

**Mathematics Test**

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1. A	21. C	41. D
2. F	22. K	42. K
3. D	23. A	43. D
4. G	24. G	44. J
5. A	25. C	45. C
6. H	26. J	46. G
7. E	27. E	47. D
8. H	28. G	48. K
9. B	29. D	49. C
10. J	30. F	50. H
11. D	31. E	51. B
12. K	32. G	52. G
13. C	33. D	53. C
14. J	34. K	54. J
15. A	35. D	55. A
16. K	36. G	56. F
17. D	37. B	57. D
18. H	38. J	58. H
19. E	39. D	59. B
20. G	40. F	60. F

### Mathematics Test Explanations

1. The correct answer is A. This is a basic algebra problem that requires you to solve for  $x$ . Isolate the variable,  $x$ , on one side of the equation, as follows:

$$4x - 9 = 11$$

$$4x = 20$$

$$x = 5$$

2. The correct answer is F. This kind of statement is called a "conditional." You are told that if the first part is true ( $XY$  is 4), then the second part ( $YZ$  is 7) will certainly be true. Since the second part is NOT true, you can conclude logically that the first part is also NOT true. Therefore, answer choice F is correct. If  $XY$  were equal to 4, then, according to the given statement,  $YZ$  would have to be 7. Remember that some ACT mathematics problems require only logic and no computations.

3. The correct answer is D. To solve this problem, first set up an equation, as follows, to find the given number ( $x$ ):

$$0.6x = 9$$

$$x = 15$$

The given number is 15. Next, calculate 25% of 15, as follows:

$$0.25x = 15$$

$$x = 3.75$$

4. The correct answer is G. The first step in solving this problem is to calculate the amount of fuel needed for each vehicle for the trip, as follows:

Vehicle A: 1,120 total miles  $\div$  16 miles per gallon = 70 gallons

Vehicle B: 1,120 total miles  $\div$  35 miles per gallon = 32 gallons

Next, find the difference between the gallons required for Vehicles A and B:

$$70 - 32 = 38$$

5. The correct answer is A. To solve this problem, set up an equation, as follows:

$$(x - 3) + (x - 2) + (x - 1) + x + (x + 1) = 390$$

Next, simplify the equation and solve for  $x$ :

$$5x - 5 = 390$$

$$5x = 395$$

$$x = 79$$

6. The correct answer is H. This problem requires you to substitute the values given for  $P$  and  $Q$  into the equation  $P - Q$ . The problem states that  $P = 5a$  and  $Q = 3b - 2a$ . Set up the equation as follows, and remember to keep track of the negative sign as you simplify the expression:

$$P - Q$$

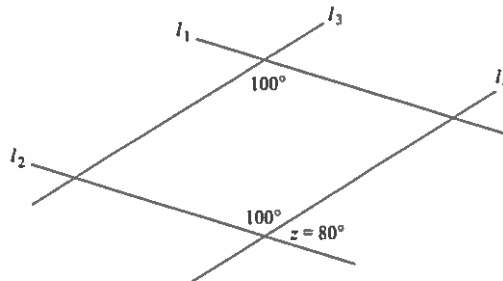
$$= 5a - (3b - 2a)$$

$$= 5a - (-2a) - 3b$$

$$= 5a + 2a - 3b$$

$$= 7a - 3b$$

7. The correct answer is E. The figure in the problem represents 2 parallel lines cut by 2 parallel transversals. The angles created as a result have special properties. Where each of the parallel lines is cut by a transversal, there are 2 pairs of vertical, or opposite, angles. Each angle in the pair is congruent to, or equal to, the other angle in the pair. Therefore, where  $l_3$  intersects  $l_1$  and also where it intersects  $l_2$ , two  $100^\circ$  angles are formed; in addition, two  $80^\circ$  angles are formed that are adjacent to the  $100^\circ$  angles, since a straight line measures  $180^\circ$ . The same angles are created where  $l_4$  intersects  $l_1$  and  $l_2$ . This means that angle  $z$  must equal  $80^\circ$ .



8. The correct answer is H. Simply plug 2 in for  $x$  wherever  $x$  appears in the equation and solve the equation. Don't forget to keep track of the negative signs!

$$-(2^2) + 4(2) - 3$$

$$= -(4) + 8 - 3$$

$$= 8 - 4 - 3 = 1$$

9. The correct answer is B. If the average of 8 numbers is 6.5, then the total of the 8 numbers is  $8 \cdot 6.5$ , or 52. If each of the 8 numbers is decreased by 3, then the total of the 8 new numbers is  $52 - 8(3)$ , or  $52 - 24$ , which is 28. To find the average, divide 28 by 8, to get 3.5.

