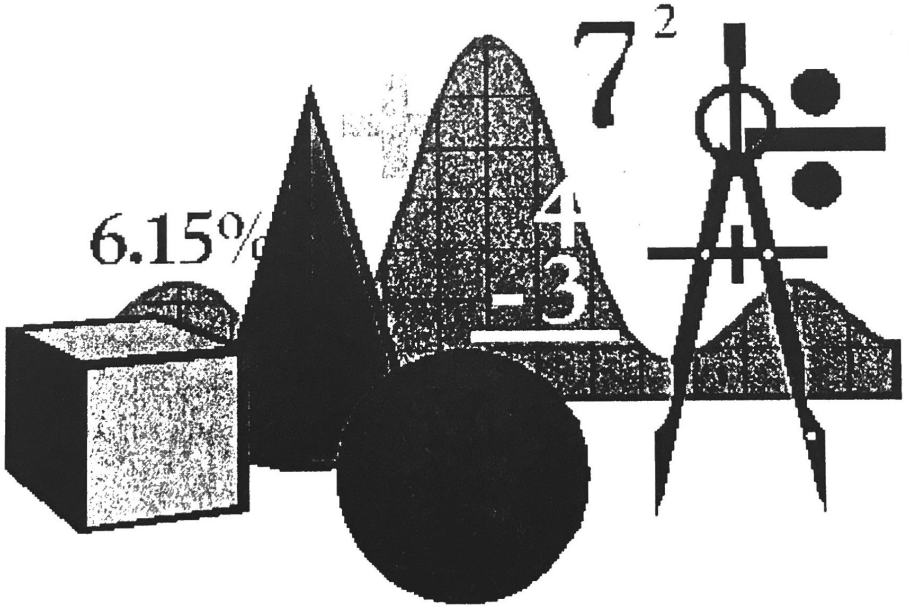
UNIVERSITY INTERSCHOLASTIC LEAGUE

Making a World of Difference

Mathematics

Invitational A • 2008



WRITE ALL ANSWERS WITH
CAPITAL LETTERS

DO NOT TURN THIS PAGE UNTIL
YOU ARE INSTRUCTED TO DO SO!

1. Evaluate: $5! \div (5)^{-1} \times \sqrt[5]{(5)^5} + 1 - 5$

(A) 2996 (B) 2500 (C) 116 (D) -604 (E) -3004

2. $777_8 + 666_7 + 555_6 =$ _____ $_5$

(A) 43321 (B) 33221 (C) 32211 (D) 13233 (E) 32111

3. X varies directly with Y and Y = -3 when X = 6. Find Y when X = -3.

(A) 9 (B) 4.5 (C) 1.5 (D) -2 (E) -6

4. Tu Lite weighs 60 pounds and is sitting on a seesaw 4 feet from the middle. Heah Bigg weighs 110 pounds and is sitting 2 feet from the center. How much weight will Tu need to gain or lose in order to balance the seesaw?

(A) gain 60 lbs (B) gain 40 lbs (C) gain 10 lbs (D) lose 5 lbs (E) lose 20 lbs

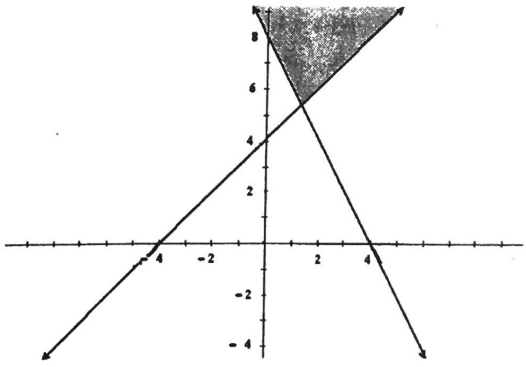
5. A flag pole is 16 ft tall and casts a shadow 24 ft long. The height of a fence post from the ground to the top of the post is 6 ft. How long is the shadow cast by the fence post at the time the shadow of the flag pole is cast?

(A) 14 ft (B) 12 ft (C) 10 ft (D) 9 ft (E) 7 ft

6. A triangle is inscribed in a circle. The lengths of the sides of the triangle are 7", 8", and 9". Find the radius of the circle. (nearest tenth)

(A) 2.7 " (B) 3.1 " (C) 4.7 " (D) 5.1 " (E) 6.7 "

7. Which of the following system of inequalities would be best represented by the shaded region shown?



(A) $y \leq x + 4$, $y \geq 8 - 2x$ (B) $y \geq 8 - 2x$, $y \geq x + 4$ (C) $y \geq x + 4$, $y \leq 8 - 2x$ (D) $y \leq 8 + 2x$, $y \leq x - 4$ (E) $y \leq x - 4$, $y \geq 8 + 2x$

8. Determine the type of conic section this equation $y^2 - 4x^2 - 6y - 8x = 11$ will produce.

(A) cardioid (B) circle (C) ellipse (D) hyperbola (E) parabola

9. A forest ranger in tower A can see the forest ranger in tower B on a bearing of 115°. What is the bearing from tower B to tower A?

(A) 295° (B) 245° (C) 115° (D) 65° (E) 25°

10. Find the value of $\cos(\text{Arccos}\ \frac{3}{5} + \text{Arcsin}\ \frac{3}{5})$.

(A) $-\frac{3}{5}$ (B) 0 (C) $\frac{3}{5}$ (D) $\frac{5}{6}$ (E) $1\frac{1}{5}$

11. Let $\begin{bmatrix} 3 & -1 \\ 2 & 5 \end{bmatrix} = 2x - 1$. Find x.

(A) 9 (B) 6.5 (C) 5 (D) 1 (E) 13

12. Mrs. Fu got 95% of the problems correct on her first test, 91% correct on her second test, and 98% correct on her third test. What was her average percent of correct answers for the three test? (nearest hundredth)

(A) 94.67 % (B) 94.62 % (C) 94.58 % (D) 94.54 % (E) 94.49%

13. If $f(\theta) = \sin 2\theta$ then $f'(120°) =$ _____.

(A) $\sqrt{3}$ (B) $\sqrt{2}$ (C) $2\sqrt{3}$ (D) $-\frac{1}{2}$ (E) -1

14. Let $x^2 - \sqrt{3}\,xy - 1 = 0$. What is the angle of rotation from it's parent function? (nearest degree)

(A) 30 ° (B) 60 ° (C) 75 ° (D) 120 ° (E) 150 °

15. Find the 10th term of the series 2, 1, 3, 4, 7, 11, ...

(A) 47 (B) 57 (C) 65 (D) 76 (E) 123

16. Five red cards and 8 black cards are shuffled together. Two cards are drawn, one after the other, without replacement. What is the probability that a red card is the second card drawn?

(A) $\frac{8}{13}$ (B) $\frac{5}{8}$ (C) $\frac{7}{13}$ (D) $\frac{5}{13}$ (E) $\frac{3}{8}$

17. If $(r + (r)^{-1})^2 = 3$, then $(r^3 + (r)^{-3}) = ?$

(A) -3 (B) -1 (C) 0 (D) 2 (E) 4

18. How many ways can Tye Gehr arrange 8 identical golf balls into 4 boxes so that each box has at least 1 golf ball in it?

(A) 495 (B) 120 (C) 70 (D) 35 (E) 24

19. Ms. Fishbreath has 22 students in her class. Eleven students like Algebra, 13 students like English, and 5 students like neither Algebra nor English. How many students like both Algebra and English?

(A) 8 (B) 7 (C) 6 (D) 5 (E) 4

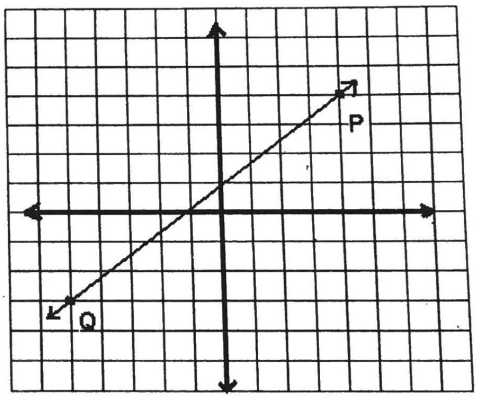
20. The universal set $U = \{u,n,i,f,o,r,m,1,2,3\}$. Subset $F = \{f,o,r,1\}$ and subset $N = \{n,o,r,m,2\}$. How many elements are in the complement set of $F \cup N$?

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

21. Willie Ghetrich deposits \$4000 in a savings account that pays 3% simple interest per year. He deposits \$6000 in another savings account that pays 5% simple interest per year. At the end of 4 years he will withdraw all of the money in both accounts and deposit all of it in a new account. How much will he have to deposit in the new account?

(A) \$10,216.00 (B) \$11,680.00 (C) \$11,800.00 (D) \$14,200.00 (E) \$16,000.00

22. Which of the points is on a line going through $(3, -1)$ and perpendicular to the line PQ?



(A) $(-6, 6)$ (B) $(12, 6)$ (C) $(-4, 8)$ (D) $(10, -6)$ (E) $(-4, -10)$

23. A PVC pipe is 10 feet long. The inside circumference of the pipe is 8π inches. One end is capped, the pipe is stood up, and water is poured in. What is the maximum number of whole gallons of water that can be poured in?

(A) 13 gal (B) 26 gal (C) 52 gal (D) 17 gal (E) 20 gal

24. Sleepy, Dopey, and Happy looked at their circular clock. The time shown was 7:20 AM. They asked Doc to find the measure of the smaller angle between the big hand and the little hand. What should Doc find the measure to be?

(A) 120° (B) 100° (C) 90° (D) 75° (E) 15°

25. The graph of $x^2 + 6x + y^2 - 6y + 15 = 0$ lies in quadrant(s):

(A) IV (B) III (C) II (D) I (E) I, II, III, & IV

26. Chia Mite leaves Salt Gap heading to the city at 40 mph. Fifteen minutes later Betty Wont leaves Salt Gap using the same route as Chia at 55 mph. How long will it take Betty to catch Chia?

(A) 25 min (B) 30 min (C) 35 min (D) 40 min (E) 45 min

27. Determine the frequency of $y = 1 + 2\cos(\frac{4\pi}{3}x)$.

(A) $\frac{2}{3}$ (B) $\frac{3}{4}$ (C) 1 (D) $1\frac{1}{3}$ (E) $1\frac{1}{2}$

28. Determine the range the function $f(x) = 2 - \sqrt{3x+5}$.

(A) $[-1\frac{2}{3}, \infty)$ (B) $(-\infty, -2]$ (C) $(-\infty, \infty)$ (D) $(-\infty, 2]$ (E) $[2, -1\frac{2}{3}]$

29. Let $f(x) = \frac{x^2 - x - 2}{x - 2}$ and s(x) be the slant asymptote of f. Find the value of s(1).

(A) -2 (B) -1 (C) 0 (D) 1 (E) 2

30. R_1, R_2 and R_3 are the roots of the equation $6x^3 - 11x^2 - x + 6 = 0$. R_1 and R_2 are the roots of the equation $6x^2 - 5x - 6 = 0$ as well. Find R_3.

(A) 1.5 (B) 1 (C) $-.5$ (D) -1.5 (E) -6

31. Let $f(x) = \frac{3x - 5}{2x}$. Find $f'(-1)$.

(A) 1 (B) 1.5 (C) 2.5 (D) 3 (E) 4

32. The focus of the figure given by the equation $y^2 + 4y + 12x + 16 = 0$ is (x , y). Find x.

(A) -1 (B) -2 (C) -3 (D) -4 (E) -6

33. Willy Luze is playing a game with a fair die. If he rolls a 1, 2, or 3 he loses 200 points. If he rolls a 4 or 5 he loses 100 points. If he rolls a 6 he wins 1000 points. How many points should Willy expect on average to gain or lose?

(A) gain $33\frac{1}{3}$ (B) gain $66\frac{2}{3}$ (C) lose $16\frac{2}{3}$ (D) lose $33\frac{1}{3}$ (E) lose $66\frac{2}{3}$

34. Two girls and two boys are lined up randomly in a row. What is the probability there is exactly one girl between the two boys?

