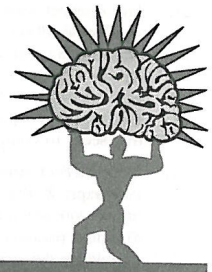


CHALLENGE 2
Mathematics Questions

Directions: Solve each problem, then mark the letter corresponding to the correct answer either in your book or on a separate sheet of scrap paper.

Be careful not to spend too much time on any one question. Instead, solve as many problems as possible, and then use the remaining time to return to the questions you were unable to answer at first.

You may use a calculator for any problem on this challenge. However, some problems can best be solved without the use of a calculator.

Note: Unless otherwise stated, you can assume that

- Diagrams that accompany problems are not necessarily drawn to scale
- All figures lie in the same plane
- The word "line" refers to a straight line (and lines that appear straight are straight)
- The word "average" refers to arithmetic mean

Questions 1–30

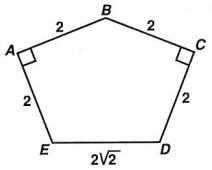
1. P percent of $20\sqrt{3}$ is 3. $P = ?$

(A) $\sqrt{3}$
(B) 3
(C) $5\sqrt{3}$
(D) $10\sqrt{3}$
(E) 20

2. A field can be plowed by 8 machines in 6 hours. If 3 of the machines are broken and cannot be used, how many hours will it take to plow the field?

(F) $12\frac{4}{5}$
(G) $11\frac{1}{2}$
(H) $10\frac{3}{4}$
(J) $9\frac{3}{5}$
(K) $8\frac{2}{3}$

3.



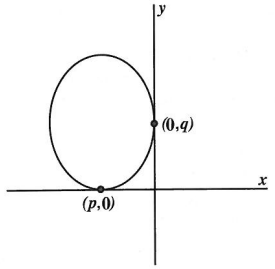
What is the area of polygon $ABCDE$ shown above?

(A) $4 + 2\sqrt{3}$
(B) $3 + 3\sqrt{2}$
(C) $6\sqrt{3}$
(D) $2 + 6\sqrt{2}$
(E) $8\sqrt{2}$

4. If x and y are negative integers, and if $x - y = 1$, what is the least possible value of xy?

(F) -2
(G) -1
(H) 0
(J) 1
(K) 2

5.



In the standard (x,y) coordinate plane, an ellipse is tangent to the x-axis and the y-axis, as shown in the graph. If $|p| < q$, then which of the following is the equation of the ellipse?

(A) $\frac{(x-q)^2}{4q^2} + \frac{(y-p)^2}{4p^2} = 1$
(B) $\frac{(x+p)^2}{p^2} + \frac{(y-q)^2}{q^2} = 1$
(C) $\frac{(x-p)^2}{p^2} + \frac{(y-q)^2}{q^2} = 1$
(D) $\frac{(x-p)^2}{2p^2} + \frac{(y-q)^2}{2q^2} = 1$
(D) $\frac{(x-p)^2}{q^2} + \frac{(y-q)^2}{p^2} = 1$

6. If $m = 121 - 5k$, and m is divisible by 3, which of the following could be true?

I. m is odd
II. m is even
III. k is divisible by 3

(F) I only
(G) II only
(H) I and II only
(J) II and III only
(K) I, II, and III

7. What is the perimeter of a rectangle that is three times as long as it is wide and has the same area as a circle of circumference 6?

(A) $\frac{8\sqrt{3\pi}}{\pi}$
(B) $\frac{8\sqrt{\pi}}{3}$
(C) $4\sqrt{3\pi}$
(D) $8\sqrt{\pi}$
(E) $8\sqrt{3\pi}$

8. A bag contains six numbered slips of paper. Four of the slips are numbered zero (0), and the other two are not. If two slips are drawn at random from the bag, what is the probability that the product of the two numbers is NOT zero?

(F) $\frac{1}{15}$
(G) $\frac{1}{12}$
(H) $\frac{2}{15}$
(J) $\frac{1}{6}$
(K) $\frac{1}{3}$

9. If a fleet of m buses uses g gallons of gasoline every two days, how many gallons of gasoline will be used by four buses every five days?