10. The correct answer is J. This question tests your ability to recognize and apply the distributive property of multiplication. According to the distributive property, for any numbers  $a$ ,  $b$ , and  $c$ ,  $c(a + b) = ca + cb$ . In this problem,  $c$  is 5 so you can factor the expression  $5a + 5b$  into  $5(a + b)$ .
11. The correct answer is D. To solve this problem, first subtract \$40 from \$375 ( $375 - 40 = 335$ ). Because \$40 is a flat fee, it will not figure in the calculations for the number of hours. Set the number of hours to  $x$ , multiply by the hourly rate, and solve:
- $$25x = 335$$
- $$x = 13.4$$
12. The correct answer is K. The easiest way to solve this problem is to plug the answer choices into the inequality and solve. Because the question asks you for the largest possible value of  $x$ , start with the largest answer choice (note that the answer choices are in ascending order):
- $$\frac{8}{32} \geq \frac{1}{4}$$
- $$\frac{8}{32} = \frac{1}{4}$$
- This satisfies the inequality, so answer choice K, because it is the largest, must be correct.
13. The correct answer is C. In order to solve this problem you must know that there are  $360^\circ$  in a circle, and that the clock shown is divided into 12 segments, 1 for each hour in the day. To calculate the number of degrees that the hour hand moves from 1:00 P.M. to 8:00 P.M. perform the following operations:
- $$360^\circ \div 12 = 30^\circ$$
- Each hour in the day is equivalent to  $30^\circ$ .
- $$30^\circ \times 7 \text{ (the number of hours between 1:00 P.M. and 8:00 P.M.)} = 210^\circ$$
14. The correct answer is J. The first step in choosing the correct answer is to locate point  $R$  in the coordinate plane. You will see that it is located in the upper-right quadrant, which means that both of the coordinates must be positive. Eliminate answer choices H and K because they both include negative coordinates. You can also eliminate answer choices F and G, because neither of the coordinates of point  $R$  is zero. That leaves answer choice J as the only possible correct answer.

15. The correct answer is A. This problem requires you to find the Greatest Common Factor. The Greatest Common Factor is  $3xy$ , because each term has at least 1 factor of 3, 1 factor of  $x$ , and 1 factor of  $y$ . When you factor  $3xy$  out of  $3x^3y^3$  you are left with  $x^2y^2$ , and when you factor  $3xy$  out of  $3xy$ , you are left with 1. Therefore, when factored,  $3x^3y^3 + 3xy = 3xy(x^2y^2 + 1)$ .
16. The correct answer is K. To find the total number of seats in the entire classroom, you must multiply the number of rows,  $(r + s)$ , by the number of seats in each row,  $t$ , using the Distributive Property:
- $$(r + s) \cdot t = (r \cdot t) + (s \cdot t)$$
17. The correct answer is D. The first step in selecting the correct answer to this problem is to recognize that  $x$  cannot be less than 16. This means that answer choices A and B can be eliminated. If you look at answer choice C, you should notice that 16 is  $\frac{1}{2}$ , or 50% of 32, not 20% of 32, so answer choice C can be eliminated. It does not make sense that 20% of 800 would be 16, so by a simple process of elimination you can arrive at the correct answer, which is answer choice D. To solve this problem mathematically, follow these steps:
- 16 is to  $x$  as 20% is to 100%.
- $$\frac{16}{x} = \frac{20}{100}$$
- cross-multiply and solve for  $x$ .
- $$20x = 1,600$$
- $$x = 80$$
18. The correct answer is H. To solve this problem quickly, notice that the slowest time (24:04) is just over 24 minutes and the fastest time (19:53) is just under 20 minutes. Therefore, the difference between the two times will be around 4 minutes. You can eliminate answer choices F and G because they are too small, and answer choice K because it is too big. Next, convert the times to seconds, as follows:
- Slowest time:  $24(60) + 4 = 1,444$  seconds
- Fastest time:  $19(60) + 53 = 1,193$  seconds
- Now subtract to find the difference in seconds:  $1,444 - 1,193 = 251$ . Finally, convert 251 seconds to minutes and seconds:  $251 \div 60 = 4$ , remainder 11.
19. The correct answer is E. In order to solve this problem you must first calculate the total cost of the watch, including tax. Since the sales tax is

6%, multiply the price of the watch (\$12.99) by 0.06, the decimal equivalent of 6%:

$$\$12.99 \times 0.06 = \$0.7794$$

\$0.7794 rounded to the nearest cent is \$0.78.

