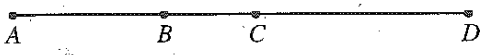
Question 30. The correct answer is G. To find BC when AD is 30 units, AC is 16 units, BD is 20 units, and the points are along $\overline{AD}$ as shown below, you must notice that $\overline{BC}$ is the intersection of $\overline{AC}$ and $\overline{BD}$.



So, the sum of the lengths of $\overline{AC}$ and $\overline{BD}$ is the same as the sum of the lengths of $\overline{AD}$ and $\overline{BC}$. Because $AC = AB + BC$, $BD = BC + CD$, and $AD = AB + BC + CD$, by substitution $AC + BD = AB + BC + BC + CD = AB + BC + CD + BC = AD + BC$.

Using the actual lengths, $AC + BD = AD + BC \Rightarrow 16 + 20 = 30 + BC \Rightarrow 36 = 30 + BC \Rightarrow BC = 6$.

If you chose F, you probably subtracted 16 from 20. If you chose K, you probably thought you needed more information to solve the problem, which is not the case.

Question 31. The correct answer is B. To find the x-coordinate where the 2 lines $y = 2x + 6$ and $y = 3x + 4$ intersect, you could substitute $y = 2x + 6$ into $y = 3x + 4$ to get $2x + 6 = 3x + 4$. Subtracting $2x$ and 4 from both sides results in the equation $2 = x$.

Another strategy is to graph the equations and estimate the coordinates of the intersection point.

If you chose C, you probably used the constant from the second equation. If you chose D, you probably used the constant from the first equation. If you chose E, you probably found the y-coordinate instead of the x-coordinate.

Question 32. The correct answer is J. To solve the equation $M = 3V + 6$ for V, you could subtract 6 from both sides to get $M - 6 = 3V$, and then divide by 3 on both sides to get $\frac{M-6}{3} = V$.

If you chose F, you did not divide the 6 by 3. If you chose G, you might have moved the 6 from the right side to the left and also forgotten to divide it by 3. If you chose H, you possibly transferred the 3 from the V to the M. If you chose K, you probably made a sign error.

Question 33. The correct answer is B. The area is bh for a parallelogram with base b and corresponding height h. For parallelogram $ABCD$, base $\overline{AD}$ is 3 + 6, or 9 inches long, and the corresponding height is 4 inches. So the area is 9(4), or 36 square inches.

The most common wrong answer is D, which comes from multiplying the two side lengths: (3 + 6)(5) = 9(5) = 45.

Question 34. The correct answer is K. To find $(b - a)^4$ given $a = b + 2$, you could solve the equation for $b - a$. By subtracting a and 2 from both sides, you get $-2 = b - a$. Substituting -2 for $b - a$ in $(b - a)^4$ yields $(-2)^4$, or 16.

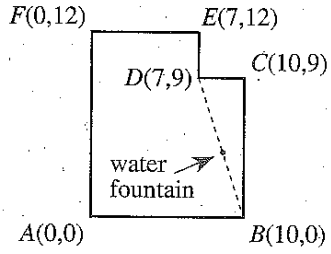
If you got stuck working this one, you could try choosing a specific value for b, say $b = 3$. Then a must be $3 + 2 = 5$. And $(b - a)^4 = (3 - 5)^4 = (-2)^4 = 16$.

If you chose F, you probably got -2 for $b - a$ but then replaced $(-2)^4$ by -2^4, or -16. Be careful $(-2)^4 = (-2)(-2)(-2)(-2) = 16$, but $-2^4 = -(2 \cdot 2 \cdot 2 \cdot 2) = -16$.

If you chose H, you probably got $b - a = 1$ or $b - a = -1$, and either $(1)^4$ or $(-1)^4$ is 1. Choices G and J come from calculating 2^4 as $2 \cdot 4$ and, for G, making a minus sign mistake.

Because $(b - a)^4$ is an even power of the number $(b - a)$, you can eliminate any negative numbers (F and G). This kind of observation can help you catch mistakes even when your problem is not multiple-choice.

Question 35. The correct answer is D. To find the location of the water fountain located halfway between points B and D, it makes sense to give coordinates to the points relative to point A (see the diagram below). The first coordinate is the number of blocks east and the second coordinate is the number of blocks north.