(A) 25% (B) $33\frac{1}{3}$% (C) 50% (D) $66\frac{2}{3}$% (E) 75%

35. Which of the following numbers is considered to be an "unlucky abundant" number?

(A) 128 (B) 112 (C) 87 (D) 63 (E) 45

Vector $v = (8, 6)$ and vector $u = (-3, 4)$. Find the dot product of vectors u and v.

(A) 0 (B) 14 (C) 15 (D) 24 (E) 36

37. Four and one-fifth million is subtracted from three and one-half billion. The difference is multiplied by five and one fourth thousand. The product is divided by two million two thousand twenty. The quotient is rounded to the nearest whole number. How many zeros are in the quotient?

(A) 6 (B) 4 (C) 3 (D) 1 (E) 0

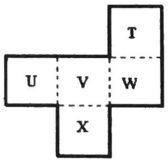
38. A mathematician considered to be one of the founders of the field of computer science was:

(A) Sophie Germain (B) Archimedes (C) Diophantus (D) Euclid (E) George Boole

39. Mr. and Mrs. Zorro want to name their new baby so that its first initial, middle initial, and last initial are in alphabetical order with no letters repeating. How many sets of these initials are possible?

(A) 260 (B) 300 (C) 600 (D) 2,600 (E) 15,600

40. A piece of paper is cut along the solid lines shown. It is folded along the dotted lines to form an open box. Which letter is on the bottom of the box if the opening is on top?



(A) T (B) U (C) V (D) W (E) X

41. Find the sum of the critical points of function $g(x) = 2x^3 - 3x^2 - 12x$.

(A) -2 (B) -1 (C) 1 (D) 3 (E) 4

42. Which of the following sets of numbers does not satisfy the closure property of addition?

(A) Evens (B) Integers (C) Irrationals (D) Rationals (E) Reals

43. The vector $(-16, 10)$ is perpendicular to which of the following vectors?

(A) $(5, -8)$ (B) $(-10, 16)$ (C) $(5, 8)$ (D) $(-16, -10)$ (E) $(-5, 8)$

44. One of the factors of $x^3 + 7x^2 + 2x + 14$ is:

(A) $x - 7$ (B) $x^2 + 2$ (C) $x + 14$ (D) $x^2 - 2$ (E) $x^2 - 7$

45. The length of a rectangle is 20 inches and its width is 14 inches. The diagonals of the rectangle intersect at point P. What is the distance from point P to one of the vertices? (nearest tenth)

(A) 12.2 in (B) 16.3 cm (C) 17.0 in (D) 23.0 in (E) 24.4 in

46. The sum of the real solutions of $\left|3 - |2 - x|\right| = 4$ is:

(A) 4 (B) 16 (C) -2 (D) -5 (E) 9

47. Which of following is a solution for $\sin 2\theta = -\sin(-\theta)$?

(A) $\frac{8\pi}{3}$ (B) $\frac{7\pi}{2}$ (C) $\frac{10\pi}{3}$ (D) $\frac{9\pi}{2}$ (E) $\frac{11\pi}{3}$

48. The absolute maximum of the function $f(x) = x^2 - 5x + 7$ on the interval $-1 \leq x \leq 3$ is :

(A) 13 (B) 3 (C) $2\frac{1}{2}$ (D) 1 (E) $\frac{3}{4}$

49. Evaluate: $\int_{-a}^{a} (4x - 3)\, dx$

(A) $4a^2$ (B) $-6a$ (C) $2a(a - 3)$ (D) $a(2a + 3)$ (E) does not exist

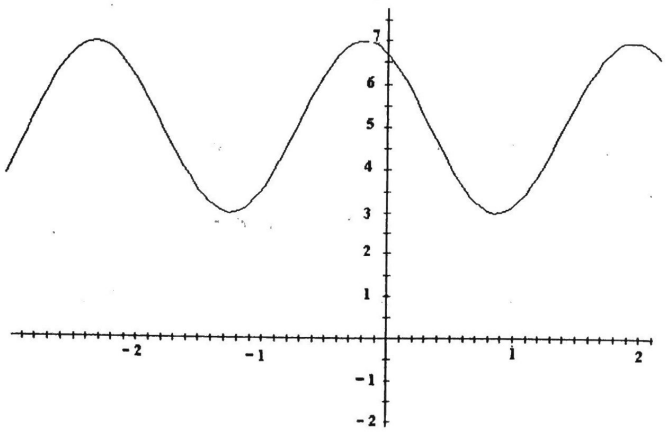
50. The number 2008 in base 9 is equivalent to the number wxy2 in base 8, where w, x, and y are digits. Find $w + x + y$.

(A) 27 (B) 24 (C) 18 (D) 16 (E) 15

51. Which of the following is NOT a solution to $|1 - 4x| - 7 < -2$?

(A) 1.742 (B) 1.427 (C) 0.247 (D) -0.472 (E) -0.742

52. The equation $y =$ _____ will produce this graph.



(A) $4 - 2\cos(3x + 1)$ (B) $5 + 3\sin(2x - 1)$ (C) $5 - 2\sin(3x - 1)$

(D) $4 - 3\cos(2x - 5)$ (E) $5 - 3\sin(2x + 1)$

...of the rectangle to the nearest tenth)

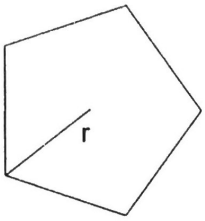
...ne graph of $r = 4\cos 2\theta$ is a(n) _____.

(A) limacon (B) circle (C) rose (D) cardioid (E) spiral

54. The point $(-3, 3)$ is rotated 30 degrees counterclockwise about the origin. The coordinates of the point after the rotation is _____. (closest approximation)

(A) $(4.1, -1.1)$ (B) $(-4.9, 1.9)$ (C) $(4.1, 1.1)$ (D) $(4.9, -1.9)$ (E) $(-4.1, 1.1)$

55. The length of the circumradius, r, shown in the regular polygon below is 5 cm. Find the area of the regular pentagon. (nearest tenth)



(A) 19.3 cm^2 (B) 29.7 cm^2 (C) 38.6 cm^2 (D) 59.4 cm^2 (E) 73.5 cm^2

56. The ellipse $4x^2 + y^2 - 8x + 4y - 8 = 0$ has a major axis with a length of:

(A) 20 (B) 16 (C) 12 (D) 8 (E) 4

57. If $a_1 = 2$, $a_2 = 1$ and $a_n = a_{n-2} + a_{n-1}$, where $n \geq 3$, then a_6 equals:

(A) 5 (B) 6 (C) 7 (D) 11 (E) 18

58. The altitude of $\triangle PQR$ forms two right triangles, $\triangle PQX$ and $\triangle RQX$. PQ = 11 cm, RX = 10 cm, and $m\angle RQX = 48°$. Find PX. (nearest tenth)

(A) 14.1 cm (B) 13.5 cm (C) 9.0 cm (D) 6.3 cm (E) 5.5 cm

59. Simplify to the form $a + bi$: $3\sqrt{-50} + \sqrt{-72}$

(A) $11 + 3\sqrt{2}\,i$ (B) $0 + 21\sqrt{2}\,i$ (C) $-21\sqrt{2} + 0\,i$

(D) $15\sqrt{2} + 6\sqrt{2}\,i$ (E) $0 - \sqrt{22}\,i$

60. The Cheep Shoppe sells baby chicks for ten cents each and sells adult hens for seventy-five cents each. One week they sold a total of 346 baby chicks and adult hens for a total of $123.00. How many baby chicks did they sell that week?

(A) 74 (B) 85 (C) 136 (D) 210 (E) 223

1. Evaluate: $(3)^3 \div (3+6) - 3! \times \sqrt{9}$

(A) -17 (B) -15 (C) -9 (D) 18 (E) 27

2. $888_9 + 555_6 + 222_3 =$ _____ 12

(A) 582 (B) 689 (C) 969 (D) 1111 (E) 1169

3. 70 miles per hour is equivalent to _____ inches per second.

(A) 840 (B) 1056 (C) 1232 (D) 1680 (E) 6160

4. Which of the following equations has a graph of a parabola that intersects the y-axis at only one point and the x-axis at only one point? $y =$ _____ .

(A) $.5x^2 - 2x + 1$ (B) $x^2 - 4x - 5$ (C) $|2x - 4| + 1$ (D) $2 \pm \sqrt{x}$ (E) $12(x)^{-1}$

5. Tryce Ikle can get to school in 12 minutes riding his bike at an average of 15 miles per hour (mph). How many minutes would it take him to walk to school if he walks at 4 mph?

(A) 31 (B) 32 (C) 45 (D) 48 (E) 72

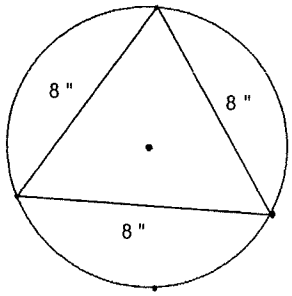
6. If $x + y = 5$ and $xy = 1$ then $x^3 + y^3 = ?$

(A) 128 (B) 124 (C) 122 (D) 115 (E) 110

7. The area of a rectangle is 300 cm^2. The ratio of its length to its width is 4:3. The perimeter of the rectangle is:

(A) 125 cm (B) 112 cm (C) 100 cm (D) 70 cm (E) 35 cm

8. Find the radius of the circle. (nearest tenth)



(A) 3.8 " (B) 5.7 " (C) 4.6 " (D) 5.2 " (E) 4.1 "

9. $\angle P$ is supplementary to $\angle Q$ and $\angle R$ is complementary to $\angle S$. If $m\angle P = 75°$ and $m\angle Q = 3 \times m\angle R$, then $m\angle S = ?$

(A) 75 ° (B) 55 ° (C) 35 ° (D) 20 ° (E) 15 °

10. Noah Sense is making a trapezoid using pennies. The bottom base is a row of 15 pennies. The next row above the base row contains 1 less penny and each successive row contains 1 less penny. He continues until the top base of the trapezoid has only 3 pennies. How much money does he need to form the trapezoid of pennies?

(A) \$1.20 (B) \$1.17 (C) \$1.14 (D) \$1.10 (E) \$1.05

11. Determine the type of conic section this equation $x^2 + 2xy + y^2 - 6x - 6y + 9 = 0$ will produce.

(A) point (B) parabola (C) line (D) hyperbola (E) ellipse

12. The roots of the equation $x^3 - bx^2 + 23x + d = 0$ are -1, 9, and R. Find R.

(A) -14 (B) -9 (C) 4 (D) 14 (E) 15

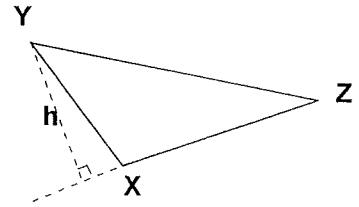
13. Determine the period of the function $y = 3 - 2\cos(\frac{x}{4} + \pi)$

(A) $\frac{\pi}{2}$ (B) π (C) 4π (D) $\frac{11\pi}{2}$ (E) 8π

14. How many points of intersection are there for the curves $r = \sin 2\theta$ and $r = 2\sin\theta$?

(A) 0 (B) 1 (C) 2 (D) 4 (E) 5

15. A triangle is drawn as shown. Find the height, h, if YZ = 18", m∠YZX = 30 °, and XZ = 12".



(A) 15" (B) 12" (C) 10" (D) 9" (E) 8"

16. Use the Fibonacci characteristic sequence ... -1.5, p, q, 3, r, ... to Find $p + q + r$.

(A) .75 (B) 2.25 (C) 6.75 (D) 8.25 (E) 11.25

17. The directrix for the parabola $-8y = x^2$ is $y =$ _____.

(A) $2\sqrt{2}$ (B) 2 (C) $\frac{\sqrt{2}}{2}$ (D) $-\frac{1}{2}$ (E) $-\frac{1}{8}$

18. If $A = \begin{bmatrix} 2 & 3 \\ 4 & x \end{bmatrix}$ and $B = \begin{bmatrix} y & 1 \\ -1 & -1 \end{bmatrix}$ then $AB = \begin{bmatrix} -1 & -1 \\ 1 & 1 \end{bmatrix}$. Find $x + y$.

