summarized by age group. Each respondent chose exactly one type of musical performance.

		Age		
		21 to 30	31 to 40	Over 40
Type of music performance	Blues	12	8	10
	Classical	7	9	11
	Jazz	7	6	8
	Rock	9	9	12
	Total	35	32	41

Of all the respondents who would like to see a blues or jazz music performance at the concert hall, what percentage, rounded to the nearest percent, were over 40 years old?

- A. 44%
- B. 35%
- C. 21%
- D. 17%

Choice B is correct. According to the table, a total of 51 respondents would like to see a blues or jazz music performance. Of those respondents, 18 are over 40 years old. Since

$\frac{18}{51} \approx 0.3529$, about 35% of the respondents who would like to see a blues or jazz music performance were over 40 years old.

Choice A is incorrect. According to the table, 18 out of 41 respondents over 40 years old, which is about 44%, would like to see a blues or jazz music performance. However, that is not the same as the percentage of respondents over 40 years old among all the respondents who would like to see a blues or jazz music performance. Choice C is incorrect and may be the result of calculation errors. Choice D is incorrect. It gives the approximate percent of all respondents who are over 40 and who would like to attend a blues or jazz music performance at the concert hall.

Question Difficulty: Medium

Math: Question 15

In the expression below, a is an integer.

$$x^2 - 3x + a$$

For which of the following values of a could this trinomial be rewritten in the form $(x + b)(x + c)$, where b and c are integers?

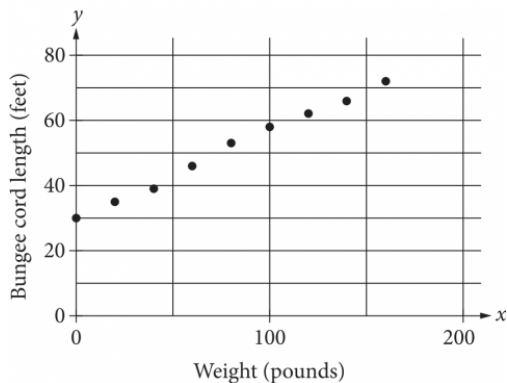
- A. -9
- B. -6
- C. 2
- D. 10

Choice C is correct. If the trinomial $x^2 - 3x + a$ can be rewritten in the form $(x + b)(x + c)$, then $b + c = -3$ and $bc = a$. Of the choices given, only for $a = 2$ are there two factors of a , namely -1 and -2 , whose sum is -3 and whose product is 2 .

Choices A, B, and D are incorrect. For each of these choices there are no two integers whose sum equals -3 and whose product is equal to the respective choice.

Question Difficulty: Medium

Math: Question 16



The scatterplot above shows the length y , in feet, of a bungee cord when a weight of x pounds is attached to it. Which of the following best approximates an equation for the line of best fit for the data?

- A. $y = 30x + 4$
- B. $y = 4x + 30$
- C. $y = 4x$
- D. $y = \frac{1}{4}x + 30$

Choice D is correct. The data in the scatterplot show a linear trend. Furthermore, it appears that the y -intercept of the line of best fit is approximately 30. The slope of the line of best fit can be estimated by using the points in the scatterplot with approximate coordinates $(0, 30)$ and $(100, 55)$. The slope is the difference of the y -values divided by the difference of the x -values, or $\frac{30 - 55}{0 - 100}$. Simplifying this ratio gives that the slope is $\frac{1}{4}$. Therefore, of the choices given,

$y = \frac{1}{4}x + 30$ best approximates an equation of the line of best fit.

Choice A is incorrect because 30 is the approximate y -intercept of the line of best fit, not the slope of the line. Choices B and C are incorrect because 4 is the reciprocal of the slope of the line of best fit.

Question Difficulty: Medium

Math: Question 17

The relationship between the density, D , in grams per cubic centimeter (g/cm^3) of liquid mercury and the temperature, T , of the liquid, in degrees Celsius, is modeled by the equation $D = 13.628 - 0.002T$.