The water fountain is at the midpoint of $\overline{BD}$, and so the midpoint formula applies. For points with coordinates (x_1,y_1) and (x_2,y_2), the midpoint has coordinates $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$. For B (10,0) and D (7,9), the midpoint is $\left(\frac{10+7}{2}, \frac{0+9}{2}\right) \Rightarrow \left(\frac{17}{2}, \frac{9}{2}\right) \Rightarrow \left(8\frac{1}{2}, 4\frac{1}{2}\right)$.

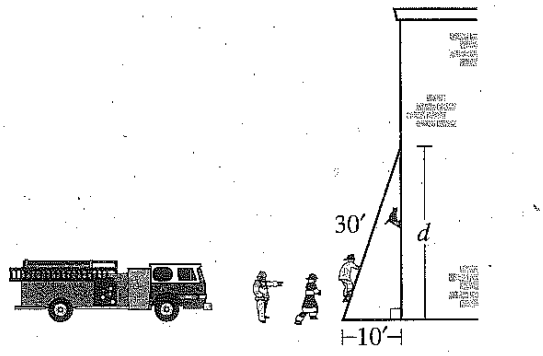
B is halfway between A and C. Choice C is halfway between B and F. If you chose E, you may have found the wrong coordinates for C, D, or E.

Once you put coordinates on the picture, you can see that only one answer choice is reasonable.

Question 36. The correct answer is J. One strategy for solving this problem is to find equations. You can let y be the larger number and obtain the equation $y = 2x + 8$ from the first sentence. The second sentence says that $2y + 3x = 65 \Rightarrow 2(2x + 8) + 3x = 65$.

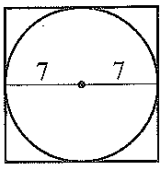
If you chose F, you probably took 3 times the larger number and added it to twice the smaller number to get 65, rather than the other way around. If you chose G, you probably defined y as $y = 2x - 8$ and then also made the same error as in F. Choice H can come from distributing the 2 in $2(2x + 8)$ as $2(2x) + 8$ and doing everything else correctly.

Question 37. The correct answer is C. To find out how far a 30-foot ladder 10 feet away from the base of a building reaches up the building, you can use the Pythagorean theorem. Let the length of the ladder be the hypotenuse, and let the legs be the distances away from the base of the building and from the ground to the top of the ladder along the building (see the figure below). This gives the equation $30^2 = 10^2 + d^2$, where d is the distance the ladder reaches up the building. Simplifying, you get $900 = 100 + d^2 \Rightarrow 800 = d^2 \Rightarrow d$ is about 28 feet.



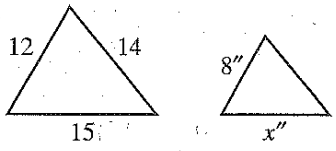
B comes from subtracting 10 from 30 or "simplifying" $\sqrt{900-100}$ to $\sqrt{900}-\sqrt{100}$.

Question 38. The correct answer is K. The most common way of finding the area of a square involves finding the side length of the square. If you draw radius lines in different positions, as shown below, you can see a relation between the radius of the circle and the side length of the square. The side length of the square is twice the radius, or $2(7) = 14$ feet. To find the area of the square, you square the side length, to get $14^2 = 196$ square feet.



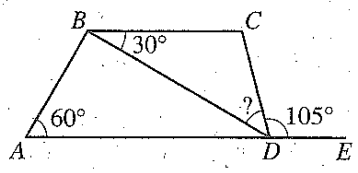
If you chose F, you probably thought 7 feet was the side length and squared 7 to get 49. If you chose J, you probably found the area of a circle, πr^2, where r is the radius, to get $\pi(7)^2 = 49\pi$.

Question 39. The correct answer is B. It might be good to sketch a picture, something like the diagram below. To find the length of the longest side of the second triangle, you can use the ratios of corresponding sides of each triangle. For example, $\frac{12}{8} = \frac{15}{x}$, where x is the length of the longest side of the second triangle. After cross multiplying, you get $12x = 120$. Then, you divide by 12 to get $x = 10$ inches.



If you chose A, you probably noticed that the first triangle's longest side is 3 units longer than its shortest side. If this same relation held in the second triangle, its longest side would be 8 + 3 = 11. This additive relation does not hold. If you chose E, you may have thought you needed the length of the middle side of the second triangle to solve the problem.