(A) 0 (B) 1 (C) 2 (D) 3 (E) 4

19. Let $f(x) = \begin{cases} x & \text{if } x \leq 0 \\ x^2 & \text{if } 0 < x \end{cases}$. Which of the following statements is a false statement.

(A) f is continuous at 0 (B) the right hand derivative at 0 is 0
(C) the left hand derivative at 0 is 1 (D) f is not differentiable at 0 (E) $f(-1) = f(1)$

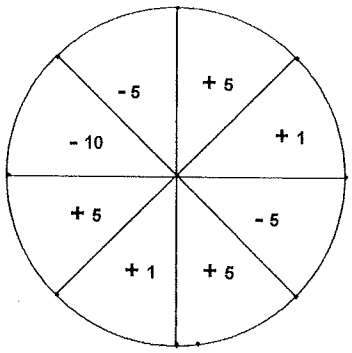
20. Let $\frac{6x^2}{5} - \frac{3xy}{2} + \frac{19y^2}{5} - 4 = 0$. What is the angle of rotation from it's parent function? (nearest degree)

(A) 8° (B) 11° (C) 15° (D) 23° (E) 30°

21. Two non negative numbers x and y exist such that the sum of the numbers is 12 and that the product of one number and the square of the other number is a maximum. What is the maximum product?

(A) 256 (B) 245 (C) 216 (D) 175 (E) 128

22. Betty Wheel spins the Wheel of Fun. The wheel consists of eight congruent sectors as shown. What is the mathematical expectation on any one spin?



(A) -3 (B) $-.375$ (C) $+.25$ (D) $+1.25$ (E) $+5$

23. The probability of scoring less than 200 on this test is 75%. What are the odds of a student scoring greater than or equal to 200 on this test?

(A) 1 to 3 (B) 1 to 4 (C) 1 to 8 (D) 3 to 1 (E) 3 to 8

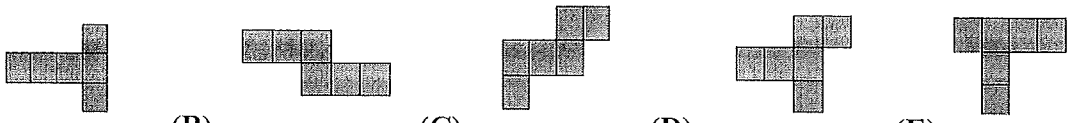
24. Berry Kold Creamery has four flavors of ice cream: vanilla, pistachio, black walnut, and strawberry. The daily sundae has three scoops of ice cream. How many variations of sundaes are there?

(A) 35 (B) 12 (C) 24 (D) 6 (E) 20

25. Vector $v = (8, 6, -2)$ and vector $u = (-4, x, 1)$. Find x if the dot product of vectors u and v is 2.

(A) 24 (B) 6 (C) 3 (D) -2 (E) -7

26. Which of the following nets when folded will not form a cube?



(A) (B) (C) (D) (E)

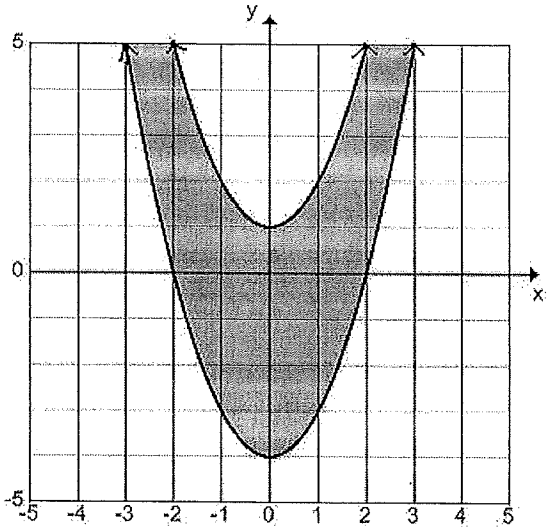
27. Melody Toone's music store sells a new CD for 125% above the wholesale cost. The store will buy the CD back in used condition for 40% of the selling price. How much profit will the store make if the selling price was $19.99?

(A) $3.11 (B) $4.89 (C) $8.88 (D) $11.88 (E) $16.88

28. A tangent and a secant intersect at point A in the exterior of a circle. The measures of the two intercepted arcs are 75° and 50°. What is the measure of angle A formed by the tangent and the secant?

(A) 125° (B) 62.5° (C) 37.5° (D) 25° (E) 12.5 °

29. Which of the following system of inequalities would be best represented by the shaded region shown?



(A) $y \geq x^2 + 4$ $y \geq x^2 - 1$ (B) $y \leq x^2 + 4$ $y \geq x^2 - 1$ (C) $y \leq x^2 - 4$ $y \geq x^2 + 1$ (D) $y \geq x^2 - 4$ $y \leq x^2 + 1$ (E) $y \geq x^2 - 4$ $y \leq x^2 - 1$

30. A porch is 3 feet high. A ramp is built to reach from the porch to the ground with an angle of elevation of 15°. How far from the base of the porch does the ramp touch the ground? (nearest inch)

(A) 11' 7" (B) 11' 2" (C) 10' 6" (D) 9' 11" (E) 8' 5"

31. Mr. White and his dog walked 1 mile at an average speed of $3\frac{1}{3}$ mph and returned home the same route at an average speed of $2\frac{1}{2}$ mph. What was their average speed for the entire walk?

(A) $2\frac{11}{12}$ mph (B) $2\frac{6}{7}$ mph (C) $2\frac{8}{9}$ mph (D) $2\frac{5}{6}$ mph (E) $2\frac{3}{4}$ mph

32. The slope of the line tangent to the curve $y = x^3 - 5x + 6$ at $x = 1$ is -2. The point of intersection of the tangent line and the curve is:

(A) $(-2, 8)$ (B) $(-1, 2)$ (C) $(-1, 11)$ (D) $(-2, 0)$ (E) $(-3, -6)$

33. Fifty-Fifty High School has five male teachers and five female teachers. How many ways are there to form a committee of three female teachers and two male teachers?

(A) 20 (B) 25 (C) 50 (D) 80 (E) 100

34. Find the product of all of the solutions of $16^{x^2+x+4} = 32^{x^2+x}$.

(A) -16 (B) -6 (C) 2 (D) 4 (E) 8

35. The average of five tests is 85. If two test scores have 5 points removed from each, 1 test score has 20 points added, and the remaining two remain the same, the new average is:

(A) 84 (B) 85 (C) 86 (D) 87 (E) 88

36. Kandy Heart had a box of valentines. She gave $\frac{2}{3}$ of them to her classmates. She gave 5 of the remaining valentines to her brothers and sisters. She had 3 left over for her father, her mother, and herself. How many valentines were in the original box?

(A) 12 (B) 18 (C) 24 (D) 30 (E) 36

37. One of Eratosthenes of Cyrene's main contributions to mathematics involved a method for finding _____.

(A) quadratic solutions (B) slopes of line (C) prime numbers
(D) diagonals of polygons (E) complex numbers

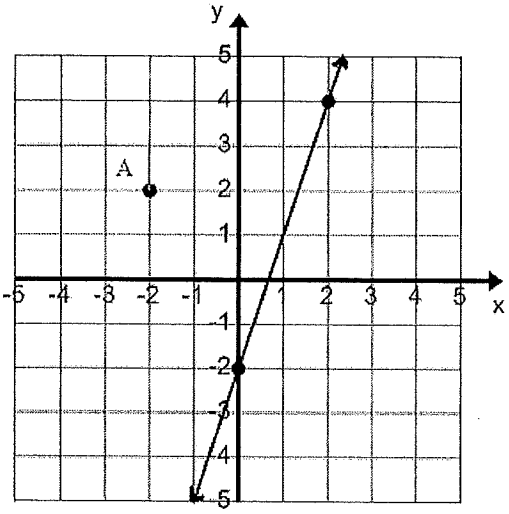
38. Line $6x - 5y = 4$ is perpendicular to line $3x - ay = 1$. What is the value of a?

(A) -3.6 (B) -2.5 (C) 2.5 (D) 3 (E) 5

39. Two circles, $(x-2)^2 + (y-5)^2 = 25$ and $(x-6)^2 + (y-13)^2 = 65$, intersect at two points. Find the equation of the line passing through the two points of intersection.

(A) $2x + y = 27$ (B) $2x + 2y = 19$ (C) $x - y = 17$ (D) $x + 2y = 17$ (E) $x - 2y = 27$

40. Line AB is parallel to the line shown. Which of the following points could be point B?



(A) $(-7, -5)$ (B) $(-6, -10)$ (C) $(4, 21)$ (D) $(2, 13)$ (E) $(5, -1)$

41. Six boys and twelve girls are in the senior class. Half the boys and 25% of the girls wear glasses. What is the probability that a student chosen randomly is a boy, wears glasses, or both?

(A) $16\frac{2}{3}\%$ (B) 25% (C) $33\frac{1}{3}\%$ (D) 50% (E) $66\frac{2}{3}\%$

42. Find the unit vector in the same direction as (8 , 15).

(A) $(\frac{8}{17}, \frac{15}{17})$ (B) (9 , 2) (C) (25 , 32) (D) $(8\sqrt{17}, 15\sqrt{17})$ (E) $(\frac{8}{15}, \frac{15}{8})$

43. The point (3 , 4) is rotated 60 degrees clockwise about the origin. The coordinates of the point after the rotation is _____. (closest approximation)

(A) (5 , — .6) (B) (— 2 , 4.6) (C) (4.6 , 2) (D) (.6 , 5) (E) (5 , — 2)

44. One of the roots of $ax^2 + bx + c = 0$ is $2 - 3i$. Find $b^2 - 4ac$, when $a = 1$.

(A) — 9 (B) — 13 (C) — 24 (D) — 30 (E) — 36

45. Evaluate: $(\log_2 8)(\log_3 9)(\log_4 4)$

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

46. Find the area, in square units, of the figure bounded by $y = x^2 - x - 2$ and below the x-axis.

(A) $1\frac{5}{6}$ (B) $2\frac{3}{4}$ (C) $3\frac{2}{3}$ (D) $4\frac{1}{2}$ (E) $6\frac{1}{3}$

47. Find the value of $\sin(\text{Arcsin}\ \frac{1}{2} - \text{Arccos}\ \frac{1}{2})$.

(A) $-\frac{\sqrt{3}}{2}$ (B) $-\frac{1}{2}$ (C) 0 (D) $\frac{1}{2}$ (E) $\frac{\sqrt{3}}{2}$

48. A scout troop leaves their vehicles and travels on a hike of 2 km on a bearing of 45° to Camp Fife for a swim. Then they travel 3 km on a bearing of 135° to the scout lodge for lunch. What is the least distance they will have to hike to return to their vehicles? (nearest tenth)

(A) 5.0 km (B) 4.3 km (C) 3.9 km (D) 3.6 km (E) 2.5 km

49. Let $f(x) = \frac{x-2}{3x+5}$. Find $f'(-1)$.

(A) $-1\frac{1}{2}$ (B) $-1\frac{1}{4}$ (C) $\frac{1}{3}$ (D) $1\frac{1}{4}$ (E) $2\frac{3}{4}$

50. Two legs of a triangle have lengths of 10 cm and 15 cm with an included angle of 30°. Find the area of the triangle.

(A) 75 cm^2 (B) 65 cm^2 (C) 55 cm^2 (D) 40.4 cm^2 (E) 37.5 cm^2

51. How many asymptotes does this function have? $f(x) = \frac{x^2+6x+8}{x^2-6x+8}$.

(A) 0 (B) 1 (C) 2 (D) 3 (E) 4

52. Find the digit in the ten-thousandths place of the series $1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \ldots$, when $x = \pi$.

(A) 0 (B) 1 (C) 4 (D) 6 (E) 9

53. Let E = {0,2,4,6,8}. Two elements of set E are selected at random without replacement. What is the probability that the mean of the two numbers selected is an odd number ?