If the equation above is graphed on a coordinate plane with T on the horizontal axis and D on the vertical axis, what is the slope of the line?

- A. -13.628
- B. 13.628
- C. -0.002
- D. 0.002

Choice C is correct. An equation graphed in the coordinate plane with T on the horizontal axis and D on the vertical axis can be written in slope-intercept form as $D = mT + b$, where m and b are constants, m is the slope of the line, and b is the D -coordinate of the D -intercept of the line. The given equation is $D = 13.628 - 0.002T$, which can be rewritten in slope-intercept form as $D = -0.002T + 13.628$. Since m is the slope of the line, the slope of the line is -0.002 .

Choice A is incorrect because -13.628 is the negative of the D -intercept of the line, not the slope. Choice B is incorrect because 13.628 is the D -intercept of the line, not the slope. Choice D is incorrect because 0.002 is the negative of the slope of the line.

Question Difficulty: Medium

Math: Question 18

The relationship between the density, D , in grams per cubic centimeter (g/cm^3) of liquid mercury and the temperature, T , of the liquid, in degrees Celsius, is modeled by the equation $D = 13.628 - 0.002T$.

Which of the following could be a correct interpretation of 13.628 in the context of the model?

- A. The average density of liquid mercury in g/cm^3
- B. The density, in g/cm^3 , of a sample of liquid mercury at temperature 0 degrees Celsius
- C. The temperature, in degrees Celsius, of a sample of liquid mercury with density 0
- D. The rate of change of the density of liquid mercury with respect to temperature in degrees Celsius

Choice B is correct. When the temperature is 0 degrees Celsius, the density is $D = 13.628 - 0.002(0) = 13.628$. Therefore, 13.628 represents the density, in g/cm^3 , of liquid mercury when the temperature is 0 degrees Celsius.

Choice A is incorrect and may be the result of not understanding the information the equation gives about the context. Choice C is incorrect and is the result of switching the meaning of the D-values and T-values. Choice D is incorrect and is the interpretation of the value -0.002 in the context of the model.

Question Difficulty: Hard

Math: Question 19

$$T = 3(ak - 1) + 4$$

In the equation above, which of the following is equivalent to ak ?

- A. $\frac{T-1}{3}$
- B. $T-3$
- C. $\frac{T+1}{3}$
- D. $\frac{T+7}{3}$

Choice A is correct. To solve for ak , first distribute 3 over the binomial $ak - 1$, which gives $T = 3ak - 3 + 4$. Combining like terms gives $T = 3ak + 1$. Subtracting 1 from each side of the equation gives $T - 1 = 3ak$. Dividing each side of this equation by 3 gives $ak = \frac{T - 1}{3}$.

Choice B is incorrect and may be the result of not applying the distributive property correctly, adding -1 to 4 to get 3 and then subtracting 3 from both sides of the equation. Choice C is incorrect and may be the result of finding $3 - 4$ rather than $-3 + 4$ after applying the distributive property on the right-hand side of the equation. Choice D is incorrect and may be the result of adding $3 + 4$ rather than $-3 + 4$ after applying the distributive property on the right-hand side of the equation.

Question Difficulty: Medium

Math: Question 20

A student has an average (arithmetic mean) score of 88 for the first 3 tests in a class. What is the lowest score that the student can earn on the fourth test to have an average score of at least 90 for the 4 tests?

- A. 92
- B. 93
- C. 94
- D. 96

Choice D is correct. The average score on the 4 tests would be equal to the sum of the scores on the 4 tests divided by 4. Since the student has an average score of 88 on 3 tests, the sum of the student's scores on the 3 tests is 88×3 , or 264. Therefore, the inequality $\frac{264 + x}{4} \geq 90$,

where x is the score on the fourth test, can be used to determine the score needed on the fourth test to have an average score of at least 90 for all 4 tests. To solve for x , multiply each side of the inequality by 4, which yields $264 + x \geq 360$. Subtracting 264 from each side of the inequality yields $x \geq 96$. Therefore, the student needs to earn a score of at least 96 on the fourth test.