(A) $\frac{10g}{m}$

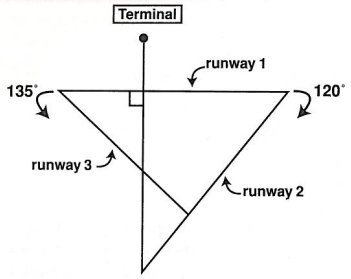
(B) $10gm$

(C) $\frac{10m}{g}$

(D) $\frac{20g}{m}$

(E) $\frac{5g}{4m}$

10.



As shown in the figure above, from runway 1, airplanes must turn either 120° to the right onto runway 2 or 135° to the left onto runway 3. Which of the following does NOT indicate a complete turn from one runway to another?

(F) 105°
(G) 75°
(H) 60°
(J) 55°
(K) 30°

11. If $A = \begin{pmatrix} 2 & -1 \\ 3 & -2 \end{pmatrix}$ and $B = \begin{pmatrix} 0 & 3 & 2 \\ 1 & -2 & -1 \end{pmatrix}$, then $2AB = ?$

(A) $\begin{pmatrix} 0 & 6 & -10 \\ 2 & -12 & 4 \end{pmatrix}$

(B) $\begin{pmatrix} -2 & 6 & 12 \\ -4 & 26 & 16 \end{pmatrix}$

(C) $\begin{pmatrix} -2 & 16 & 10 \\ -4 & 10 & 0 \end{pmatrix}$

(D) $\begin{pmatrix} -2 & 16 & 10 \\ -4 & 26 & 16 \end{pmatrix}$

(E) $\begin{pmatrix} -2 & 8 & 14 \\ 2 & 16 & -8 \end{pmatrix}$

12. If $f(x) = 6^x$ and $g(x) = \log_6 x$, which of the following expressions is equal to $f(2g(M))$?

(F) $2M$
(G) 6^M
(H) M^6
(J) M^2
(K) 6^{2M}

13. An isosceles triangle has two legs at a length of 3 feet. The angle between the two legs measures 32°. What is the length of the triangle's third side?

(A) $3\cos 32°$
(B) $3\sin 32°$
(C) $3\sin 16°$
(D) $6\tan 16°$
(E) $6\sin 16°$

14. If $r = \frac{3p + q}{2}$ and $s = p - q$, for which of the following values of p would $r^2 = s^2$?

(F) $\frac{1}{5}q$

(G) $10 - \frac{3}{2}q$

(H) $q - 1$

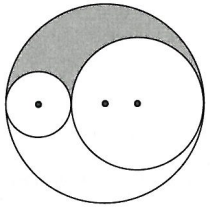
(J) $3q$

(K) $\frac{9}{2}q - 9$

15. The ratio of Elaine's weekly salary to Carl's weekly salary is 3:2. If Elaine receives a 20% raise and Carl receives a $200 raise, the ratio will change to 6:5. Elaine's current salary is

(A) $720
(B) $600
(C) $480
(D) $400
(E) $200

16.



In the figure above, the centers of all three circles lie on the same line. The radius of the middle-sized circle is twice that of the smallest circle. If the radius of the smallest circle is 1, what is the length of the boundary of the shaded region?

(F) 9
(G) 3π
(H) 12
(J) 6π
(K) 12π

17. In the standard (x,y) coordinate plane, point $(a,5)$ lies along a line of slope $\frac{1}{3}$ that passes through point $(2,-3)$. What is the value of a?

(A) 35
(B) 26
(C) 3
(D) -3
(E) -26

18. How many distinct triple-scoop ice cream cones, scoops stacked one atop another, can be created using at least one but not more than three ice-cream flavors, if each scoop contains only one flavor?

(F) 9
(G) 12
(H) 15
(J) 21
(K) 27

19. If $\frac{x}{y}$ is a negative integer, which of the following terms must also be a negative integer?

(A) $\frac{x^2}{y}$

(B) $-\frac{x^2}{y^2}$

(C) $\frac{x}{y^2}$

(D) $x + y$

(E) xy

20. If A and B are positive integers, and if the square root of $24AB$ is an integer, then which of the following CANNOT be true?