(A) 30% (B) 40% (C) 50% (D) 60% (E) 70%

54. I'm an unhappy deficient number but a number that is lucky to be prime. Which of the following numbers am I?

(A) 11 (B) 23 (C) 37 (D) 71 (E) 91

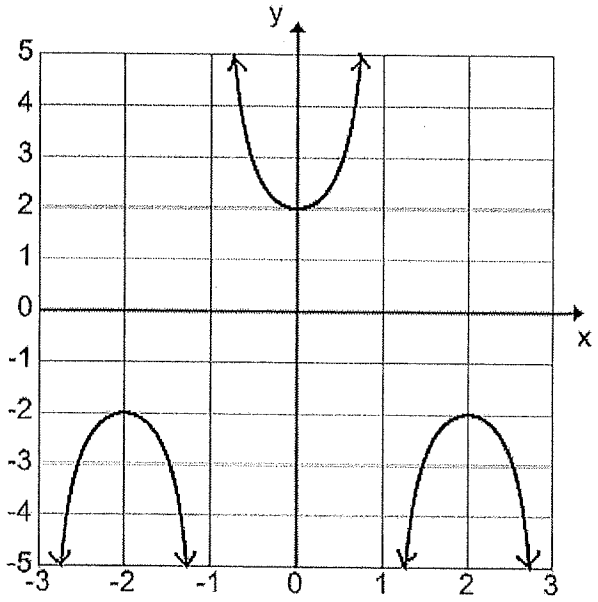
55. Find the remainder when $f(x) = x^3 + 2x^2 - 3x - 4$ is divided by $x - 5$.

(A) 156 (B) 120 (C) 1 (D) -29 (E) -64

56. If $a_1 = -3$, $a_2 = 1$ and $a_n = (a_{n-1})(a_{n-2})$, where $n \geq 3$, then a_5 equals:

(A) 9 (B) 3 (C) -1 (D) -3 (E) -27

57. The equation y = _____ will produce this graph.



(A) 2 sec $(2\pi x)$ (B) 2 csc $(\frac{x}{2} + \pi)$ (C) 4 sec $(\frac{x}{2} + \pi)$ (D) 4 csc $(\frac{\pi}{2}x)$ (E) 2 sec $(\frac{\pi}{2}x)$

58. Point A (2 , — 4) lies in the x-y plane. Point A is reflected across the line y = — x to point B. Point B is reflected across the x-axis to point C. Point C is reflected across the line y = x to point D. Find the coordinates of the point D.

(A) (2 , 4) (B) (2 , 2) (C) (— 2 , 4) (D) (4 , 4) (E) (— 2, — 4)

59. Which equality axiom of multiplication is demonstrated by $(a)(a)^{-1} = 1$?

(A) Identity (B) Associative (C) Inverse (D) Commutative (E) Distributive

60. The value of $(0.08333...)^{-1} \div (0.0625)^{-1} \times (.0555...)$ is:

(A) $13\frac{1}{2}$ (B) $10\frac{2}{3}$ (C) $\frac{1}{24}$ (D) $\frac{2}{27}$ (E) $\frac{3}{32}$

University Interscholastic League
MATHEMATICS CONTEST
HS • Invitation B • 2008
Answer Key

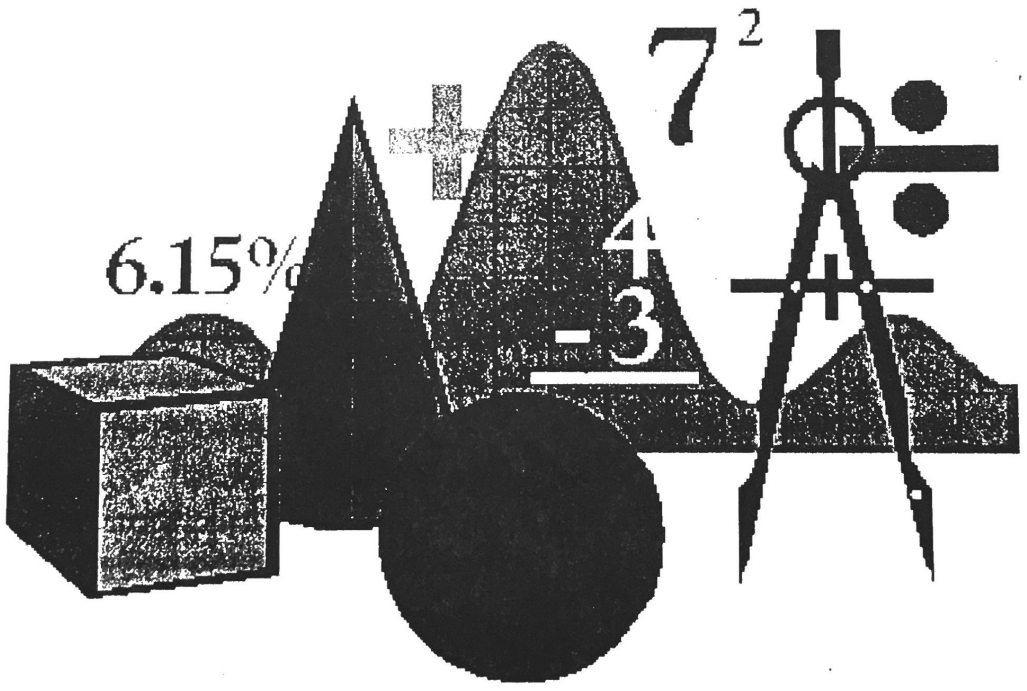
1. B	21. A	41. D
2. B	22. B	42. A
3. C	23. A	43. A
4. D	24. E	44. E
5. C	25. B	45. A
6. E	26. E	46. D
7. D	27. A	47. B
8. C	28. E	48. D
9. B	29. D	49. E
10. B	30. B	50. E
11. C	31. B	51. D
12. C	32. A	52. D
13. E	33. E	53. D
14. B	34. A	54. C
15. D	35. D	55. A
16. C	36. C	56. A
17. B	37. C	57. E
18.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

UNIVERSITY INTERSCHOLASTIC LEAGUE

Making a World of Difference

Mathematics

District I • 2008



WRITE ALL ANSWERS WITH
CAPITAL LETTERS

DO NOT TURN THIS PAGE UNTIL
YOU ARE INSTRUCTED TO DO SO!

Evaluate: $4! + (8)^{-2} \times 8 \div (4)^{\frac{1}{2}} - 16$

(A) -9 (B) $-8\frac{1}{4}$ (C) $4\frac{1}{8}$ (D) 8 (E) $8\frac{1}{16}$

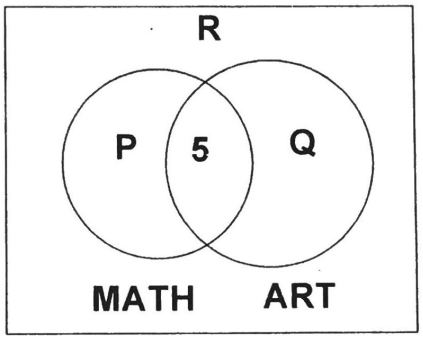
2. If x is 40% more than y and y is $\frac{2}{3}$ z, then z is what percent of x?

(A) 250% (B) $107\frac{1}{7}\%$ (C) $93\frac{1}{3}\%$ (D) 40% (E) $26\frac{2}{3}\%$

3. If the roots of $x^3 + bx^2 + cx + d = 0$ are -3, -2, and 3, then $b + c + d$ equals:

(A) -25 (B) -18 (C) -2 (D) 9 (E) 11

4. The 8th grade class at Venn Middle School has 40 students. Twenty-nine of them like MATH and 14 of them like ART. Using the Venn diagram, determine the value of R.



(A) 10 (B) 5 (C) 3 (D) 2 (E) 0

5. Point A (-3 , 1) is reflected across the line y = x to point B. Then point B is rotated 90 ° coun clockwise around the origin to point C. Then point C is reflected over the line y = x to point D What are the coordinates of point D?

(A) (1 , 3) (B) (1 , -3) (C) (3, -1) (D) (3 , 1) (E) (-1 , 3)

6. The faces of a regular icosahedron are _____.

(A) hexagons (B) pentagons (C) rectangles (D) squares (E) triangles

7. If $a_1 = -1$, $a_2 = 0$, $a_3 = 1$ and $a_n = [(a_{n-1}) + (a_{n-2})] \div (a_{n-3})$, where $n \geq 4$, then a_7 is _

(A) 2 (B) 1 (C) 0 (D) -1 (E) undefined

8. Speedy lives 45 miles from Mike. Speedy travels at 14 mph and Mike travels at 16 mph. How long will it take for them to meet if they ride their bicycles toward each other and they leave the same time?

(A) 1 hr (B) 1.25 hrs (C) 1.5 hrs (D) 1.75 hrs (E) 2 hrs

9. Two aircraft carriers leave Port O' Math at 6:00 a.m. Carrier FlatPlane travels at 14 mph on a bearing of 328°. Carrier StraitRay travels 18 mph on a bearing of 240°. How far apart will they be at 10:00 a.m. that same day ? (nearest tenth of a mile)

(A) 92.7 mi (B) 89.7 mi (C) 88.0 mi (D) 63.6 mi (E) 44.8 mi

10. Which of following equations has a period of 4, a vertical shift of 2, and a frequency of $\frac{1}{4}$?

(A) $y = 2 + 2\sin(\frac{\pi}{4}x + 4)$ (B) $y = 2 + 4\sin(\frac{\pi}{2}x + 4)$ (C) $y = 4 + 2\sin(\frac{\pi}{2}x + 4)$

(D) $y = 4 + 4\sin(\frac{\pi}{2}x + 2)$ (E) $y = 2 + 2\sin(\frac{\pi}{4}x + 4)$

11. Find $a + b + c + d$ given the Fibonacci characteristic sequence: $-4, a, b, 2, c, d, \ldots$

(A) -7 (B) 0 (C) 5 (D) 6 (E) 8

12. Find $x + y$ if $\begin{bmatrix} -1 & 3 \\ 5 & -4 \end{bmatrix} \begin{bmatrix} -2 \\ y \end{bmatrix} = \begin{bmatrix} x \\ -18 \end{bmatrix}$.

(A) -11 (B) -4 (C) 6 (D) 9 (E) 10

13. Find, to the nearest degree, the acute angle between the lines whose slopes are $-\frac{4}{5}$ and $\frac{4}{5}$.

(A) 77 ° (B) 64 ° (C) 58 ° (D) 51 ° (E) 33 °

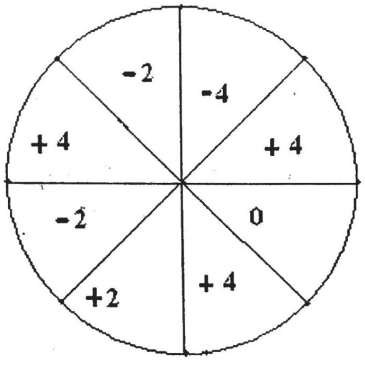
14. Let $f(x) = \frac{4x - 3}{5 + 2x}$. Find $f'(-2)$.

(A) -32 (B) -16 (C) 6 (D) 14 (E) 26

15. The zoo has two bears, a polar bear and a grizzly bear. The grizzly bear is a female. What is the probability that both bears are females?

(A) 25 % (B) $33\frac{1}{3}$ % (C) 50 % (D) $66\frac{2}{3}$ % (E) 100 %

16. Willie When spins the wheel. The wheel consists of eight congruent sectors as shown. What is the mathematical expectation on any one spin?



(A) $-\frac{3}{4}$ (B) $-\frac{1}{4}$ (C) $\frac{3}{4}$ (D) $1\frac{3}{4}$ (E) $2\frac{1}{4}$

17. What is the digit in the ones place of 7^{77} ?

(A) 0 (B) 1 (C) 3 (D) 7 (E) 9

18. Which of the following people was considered to be the "first notable woman in mathematics?" (She was killed and dragged through the streets by a religious sect.)

(A) Sonya Kovalevsky (B) Agnesi (C) Lady Lovelace (D) Hypatia (E) Sophie Germain

19.

The distances between the hash marks (|) are equal. The sum of B and C is?

(A) 3.65 (B) 3.95 (C) 4.25 (D) 4.55 (E) 4.85

20. If x = 7 then 7 = x an example of the _____ property of equality.

(A) Transitive (B) Symmetric (C) Distributive (D) Reflexive (E) Associative

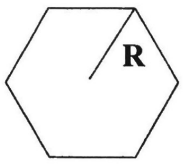
21. Which of the following equations has a graph of a parabola that intersects the positive y-axis once and the negative x-axis twice? y = _____ .

