# Math

## Module 1
(27 questions)

### QUESTION 1

**Choice B** is correct. The perimeter of a triangle is the sum of the lengths of all three of its sides. It's given that the lengths of two sides of a triangle are 4 centimeters and 6 centimeters. Let $x$ represent the length, in centimeters, of the third side of this triangle. The sum of the lengths, in centimeters, of all three sides of the triangle can be represented by the expression $4+6+x$. Since it's given that the perimeter of the triangle is 18 centimeters, it follows that $4+6+x=18$, or $10+x=18$. Subtracting 10 from both sides of this equation yields $x=8$. Therefore, the length, in centimeters, of the third side of this triangle is 8.

*Choice A* is incorrect. If the length of the third side of this triangle were 2 centimeters, the perimeter, in centimeters, of the triangle would be $4+6+2$, or 12, not 18. *Choice C* is incorrect. If the length of the third side of this triangle were 10 centimeters, the perimeter, in centimeters, of the triangle would be $4+6+10$, or 20, not 18. *Choice D* is incorrect. If the length of the third side of this triangle were 24 centimeters, the perimeter, in centimeters, of the triangle would be $4+6+24$, or 34, not 18.

### QUESTION 2

**Choice C** is correct. It's given that $16x+30=190$. Subtracting 30 from each side of this equation yields $16x=160$. Therefore, the equation $16x=160$ is equivalent to the given equation and has the same solution.

*Choice A* is incorrect and may result from conceptual or calculation errors.
*Choice B* is incorrect and may result from conceptual or calculation errors.
*Choice D* is incorrect and may result from conceptual or calculation errors.

## QUESTION 3

**Choice B** is correct. It's given that Ty plans to walk at an average speed of 4 kilometers per hour. The number of kilometers Ty will walk is determined by the expression $4s$, where $s$ is the number of hours Ty walks. The given goal of at least 24 kilometers means that the inequality $4s \geq 24$ represents the situation. Dividing both sides of this inequality by 4 gives $s \geq 6$, which corresponds to a minimum of 6 hours Ty must walk.

*Choice A* is incorrect and may result from conceptual or calculation errors.
*Choice C* is incorrect and may result from conceptual or calculation errors.
*Choice D* is incorrect and may result from conceptual or calculation errors.

## QUESTION 4

**Choice A** is correct. It's given that $g(x) = x^2 + 9$. Substituting 25 for $g(x)$ in this equation yields $25 = x^2 + 9$. Subtracting 9 from both sides of this equation yields $16 = x^2$. Taking the square root of each side of this equation yields $x = \pm 4$. It follows that $g(x) = 25$ when the value of $x$ is 4 or $-4$. Only 4 is listed among the choices.

*Choice B* is incorrect and may result from conceptual or calculation errors.
*Choice C* is incorrect and may result from conceptual or calculation errors.
*Choice D* is incorrect and may result from conceptual or calculation errors.

## QUESTION 5

**Choice A** is correct. Since $x$ is a factor of each term in the given expression, the expression is equivalent to $x(9x) + x(5)$, or $x(9x + 5)$.

*Choice B* is incorrect. This expression is equivalent to $45x^2 + 5x$, not $9x^2 + 5x$.
*Choice C* is incorrect. This expression is equivalent to $9x^2 + 45x$, not $9x^2 + 5x$.
*Choice D* is incorrect. This expression is equivalent to $9x^3 + 5x^2$, not $9x^2 + 5x$.

## QUESTION 6

The correct answer is 9. The mean of a data set is the sum of the values in the data set divided by the number of values in the data set. It follows that the mean height, in centimeters, of these plants is the sum of the heights, in centimeters, of each plant, $6 + 10 + 13 + 2 + 15 + 22 + 10 + 4 + 4 + 4$, or 90, divided by the number of plants in the data set, 10. Therefore, the mean height, in centimeters, of these plants is $\frac{90}{10}$, or 9.