Now, add the sales tax to the price of the watch:

$$\$12.99 + \$0.78 = \$13.77$$

Based on these calculations, you will need \$0.77 in exact change.

20. **The correct answer is G.** An expression is undefined when the denominator equals 0. Set the denominator equal to 0 and solve for  $x$ :

$$16 - x^2 = 0$$

$$16 = x^2$$

$$4 = x$$

21. **The correct answer is C.** To solve this problem, you can use your calculator to determine the square root of 99:

$$\sqrt{99} = 9.9498$$

Clearly, 10 is the smallest integer greater than the square root of 99:  $10 > 9.9498$ . You could also have figured that  $\sqrt{99}$  is slightly less than  $\sqrt{100}$ , which is 10, making 10 the smallest integer greater than the square root of 99.

22. **The correct answer is K.** The key to solving this problem is to recognize that the box has a top and a bottom, plus 4 sides. Because the tape must go completely *around* all 4 sides of the box, you must account for the sides as follows:

$$2(40 \text{ cm}) = 80 \text{ cm (top and bottom, length)}$$

$$2(13 \text{ cm}) = 26 \text{ cm (top and bottom, width)}$$

$$4(20 \text{ cm}) = 80 \text{ cm (four sides, height)}$$

$$80 + 26 + 80 = 186 \text{ cm}$$

23. **The correct answer is A.** The first step in solving this problem is to calculate the value of Kahla's inventory at each price point, as follows:

$$\left. \begin{array}{l} \text{Shop A, Brand X: } 150 \times 20 = 3,000 \\ \text{Shop B, Brand X: } 100 \times 20 = 2,000 \end{array} \right\} = \$5,000$$

$$\left. \begin{array}{l} \text{Shop A, Brand Y: } 200 \times 25 = 5,000 \\ \text{Shop B, Brand Y: } 120 \times 25 = 3,000 \end{array} \right\} = \$8,000$$

$$\left. \begin{array}{l} \text{Shop A, Brand Z: } 225 \times 30 = 6,750 \\ \text{Shop B, Brand Z: } 175 \times 30 = 5,250 \end{array} \right\} = \$12,000$$

Next, find the total value:  $\$5,000 + \$8,000 + \$12,000 = \$25,000$ .

24. **The correct answer is G.** To find the solutions of the expression  $x^2 + 2x = 8$ , first put it in the correct quadratic form by subtracting 8 from both sides:  $x^2 + 2x - 8 = 0$ . Now you can factor the polynomial  $x^2 + 2x - 8$ :

$$(x + \underline{\quad})(x - \underline{\quad}) = 0$$

Find 2 factors of  $-8$  that, when added together give you 2, and plug them into the solution sets:

$$(x + 4)(x - 2) = 0$$

Now, solve for  $x$ :

$$(x + 4) = 0, \text{ so } x = -4$$

$$(x - 2) = 0, \text{ so } x = 2$$

The solutions of  $x^2 + 2x = 8$  are  $-4$  and  $2$ .

25. **The correct answer is C.** The key to solving this problem is to recognize that if  $(f + g)^2 = 81$ , then  $f + g$  must equal 9, because  $9^2$  equals 81. Now, since you are given that  $fg = 20$ , you need to find 2 numbers that, when added together give you 9, and, when multiplied together give you 20. The only 2 numbers that will satisfy both equations are 4 and 5. Substitute 4 for  $f$  and 5 for  $g$  in the final equation:  $f^2 + g^2 = 4^2 + 5^2 = 16 + 25 = 41$ .

26. **The correct answer is J.** When exponents are raised to an exponential power, the rules state that you must multiply the exponents by the power to which they are raised. In this problem,  $x$  is raised to the  $(4a - 3)$  power. This exponent is then squared, so you should multiply  $4a - 3$  by 2:  $2(4a - 3) = 8a - 6$ . You now have the equation  $x^{8a-6} = x^{10}$ . Since the coefficients are equal ( $x$ ), the exponents must also be equal, so  $8a - 6 = 10$ . Solve for  $a$ :

$$8a - 6 = 10$$

$$8a = 16$$

$$a = 2$$

27. **The correct answer is E.** The first step in solving this problem is to determine the value of  $i^6$  and  $3i^4$ . Even though this problem contains a complex number, it is actually a relatively simple exponent problem. You are given that  $i^2 = -1$ , which means that  $i^6 = (i^2)(i^2)(i^2) = (-1)(-1)(-1)$ , which equals  $-1$ . By the same token,  $3i^4 = 3(i^2)(i^2) = 3(-1)(-1)$ , which equals 3. Therefore, the value of  $i^6 + 3i^4$  is  $-1 + 3$ , or 2.