(A) $3 - 8x - 2x^2$ (B) $2x^2 + 8x + 3$ (C) $|8x + 3|$ (D) $-|2x^2 - 3|$ (E) $2x^2 - 8$

22. Which of the following is NOT a solution to $3|2 - x| + 4 < 5$?

(A) 2.1 (B) 1.8 (C) 1.6 (D) 2.3 (E) 2

23. The length of the circumradius, R, shown in the regular polygon below is 4 cm. Find the area of the regular hexagon. (nearest tenth)



(A) 55.4 cm^2 (B) 41.6 cm^2 (C) 34.6 cm^2 (D) 27.7 cm^2 (E) 24.0 cm^2

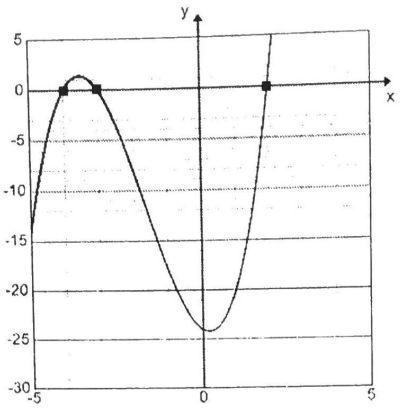
24. Two ellipses, $(2x - 5)^2 + 2y^2 = 10$ and $2x^2 + (y + 3)^2 = 9$, intersect at two points. Find the equation of the line passing through the two points of intersection.

(A) $y = -\frac{1}{12} - \frac{5}{3}x$ (B) $y = \frac{3}{5}x - \frac{4}{5}$ (C) $y = \frac{5}{4} - \frac{5}{3}x$ (D) $y = \frac{4}{5} - \frac{3}{5}x$ (E) $y = \frac{3}{5} - \frac{4}{5}x$

25. Determine the type of conic section this equation, $4x^2 - 6xy - 9y^2 - 36 = 0$ will produce.

(A) cardioid (B) circle (C) ellipse (D) hyperbola (E) parabola

26. The x-intercepts of the graph of $f(x) = Ax^3 + Bx^2 + Cx + D$ shown below are integers. Find $A + B + C + D$.



(A) -20 (B) -9 (C) -5 (D) 10 (E) 24

27. Which of the following expressions is not equivalent?

(A) $\cot(\theta) = \tan(\frac{\pi}{2} - \theta)$ (B) $\tan(\theta + \pi) = \cot(\theta + \frac{\pi}{2})$ (C) $-\tan(\theta) = \cot(\theta - \frac{\pi}{2})$

(D) $\cot(\theta + \frac{\pi}{2}) = \tan(\pi - \theta)$ (E) $\tan(\theta) = -\cot(\frac{\pi}{2} + \theta)$

28. How many distinct solutions exist for $2\cos^2 x - \cos x - 1 = 0$, where $0 < x < 2\pi$?

(A) 0 (B) 1 (C) 2 (D) 3 (E) 4

29. The focus for the parabola $(y + 1)^2 = -12(x + 2)$ is:

(A) $(-5, -1)$ (B) $(-2, -4)$ (C) $(-1, -1)$ (D) $(-2, -2)$ (E) $(1, -1)$

30. Simplify to the form $a + bi$: $(3 + \sqrt{-18})(4 - \sqrt{-8})$

(A) $0 + 6\sqrt{2}\,i$ (B) $0 - 18\sqrt{2}\,i$ (C) $24 + 6\sqrt{2}\,i$ (D) $24 - 18\sqrt{2}\,i$ (E) $0 + 0\,i$

31. The absolute minimum of the function $f(x) = 3x^2 + 2x - 1$ on the interval $-1 \le x \le 1$ is :

(A) $-\frac{1}{3}$ (B) $-\frac{1}{4}$ (C) $-1\frac{1}{3}$ (D) $-\frac{3}{4}$ (E) $-\frac{2}{3}$

32. Find the digit in the ten-thousandth place of the series $1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \ldots$, when $x = e$.

(A) 1 (B) 2 (C) 4 (D) 5 (E) 6

33. Five golf balls are numbered 2, 3, 5, 7, and 11. Two balls are selected at random without replacement. What is the probability that the sum of the numbers on the two balls is a prime number?

(A) 20% (B) 25% (C) 30% (D) 50% (E) 70%

34. The addresses in the town of Texasmathville consists of 4 digits. The first digit is a composite number, the second digit is a prime number, the third digit is a unit, and the last digit is a factor of 10. How many unique combinations fit this criteria?

(A) 75 (B) 64 (C) 60 (D) 48 (E) 36

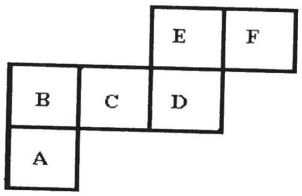
35. The vector $(-3, -5)$ is perpendicular to which of the following vectors?

(A) $(3, 5)$ (B) $(10, 6)$ (C) $(25, -15)$ (D) $(-5, -3)$ (E) $(5, 3)$

36. The Torus Ring Bakery has plain donuts, sugar-free donuts, jelly-filled donuts, and glazed donuts. How many different ways can the shop package a dozen donuts?

(A) 1365 (B) 1440 (C) 1680 (D) 1728 (E) 1820

37. The following net can be cut out and folded to form a cube. Which of the faces of the cube will be opposite the face labeled F ?



(A) A (B) B (C) C (D) D (E) E

38. $111111_2 + 333_4 + 77_8 =$ _____ 12

(A) 139 (B) 137 (C) 126 (D) 96 (E) 63

39. If $x + y = -2$ and $xy = 2$ then $x^3 + y^3 = ?$

(A) 20 (B) 16 (C) 12 (D) 4 (E) 0

40. Millie Ton weighs 48 kilograms and is sitting on a seesaw 150 cm from the middle. Les Pounds is sitting 120 cm from the center. How much does Les weigh if the seesaw is balanced?

(A) 36 kg (B) 42 kg (C) 50 kg (D) 56 kg (E) 60 kg

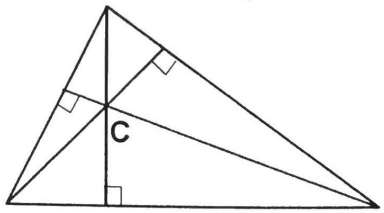
41. If $f(x) = 3x^2 - x + 2$ and $g(x) = 4 - 5x$, then $g^{-1}[f(-3)]$ equals:

(A) -156 (B) -32 (C) -7.2 (D) -5.6 (E) -4.4

42. Let $f(x) = \frac{3+4x}{x-4}$. If $g(x)$ is the inverse function of $f(x)$, find the value of $g(-2)$.

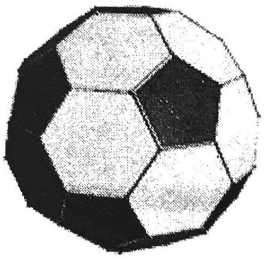
(A) $-5\frac{1}{2}$ (B) 1 (C) $1\frac{1}{5}$ (D) $-\frac{2}{11}$ (E) $\frac{5}{6}$

43. The point of intersection, C, of the triangle is called the _____.



(A) center (B) centroid (C) circumcenter (D) incenter (E) orthocenter

44. A truncated icosahedron is an Archimedian solid with 12 regular pentagonal faces, K regular hexagonal faces, 60 vertices, and 90 edges. Find K.

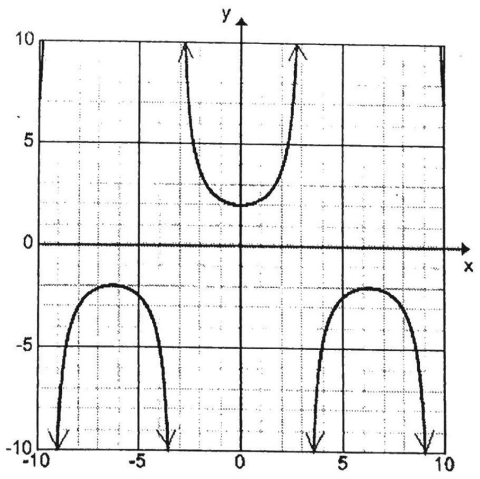


(A) 5 (B) 10 (C) 16 (D) 20 (E) 32

45. Let $Z_1 = \sqrt{2}(\cos 3 + i \sin 3)$ and $Z_2 = \sqrt{3}(\cos 5 + i \sin 5)$. Find $(Z_1)(Z_2)$. (nearest hundredth)

(A) $2.43 + .34i$ (B) $.58 + .02i$ (C) $-.36 + 2.42i$ (D) $-.24 + .53i$ (E) $-1.86 + 1.59i$

46. The equation y = _____ will produce this graph.

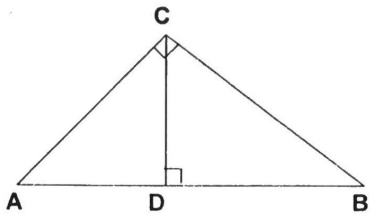


(A) $2\csc[\frac{1}{2}(x+\pi)]$ (B) $4\sec(\frac{x}{2}-\pi)$ (C) $2\csc(\frac{x}{2}-\frac{\pi}{2})$ (D) $2\sec(\frac{\pi x}{2})$ (E) $4\csc(x+\frac{\pi}{2})$

47. Willett Leek's right cylindrical wading pool has a circumference of 12.57 feet. He puts 100 gallons of water in the pool. How deep is the water in the pool? (nearest $\frac{1}{4}$ ").

(A) $9\frac{3}{4}$ " (B) 10 " (C) $11\frac{1}{2}$ " (D) $12\frac{3}{4}$ " (E) $15\frac{1}{4}$ "

48. Find AD if AB = 25 cm and AC = 15 cm. (nearest tenth)



(A) 6.3 cm (B) 9.0 cm (C) 10.0 cm (D) 11.8 cm (E) 19.4 cm

49. Find the area of the region bounded by the curve $y = x^2 - 2x - 3$ and the x-axis. (square units)

(A) $10\frac{2}{3}$ (B) 9 (C) $7\frac{1}{3}$ (D) 6 (E) $1\frac{2}{3}$

50. I am a "square" number that is "happy" and "abundant". Which of the following numbers could I be?

(A) 64 (B) 88 (C) 100 (D) 120 (E) 256

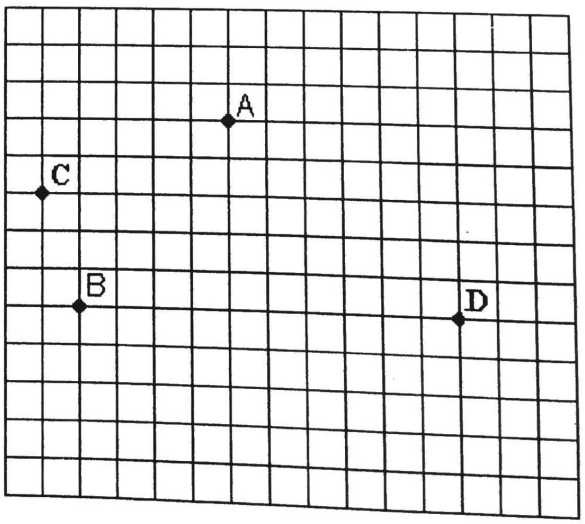
51. Find the angle of rotation, θ (nearest degree), where $0° < \theta < 90°$, such that the conic $x^2 + 4xy - 2y^2 = 6$ contains no xy term in its equation.

(A) 17° (B) 27° (C) 30° (D) 33° (E) 38°

52. Coach Cliff is recruiting students for his math team from his class. There are 8 boys and 6 girls in his class. How many different teams of 4 students can he form if each team has 3 boys and 1 girl or 3 girls and 1 boy?

(A) 248 (B) 328 (C) 336 (D) 426 (E) 496

53. Line BD is parallel to the x-axis and perpendicular to the y-axis. If point B's coordinates are $(-3, -2)$, which of the following would be the coordinates of point A?