## QUESTION 7

The correct answer is 224. It's given that a student council group uses the function $p(x) = 5x - 220$ to determine their profit $p(x)$, in dollars, for selling $x$ school posters. Substituting 900 for $p(x)$ in the given function yields $900 = 5x - 220$. Adding 220 to each side of this equation yields $1{,}120 = 5x$. Dividing each side of this equation by 5 yields $224 = x$. Therefore, in order to earn a profit of $900, they must sell 224 school posters.

## QUESTION 8

**Choice A** is correct. Since Jay walks at a speed of 3 miles per hour for $w$ hours, Jay walks a total of $3w$ miles. Since Jay runs at a speed of 5 miles per hour for $r$ hours, Jay runs a total of $5r$ miles. Therefore, the total number of miles Jay travels can be represented by $3w+5r$. Since the combined total number of miles is 14, the equation $3w+5r=14$ represents this situation.

*Choice B* is incorrect and may result from conceptual errors. *Choice C* is incorrect and may result from conceptual errors. *Choice D* is incorrect and may result from conceptual errors.

## QUESTION 9

**Choice C** is correct. It's given that John made a $16 payment each month for $p$ months. The total amount of these payments can be represented by the expression $16p$. The down payment can be added to that amount to find the total amount John paid, yielding the expression $16p+37$. It's given that John paid a total of $165. Therefore, the expression for the total amount John paid can be set equal to that amount, yielding the equation $16p+37=165$.

*Choice A* is incorrect and may result from conceptual or calculation errors. *Choice B* is incorrect and may result from conceptual or calculation errors. *Choice D* is incorrect and may result from conceptual or calculation errors.

## QUESTION 10

**Choice B** is correct. Adding 57 to each side of the given equation yields $y=px+57$. Therefore, the equation $y=px+57$ correctly expresses $y$ in terms of $p$ and $x$.

*Choice A* is incorrect and may result from conceptual errors. *Choice C* is incorrect and may result from conceptual errors. *Choice D* is incorrect and may result from conceptual errors.

## QUESTION 11

**Choice A** is correct. Since it's given that the account balance, $A(t)$, in dollars, after $t$ years can be modeled by an exponential function, it follows that function $A$ can be written in the form $A(t)=Nr^t$, where $N$ is the initial value of the function and $r$ is a constant related to the growth of the function. It's given that the initial balance of the account is $36,100.00, so it follows that the initial value of the function, or $N$, must be 36,100.00. Substituting 36,100.00 for $N$ in the equation $A(t)=Nr^t$ yields $A(t)=36{,}100.00r^t$. It's given that the account balance after 13 years, or when $t=13$, is $68,071.93. It follows that $A(13)=68{,}071.93$, or $36{,}100.00r^{13}=68{,}071.93$. Dividing each side of the equation $36{,}100.00r^{13}=68{,}071.93$ by 36,100.00 yields $r^{13}=\frac{68{,}071.93}{36{,}100.00}$. Taking the 13th root of both sides of this equation yields $r=\sqrt[13]{\frac{68{,}071.93}{36{,}100.00}}$, or $r$ is approximately equal to 1.05. Substituting 1.05 for $r$ in the equation $A(t)=36{,}100.00r^t$ yields $A(t)=36{,}100.00(1.05)^t$, so the equation $A(t)=36{,}100.00(1.05)^t$ could define $A$.

*Choice B* is incorrect. Substituting 0 for $t$ in this function indicates an initial balance of $31,971.93, rather than $36,100.00. *Choice C* is incorrect. Substituting 0 for $t$ in this function indicates an initial balance of $31,971.93, rather than $36,100.00. Additionally, this function indicates the account balance is decreasing, rather than increasing, over time. *Choice D* is incorrect. This function indicates the account balance is decreasing, rather than increasing, over time.