Question 40. The correct answer is K. To find the measure of $\angle BDC$ in the figure below, it is helpful to recognize that $\overline{AD}$ and $\overline{BC}$ are parallel and are connected by transversal $\overline{BD}$. Then $\angle CBD$ and $\angle ADB$ are alternate interior angles and so each measures 30°. (Go ahead and write in "30°" for $\angle ADB$ on the figure.)

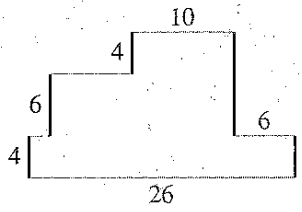


By definition, $\angle ADE$ is a straight angle and has a measure of 180°. Because $\angle ADE$ is made up of $\angle ADB$, $\angle BDC$, and $\angle CDE$, you know that the measures of those 3 angles add up to 180°. You might write this, using m to represent *measure*, as $m\angle ADB + m\angle BDC + m\angle CDE = 180°$. Substituting the measures you know gives $30° + m\angle BDC + 105° = 180° \Rightarrow m\angle BDC + 135° = 180° \Rightarrow m\angle BDC = 45°$.

If you chose H, you might have thought $\triangle BDC$ is isosceles. If you chose J, possibly you estimated the measure of $\angle BDC$ or made a subtraction error.

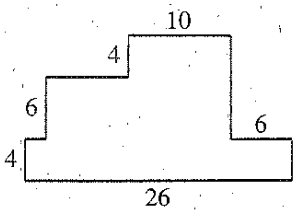
Question 41. The correct answer is E. This figure has 10 sides, but lengths are given for only 6 of the sides. Those lengths add up to 4 + 6 + 4 + 10 + 6 + 26 = 56 inches. The perimeter is longer than this because of the missing 4 sides.

Then you should find the lengths of the missing sides, right? The figure below focuses on the vertical sides. The vertical sides that face left have lengths 4, 6, and 4. The lengths of the sides that face right are unknown. But, the vertical distance that the left-facing sides cover is the same as the vertical distance that the right-facing sides cover.



So, since the total length of the left-facing sides is 4 + 6 + 4 = 14 inches, the total length of the right-facing sides is also 14 inches.

Finding the lengths of the horizontal sides (see the figure below) is a similar process. The horizontal distance covered by the top-facing sides must be 26 inches because that's what's covered by the bottom-facing sides.



This makes the perimeter the sum of the lengths of the left-facing, right-facing, top-facing, and bottom-facing sides, which is 14 + 14 + 26 + 26 = 80 inches. You can't know the length of each side, but you can find the perimeter.

If you chose C, you probably just found the sum of the side lengths shown: 4 + 6 + 4 + 10 + 6 + 26 = 56. If you chose D, you may have left out the right-facing sides, or you may have estimated the lengths of the 4 missing sides and been too low. Estimation is a reasonable strategy for this question.

Question 42. The correct answer is F. To find out how many of the 804 seniors in a certain high school are going to a state university when approximately $\frac{2}{5}$ of the seniors are going to college, and when $\frac{1}{4}$ of those going to college are going to a state university, you could first find how many of the 804 seniors are going to college. This is $\frac{2}{5}(804)$, or almost 322 seniors. Then, find the number of those 322 seniors going to college who are going to a state university, which is $\frac{1}{4}(322)$, or about 80 seniors that are going to a state university.

J is closest to $\frac{1}{4}$ of 804.

Question 43. The correct answer is E. You could take a brute-force approach and test all the given values of y and see if you could find an x that worked. For example, if $y = 45$ from A, then the two numbers are $x^2 \cdot 45^2$ and $x \cdot (45)^3$. You can see that 45^2 is a common factor of these two numbers, so 45 can't be the *greatest* common factor.

Maybe it will be productive to be more general and avoid having to test all 5 values of y. Notice that xy^2 is a common factor of x^2y^2 and xy^3. Because it is a common factor, it must be a factor of 45 (the greatest common factor). Because 45 factors as $5 \cdot 3^2$, it seems natural to see whether $x = 5$ and $y = 3$ is a possible solution. In this case, the two numbers are $5^2 \cdot 3^2$ and $5 \cdot 3^3$, and then the greatest common factor is $5 \cdot 3^2 = 45$. It works.

B is a possible value of xy, C is a possible value of y^2, D is a possible value of x, and E is a possible value of x (when $y = 1$). If you don't see right away what to do, dig in and test some numbers to see what happens.