(A) (1, 3) (B) $(-4, 1)$ (C) (2, 2) (D) (1, 7) (E) $(7, -2)$

54. $\int \frac{2}{2x-1}\,dx =$ _____ $+ C$, where C is an arbitrary constant.

(A) $2\ln(2x-1)$ (B) $\frac{\ln(2x-1)}{4}$ (C) $2x\ln(2x-1)$ (D) $\ln(2x-1)$ (E) $\frac{1}{2\ln(2x-1)}$

55. In the expansion of $(2x+3y)^6$, the coefficient of the 4th term is:

(A) 864 (B) 915 (C) 3140 (D) 3456 (E) 4320

56. Find the value of $\tan(\text{Arctan}\frac{7}{24} + \text{Arctan}\frac{24}{25})$. (closest approximation)

(A) $\frac{\sqrt{3}}{3}$ (B) $\frac{7}{25}$ (C) 1 (D) $\sqrt{3}$ (E) $\frac{\sqrt{3}}{2}$

57. The roots of the equation $x^3 + bx^2 + x + d = 0$ are -3, 8, and R. Find R.

(A) -24 (B) -11 (C) -6 (D) 5 (E) 10

58. A triangle is inscribed in a circle. The lengths of the sides of the triangle are 7", 24", and 25". Find the radius of the circle. (nearest tenth)

(A) 12.5 " (B) 10.6 " (C) 9.3 " (D) 6.7 " (E) 3.0 "

59. Points $(-1, 2)$, $(5, -2)$, and (x, y) are collinear. Find (x, y).

(A) $(1, -1)$ (B) $(0, -2)$ (C) $(2, 0)$ (D) $(7, -5)$ (E) $(3, 1)$

60. Barry Peels cooked a batch of cookies. He ate 2 of them while they were still warm. He dropped 25% of what was left on the floor and had to throw them away. He kept $\frac{3}{4}$ of the remaining ones to take to work for lunch each day. He took the remaining 6 to his grandmother. How many cookies did he cook?

(A) 34 (B) 32 (C) 30 (D) 26 (E) 24

1. **Evaluate:** $(21 - 15) \times 10 \div 6 \times 3! - 1 \times [(4 - 9) \times 16]$

   A. 140 **B.** −20 **C.** 160 **D.** 98 **E.** 100

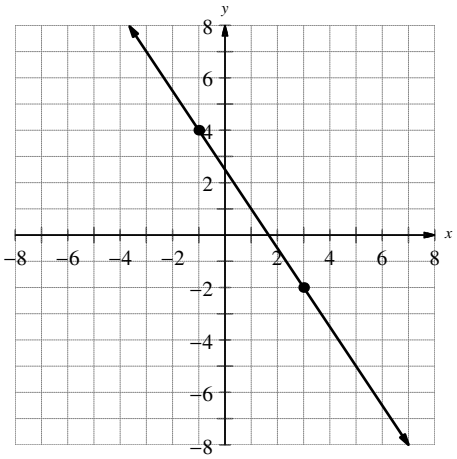
2. **Max buys a dozen tacos, three burritos, and six tostados. Tacos cost \$1.25 each; burritos cost \$1.85 each; tostados cost \$2.10 each. He paid with two twenty-dollar bills. How much does he have left?**

   A. \$6.85 **B.** \$5.95 **C.** \$6.45 **D.** \$7.25 **E.** \$7.65

3. **If** $(ax + 6)(x - a) = 7x^2 + bx + c$, **then** $b + c =$

   A. −77 **B.** −81 **C.** −85 **D.** −89 **E.** −93

4. **Find the equation of the line shown.**



   A. $6x + 4y = 7$
   B. $3x - 2y = 3$
   C. $6x - 4y = 1$
   D. $3x - 3y = 4$
   E. $3x + 2y = 5$

5. **Lisa has some lollipops. She gives 20% to Bart. Of the remaining, she then gives 25% to Milhouse. Of the remaining, she then gives** $33\frac{1}{3}\%$ **to Marge. Each of Bart, Milhouse, and Marge received the same number of lollipops. If Lisa has 48 lollipops left, how many lollipops did she start with?**

   A. 120 **B.** 144 **C.** 100 **D.** 180 **E.** 240

6. **How many subsets of the set {n, u, m, b, e, r} contain the element "n"?**

   A. 24 **B.** 16 **C.** 48 **D.** 64 **E.** 32

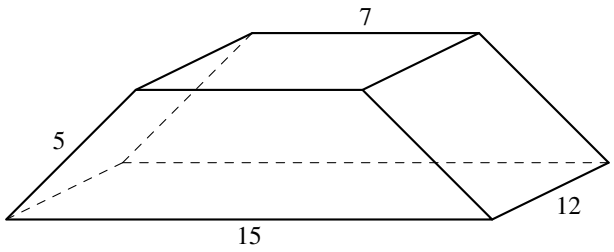
7. **The points** $(-2, 7)$, $(3, 22)$, **and** $(18, k)$ **are collinear. Find** k.

   A. 73 **B.** 61 **C.** 79 **D.** 58 **E.** 67

8. Solve for x in terms of y: $\frac{5y}{6} - \frac{7}{3x} = \frac{y}{12}$

A. $x = \frac{26}{5y}$ **B.** $x = \frac{28}{9y}$ **C.** $x = \frac{37}{11y}$ **D.** $x = \frac{15}{7y}$ **E.** $x = \frac{23}{18y}$

9. Find the volume of the isosceles trapezoidal prism.



A. 312
B. 344
C. 372
D. 396
E. 408

10. $(3542_7 + 1315_7) \times 4_7 =$ _____ $_7$

A. 31660 **B.** 31360 **C.** 30430 **D.** 31430 **E.** 30560

11. Today, a trucker drove 6 hours 24 minutes and covers 352 miles. Tomorrow, he needs to travel 430 miles and must arrive at 5:00pm. Assuming he breaks for 30 minutes to eat lunch, but otherwise can average the same speed as today, what time should he leave? (Round.)

A. 8:32am **B.** 8:41am **C.** 8:53am **D.** 9:06am **E.** 9:19am

12. Which of the following does not represent y as a function of x?

I. $x = \sqrt{y}$ II. $x^2 + y^2 = 1$ III. $\frac{x}{y} = 1$ IV. $|x| + |y| = 4$

A. All 4 **B.** I, II, and IV **C.** II and IV **D.** I and IV **E.** II and III

13. If $a + bi$ and $a - bi$ are the two complex roots of $x^2 + 4x + 8 = 0$, with $b > 0$, what is $a + b$?

A. 0 **B.** 2 **C.** 4 **D.** 6 **E.** 8

14. The sum of the coefficients of the 2nd and 3rd terms in the expansion of $(x + 5)^4$ is

A. 15 **B.** 12 **C.** 9 **D.** 8 **E.** 10

15. If $4^{3k-1} = 8^{5-k}$, then $k =$

A. $\frac{13}{6}$ **B.** $\frac{7}{3}$ **C.** $\frac{23}{9}$ **D.** $\frac{5}{3}$ **E.** $\frac{17}{9}$

16. If $f(x) = 3x + 5$ and $g(x) = 7x$, then $f(g(x)) + g(f(x)) =$

A. $20x + 10$ **B.** $21x + 42$ **C.** $42x + 40$ **D.** $42x + 42$ **E.** $21x + 35$

17. Find the remainder when $(x^4 - 7x^3 + 12x^2 - 5x + 8)$ is divided by $(x - 3)$.

A. 15 **B.** -7 **C.** -9 **D.** 21 **E.** -1

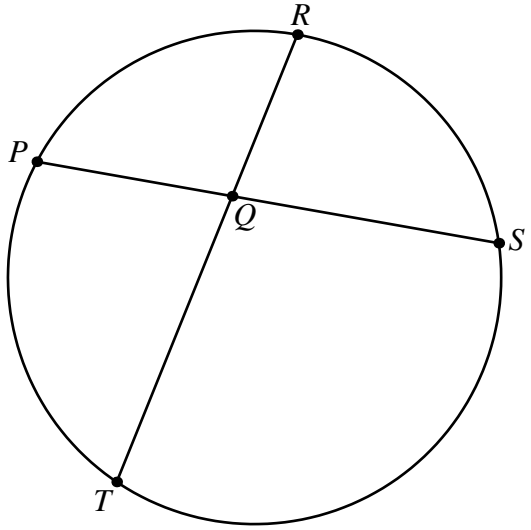
18. A pipe is a right circular cylinder. Its diameter is 4 inches and its height is 8 feet. How many gallons does it hold? (Round.)

A. 3.77 **B.** 4.08 **C.** 4.39 **D.** 4.87 **E.** 5.22

19. Let T_n be the nth triangular and S_n be the nth square number. Find the value of $\sqrt{T_8 + T_9 + S_{12}}$.

A. T_4 **B.** S_4 **C.** T_5 **D.** S_5 **E.** T_6

20. Given the circle, if $m\overset{\frown}{STP} = 3(m\overset{\frown}{PR})$, $m\overset{\frown}{RS} = m\overset{\frown}{TP} - 12°$, and $m\overset{\frown}{PR} = m\overset{\frown}{RS}$. Find $m\angle TQS$.



A. 92°
B. 98°
C. 102°
D. 108°
E. 112°

21. $\lim\limits_{x \to 4} \dfrac{x - 4}{2 - \sqrt{x}} =$

A. -4 **B.** 4 **C.** 2 **D.** -2 **E.** does not exist

22. Find the range of $y = 8 \sin\left[\frac{\pi}{2}(x - 4)\right] + 3$.

A. $[-5, 11]$ **B.** $[-8, 8]$ **C.** $[-3, 3]$ **D.** $[-1, 7]$ **E.** $[-7, 15]$

23. If $\sin\theta = -\frac{\sqrt{3}}{2}$ and $\tan\theta < 0$, find $\cos(-\theta)$.

A. $\frac{\sqrt{3}}{2}$ **B.** $\frac{1}{2}$ **C.** $-\frac{1}{2}$ **D.** $\frac{\sqrt{2}}{2}$ **E.** $-\frac{\sqrt{2}}{2}$

24. If $a_1 = 1$, $a_2 = 4$, $a_3 = a_{n-2} + 2a_{n-1}$, for $n \geq 3$, find $a_4 - a_5 + a_6$.

A. 53 **B.** 57 **C.** 48 **D.** 42 **E.** 56

25. According to Descartes' Rule of Signs, how many possible negative roots does $f(x) = -x^4 - 7x^3 + 5x^2 + 7x + 8$ have?

A. 1 **B.** 2 or 0 **C.** 4, 2, or 0 **D.** 3 or 1 **E.** 3

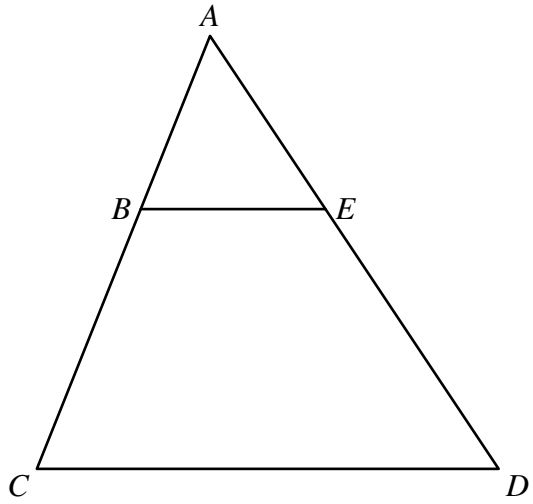
26. The parabola $y = ax^2 + bx + c$ has a vertex of $(4, \frac{1}{2})$ and an x-intercept of 6. Find $a + b$.

A. $\frac{7}{8}$ **B.** $-\frac{5}{8}$ **C.** $\frac{11}{8}$ **D.** $\frac{7}{4}$ **E.** $\frac{11}{4}$

27. If $f(x) = 3x^2 - 6x + 7$, find $f'(5)$.

A. 36 **B.** 27 **C.** 24 **D.** 12 **E.** 18

28. $\overline{BE} \parallel \overline{CD}$, $AB = 4$, $AC = 10$, and $AE = 6$. Find ED.