## QUESTION 12

**Choice B** is correct. Since $\overline{PR}$ and $\overline{QS}$ are diameters of the circle shown, $\overline{OS}$, $\overline{OR}$, $\overline{OP}$, and $\overline{OQ}$ are radii of the circle and are therefore congruent. Since $\angle SOP$ and $\angle ROQ$ are vertical angles, they are congruent. Therefore, arc $PS$ and arc $QR$ are formed by congruent radii and have the same angle measure, so they are congruent arcs. Similarly, $\angle SOR$ and $\angle POQ$ are vertical angles, so they are congruent. Therefore, arc $SR$ and arc $PQ$ are formed by congruent radii and have the same angle measure, so they are congruent arcs. Let $x$ represent the length of arc $SR$. Since arc $SR$ and arc $PQ$ are congruent arcs, the length of arc $PQ$ can also be represented by $x$. It's given that the length of arc $PS$ is twice the length of arc $PQ$. Therefore, the length of arc $PS$ can be represented by the expression $2x$. Since arc $PS$ and arc $QR$ are congruent arcs, the length of arc $QR$ can also be represented by $2x$. This gives the expression $x+x+2x+2x$. Since it's given that the circumference is $144\pi$, the expression $x+x+2x+2x$ is equal to $144\pi$. Thus $x+x+2x+2x=144\pi$, or $6x=144\pi$. Dividing both sides of this equation by 6 yields $x=24\pi$. Therefore, the length of arc $QR$ is $2(24\pi)$, or $48\pi$.

*Choice A* is incorrect. This is the length of arc $PQ$, not arc $QR$. *Choice C* is incorrect and may result from conceptual or calculation errors. *Choice D* is incorrect and may result from conceptual or calculation errors.

## QUESTION 13

The correct answer is 40. It's given in the first equation of the system that $y=-2x$. Substituting $-2x$ for $y$ in the second equation of the system yields $3x+(-2x)=40$. Combining like terms on the left-hand side of this equation yields $x=40$. Therefore, the value of $x$ is 40.

## QUESTION 14

The correct answer is 14. The maximum value is the largest value in the data set. The frequency refers to the number of times a data value occurs. The given frequency table shows that for this data set, the data value 6 occurs three times, the data value 7 occurs three times, the data value 8 occurs eight times, the data value 9 occurs eight times, the data value 10 occurs nine times, the data value 11 occurs eleven times, the data value 12 occurs nine times, the data value 13 occurs zero times, and the data value 14 occurs six times. Therefore, the maximum data value in the data set is 14.

## QUESTION 15

**Choice C** is correct. The Pythagorean theorem states that for a right triangle, the sum of the squares of the lengths of the two legs is equal to the square of the length of the hypotenuse. It's given that one leg of a right triangle has a length of 43.2 millimeters. It's also given that the hypotenuse of the triangle has a length of 196.8 millimeters. Let $b$ represent the length of the other leg of the triangle, in millimeters. Therefore, by the Pythagorean theorem, $43.2^2 + b^2 = 196.8^2$, or $1{,}866.24 + b^2 = 38{,}730.24$. Subtracting 1,866.24 from both sides of this equation yields $b^2 = 36{,}864$. Taking the positive square root of both sides of this equation yields $b = 192$. Therefore, the length of the other leg of the triangle, in millimeters, is 192.

*Choice A* is incorrect and may result from conceptual or calculation errors. *Choice B* is incorrect and may result from conceptual or calculation errors. *Choice D* is incorrect and may result from conceptual or calculation errors.

## QUESTION 16

**Choice D** is correct. It's given that a wire with a length of 106 inches is cut into two parts. It's also given that one part has a length of $x$ inches and the other part has a length of $y$ inches. This can be represented by the equation $x + y = 106$. It's also given that the value of $x$ is 6 more than 4 times the value of $y$. This can be represented by the equation $x = 4y + 6$. Substituting $4y + 6$ for $x$ in the equation $x + y = 106$ yields $4y + 6 + y = 106$, or $5y + 6 = 106$. Subtracting 6 from each side of this equation yields $5y = 100$. Dividing each side of this equation by 5 yields $y = 20$. Substituting 20 for $y$ in the equation $x = 4y + 6$ yields $x = 4(20) + 6$, or $x = 86$.

*Choice A* is incorrect. This value represents less than half of the total length of 106 inches; however, $x$ represents the length of the longer part of the wire, since it's given that the value of $x$ is 6 more than 4 times the value of $y$. *Choice B* is incorrect. This value represents less than half of the total length of 106 inches; however, $x$ represents the length of the longer part of the wire, since it's given that the value of $x$ is 6 more than 4 times the value of $y$. *Choice C* is incorrect. This represents a part that is 6 more than the length of the other part, rather than 6 more than 4 times the length of the other part.