28. **The correct answer is G.** The slope-intercept form for the equation of a line is  $y = mx + b$ , where  $m$

is the slope and  $b$  is the  $y$ -intercept. Put the given equation in the standard form as follows:

$$5x - 4y = 7$$

$$-4y = -5x + 7$$

$$y = \frac{5x}{4} - \frac{7}{4}$$

Based on this solution,  $b$ , the  $y$ -intercept, is equal to  $-\frac{7}{4}$ .

29. The correct answer is D. A circle centered at  $(a, b)$  with a radius  $r$  has the equation  $(x - a)^2 + (y - b)^2 = r^2$ . Based on this definition, a circle with the equation  $(x + 3)^2 + (y - 2)^2 = 10$  would have a radius of  $\sqrt{10}$ . If  $r^2 = 10$ , then  $r = \sqrt{10}$ .
30. The correct answer is F. The sine of any acute angle is calculated by dividing the length of the side opposite the acute angle by the length of the hypotenuse ( $\sin = \frac{\text{opp}}{\text{hyp}}$ ). In this problem, the length of the side opposite angle  $\beta$  is  $l$ , and the length of the hypotenuse is  $n$ . Therefore, the sin of angle  $\beta$  is  $\frac{l}{n}$ .
31. The correct answer is E. You should think of this problem as a basic fraction, where  $(4a^3b) \times (-5a^5b^3)$  is the numerator and  $(10a^4b^2)$  is the denominator. The first step is to multiply together the 2 elements in the numerator, as follows:
- When multiplying exponents, the rules state that you should add exponents with like coefficients, so  $(4a^3b)(-5a^5b^3) = -20a^8b^4$ .
- To solve a fraction, you simply divide the numerator by the denominator.
- When dividing exponents, the rules state that you should subtract exponents of the same coefficients in the denominator from the exponents of the same coefficients in the numerator, so  $-20a^8b^4 \div 10a^4b^2 = -2a^4b^2$ .
32. The correct answer is G. Because the 3 lines are parallel, the distances between the points of intersection of each of the transversals are directly proportional. So, the distance from point  $E$  to point  $C$  ( $6''$ ) is directly proportional to the distance from point  $A$  to point  $C$  ( $2''$ ), and the distance from point  $F$  to point  $D$  ( $8''$ ) is proportional to the distance from point  $D$  to

point  $B$  ( $x''$ ). Set up the following proportion and solve for  $x$ :

$$6 : 2 \text{ as } 8 : x$$

$$\frac{6}{2} = \frac{8}{x}$$

$$x = \frac{16}{6}, \text{ which can be simplified to } \frac{8}{3}.$$

33. The correct answer is D. A square is a parallelogram with 4 right angles and 4 sides of the same length. The perimeter of a square is the distance around the square, or the sum of all 4 sides. Since the perimeter is given as 28, the length of each side of the square must be  $28 \div 4$ , or 7. This means that radii  $\overline{DA}$  and  $\overline{DC}$  are both equal to 7. The area of a circle is calculated using the formula  $A = \pi r^2$ . Plug 7 in for  $r$  and solve:
- $$A = \pi r^2 = \pi(7)^2$$
- $$A = \pi 49, \text{ or } 49\pi$$
34. The correct answer is K. According to the graph shown, the number 2 is included, but the number 4 is not included. This means that  $x$  must be less than or equal to 2 ( $x \leq 2$ ) and/or  $x$  must be greater than 4 ( $x > 4$ ). You can eliminate answer choices F and G, which both indicate that  $x$  is greater than or equal to 4 ( $x \geq 4$ ). You can also eliminate answer choice H, which says that  $x$  is less than but not equal to 2 ( $x < 2$ ). Now you must decide whether to use *and* or to use *or*. Since the sets do not overlap on the graph, the correct answer is  $x \leq 2$  or  $x > 4$ .
35. The correct answer is D. To solve this problem, substitute the given dimensions into the equation, as follows:

$$\begin{aligned} \text{Surface area} &= 2\pi(5)^2 + 2\pi(5)(10) \\ &= 2\pi(25) + 2\pi(50) \\ &= 50\pi + 100\pi \\ &= 150\pi \end{aligned}$$

36. The correct answer is G. Because a negative number cannot have a real square root, the value under a square root sign *must* be positive. In this problem, the value under the square root sign is  $4\left(\frac{x^2}{3y}\right)$ . Choose values for the answer choices and eliminate those choices that would give you a negative value under the square root sign:

If  $y$  is negative, then  $3y$  will be negative, so the value under the square root sign could also be negative. Eliminate answer choice F.