Choice A is incorrect and may be the result of mistakenly thinking that because the average of 88 and 92 is 90, the average of the first three test scores and 92 must be 90. Choices B and C are incorrect and may be the result of computation errors.

Question Difficulty: Hard

Math: Question 21

A circle in the xy -plane has equation $(x - 3)^2 + (y - 4)^2 = 36$. What is the radius of the circle?

- A. 3
- B. 5
- C. 6
- D. 18

Choice C is correct. The given equation for the circle is in the standard form $(x - h)^2 + (y - k)^2 = r^2$, where h and k are constants, (h, k) is the center of the circle, r is a positive constant and the radius of the circle. In the given equation, $r^2 = 36$, so $r = \sqrt{36}$, or 6.

Choices A, B, and D are incorrect and may be the result of misunderstanding the equation of a circle.

Question Difficulty: Medium

Math: Question 22

The average annual housing costs, in dollars, for US families for the years 1990 through 2009 can be modeled by the function $f(x) = 8,673(1.038)^x$, where x represents the number of years since 1990. Based on the model, the average housing costs in 1993 were how many times as great as the average housing costs in 1992 ?

- A. 1.038
- B. $(1.038)^2$
- C. $8,673(1.038)$
- D. $8,673(1.038)^2$

Choice A is correct. Since x represents the number of years since 1990, the value of x representing the year 1993 can be found by subtracting $x = 1993 - 1990$, or $x = 3$. Similarly, the value of x representing 1992 is $x = 1992 - 1990$, or $x = 2$. To find how many times as great the average housing costs in 1993 were compared to those in 1992, evaluate the function for $x = 3$ and $x = 2$ and divide the resulting values, which gives $\frac{f(3)}{f(2)} = \frac{8,673(1.038)^3}{8,673(1.038)^2}$. Since there are

common nonzero factors in the numerator and denominator of the right-hand side of the equation, the fraction can be simplified as follows: $\frac{8,673(1.038)^3}{8,673(1.038)^2} = \frac{(1.038)^3}{(1.038)^2} = 1.038$.

Alternately, in an exponential function in the form $f(x) = a \cdot b^x$, the value of $f(x + 1) = f(x) \cdot b$. Since 1993 is one year greater than 1992, it follows that the average housing costs in 1993 are 1.038 times as great as the average housing costs in 1992 because the value of b in this function is 1.038.

Choices B, C, and D are incorrect and are the result of incorrectly simplifying the right-hand side of the equation or using incorrect values of x .

Question Difficulty: Hard

Math: Question 23

A botanist conducted a 20-year study of the growth patterns of red maple trees and silver maple trees in a nature preserve. The growth rate for a species is defined as the average number of inches taller the trees in the species grew each year. The growth factor for a species is the factor by which the diameter of a tree trunk of the species, measured in inches at 5 feet above ground level, is multiplied to determine the age of the tree.

The results of the study are given in the table below.

Growth Rate and Growth Factor for Two Tree Species		
Tree species	Growth rate (inches per year)	Growth factor (years per inch)
Red maple	0.30	4.5
Silver maple	0.49	3.0

To estimate the heights of the trees in the study, the botanist used the formula $h = gt + b$, where h is the height of a tree in inches, g is the growth rate, t is the amount of time in years since the study began, and b is the height of the tree at the beginning of the study.

At the beginning of the study, a certain silver maple tree was 82.50 inches tall and a certain red maple tree was 85.35 inches tall. Assuming the two trees grew at the average growth rate determined in the study, approximately how many years after the beginning of the study did the silver maple reach the same height as the red maple?