A. 12
B. 9
C. 8
D. 10
E. 6

29. What graph is produced by the polar equation $r = 3 - \sin\theta$?

A. dimpled limaçon **B.** limaçon with inner loop **C.** cardioid **D.** spiral **E.** circle

30. If $f(x) = \dfrac{6x-3}{x+2}$, then $f^{-1}(3) =$

A. -4 **B.** 3 **C.** 6 **D.** 1 **E.** -2

31. A wheel with 8 equal sectors is spun. On the wheel are the numbers 1 through 8. What is the probability of spinning two prime numbers in a row?

A. $\frac{1}{2}$ **B.** $\frac{1}{4}$ **C.** $\frac{1}{16}$ **D.** $\frac{9}{64}$ **E.** $\frac{25}{64}$

32. 0.23444... in base 6 is equal to what base 6 fraction?

A. $\frac{211}{500}_6$ **B.** $\frac{234}{550}_6$ **C.** $\frac{232}{550}_6$ **D.** $\frac{232}{500}_6$ **E.** $\frac{234}{555}_6$

33. The intersection of the medians of a scalene triangle is called the _____ .

A. orthocenter **B.** centroid **C.** circumcenter **D.** incenter **E.** Gergonne point

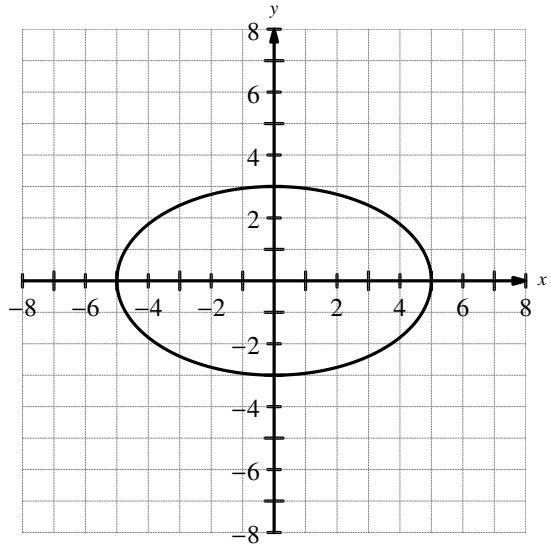
34. How much should be invested at 2.85% compounded quarterly over 5 years to have a total of \$4000.00?

A. \$3524.89 **B.** \$3431.86 **C.** \$3329.75 **D.** \$3470.50 **E.** \$3506.30

35. What is the smallest prime q where p and $q = 2p + 1$ are both prime, but q is not a Germain prime?

A. 7 **B.** 11 **C.** 13 **D.** 17 **E.** 19

36. Find the equation of the ellipse shown.



A. $25x^2 + 16y^2 = 400$
B. $16x^2 + 25y^2 = 400$
C. $25x^2 + 9y^2 = 225$
D. $9x^2 + 25y^2 = 225$
E. $16x^2 + 9y^2 = 144$

37. Let r and s be the roots of $5x^2 - 4x + 5 = 0$. Find $r^3s + 2r^2s^2 + rs^3$.

A. $\frac{5}{4}$ **B.** $\frac{25}{16}$ **C.** 1 **D.** $\frac{4}{5}$ **E.** $\frac{16}{25}$

38. How many integral values of n exist such that $n \geq 2$ and $\frac{(n+3)!}{n!} \leq 200$?

A. 1 **B.** 2 **C.** 3 **D.** 4 **E.** 5

39. Bob can lay 100 ft^2 of carpet in 20 minutes. Tim can lay 120 ft^2 of carpet in 15 minutes. How long will it take them working together to lay carpet in three rooms: 12 ft by 8 ft, 10 ft by 10 ft, and 15 ft by 12 ft? (Round.)

A. 23.4 min **B.** 24.7 min **C.** 26.7 min **D.** 28.9 min **E.** 32.4 min

40. Find the largest angle of the triangle whose vertices are $(1, 3)$, $(5, 7)$, and $(8, 5)$. (Round.)

A. 109° **B.** 105° **C.** 101° **D.** 97° **E.** 93°

41. If $\begin{vmatrix} k & 5 \\ 4 & 3k \end{vmatrix} = 1$ and $k < 0$, then $k =$

A. $-\sqrt{15}$ **B.** -2 **C.** $-\sqrt{7}$ **D.** $-\sqrt{11}$ **E.** -3

42. If $\log_3(x + 4) - \log_3(x) = 2$, then $x =$

A. $\frac{1}{4}$ **B.** $\frac{1}{2}$ **C.** $\frac{1}{3}$ **D.** $\frac{3}{2}$ **E.** $\frac{3}{4}$

43. Find the area bounded by the curve $y = 3 - 2x - x^2$ and the x-axis.

A. $\frac{4}{3}$ **B.** $\frac{8}{3}$ **C.** 8 **D.** $\frac{16}{3}$ **E.** $\frac{32}{3}$

44. If $\frac{A}{x+3} + \frac{B}{x-4} = \frac{6x - 38}{x^2 - x - 12}$, then $A + B =$

A. 6 **B.** 10 **C.** 8 **D.** 4 **E.** 12

45. The pattern continues. Find the sum of all entries in Rows 5 through 21.

Row 1: 1
Row 2: 1 3
Row 3: 1 3 5
Row 4: 1 3 5 7
⋮

A. 3281
B. 3851
C. 3042
D. 3282
E. 3379

46. Find the directrix of the parabola $(y-4)^2 = 8(x+7)$.

A. $y = 2$ B. $y = 6$ C. $x = -9$ D. $x = -5$ E. $x = -7$

47. The function $f(x) = \dfrac{x^2 - 3x - 18}{x^2 - 4x - 21}$ has a removable discontinuity when $x =$

A. 3 B. 7 C. 6 D. −3 E. −7

48. The function $f(x) = 2x^3 - 8x + 7$ has an inflection point at (h, k). Find h.

A. −1 B. 1 C. 2 D. 0 E. 4

49. If $2^k \times 4^{2k+1} \times 8^{3k+1} = 2^{439}$, find $3^{(k-1)/6}$.

A. 9 B. 81 C. 243 D. 729 E. 2187

50. A boat leaves port and sails 22.3 miles at a bearing of 72°. Then, it turns and sails 7.9 miles at a bearing of 113°. What bearing should the boat travel to return to port? (Round.)

A. 197.6° B. 178.9° C. 187.6° D. 182.5° E. 193.9°

51. The dot product of the vectors $\langle 2, k\rangle$ and $\langle 4k-1, 5\rangle$ is 63. Find the magnitude of the vector $\langle -12, k\rangle$.

A. 5 B. 13 C. 18 D. 24 E. 17

52. The center of a circle is $(4, -4)$. The point $(1, 0)$ lies on the circle. Find the area of the segment of the circle above the x-axis. (Round.)

A. 0.82 B. 0.78 C. 0.67 D. 0.61 E. 0.54

53. Sound intensity is power of sound per area. The basis of intensity is related to the threshold of hearing, $I_0 = 10^{-12}$ W/m^2. The formula for intensity I is relative to the sound level L by $L = 10 \log\left(\frac{I}{I_0}\right)$, where L is measured in decibels. How many times more intense is a sound of level 30 dB than a sound of level 18 dB? (Round.)

A. 15.8 **B.** 12.3 **C.** 8.76 **D.** 3.33 **E.** 1.67

54. How many zeros are at the end of the number (51!) × (52!) when written out?

A. 16 **B.** 18 **C.** 20 **D.** 22 **E.** 24

55. Find the smallest positive solution to $\sin^2(x) + \sin(x) + \frac{1}{4} = 0$.

A. $\frac{\pi}{3}$ **B.** $\frac{\pi}{6}$ **C.** $\frac{11\pi}{6}$ **D.** $\frac{7\pi}{6}$ **E.** $\frac{5\pi}{6}$

56. If $3x^2 - 4y^2 = 5$, find $\frac{dy}{dx}$.

A. $-\frac{x}{y}$ **B.** $-\frac{4x}{3y}$ **C.** $-\frac{3x}{4y}$ **D.** $\frac{4x}{3y}$ **E.** $\frac{3x}{4y}$

57. What is the y-intercept of the slant asymptote of $f(x) = \frac{4x^2 - 3x - 2}{x - 5}$?

A. 17 **B.** 83 **C.** 14 **D.** 76 **E.** 35

58. A hockey team has 6 forwards, 8 wingers, and 7 defensemen. Not counting the goaltender, the team can put 5 players on the ice. How many combinations of 1 forward, 2 wingers, and 2 defensemen can be created?

A. 1796 **B.** 3528 **C.** 7056 **D.** 14112 **E.** 18934

59. How many solutions to the equation $x+y+z = 15$ exist with x, y, z non-negative integers with $x \geq y \geq z$?

A. 31 **B.** 28 **C.** 18 **D.** 27 **E.** 17

60. The parabola $y = 2x^2 + 11x + 8$ is tangent to the line $y = 3x$ at (h, k). Find h.

A. -2 **B.** 3 **C.** -4 **D.** 1 **E.** 7

1. **Evaluate:** $(21 - 15) \times 10 \div 6 \times 3! - 1 \times [(4 - 9) \times 16]$

   A. 140 **B.** −20 **C.** 160 **D.** 98 **E.** 100

2. **Max buys a dozen tacos, three burritos, and six tostados. Tacos cost \$1.25 each; burritos cost \$1.85 each; tostados cost \$2.10 each. He paid with two twenty-dollar bills. How much does he have left?**

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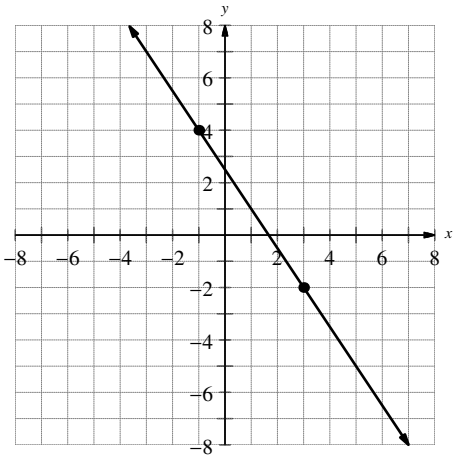

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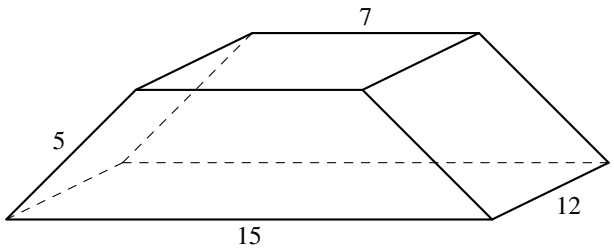

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I. $x = \sqrt{y}$ II. $x^2 + y^2 = 1$ III. $\frac{x}{y} = 1$ IV. $|x| + |y| = 4$

A. All 4 **B.** I, II, and IV **C.** II and IV **D.** I and IV **E.** II and III

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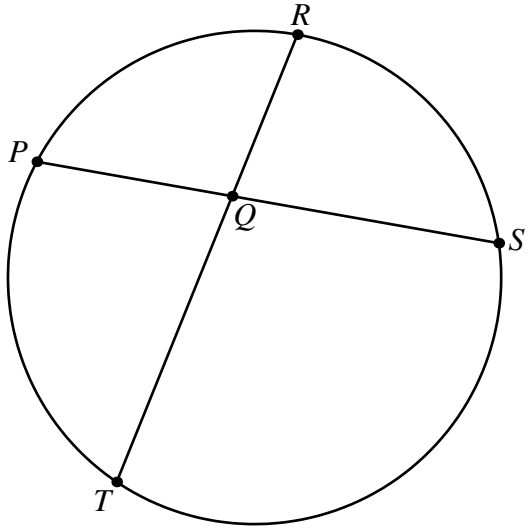
19. Let T_n be the nth triangular and S_n be the nth square number. Find the value of $\sqrt{T_8 + T_9 + S_{12}}$.

A. T_4 **B.** S_4 **C.** T_5 **D.** S_5 **E.** T_6

20. Given the circle, if $m\overset{\frown}{STP} = 3(m\overset{\frown}{PR})$, $m\overset{\frown}{RS} = m\overset{\frown}{TP} - 12°$, and $m\overset{\frown}{PR} = m\overset{\frown}{RS}$. Find $m\angle TQS$.