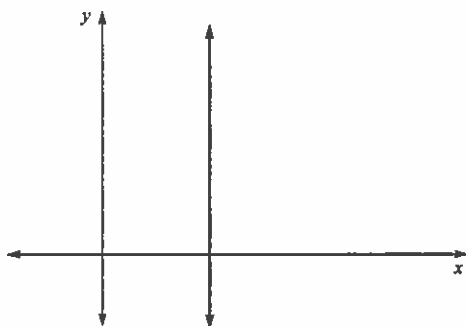
If  $y$  is positive, then  $3y$  will be positive. Since the square of a negative number is also positive, even if  $x$  is negative, as long as  $y$  is positive the value under the square root sign will be positive. Answer choice G will work.

Answer choices H and J are not true, because you have just determined that  $y$  must be positive, which means that, while  $y$  could be either 4 or  $\frac{1}{2}$ , it could also be some other positive value.

Answer choice K does not work, because  $y$  must be a positive number. By process of elimination, you are left with answer choice G.

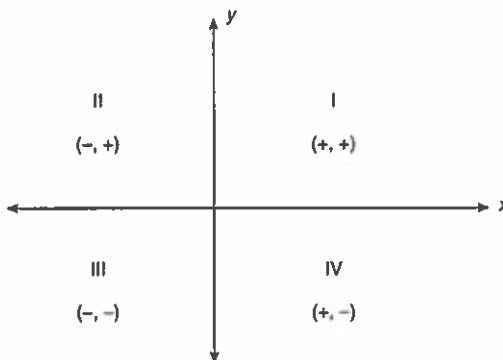
37. The correct answer is B. To solve this problem, first list all of the distinct factors of 96: 96, 48, 32, 24, 16, 12, 8, 6, 4, 3, 2, 1. All of these numbers divide evenly into 96. Next, list all of the distinct factors of 64: 64, 32, 16, 8, 4, 2, 1. All of these numbers divide evenly into 64. The only factors that both 96 and 64 have in common are 1, 2, 4, 8, 16, and 32. Since you are told that  $c$  is NOT a factor of either 16 or 20, you can eliminate 1, 2, 4, 8, and 16, which factor evenly into either 16 or 20. This leaves you with a value for  $c$  of 32. When you add the digits ( $3 + 2$ ) you get 5.

38. The correct answer is J. The slope of a line is defined as the change in the  $y$ -values over the change in the  $x$ -values in the standard  $(x, y)$  coordinate plane. Slope can be calculated by using the following formula:  $\frac{(y_1 - y_2)}{(x_1 - x_2)}$ . Any line parallel to the  $y$ -axis is a vertical line: The  $x$ -values do not change (see diagram).



The slope of a vertical line is undefined, answer choice J, because there is no change in  $x$ , which means that the denominator  $(x_1 - x_2)$  is zero.

39. The correct answer is D. If the coordinates of point J are nonzero and have the same sign, they must both either be positive  $(+, +)$  or negative  $(-, -)$ . Therefore, they must be located in either Quadrant I, or Quadrant III, as shown below:



40. The correct answer is F. The first step in solving this problem is to calculate the sine and the cosine for both angle  $a$  and angle  $b$ . The sine of any acute angle is calculated by dividing the length of the side opposite the acute angle by the length of the hypotenuse ( $\sin = \frac{\text{opp}}{\text{hyp}}$ ). The cosine of any acute angle is calculated by dividing the length of the side adjacent to the acute angle by the hypotenuse ( $\cos = \frac{\text{adj}}{\text{hyp}}$ ). In this problem, the sin of angle  $a$  is  $\frac{12}{15}$ , which reduces to  $\frac{4}{5}$ , and the cos of angle  $a$  is  $\frac{9}{15}$ , reduces to  $\frac{3}{5}$ . The sin of angle  $b$  is  $\frac{9}{15}$ , or  $\frac{3}{5}$ , and the cos of angle  $b$  is  $\frac{12}{15}$ , or  $\frac{4}{5}$ . Now you can plug these values into the equation given in the problem and solve for  $\sin(a - b)$ :

$$\begin{aligned} \sin(a - b) &= \sin a \cos b - \cos a \sin b \\ \sin(a - b) &= \left(\frac{4}{5}\right)\left(\frac{4}{5}\right) - \left(\frac{3}{5}\right)\left(\frac{3}{5}\right) \\ \sin(a - b) &= \left(\frac{16}{25}\right) - \left(\frac{9}{25}\right) = \frac{7}{25} \end{aligned}$$

41. The correct answer is D. This problem can be solved by first converting the fraction and the percent to their decimal equivalents:  $1/100 = (0.01)$  and  $10\% = (0.10)$ . Now, multiply the decimal values:  $0.01 \times 0.10 = 0.001$ .
42. The correct answer is K. The best approach to this problem is to pick some numbers for  $n$ , plug them into the answer choices, and eliminate the answer choices that do not always yield an odd number.