I. Both A and B are odd.
II. The square root of AB is an integer.
III. Both A and B are divisible by 6.

(F) I only
(G) II only
(H) III only
(J) I and II only
(K) I, II, and III

21. If the arithmetic mean (simple average) of four numbers is 4, and if the number 6 is added to these four numbers, by what percent has the arithmetic mean changed?

(A) 10%
(B) 20%
(C) 40%
(D) 50%
(E) 60%

22. How many gallons of milk that is 2% butterfat must be mixed with milk that is 3.5% butterfat to get 10 gallons that is 3% butterfat?

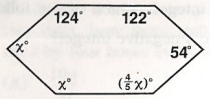
(F) 4

(G) $\frac{11}{3}$

(H) $\frac{7}{2}$

(J) $\frac{10}{3}$

(K) 3

23. 

If two of the angles of the polygon shown above are congruent, what is the least possible sum of two of the polygon's angle measures?

(A) 162°
(B) 174°
(C) 176°
(D) 204°
(E) 216°

24. In a geometric series, each term is a constant multiple of the preceding one. If 4, x, and y are the first three terms in a geometric series, which of the following represents the fifth term in the series?

(F) $\frac{y^2}{4}$
(G) $\frac{64}{y^2}$
(H) $8y^2$
(J) $\frac{y^2}{16}$
(K) $\frac{2}{y^2}$

25. Which of the following is one root of the equation $x^2 + 13 = 4x$?

(A) $4 + i$
(B) $3 - 2i$
(C) $4 + 3i$
(D) $2 - 6i$
(E) $2 + 3i$

26. In the standard (x,y) coordinate plane, the graph of $y = 3\sin 3x$ contains all of the following (x,y) pairs EXCEPT

(F) $\left(\frac{4}{3}\pi, 0\right)$
(G) $\left(\frac{5}{6}\pi, 3\right)$
(H) $\left(\frac{1}{2}\pi, -3\right)$
(J) $\left(\frac{1}{4}\pi, \frac{3}{2}\right)$
(K) $\left(\frac{11}{6}\pi, -\frac{3}{2}\right)$

27. One marble is picked randomly from a bag containing one red marble and two green marbles. One marble is also picked randomly from another bag, which contains three red marbles and four blue marbles. What is the probability that neither marble picked is red?

(A) $\frac{10}{21}$
(B) $\frac{3}{7}$
(C) $\frac{8}{21}$
(D) $\frac{5}{14}$
(E) $\frac{1}{3}$

28. If $x = \log 2$, $y = \log 3$, and $z = \log 5$, then $\log\frac{5}{12} = ?$

(F) $z - x - 2y$
(G) $z + x - 2y$
(H) $z - x + 2y$
(J) $z + 2x - y$
(K) $z - 2x - y$

29. The sum of three consecutive even integers is added to the sum of three consecutive odd integers. If the sum of all six integers, each integer a positive number, is less than 30, the six integers must include each of the following EXCEPT

(A) 2
(B) 3
(C) 4
(D) 5
(E) 6

30. A closed rectangular box contains 384 cubic feet. If the box's height is two-thirds its length, and if the box's height is twice its width, what is the box's total surface area (which includes all six faces) in square feet?

(F) 176
(G) 192
(H) 248
(J) 264
(K) 352

ANSWERS AND EXPLANATIONS

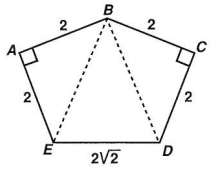
1. **The correct answer is (C).** P percent means $\frac{p}{100}$. Hence, $\frac{p}{100} \times 20\sqrt{3} = 3$. To answer the question, solve for P:

$$\frac{P}{100} \times 20\sqrt{3} = 3$$
$$\frac{P\sqrt{3}}{5} = 3$$
$$P\sqrt{3} = 15$$
$$P = \frac{15}{\sqrt{3}} = \frac{15\sqrt{3}}{\sqrt{3}\sqrt{3}} = \frac{15\sqrt{3}}{3} = 5\sqrt{3}$$

2. **The correct answer is (J).** In this inverse-variation problem, the number of machines multiplied by the number of hours remains constant:

$$(8)(6) = (5)(x)$$
$$5x = 48$$
$$x = 9\frac{3}{5}$$

3. **The correct answer is (A).** Divide the polygon into three triangles as shown below. The area of each of the two outer triangles $= \frac{1}{2}bh = \frac{1}{2}(2)(2) = 2$. (Their combined area is 4.) Since the two outer triangles are both 1:1:$\sqrt{2}$ right triangles, $BE = BD = 2\sqrt{2}$. Hence, the central triangle is equilateral. To calculate its area: $\frac{s^2\sqrt{3}}{4} = \frac{(2\sqrt{2})^2\sqrt{3}}{4} = \frac{8\sqrt{3}}{4} = 2\sqrt{3}$. Hence, the area of the polygon is $4 + 2\sqrt{3}$.