Question 44. The correct answer is G. Because 115% of "the number" is 460, then "the number" is $\frac{460}{1.15}$, which is 400. Next, 75% of "the number" 400 is 300.

You can also solve this with equations. Let n be "the number." Then $1.15n = 460$ and you want to find $0.75n$.

J is 75% of 460 $\Rightarrow$ (0.75)460 $\Rightarrow$ 345. If you chose K, you probably found "the number" but not 75% of that.

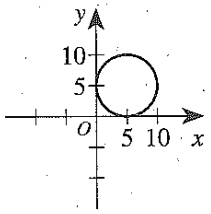
Question 45. The correct answer is E. To find the distance between 2 points in the standard (x,y) coordinate plane, you can use the distance formula, $\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$. So the distance is $\sqrt{(5-0)^2+(0-1)^2} \Rightarrow \sqrt{5^2+1^2} \Rightarrow \sqrt{26}$ coordinate units.

A can come from mixing x and y coordinates: $\sqrt{(5-1)^2+(0-0)^2}$. If you chose B, you probably added 1 + 5 or simplified the radical expression incorrectly.

Question 46. The correct answer is G. To find the ratio of the circumferences of 2 circles for which the ratio of their radii is 4:9, you would recognize that both circumference and radius are 1-dimensional attributes of a circle. Because of that, the ratios should be the same, 4:9. Another way is to use the ratio of the radii and let $4x$ be the radius of the first circle and $9x$ be the radius of the second circle. Then, the circumferences would be $2\pi(4x)$ and $2\pi(9x)$, respectively. Setting them in a ratio, you get $8\pi x:18\pi x$, which simplifies to 4:9.

If you chose F, you probably thought that you should take the ratio of the square roots, $\sqrt{4}:\sqrt{9}$, or 2:3. If you chose H, you probably thought that you should take the ratio of the squares, $4^2:9^2$, or 16:81 (which is the ratio of the circles' areas).

Question 47. The correct answer is D. You may want to have a picture of this situation in your mind, or even sketch it out in the space in your test booklet. Your picture might look something like this.



One way to find an equation for a circle is to know the coordinates of the center, (h,k), and the radius, r. Then, an equation is $(x-h)^2+(y-k)^2=r^2$. For this circle, the center is at (5,5) and the radius is 5. (It's fairly easy to see that. If you needed to prove those are exactly right, you could use symmetry or you could use the fact that a tangent line is perpendicular to the radius that goes through the point of tangency.) Given center (5,5) and radius 5, the circle has equation $(x-5)^2+(y-5)^2=5^2$.

Another way to solve this problem is to find the coordinates of points on the circle and see which equation(s) each point satisfies. The points (0,5), (5,0), (5,10), and (10,5) are all on the circle. Testing these points in all the equations would probably take longer than the first method, but testing the points in the equation you think is correct would be a good check of your answer.

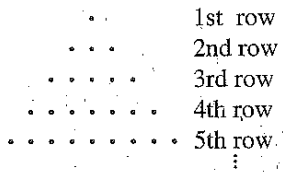
B is a circle centered at (0,0) instead of (5,5). If you chose C, you probably forgot to square the radius on the right side of the equation. If you chose E, you likely used $(x+h)$ and $(y+k)$ in the equation. Testing (10,5) would have helped you eliminate these incorrect answers.

Question 48. The correct answer is J. To find an equivalent expression for $\frac{1}{1+i}\frac{1-i}{1-i}$, you can multiply and get $\frac{1(1-i)}{(1+i)(1-i)} = \frac{1-i}{1-i^2} = \frac{1-i}{1-(-1)} = \frac{1-i}{2}$.

If you chose G, possibly you thought $\frac{1}{1+i}$ was equivalent to $1 + i$ and canceled $1 - i$ in both places.

If you chose H, you probably simplified $1 - i^2$ as 1 and got $\frac{1-i}{1}$, or $1 - i$.

Question 49. The correct answer is D. You want to find which statement describes the total number of dots in the first n rows of the figure below.



You could make a table like the one below, showing the number of rows and the total number of dots.

Number of rows	1	2	3	4	5
Total number of dots	1	4	9	16	25

You would probably recognize that the total number of dots is the square of the number of rows. This seems like a consistent relationship (it works for all 5 columns in your table). You can rule out A because the total is not always 25. For B, the total would have to go 2, 4, 6, 8, 10. For C, the total would need to be 5, 10, 15, 20, 25.