If  $n = 1$ , then  $4n^2 = 4(1)^2 = 4$ , which is not odd. Eliminate answer choice F.

If  $n = 1$ , then  $3n^2 + 1 = 3(1)^2 + 1 = 3 + 1 = 4$ , which is not odd. Eliminate answer choice G.

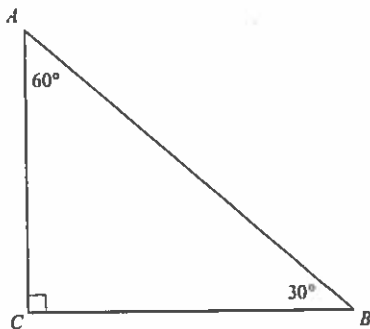
If  $n = 1$ , then  $6n^2 = 6(1)^2 = 6$ , which is not odd. Eliminate answer choice H.

If  $n = 1$ , then  $n^2 - 1 = (1)^2 - 1 = 0$ , which is not odd. Eliminate answer choice J.

If  $n = 1$ , then  $4n^2 - 1 = 4(1)^2 - 1 = 4 - 1 = 3$ , which is odd. Try another number:  $n = 2$ , then  $4n^2 - 1 = 4(2)^2 - 1 = 16 - 1 = 15$ , which is also odd. Answer choice K will work.

Answer choice K is the only one that will give you an odd number for any value of  $n$ .

43. The correct answer is D. The area of a triangle is calculated using the formula  $A = \frac{1}{2}(bh)$ , where  $b$  is the length of the base, and  $h$  is the height. Based on the measures of the angles given, you can draw triangle  $ABC$  as shown below:



You are given that  $\overline{AB}$ , the hypotenuse, is 8 units long. Because this is a 30–60–90 triangle, you can

calculate the lengths of the base ( $\overline{BC}$ ) and the height ( $\overline{AC}$ ). The relationship between the sides of a 30–60–90 triangle is as follows: The side opposite the 30° angle is equal to  $\frac{1}{2}$  of the length of the hypotenuse, and the side opposite the 60° angle is equal to  $\frac{\sqrt{3}}{2}$  of the length of the hypotenuse times  $\sqrt{3}$ . Calculate the lengths of the sides:

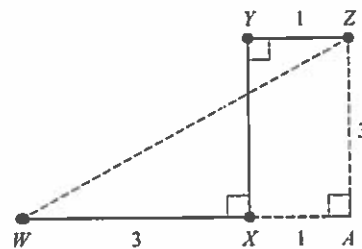
$$\text{Side } \overline{BC} \text{ (the base)} = \frac{1}{2}(8)\sqrt{3} = 4\sqrt{3}$$

$$\text{Side } \overline{AC} \text{ (the height)} = \frac{1}{2}(8) = 4$$

Now you can plug these values into the formula for the area of a triangle:

$$A = \frac{1}{2}(4\sqrt{3})(4) = \frac{1}{2}(16\sqrt{3}) = 8\sqrt{3}$$

44. The correct answer is J. The best approach to solving this problem is to draw a picture like the one shown below:



Extend line  $\overline{WX}$  through point  $X$  to an imaginary point  $A$  that is below point  $Z$ . Then, when you draw line  $\overline{WZ}$ , you create a special right triangle ( $WAZ$ ) with sides of length 3, 4, and 5. Use your knowledge of the special 3–4–5 right triangle to determine  $\overline{WZ} = 5$ .

45. The correct answer is C. The area of a rectangle is calculated by multiplying the length by the width ( $A = w \times l$ ). Calculate the area of the first rectangle as follows:

Set the width equal to  $x$ , and the length equal to  $4x$ .

$$A = x(4x) = 4x^2$$

Now calculate the area of the second rectangle:

The length and width are tripled, so the width =  $3x$  and the length =  $12x$

$$A = (3x)(12x) = 36x^2$$

The area of the second rectangle is  $36x^2$ , which is 9 times greater than the area of the first rectangle ( $4x^2$ ).