4. **The correct answer is (K).** Solve this problem using the rules for signs and with a bit of logical reasoning. Using negative integers approaching zero (0) will yield the least product. Start with −1, then decrease the values of x and y if necessary. The first two values that satisfy the equation are: $y = -2$, $x = -1$ [$-1 - (-2) = 1$]. Accordingly, $xy = 2$.

5. **The correct answer is (C).** The ellipse's center is at (p,q); hence, applying the standard form of the equation for an ellipse, in which the ellipse's center is at (h,k), $h = p$ and $k = q$. The length of the ellipse's x-axis is $-2p$, and the length of its y-axis is $2q$. Since $|p| < q$, the ellipse is vertically oriented. Accordingly, in the standard form of the equation for an ellipse, the larger denominator, in this case q^2, is under the variable y:

$$\frac{(x-p)^2}{p^2} + \frac{(y-q)^2}{q^2} = 1$$

6. **The correct answer is (H).** A number that is divisible by 3 could be either odd or even. For example, m could be 18 (even) or 21 (odd). Therefore, either statement I or statement II could be true. However, k cannot be divisible by 3, because 121 is not. (A number divisible by 3 subtracted from a number that is not yields a number that is not—for example, $14 - 6 = 8$.)

7. **The correct answer is (A).** A circle's circumference $= 2\pi r$. Given a circumference of 6, $r = \frac{3}{\pi}$. The area of a circle with this radius is $\pi\left(\frac{3}{\pi}\right)^2 = \frac{9}{\pi}$. Letting w equal the rectangle's width, its length is $3w$ and its area is $(w)(3w) = 3w^2$. Given the area of the circle equals that of the rectangle, $3w^2 = \frac{9}{\pi}$. In order to find the rectangle's perimeter, first solve for w:

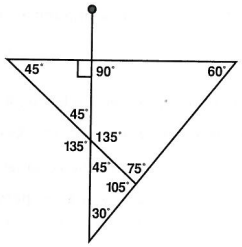
$$3w^2 = \frac{9}{\pi}$$
$$w^2 = \frac{3}{\pi}$$
$$w = \sqrt{\frac{3}{\pi}} = \frac{\sqrt{3}}{\sqrt{\pi}}$$

The perimeter is $2l + 2w = 6w + 2w = 8w = \frac{8\sqrt{3}}{\sqrt{\pi}} = \frac{8\sqrt{3\pi}}{\pi}$.

8. **The correct answer is (F).** The probability of drawing a non-zero number on the first draw is 2 in 6, or $\frac{1}{3}$. In this event, 1 of the remaining 5 slips is non-zero, and hence the probability of drawing that slip is 1 in 5, or $\frac{1}{5}$. To calculate the probability of a non-zero product, multiply together the two individual probabilities you just calculated: $\frac{1}{3} \times \frac{1}{5} = \frac{1}{15}$.

9. **The correct answer is (A).** The surest way of handling this problem is to substitute simple numbers for g and m. If $g = 2$ and $m = 1$, then each bus uses 1 gallon of gasoline each day and, accordingly, 4 buses would use a total of 20 gallons every 5 days. Substituting the number 2 for g and 1 for m in choice (A) yields the result you're looking for: $\frac{10g}{m} = \frac{(10)(2)}{4} = 20$.

10. **The correct answer is (J).** The key to this problem is in determining the interior angles of the various triangles formed by the runways. The interior angle formed by the 120°-turn from runway 1 to 2 is 60° (a 180°-turn would reverse the airplane's direction). Similarly, the interior angle formed by the 135°-turn from runway 1 to 3 is 45° (180° − 135°). Two triangle "angle triplets" emerge: a 45°-45°-90° triplet and a 30°-60°-90° triplet, as shown in the figure below. Since the sum of any triangle's interior angles is 180°, the remaining angles can also be determined:



The only answer choice not appearing in the figure above is 55°.