## QUESTION 17

**Choice B** is correct. It's given that $f(x) = (x + 6)(x + 5)(x - 4)$ and $y = f(x) - 3$. Substituting $(x + 6)(x + 5)(x - 4)$ for $f(x)$ in the equation $y = f(x) - 3$ yields $y = (x + 6)(x + 5)(x - 4) - 3$. Substituting $-6$ for $x$ in this equation yields $y = (-6 + 6)(-6 + 5)(-6 - 4) - 3$, or $y = -3$. Substituting $-5$ for $x$ in the equation $y = (x + 6)(x + 5)(x - 4) - 3$ yields $y = (-5 + 6)(-5 + 5)(-5 - 4) - 3$, or $y = -3$. Substituting 4 for $x$ in the equation $y = (x + 6)(x + 5)(x - 4) - 3$ yields $y = (4 + 6)(4 + 5)(4 - 4) - 3$, or $y = -3$. Therefore, when $x = -6$ then $y = -3$, when $x = -5$ then $y = -3$, and when $x = 4$ then $y = -3$. Thus, the table of values in choice B represents $y = f(x) - 3$.

*Choice A* is incorrect. This table represents $y=x-3$ rather than $y=f(x)-3$.
*Choice C* is incorrect. This table represents $y=x+3$ rather than $y=f(x)-3$.
*Choice D* is incorrect. This table represents $y=f(x)+3$ rather than $y=f(x)-3$.

## QUESTION 18

**Choice D** is correct. It's given that a hose puts $88x$ ounces of water in a bucket in $5y$ minutes. Therefore, the rate at which the hose puts water in the bucket, in ounces per minute, can be represented by the expression $\frac{88x}{5y}$. Let $w$ represent the number of ounces of water the hose puts in the bucket in $9y$ minutes at this rate. It follows that the rate at which the hose puts water in the bucket, in ounces per minute, can be represented by the expression $\frac{w}{9y}$. The expressions $\frac{88x}{5y}$ and $\frac{w}{9y}$ represent the same rate, so it follows that $\frac{88x}{5y}=\frac{w}{9y}$. Multiplying both sides of this equation by $9y$ yields $\frac{792xy}{5y}=w$, or $\frac{792x}{5}=w$. Therefore, the number of ounces of water the hose puts in the bucket in $9y$ minutes can be represented by the expression $\frac{792x}{5}$.

*Choice A* is incorrect and may result from conceptual or calculation errors.
*Choice B* is incorrect and may result from conceptual or calculation errors.
*Choice C* is incorrect and may result from conceptual or calculation errors.

## QUESTION 19

**Choice D** is correct. A system of two linear equations in two variables, $x$ and $y$, has no solution if the lines represented by the equations in the $xy$-plane are distinct and parallel. The graphs of two lines in the $xy$-plane represented by equations in the form $Ax+By=C$, where $A$, $B$, and $C$ are constants, are parallel if the coefficients for $x$ and $y$ in one equation are proportional to the corresponding coefficients in the other equation. The first equation in the given system can be written in the form $Ax+By=C$ by subtracting $9y$ from both sides of the equation to yield $4x-18y=5$. The second equation in the given system can be written in the form $Ax+By=C$ by subtracting $4x$ from both sides of the equation to yield $-4x+hy=2$. The coefficient of $x$ in this second equation, $-4$, is $-1$ times the coefficient of $x$ in the first equation, 4. For the lines to be parallel, the coefficient of $y$ in the second equation, $h$, must also be $-1$ times the coefficient of $y$ in the first equation, $-18$. Thus, $h=-1(-18)$, or $h=18$. Therefore, if the given system has no solution, the value of $h$ is 18.

*Choice A* is incorrect. If the value of $h$ is $-9$, then the given system would have one solution, rather than no solution. *Choice B* is incorrect. If the value of $h$ is 0, then the given system would have one solution, rather than no solution. *Choice C* is incorrect. If the value of $h$ is 9, then the given system would have one solution, rather than no solution.