46. The correct answer is G. Systems of equations will have infinite solutions when the equations are equal to each other. The first step in solving this problem is to recognize that the second equation is exactly twice the value of the first equation:  $6x = 2(3x)$ ,  $8y = 2(4y)$ , so  $7b$  must equal  $2(14)$ . Solve for  $b$ :

$$7b = 2(14)$$

$$7b = 28$$

$$b = 4$$

47. The correct answer is D. Logarithms are used to indicate exponents of certain numbers called bases. This problem tells you that log to the base 3 of  $x$  equals 2. By definition,  $\log_a b = c$  if  $a^c = b$ . Therefore,  $\log_3 x = 2$  if  $3^2 = x$ . Since  $3^2 = 9$ , answer choice D is correct.

48. The correct answer is K. The first step in solving this problem is to recognize that the distance from the point on the ground to the telephone pole is equal to the length of the side adjacent to the  $37^\circ$  angle, and that the height of the telephone pole is equal to the length of the side opposite the  $37^\circ$  angle. The length of the side opposite to any given angle divided by the length of the side adjacent to any given angle is the tangent of that angle. So, in this problem,  $\tan 37^\circ = \frac{24}{\text{distance}}$ . Solve for the distance:

$$\tan 37^\circ = \frac{24}{\text{distance}}$$

$$(\text{distance}) \tan 37^\circ = 24$$

$$\text{distance} = \frac{24}{\tan 37^\circ} = 24 \left( \frac{1}{\tan 37^\circ} \right)$$

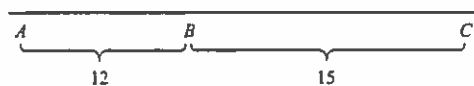
By definition, cotangent is  $\frac{1}{\tan}$ , so the distance is equal to  $24 \cot 37^\circ$ .

49. The correct answer is C. The area of a parallelogram is calculated by using the formula  $A = (b \times h)$ , where  $b$  is the base and  $h$  is the height. The length of the sides,  $(\sqrt{61})$  is not relevant in calculating the area. Plug the given values into the formula:

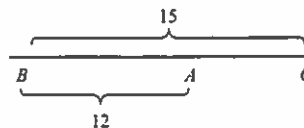
$$A = 6 \times 5$$

$$A = 30$$

50. The correct answer is H. The easiest way to solve this problem is to draw a line and place the given points on the line, as follows:



Based on the line above, one possible length of  $\overline{BC}$  is 27. Eliminate answer choices F, J, and K. Since you are left with answer choices G and H, you need to determine if  $\overline{AC}$  could also be 3 meters long. Draw another line, and change the order of the points:



Based on this line, another possible length of  $\overline{AC}$  is 3, so answer choice H is correct.

51. The correct answer is B. Given that both figures have the same area,  $\frac{1}{2}(a)(2a) = (b)(3b)$ . Therefore,  $a^2 = 3b^2$ ; taking the square root of both sides results in  $a = \sqrt{(3b^2)}$  or  $a = b\sqrt{3}$ .
52. The correct answer is G. In this problem, the quantity  $6a^4b^3$  is less than zero, which means it must be negative. Since 6 is positive, and  $a^4$  will always be positive,  $b^3$  must be negative. By definition, if you cube a negative number, the result will be negative. Therefore, if  $b^3$  is negative, then  $b$  must be negative, or less than zero. This means that  $b$  CANNOT be greater than zero, so answer choice G is correct.
53. The correct answer is C. In a geometric sequence, the quotient of any 2 successive members or terms of the sequence is a constant. This means that the exponent is 1 larger in each successive element of the progression, because you multiply by the same number each time you move to the next element in the sequence. Here, the second term of the sequence will have an exponent of 1 ( $sp$ ), the third term of the sequence will have an exponent of 2 ( $s^2p$ ), the fourth term will have an exponent of 3 ( $s^3p$ ), and so on. You can see that the exponent of any given term is 1 less than the number of the term. Therefore, the exponent of  $s$  of the 734th term must be 733, ( $s^{733}p$ ).
54. The correct answer is J. If a system of 2 linear equations in 2 variables has no solution, that means that the lines do not cross each other anywhere in the  $(x, y)$  coordinate plane. If the lines do not cross each other, then they must be parallel. Parallel lines have the same slope. The line shown has a positive slope, so you can



eliminate answer choice F, which has a slope of zero, and answer choices G and H which have negative slopes. Parallel lines cannot have the same  $y$ -intercept, so eliminate answer choice K.