11. **The correct answer is (D).** The number of columns in A equals the number of rows in B. Accordingly, to form product matrix AB, multiply each row of A by each column of B, arranging the six resulting entries in a 2-row, 3-column matrix as follows:

Column 1:

Row 1: (A row 1)(B col. 1) = (2)(0) + (−1)(1) = −1

Row 2: (A row 2)(B col. 1) = (3)(0) + (−2)(1) = −2

Column 2:

Row 1: (A row 1)(B col. 2) = (2)(3) + (−1)(−2) = 8

Row 2: (A row 2)(B col. 2) = (3)(3) + (−2)(−2) = 13

Column 3:

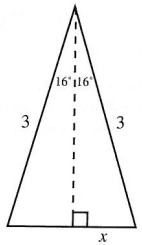
Row 1: (A row 1)(B col. 3) = (2)(2) + (−1)(−1) = 5

Row 2: (A row 2)(B col. 3) = (3)(2) + (−2)(−1) = 8

Matrix $AB = \begin{pmatrix} -1 & 8 & 5 \\ -2 & 13 & 8 \end{pmatrix}$. Accordingly, $2AB = \begin{pmatrix} -2 & 16 & 10 \\ -4 & 26 & 16 \end{pmatrix}$

12. **The correct answer is (J).** $2g(M) = 2\log_6 M = \log_6 M^2$. Hence, $f(2g(M)) = M^2$.

13. **The correct answer is (E).** As you can see from the figure below, letting x = half the length of the base, $\sin 16° = \frac{x}{3}$; $x = 3\sin 16°$; and the length of the entire base = $6\sin 16°$.



14. **The correct answer is (F).** Assuming that $r^2 = s^2$, $\left(\frac{3p+q}{2}\right)^2 = (p+q)^2$. Square both quantities in this equation, isolate zero (0) on one side of the equation, then factor the quadratic expression into two binomials. Find the two roots of p by setting each binomial equal to 0:

$$\frac{9p^2 + 6pq + q^2}{4} = p^2 - 2pq + q^2$$
$$9p^2 + 6pq + q^2 = 4p^2 - 8pq + 4q^2$$
$$5p^2 + 14pq - 3q^2 = 0$$
$$(5p - q)(p + 3q) = 0$$
$$5p - q = 0\,,\; p + 3q = 0$$
$$5p = q\,,\; p = -3q$$
$$p = \frac{q}{5}\,,\; -3q$$

One of these two roots, $\frac{q}{5}$, is the same as $\frac{1}{5}q$.

15. **The correct answer is (B).** Let Elaine's salary be $3k$, and Carl's salary be $2k$. A 20% raise for Elaine will bring her salary to $(1.2)(3k) = 3.6k$, while a \$200 raise for Carl will bring his salary to $2k + 200$. Thus,

$(3.6k) : (2k + 200) = 6{:}5$. Express the proportion as a fraction, then solve for k:

$$\frac{3.6k}{2k + 200} = \frac{6}{5}$$
$$18k = 12k + 1,200$$
$$6k = 1,200$$
$$k = 200$$

Elaine's salary is $3k$, or \$600.

16. **The correct answer is (J).** Since the smallest circle has a radius of 1, the medium circle has a radius of 2, and hence the diameter of the large circle must be 6, which makes its radius 3. The arc of a semi-circle is half the circle's circumference—that is, πr. So the length of the boundary of the shaded region is the sum of the arcs of the three semi-circles: $\pi + 2\pi + 3\pi = 6\pi$.