B works for the total of the first 2 rows. If you chose C, that works for the total of the first 5 rows. If you chose E, you might have seen that the relationship was not linear and viewed this as inconsistent.

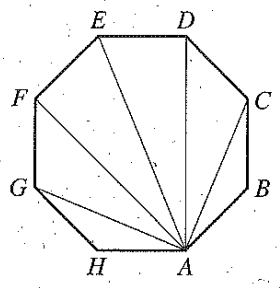
Question 50. The correct answer is F. If the first 8 students in the class play only guitar and the next 9 play only piano, that accounts for 17 of the 20 students in the class. The other 3 students could play only trombone. This describes a class where 0 students play both guitar and piano, and you can't get any less than this.

G is 9 – 8 and K is 9 + 8. If you chose H, that is the maximum rather than the minimum number.

Question 51. The correct answer is A. To find the real numbers x such that $x + 3 > x + 5$, you could subtract x and 3 from both sides. The result is $0 > 2$, and because that inequality is never true, there is no solution for x. The solution set is the empty set.

If you chose B, you probably got mixed up on the direction of the inequality and got $0 < 2$, which is true for all values of x. If you chose C, you probably got $0 > 2$ and then thought that a negative value for x would change the direction of the inequality.

Question 52. The correct answer is H. You can use symmetry to solve this problem. A picture might be useful. As shown below, there are 5 diagonals coming into each vertex point.



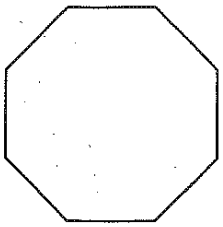
Because there are 8 vertex points, you might be tempted to conclude that there are $8 \cdot 5 = 40$ diagonals. But this method counts each diagonal exactly twice. (It counts $\overline{AD}$ as a diagonal coming into vertex A and counts $\overline{DA}$ as a diagonal coming into vertex D, but these are the same diagonal.) Because each diagonal is counted exactly twice, there are $\frac{40}{2} = 20$ diagonals.

If you like other kinds of patterns, you might choose a different solution path. You can list the diagonals. But, to be sure you list them all, organize them into a pattern such as the one below.

$\overline{AC}$
$\overline{AD}$ $\overline{BD}$
$\overline{AE}$ $\overline{BE}$ $\overline{CE}$
$\overline{AF}$ $\overline{BF}$ $\overline{CF}$ $\overline{DF}$
$\overline{AG}$ $\overline{BG}$ $\overline{CG}$ $\overline{DG}$ $\overline{EG}$
$\overline{BH}$ $\overline{CH}$ $\overline{DH}$ $\overline{EH}$ $\overline{FH}$
$\overline{CA}$ $\overline{DA}$ $\overline{EA}$ $\overline{FA}$ $\overline{GA}$
$\overline{DB}$ $\overline{EB}$ $\overline{FB}$ $\overline{GB}$ $\overline{HB}$
$\overline{EC}$ $\overline{FC}$ $\overline{GC}$ $\overline{HC}$
$\overline{FD}$ $\overline{GD}$ $\overline{HD}$
$\overline{GE}$ $\overline{HE}$
$\overline{HF}$

The ones that are light gray are already listed. You wouldn't have to write those down. Now you can tell there are $5 + 5 + 4 + 3 + 2 + 1 = 20$ diagonals.

Alternately, you could draw in every diagonal and count them. This method would work if you were careful to draw in every diagonal and to count every one you drew in. Try it below.



If you chose F, you probably reasoned that because the pentagon (a 5-sided figure) has 5 diagonals, then an octagon (an 8-sided figure) has 8 diagonals. As you can see from the picture above, this pattern doesn't hold. If you chose G, you may have tried to count all of the diagonals directly and missed a few. Choice K is the result of counting each diagonal twice.

Question 53. The correct answer is B. Douglas will count any color other than red, blue, green, and purple in the Other sector. The table below gives percentages of friends who picked red, blue, green, and purple.

Color	Red	Blue	Green	Purple	Other
Percentage	25%	30%	20%	10%	

The 4 known percentages add up to 85%. That leaves 15% for the Other sector. That means 15% of the 360° in the circle belong in the Other sector. This is (0.15)(360°) = 54°.

C is 15% of 180° rather than of 360°. If you chose D, you probably found the correct percent for the Other sector and then just labeled it degrees.