- A. 5
- B. 15
- C. 25
- D. The silver maple did not reach the height of the red maple during the study.

Choice B is correct. It is given that the botanist used the formula $h = gt + b$ to estimate the heights of the trees. Substituting the values of the growth rate, g , from the table and the given heights at the beginning of the study, b , into the formula gives the two equations that represent the predicted height for each type of tree, namely $h_{\text{silver}} = 0.49t + 82.50$ and $h_{\text{red}} = 0.30t + 85.35$. The number of years after the beginning of the study until the silver maple reached the same height as the red maple is found by setting the two height equations equal to each other, $0.49t + 82.50 = 0.30t + 85.35$. Subtracting $0.30t$ from each side of the equation gives $0.19t + 82.50 = 85.35$. Subtracting 82.50 from each side of the equation gives $0.19t = 2.85$. Dividing each side of the equation by 0.19 gives the solution, $t = 15$.

Choice A is incorrect and may be the result of incorrectly setting up the equations or of computation errors. Substituting the choice A value of 5 years into the equations gives the height of a silver maple as 84.95 inches and the height of a red maple as 83.85 inches; thus they are not the same height. The choice C value of 25 years is outside the time period of the 20-year study. However, substituting the choice C value of 25 years into the equations gives

the height of a silver maple as 94.75 inches and the height of a red maple as 89.85 inches; thus they are not the same height. Choice D is incorrect because the two trees did reach the same height during the 20-year study.

Question Difficulty: Hard

Math: Question 24

A botanist conducted a 20-year study of the growth patterns of red maple trees and silver maple trees in a nature preserve. The growth rate for a species is defined as the average number of inches taller the trees in the species grew each year. The growth factor for a species is the factor by which the diameter of a tree trunk of the species, measured in inches at 5 feet above ground level, is multiplied to determine the age of the tree.

The results of the study are given in the table below.

Growth Rate and Growth Factor for Two Tree Species		
Tree species	Growth rate (inches per year)	Growth factor (years per inch)
Red maple	0.30	4.5
Silver maple	0.49	3.0

To estimate the heights of the trees in the study, the botanist used the formula $h = gt + b$, where h is the height of a tree in inches, g is the growth rate, t is the amount of time in years since the study began, and b is the height of the tree at the beginning of the study.

Which formula gives the growth rate of the trees in terms of the other variables?

- A. $g = t(b - h)$
- B. $g = \frac{h}{t} - b$
- C. $g = \frac{h - b}{t}$
- D. $g = \frac{b - h}{t}$

Choice C is correct. The formula for estimating the heights of the trees in the study is given as $h = gt + b$. To solve this equation for the growth rate, g , subtract b from both sides of the equation, which gives $h - b = gt$. Dividing both sides of the equation by t gives $\frac{h - b}{t} = g$.

Choices A, B, and D are incorrect and may be the result of incorrect steps when solving for g . Choice A may be the result of subtracting h from both sides of the equation and then incorrectly simplifying. Choice B may be the result of incorrectly simplifying the equation after subtracting b and then dividing by t . Choice D may be the result of incorrectly subtracting h rather than b .

Question Difficulty: Medium

Math: Question 25

A botanist conducted a 20-year study of the growth patterns of red maple trees and silver maple trees in a nature preserve. The growth rate for a species is defined as the average number of inches taller the trees in the species grew each year. The growth factor for a species is the factor by which the diameter of a tree trunk of the species, measured in inches at 5 feet above ground level, is multiplied to determine the age of the tree.

The results of the study are given in the table below.

Growth Rate and Growth Factor for Two Tree Species		
Tree species	Growth rate (inches per year)	Growth factor (years per inch)
Red maple	0.30	4.5
Silver maple	0.49	3.0

To estimate the heights of the trees in the study, the botanist used the formula $h = gt + b$, where h is the height of a tree in inches, g is the growth rate, t is the amount of time in years since the study began, and b is the height of the tree at the beginning of the study.