A. 92°
B. 98°
C. 102°
D. 108°
E. 112°

21. $\lim\limits_{x \to 4} \dfrac{x - 4}{2 - \sqrt{x}} =$

A. -4 **B.** 4 **C.** 2 **D.** -2 **E.** does not exist

22. Find the range of $y = 8 \sin\left[\frac{\pi}{2}(x - 4)\right] + 3$.

A. $[-5, 11]$ **B.** $[-8, 8]$ **C.** $[-3, 3]$ **D.** $[-1, 7]$ **E.** $[-7, 15]$

23. If $\sin\theta = -\frac{\sqrt{3}}{2}$ and $\tan\theta < 0$, find $\cos(-\theta)$.

A. $\frac{\sqrt{3}}{2}$ **B.** $\frac{1}{2}$ **C.** $-\frac{1}{2}$ **D.** $\frac{\sqrt{2}}{2}$ **E.** $-\frac{\sqrt{2}}{2}$

24. If $a_1 = 1$, $a_2 = 4$, $a_3 = a_{n-2} + 2a_{n-1}$, for $n \geq 3$, find $a_4 - a_5 + a_6$.

A. 53 **B.** 57 **C.** 48 **D.** 42 **E.** 56

25. According to Descartes' Rule of Signs, how many possible negative roots does $f(x) = -x^4 - 7x^3 + 5x^2 + 7x + 8$ have?

A. 1 **B.** 2 or 0 **C.** 4, 2, or 0 **D.** 3 or 1 **E.** 3

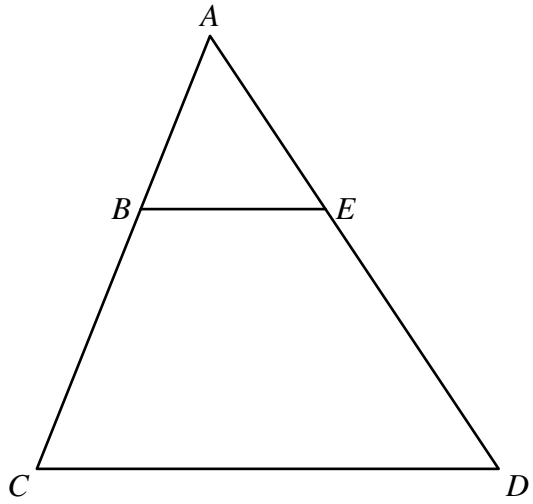
26. The parabola $y = ax^2 + bx + c$ has a vertex of $(4, \frac{1}{2})$ and an x-intercept of 6. Find $a + b$.

A. $\frac{7}{8}$ **B.** $-\frac{5}{8}$ **C.** $\frac{11}{8}$ **D.** $\frac{7}{4}$ **E.** $\frac{11}{4}$

27. If $f(x) = 3x^2 - 6x + 7$, find $f'(5)$.

A. 36 **B.** 27 **C.** 24 **D.** 12 **E.** 18

28. $\overline{BE} \parallel \overline{CD}$, $AB = 4$, $AC = 10$, and $AE = 6$. Find ED.



A. 12
B. 9
C. 8
D. 10
E. 6

29. What graph is produced by the polar equation $r = 3 - \sin\theta$?

A. dimpled limaçon **B.** limaçon with inner loop **C.** cardioid **D.** spiral **E.** circle

30. If $f(x) = \dfrac{6x-3}{x+2}$, then $f^{-1}(3) =$

A. -4 **B.** 3 **C.** 6 **D.** 1 **E.** -2

31. A wheel with 8 equal sectors is spun. On the wheel are the numbers 1 through 8. What is the probability of spinning two prime numbers in a row?

A. $\frac{1}{2}$ **B.** $\frac{1}{4}$ **C.** $\frac{1}{16}$ **D.** $\frac{9}{64}$ **E.** $\frac{25}{64}$

32. 0.23444... in base 6 is equal to what base 6 fraction?

A. $\frac{211}{500}_6$ **B.** $\frac{234}{550}_6$ **C.** $\frac{232}{550}_6$ **D.** $\frac{232}{500}_6$ **E.** $\frac{234}{555}_6$

33. The intersection of the medians of a scalene triangle is called the _____ .

A. orthocenter **B.** centroid **C.** circumcenter **D.** incenter **E.** Gergonne point

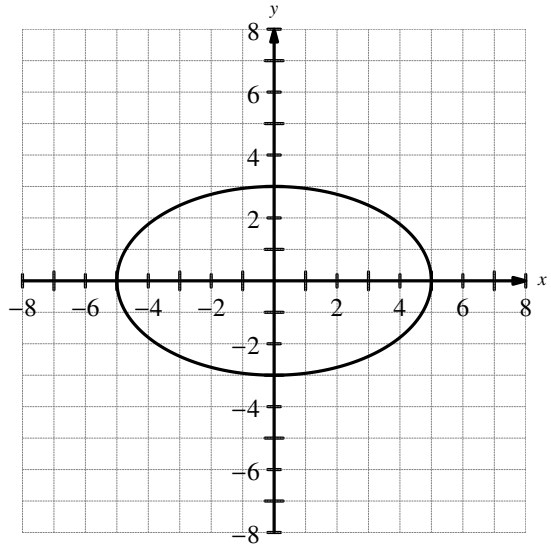
34. How much should be invested at 2.85% compounded quarterly over 5 years to have a total of \$4000.00?

A. \$3524.89 **B.** \$3431.86 **C.** \$3329.75 **D.** \$3470.50 **E.** \$3506.30

35. What is the smallest prime q where p and $q = 2p + 1$ are both prime, but q is not a Germain prime?

A. 7 **B.** 11 **C.** 13 **D.** 17 **E.** 19

36. Find the equation of the ellipse shown.



A. $25x^2 + 16y^2 = 400$
B. $16x^2 + 25y^2 = 400$
C. $25x^2 + 9y^2 = 225$
D. $9x^2 + 25y^2 = 225$
E. $16x^2 + 9y^2 = 144$

37. Let r and s be the roots of $5x^2 - 4x + 5 = 0$. Find $r^3s + 2r^2s^2 + rs^3$.

A. $\frac{5}{4}$ **B.** $\frac{25}{16}$ **C.** 1 **D.** $\frac{4}{5}$ **E.** $\frac{16}{25}$

38. How many integral values of n exist such that $n \geq 2$ and $\frac{(n+3)!}{n!} \leq 200$?

A. 1 **B.** 2 **C.** 3 **D.** 4 **E.** 5

39. Bob can lay 100 ft^2 of carpet in 20 minutes. Tim can lay 120 ft^2 of carpet in 15 minutes. How long will it take them working together to lay carpet in three rooms: 12 ft by 8 ft, 10 ft by 10 ft, and 15 ft by 12 ft? (Round.)

A. 23.4 min **B.** 24.7 min **C.** 26.7 min **D.** 28.9 min **E.** 32.4 min

40. Find the largest angle of the triangle whose vertices are $(1, 3)$, $(5, 7)$, and $(8, 5)$. (Round.)

A. 109° **B.** 105° **C.** 101° **D.** 97° **E.** 93°

41. If $\begin{vmatrix} k & 5 \\ 4 & 3k \end{vmatrix} = 1$ and $k < 0$, then $k =$

A. $-\sqrt{15}$ **B.** -2 **C.** $-\sqrt{7}$ **D.** $-\sqrt{11}$ **E.** -3

42. If $\log_3(x + 4) - \log_3(x) = 2$, then $x =$

A. $\frac{1}{4}$ **B.** $\frac{1}{2}$ **C.** $\frac{1}{3}$ **D.** $\frac{3}{2}$ **E.** $\frac{3}{4}$

43. Find the area bounded by the curve $y = 3 - 2x - x^2$ and the x-axis.

A. $\frac{4}{3}$ **B.** $\frac{8}{3}$ **C.** 8 **D.** $\frac{16}{3}$ **E.** $\frac{32}{3}$

44. If $\frac{A}{x+3} + \frac{B}{x-4} = \frac{6x - 38}{x^2 - x - 12}$, then $A + B =$

A. 6 **B.** 10 **C.** 8 **D.** 4 **E.** 12

45. The pattern continues. Find the sum of all entries in Rows 5 through 21.

Row 1: 1
Row 2: 1 3
Row 3: 1 3 5
Row 4: 1 3 5 7
⋮

A. 3281
B. 3851
C. 3042
D. 3282
E. 3379

46. Find the directrix of the parabola $(y-4)^2 = 8(x+7)$.

A. $y = 2$ B. $y = 6$ C. $x = -9$ D. $x = -5$ E. $x = -7$

47. The function $f(x) = \dfrac{x^2 - 3x - 18}{x^2 - 4x - 21}$ has a removable discontinuity when $x =$

A. 3 B. 7 C. 6 D. −3 E. −7

48. The function $f(x) = 2x^3 - 8x + 7$ has an inflection point at (h, k). Find h.

A. −1 B. 1 C. 2 D. 0 E. 4

49. If $2^k \times 4^{2k+1} \times 8^{3k+1} = 2^{439}$, find $3^{(k-1)/6}$.

A. 9 B. 81 C. 243 D. 729 E. 2187

50. A boat leaves port and sails 22.3 miles at a bearing of 72°. Then, it turns and sails 7.9 miles at a bearing of 113°. What bearing should the boat travel to return to port? (Round.)

A. 197.6° B. 178.9° C. 187.6° D. 182.5° E. 193.9°

51. The dot product of the vectors $\langle 2, k\rangle$ and $\langle 4k-1, 5\rangle$ is 63. Find the magnitude of the vector $\langle -12, k\rangle$.

A. 5 B. 13 C. 18 D. 24 E. 17

52. The center of a circle is $(4, -4)$. The point $(1, 0)$ lies on the circle. Find the area of the segment of the circle above the x-axis. (Round.)

A. 0.82 B. 0.78 C. 0.67 D. 0.61 E. 0.54

53. Sound intensity is power of sound per area. The basis of intensity is related to the threshold of hearing, $I_0 = 10^{-12}$ W/m^2. The formula for intensity I is relative to the sound level L by $L = 10 \log\left(\frac{I}{I_0}\right)$, where L is measured in decibels. How many times more intense is a sound of level 30 dB than a sound of level 18 dB? (Round.)

A. 15.8 **B.** 12.3 **C.** 8.76 **D.** 3.33 **E.** 1.67

54. How many zeros are at the end of the number (51!) × (52!) when written out?

A. 16 **B.** 18 **C.** 20 **D.** 22 **E.** 24

55. Find the smallest positive solution to $\sin^2(x) + \sin(x) + \frac{1}{4} = 0$.

A. $\frac{\pi}{3}$ **B.** $\frac{\pi}{6}$ **C.** $\frac{11\pi}{6}$ **D.** $\frac{7\pi}{6}$ **E.** $\frac{5\pi}{6}$

56. If $3x^2 - 4y^2 = 5$, find $\frac{dy}{dx}$.

A. $-\frac{x}{y}$ **B.** $-\frac{4x}{3y}$ **C.** $-\frac{3x}{4y}$ **D.** $\frac{4x}{3y}$ **E.** $\frac{3x}{4y}$

57. What is the y-intercept of the slant asymptote of $f(x) = \frac{4x^2 - 3x - 2}{x - 5}$?

A. 17 **B.** 83 **C.** 14 **D.** 76 **E.** 35

58. A hockey team has 6 forwards, 8 wingers, and 7 defensemen. Not counting the goaltender, the team can put 5 players on the ice. How many combinations of 1 forward, 2 wingers, and 2 defensemen can be created?

A. 1796 **B.** 3528 **C.** 7056 **D.** 14112 **E.** 18934

59. How many solutions to the equation $x+y+z = 15$ exist with x, y, z non-negative integers with $x \geq y \geq z$?

A. 31 **B.** 28 **C.** 18 **D.** 27 **E.** 17

60. The parabola $y = 2x^2 + 11x + 8$ is tangent to the line $y = 3x$ at (h, k). Find h.

A. -2 **B.** 3 **C.** -4 **D.** 1 **E.** 7

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