17. **The correct answer is (B).** Given any two xy-coordinate points, a line's slope $m = \frac{y_1 - y_2}{x_1 - x_2}$. Accordingly, $\frac{1}{3} = \frac{5 - (-3)}{a - 2}$. Simplify, then cross-multiply to solve for a:

$$\frac{1}{3} = \frac{8}{a - 2}$$
$$a - 2 = (3)(8)$$
$$a - 2 = 24$$
$$a = 26$$

18. **The correct answer is (K).** List the possibilities methodically. Letting A, B, and C signify the three flavors, here's one way to do it:

All three scoops same flavor: 3 possibilities (AAA, BBB, CCC)

Each scoop a different flavor: 6 permutations (ABC, ACB, BAC, BCA, CAB, CBA)

Two of the scoops same flavor: 18 possibilities, 6 permutations for each flavor. (For example, if flavor A is used for two scoops, here are the six permutations: AAB, AAC, ABA, ACA, BAA, CAA.)

19. **The correct answer is (B).** $-\frac{x^2}{y^2}$ must be a negative integer, even if x and y are not themselves integers. Because the overall fraction is an integer, $\frac{x^2}{y^2}$ must be an integer. Any number squared is positive, so $\frac{x^2}{y^2}$ must be positive. Accordingly, $-\frac{x^2}{y^2}$ must be negative. Choice (A) can be either a positive or negative integer, depending on whether y is positive or negative. Choice (C) can be a non-integer, since the denominator of the original expression is squared. Also, (C) can be either positive or negative, depending on the sign of x. Choice (D) might be either an integer or a non-integer, and can be either positive or negative, depending on whether x is negative or y is negative. Choice (E) must be negative, but it is not necessarily an integer—for example:

$$-\frac{\frac{2}{3}}{\frac{2}{3}} = -1, \text{ but } -\frac{2}{3} \times \frac{2}{3} = -\frac{4}{9} \text{ (a non-integer)}$$

20. **The correct answer is (J).** The prime factorization of 24 is $2 \times 2 \times 2 \times 3$. Given that $24AB$ is a perfect square (that is, its square root is an integer), B must have a factor of 2 as well as a factor of 3. Since 2 is a factor of AB, A and B cannot both be odd. (The product of two odd integers is always an odd integer, which is not divisible by 2.) So statement I cannot be true. As for statement II, if AB and $24AB$ were both perfect squares, then 24 would be a perfect square. But it's not; so statement II cannot be true. As for statement III, if A were 6 and B were 36, for example, $24B$ would be a perfect square with both A and B divisible by 6:

$$\sqrt{(24)(6)(36)} = \sqrt{(144)(36)} = (12)(6)$$

A single example such as this one shows that statement III could be true. Hence, only statements I and II cannot be true.

21. **The correct answer is (A).** Since the average of the four original numbers is 4, their sum must be 16. To calculate the average of all five numbers, divide the new sum (22) by the number of terms (5). The new average is $\frac{22}{5}$, which is 10%, or $\frac{2}{20}$, greater than the original average $\left(\frac{20}{5}\right)$.

22. **The correct answer is (J).** Letting g represent the number of gallons that is 2% butterfat, $10 - g$ is the amount that is 3.5% butterfat. Solve for g in the following equation:

$$\begin{aligned} .02g + .035(10 - g) &= .03(10) \\ .02g + .35 - .035g &= .3 \\ 20g + 350 - 35g &= 300 \\ -15g &= -50 \\ g &= \frac{10}{3} \end{aligned}$$

23. **The correct answer is (B).** The figure shows a hexagon. The sum of the measures of the six angles = 720°. Subtracting the three known angles from 720 leaves 420°, which is the sum of the measures of the three unknown angles. Set up an equation, then solve for x:

$$\begin{aligned} x + x + \frac{4}{5}x &= 420 \\ \frac{14}{5}x &= 420 \\ x &= (420)\frac{5}{14} = (30)(5) = 150 \end{aligned}$$

Of the three unknown angles, two measure 150° each. The third unknown angle measures 120°. The polygon's two least possible angles are 54° and 120°. Their sum is 174°.