Which of the following functions can be used to determine the age in years, $a(d)$, of a silver maple tree whose trunk has a diameter of d inches measured at 5 feet above ground level?

- A. $a(d) = 4.5d$
- B. $a(d) = 3d$
- C. $a(d) = 0.49d$
- D. $a(d) = 0.3d$

Choice B is correct. The growth factor for a species of tree is the factor by which the diameter of a tree trunk of the species is multiplied to determine the age of the tree. Therefore, the age is the product of the growth factor and the diameter, or $a(d) = g \cdot d$. Substituting the value for g from the table gives $a(d) = 3.0d$, or $a(d) = 3d$.

Choice A is incorrect and may be the result of using the growth factor of red maples rather than the growth factor of silver maples. Choice C is incorrect and may be the result of using the growth rate for silver maples rather than the growth factor. Choice D is incorrect and may be the result of using the growth rate for red maples rather than the growth factor for silver maples.

Question Difficulty: Hard

Math: Question 26

$$y = -x^2 + 10x - 27$$

$$y + 9 = x$$

Which of the following gives all of the ordered pairs (x, y) that satisfy the system of equations above?

- A. $(6, -3)$
- B. $(3, 6)$ and $(3, -6)$
- C. $(3, -6)$ and $(6, -3)$
- D. There is no solution to this system of equations.

Choice C is correct. One way to solve the system of equations is to first solve the second equation for y by subtracting 9 from both sides of the equation, which gives $y = x - 9$. Next, substitute $x - 9$ for y in the equation $y = -x^2 + 10x - 27$, which gives $x - 9 = -x^2 + 10x - 27$. Solve the equation for x by moving all terms to the left side of the equation and setting the equation equal to 0, which gives $x^2 - 9x + 18 = 0$. This can be factored by finding two numbers whose sum is -9 and whose product is 18. Two numbers that satisfy those conditions are -3 and -6 ; thus the equation $x^2 - 9x + 18 = 0$ can be rewritten as $(x - 3)(x - 6) = 0$. Therefore, there are two values of x that satisfy the system of equations, $x = 3$ and $x = 6$. Substituting these x -values back into the second equation yields the associated y -values and the solutions of $(3, -6)$ and $(6, -3)$.

Choices A, B, and D are incorrect and may be the result of computation or substitution errors.

Question Difficulty: Hard

Math: Question 27

On a map, Marcel measures the distance between two cities to be about $1\frac{5}{8}$ inches. The scale of the map shows that $\frac{1}{8}$ inch is equal to 25 miles. If 1 kilometer is approximately 0.6214 miles, what is the best approximation of the actual distance between the two cities, in kilometers?

- A. 65
- B. 202
- C. 325
- D. 523

Choice D is correct. On the scale of the map, $\frac{1}{8}$ inch is equal to 25 miles. Marcel measures the distance between two cities on the map to be about $1\frac{5}{8}$ inches, which is $13 \times \frac{1}{8}$ inches. This corresponds to a distance of 13×25 miles, or 325 miles. The question asks for this distance in kilometers. Since 1 kilometer is approximately 0.6214 miles, the actual distance between the two cities is y kilometers, where $\frac{y}{325} = \frac{1}{0.6214}$. Multiplying both sides of this equation by 325 gives $y = \frac{325}{0.6214}$, which is approximately equal to 523.

Choice A is incorrect and may result from applying the conversion from miles to kilometers twice to the distance of 25 miles given in the map scale. Choice B is incorrect and may result from applying the conversion from miles to kilometers in the wrong direction. Choice C is incorrect and may be the result of forgetting to convert the actual distance between the two cities from miles to kilometers.

Question Difficulty: Hard

Math: Question 28

A store manager needs to order two different products. Product X costs \$12 per unit, and Product Y costs \$9 per unit. The manager has \$115 to spend on a combination of these products. If the manager decides to buy 5 units of Product X, what is the maximum whole number of units of Product Y that the manager can buy?