55. **The correct answer is A.** Because angle  $x$  is less than  $90^\circ$ , it is an acute angle. The tangent of any acute angle is calculated by dividing the length of the side opposite of the acute angle by the length of the side adjacent to the acute angle ( $\tan = \frac{\text{opp}}{\text{adj}}$ ). This means that the length of the side opposite angle  $x$  is 15, and the length of the side adjacent to angle  $x$  is 8. The cosine of any acute angle is calculated by dividing the length of the side adjacent to the acute angle by the hypotenuse ( $\cos = \frac{\text{adj}}{\text{hyp}}$ ). Since you know the lengths of 2 of the sides, you can calculate the hypotenuse by using the Pythagorean Theorem:

Pythagorean Theorem:  $a^2 + b^2 = c^2$ , where  $c$  is the hypotenuse.

$$8^2 + 15^2 = c^2$$

$$64 + 225 = c^2$$

$$289 = c^2$$

$$\sqrt{289} = c, \text{ so } c = 17$$

The hypotenuse is 17, which means that the cos of angle  $x$  is  $\frac{8}{17}$ .

56. **The correct answer is F.** To solve this problem, first look at the answer choices. You can eliminate answer choice J, because if either  $L$ ,  $M$ , or  $N$  were 0, then  $LMN$  would equal 0; you are given that  $LMN = 1$ . Answer choice F must be correct, because  $LM = 1/N$  is true when  $LMN = 1$  (divide both sides by  $N$ ). The remaining answer choices could be true, but you can find at least one instance where they do not have to be true.
57. **The correct answer is D.** A number is rational when it can be written as a fraction. Additionally, any square root that is not a perfect root is an *irrational* number. Only answer choice D can be simplified such that it is a rational number:

$$\frac{\sqrt{81}}{\sqrt{169}} = \frac{9}{13}$$

58. **The correct answer is H.** In order to determine the volume of water to remove from the aquarium, you must first calculate the total amount of water that the aquarium holds. Volume is calculated by multiplying the length (24 inches) by the width (12 inches) by the height/depth (10 inches):

$$24 \times 12 \times 10 = 2,880$$

The total volume of the aquarium is 2,880 cubic inches. Since Rana must remove half of that volume to clean the aquarium, divide 2,880 by 2:

$$2,880 \div 2 = 1,440$$

Rana must remove 1,440 cubic inches of water.

59. **The correct answer is B.** The slope-intercept form of the equation of a line is  $y = mx + b$ , where  $m$  is the slope and  $b$  is the  $y$ -intercept. Parallel lines have the same slope. Since line  $p$  has a slope of 3, line  $q$  must also have a slope of 3. Eliminate answer choices A and C because the slope is not 3. Now you need to determine the  $y$ -intercept. Line  $q$  intercepts the  $y$ -axis below the origin  $(0, 0)$ , which means that the  $y$ -intercept must be negative. Eliminate answer choice E, which has a positive  $y$ -intercept. This leaves answer choices B and D. The distance between lines  $p$  and  $q$  is 3, as shown in the figure. If you draw a perpendicular line from the origin to line  $q$ , you will create a right triangle, with the  $y$ -axis as the hypotenuse. Since the hypotenuse is longer than either of the sides, which equal 3, the  $y$ -intercept of line  $q$  will be greater than 3, so answer choice B must be correct.
60. **The correct answer is F.** If 2 numbers,  $x$  and  $y$ , differ by 12, that means that  $x - y = 12$ . Multiplying the 2 numbers,  $(x)(y)$ , will yield the product. Solve the first equation for  $x$ , then substitute the result for  $x$  in the second equation, as follows:

$$\begin{array}{l} x - y = 12 \\ x = y + 12 \\ (y + 12)y \end{array} \begin{array}{l} \text{First equation} \\ \text{Second equation} \end{array}$$

Since one of the answer choices must be the solution to that equation, plug in the answer choices, starting with the smallest value ( $-36$ ) (note that the answer choices are in ascending order):

$$(y + 12)y = -36$$

$$(y + 12)y + 36 = 0$$

$$y^2 + 12y + 36 = 0$$

$$(y + 6)^2 = 0$$

$$y = -6$$

Now, substitute  $-6$  for  $y$  in the first equation and solve for  $x$ :

$$x - (-6) = 12$$

$$x = 6$$

Both equations are satisfied, and  $-36$  is the smallest value among the answer choices, so the smallest possible value for the product of 2 real numbers that differ by 12 is  $-36$ .