## QUESTION 20

The correct answer is 52. It's given that 13 is $p$% of 25. It follows that $\frac{13}{25}=\frac{p}{100}$. Multiplying both sides of this equation by 100 gives $52=p$. Therefore, the value of $p$ is 52.

## QUESTION 21

The correct answer is $-3$. Squaring both sides of the given equation yields $(x-2)^2=3x+34$, which can be rewritten as $x^2-4x+4=3x+34$. Subtracting $3x$ and $34$ from both sides of this equation yields $x^2-7x-30=0$. This quadratic equation can be rewritten as $(x-10)(x+3)=0$. According to the zero product property, $(x-10)(x+3)$ equals zero when either $x-10=0$ or $x+3=0$. Solving each of these equations for $x$ yields $x=10$ or $x=-3$. Therefore, the given equation has two solutions, 10 and $-3$. Of these two solutions, $-3$ is the smallest solution to the given equation.

## QUESTION 22

**Choice B** is correct. It's given that $g(x)=f(x-1)$. Since $f(x)=(x+6)(x+5)(x+1)$, it follows that $f(x-1)=(x-1+6)(x-1+5)(x-1+1)$. Combining like terms yields $f(x-1)=(x+5)(x+4)(x)$. Therefore, $g(x)=x(x+5)(x+4)$. The $x$-intercepts of a graph in the $xy$-plane are the points where $y=0$. The $x$-coordinates of the $x$-intercepts of the graph of $y=g(x)$ in the $xy$-plane can be found by solving the equation $0=x(x+5)(x+4)$. Applying the zero product property to this equation yields three equations: $x=0$, $x+5=0$, and $x+4=0$. Solving each of these equations for $x$ yields $x=0$, $x=-5$, and $x=-4$, respectively. Therefore, the $x$-intercepts of the graph of $y=g(x)$ are $(0, 0)$, $(-5, 0)$, and $(-4, 0)$. It follows that the values of $a$, $b$, and $c$ are 0, $-5$, and $-4$. Thus, the value of $a+b+c$ is $0+(-5)+(-4)$, which is equal to $-9$.

*Choice A* is incorrect. This is the value of $a+b+c$ if $g(x)=f(x+1)$. *Choice C* is incorrect. This is the value of $a+b+c-1$ if $g(x)=(x-6)(x-5)(x-1)$. *Choice D* is incorrect. This is the value of $a+b+c$ if $f(x)=(x-6)(x-5)(x-1)$.

## QUESTION 23

**Choice D** is correct. It's given that for $x>0$, $f(x)$ is equal to 201% of $x$. This is equivalent to $f(x)=\frac{201}{100}x$, or $f(x)=2.01x$, for $x>0$. This function indicates that as $x$ increases, $f(x)$ also increases, which means $f$ is an increasing function. Furthermore, $f(x)$ increases at a constant rate of 2.01 for each increase of $x$ by 1. A function with a constant rate of change is linear. Thus, the function $f$ can be described as an increasing linear function.

*Choice A* is incorrect and may result from conceptual errors. *Choice B* is incorrect and may result from conceptual errors. *Choice C* is incorrect. This could describe the function $f(x)=(2.01)^x$, where $f(x)$ is equal to 201% of $f(x-1)$, not $x$, for $x>0$.

## QUESTION 24

**Choice A** is correct. It's given that $g(x)=f(x+5)$. Since $f(x)=4x^2+64x+262$, it follows that $f(x+5)=4(x+5)^2+64(x+5)+262$. Expanding the quantity $(x+5)^2$ in this equation yields $f(x+5)=4(x^2+10x+25)+64(x+5)+262$. Distributing the 4 and the 64 yields $f(x+5)=4x^2+40x+100+64x+320+262$. Combining like terms yields $f(x+5)=4x^2+104x+682$. Therefore, $g(x)=4x^2+104x+682$. For a quadratic function defined by an equation of the form $g(x)=a(x-h)^2+k$, where $a$, $h$, and $k$ are constants and $a$ is positive, $g(x)$ reaches its minimum, $k$,