The correct answer is 6. Let x be the number of units of Product X the manager will buy, and let y be the number of units of Product Y the manager will buy. Since Product X costs \$12 per unit and Product Y costs \$9 per unit, the total amount, in dollars, the manager will spend on Product X and Product Y is $12x + 9y$. Since the manager has \$115 to spend on a combination of Product X and Product Y, the total amount spent, in dollars, $12x + 9y$, must be less than or equal to 115; that is, $12x + 9y \leq 115$. If the manager decides to buy 5 units of Product X, this means $x = 5$. Substituting 5 for x in the inequality gives $12(5) + 9y \leq 115$. This can be rewritten as $60 + 9y \leq 115$. Subtracting 60 from both sides of this inequality gives $9y \leq 55$. Dividing both sides of this inequality by 9 gives $y \leq 6\frac{1}{9}$. Therefore, the maximum number of whole units of Product Y the manager can buy is 6.

Question Difficulty: Medium

Math: Question 29

$$t^2 - 7t + 12 = 0$$

What is the positive difference of the two values of t that satisfy the equation above?

Click on the answer box and type in a number. Backspace to erase.

The correct answer is 1. The values of t that satisfy $t^2 - 7t + 12 = 0$ can be found by factoring the left-hand side of the equation. To factor $t^2 - 7t + 12$, find a pair of numbers whose sum is 7 and whose product is 12; this is 3 and 4. Thus, $t^2 - 7t + 12 = 0$ can be rewritten as $(t - 3)(t - 4) = 0$, and so the values of t that satisfy the equation are 3 and 4. The positive difference of 3 and 4 is $4 - 3 = 1$.

Question Difficulty: Hard

Math: Question 30

One month prior to a local election, 150 adults were randomly selected and asked whom they were planning to vote for. The partially complete two-way table below summarizes data from the sample.

	Male	Female	Total
Candidate A	x	y	100
Candidate B			50
Total	90	60	150

If the ratio of x to y is 3:2, what is the value of x ?

The correct answer is 60. From the table, the total number of voters for Candidate A is the sum of the number of male voters and the number of female voters for Candidate A; that is, $x + y = 100$. If the ratio of x to y is 3:2, then $\frac{x}{y} = \frac{3}{2}$. Multiplying both sides of this equation by y gives

$x = \frac{3}{2}y$, and multiplying both sides of this equation by $\frac{2}{3}$ gives $\frac{2}{3}x = y$. Substituting $\frac{2}{3}x$ for y

in the equation $x + y = 100$ gives $x + \frac{2}{3}x = 100$, which can be rewritten as $\frac{5}{3}x = 100$.

Multiplying both sides of this equation by $\frac{3}{5}$ gives $x = 60$.

Question Difficulty: Hard

Math: Question 31

One month prior to a local election, 150 adults were randomly selected and asked whom they were planning to vote for. The partially complete two-way table below summarizes data from the sample.

	Male	Female	Total
Candidate A	x	y	100
Candidate B			50
Total	90	60	150

To the nearest tenth percent, what is the difference between the percent of votes for Candidate A and the percent of votes for Candidate B, based on the data in the table? (Ignore the percent sign when gridding your answer. For example, if your answer is 78.2%, then grid 78.2)

The correct answer is 33.3. There were a total of 150 votes, of which 100 votes were for Candidate A and 50 votes were for Candidate B. Thus, $\frac{100}{150} \times 100\% = 66.\overline{66}\%$ voted for

Candidate A, and $\frac{50}{150} \times 100\% = 33.\overline{33}\%$ voted for Candidate B. Therefore, to the nearest

tenth percent, the difference between the percent of votes for Candidate A and the percent of votes for Candidate B is $66.\overline{66} - 33.\overline{33} = 33.3$.

Question Difficulty: Hard