24. **The correct answer is (F).** Since the ratio between each term and the one that precedes it is constant, you can set up an equal proportion, then cross-multiply to solve for x:

$$\begin{aligned} \frac{x}{4} &= \frac{y}{x} \\ x^2 &= 4y \\ x &= \pm 2\sqrt{y} \end{aligned}$$

(The fifth term $T_5 = ar^{(5-1)}$, where a = the first term and r = the constant ratio). To solve the problem, express r in terms of y, then simplify:

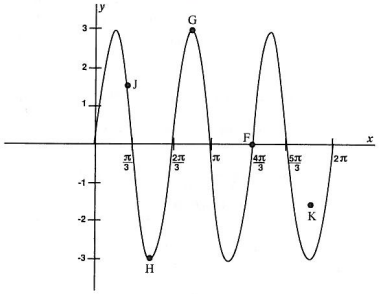
$$T_5 = 4\left(\frac{y}{x}\right)^4 = 4\left(\frac{y}{2\sqrt{y}}\right)^4 = \frac{4y^4}{16y^2} = \frac{y^2}{4}$$

25. **The correct answer is (E).** First, express the equation in standard form: $x^2 - 4x + 13 = 0$ [$a = 1$, $b = -4$, $c = 13$]. Then, apply the quadratic formula:

$$\begin{aligned} x &= \frac{-(-4) \pm \sqrt{(-4)^2 - 4(1)(13)}}{2(1)} \\ &= \frac{4 \pm \sqrt{16 - 52}}{2} \\ &= \frac{4 \pm \sqrt{-36}}{2} \\ &= \frac{4 \pm 6i}{2} \\ &= 2 \pm 3i \end{aligned}$$

The two roots are $2 + 3i$, choice (E), and $2 - 3i$.

26. **The correct answer is (K).** The curve's amplitude and its frequency over period 2π are each 3. Here's the curve's graph:



Observation reveals that the graph intercepts the x-axis in regular $\frac{1}{3}\pi$ intervals beginning at $x = \frac{1}{3}\pi$, and that it attains its positive as well as negative amplitude at regular $\frac{1}{3}\pi$ intervals as well. Choices (J) and (K) are the only two that provide points between an amplitude point and x-intercept. The point $\left(\frac{1}{4}\pi, \frac{3}{2}\right)$ which is choice (J), is the precise midpoint between $\left(\frac{1}{6}\pi, 3\right)$ and $\left(\frac{1}{3}\pi, 0\right)$, and therefore is a point on the curve. However, at $x = x = \frac{11}{6}\pi$, the curve is at negative amplitude -3. Hence, $\left(\frac{11}{6}\pi, -\frac{3}{2}\right)$, which is choice (K), cannot be a point on the curve.

27. **The correct answer is (C).** The probability of selecting two red marbles is $\frac{1}{3} \times \frac{3}{7}$, or $\frac{3}{21}$. To find the probability of selecting *no* red marbles, subtract from 1 each individual probability you just calculated, then combine by multiplying: $\left(1 - \frac{1}{3}\right) \times \left(1 - \frac{3}{7}\right) = \frac{2}{3} \times \frac{4}{7} = \frac{8}{21}$.

28. **The correct answer is (K).** Applying the laws of algorithms, $\log\frac{5}{12} = \log\frac{5}{(2^2)(3)} = \log 5 - (\log 2^2 + \log 3) = \log 5 - 2\log 2 - \log 3 = z - 2x - y$.

29. **The correct answer is (A).** To solve this problem, apply a dose of logic and some methodical trial and error. The sum of all six numbers must be an odd integer because *three* of the terms are *odd*. The least possible sum is 21 [(1 + 3 + 5) + (2 + 4 + 6)]. Thus the only other sums to consider are 23, 25, 27, and 29. A bit of trial and error reveals that, among these four sums, only 27 meets the criteria for the six integers, and only with one combination: [(1 + 3 + 5) + (4 + 6 + 8)]. The two possible groups of six integers share in common the integers 1, 3, 4, 5, and 6. Thus among the five answer choices, (A) is the only one that does *not* appear in each set.

30. **The correct answer is (K).** The ratio of the box's three linear dimensions (length : height : width) is 3:2:1. You can find the box's width w as follows:

$$\begin{aligned} (w)(2w)(3w) &= 384 \\ 6w^3 &= 384 \\ w^3 &= 64 \end{aligned}$$

$w = 4$

Since $w = 4$, $h = 8$ and $l = 12$. Determine the box's surface area as follows:

$$\begin{aligned} 2lw + 2wh + 2lh &= 2(48) + 2(32) + 2(96) \\ &= 96 + 64 + 192 \\ &= 352 \end{aligned}$$