when the value of $x$ is $h$. The equation $g(x)=4x^2+104x+682$ can be rewritten in this form by completing the square. This equation is equivalent to $g(x)=4(x^2+26x)+682$, or $g(x)=4(x^2+26x+169-169)+682$. This equation can be rewritten as $g(x)=4((x+13)^2-169)+682$, or $g(x)=4(x+13)^2-4(169)+682$, which is equivalent to $g(x)=4(x+13)^2+6$. This equation is in the form $g(x)=a(x-h)^2+k$, where $a=4$, $h=-13$, and $k=6$. Therefore, $g(x)$ reaches its minimum when the value of $x$ is $-13$.

*Choice B* is incorrect. This is the value of $x$ for which $f(x)$, rather than $g(x)$, reaches its minimum. *Choice C* is incorrect and may result from conceptual or calculation errors. *Choice D* is incorrect. This is the value of $x$ for which $f(x-5)$, rather than $f(x+5)$, reaches its minimum.

## QUESTION 25

**Choice D** is correct. It's given that $w$ represents the total fence area, in square feet. Since the fence will be stained twice, the amount of stain, in gallons, will need to cover $2w$ square feet. It's also given that one gallon of stain will cover 170 square feet. Dividing the total area, in square feet, of the surface to be stained by the number of square feet covered by one gallon of stain gives the number of gallons of stain that will be needed. Dividing $2w$ by 170 yields $\frac{2w}{170}$, or $\frac{w}{85}$. Therefore, the equation that represents the total amount of stain $S$, in gallons, needed to stain the fence of the yard twice is $S=\frac{w}{85}$.

*Choice A* is incorrect. This equation represents the total amount of stain, in gallons, needed to stain the fence once, not twice. *Choice B* is incorrect and may result from conceptual or calculation errors. *Choice C* is incorrect and may result from conceptual or calculation errors.

## QUESTION 26

**Choice B** is correct. It's given that 483 out of 803 voters responded that they would vote for Angel Cruz. Therefore, the proportion of voters from the poll who responded they would vote for Angel Cruz is $\frac{483}{803}$. It's also given that there are a total of 6,424 voters in the election. Therefore, the total number of people who would be expected to vote for Angel Cruz is $6{,}424\left(\frac{483}{803}\right)$, or 3,864. Since 3,864 of the 6,424 total voters would be expected to vote for Angel Cruz, it follows that $6{,}424-3{,}864$, or 2,560 voters would be expected not to vote for Angel Cruz. The difference in the number of votes for and against Angel Cruz is $3{,}864-2{,}560$, or 1,304 votes. Therefore, if 6,424 people vote in the election, Angel Cruz would be expected to win by 1,304 votes.

*Choice A* is incorrect. This is the difference in the number of voters from the poll who responded that they would vote for and against Angel Cruz. *Choice C* is incorrect. This is the total number of people who would be expected to vote for Angel Cruz. *Choice D* is incorrect. This is the difference between the total number of people who vote in the election and the number of voters from the poll.

## QUESTION 27

The correct answer is 1,260. Since it's given that prisms X and Y are similar, all the linear measurements of prism Y are $k$ times the respective linear measurements of prism X, where $k$ is a positive constant. Therefore, the surface area of prism Y is $k^2$ times the surface area of prism X and the volume of prism Y is $k^3$ times the volume of prism X. It's given that the surface area of prism Y is 1,450 $cm^2$, and the surface area of prism X is 58 $cm^2$, which implies that $1{,}450 = 58k^2$. Dividing both sides of this equation by 58 yields $\frac{1{,}450}{58} = k^2$, or $k^2 = 25$. Since $k$ is a positive constant, $k = 5$. It's given that the volume of prism Y is 1,250 $cm^3$. Therefore, the volume of prism X is equal to $\frac{1{,}250}{k^3}$ $cm^3$, which is equivalent to $\frac{1{,}250}{5^3}$ $cm^3$, or 10 $cm^3$. Thus, the sum of the volumes, in $cm^3$, of the two prisms is $1{,}250 + 10$, or 1,260.