1. Evaluate: $(21 - 15) \times 10 \div 6 \times 3! - 1 \times [(4 - 9) \times 16]$
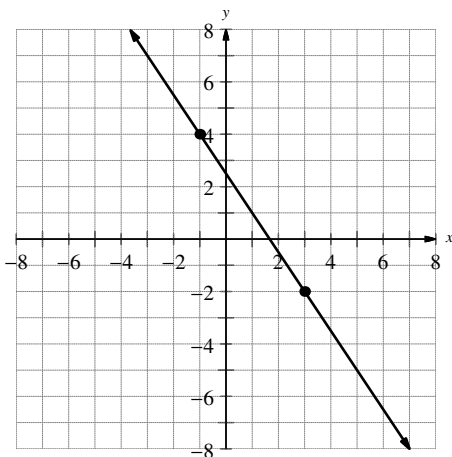
   A. 140 **B.** −20 **C.** 160 **D.** 98 **E.** 100

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: $\dfrac{5y}{6} - \dfrac{7}{3x} = \dfrac{y}{12}$

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

9. Find the volume of the isosceles trapezoidal prism.
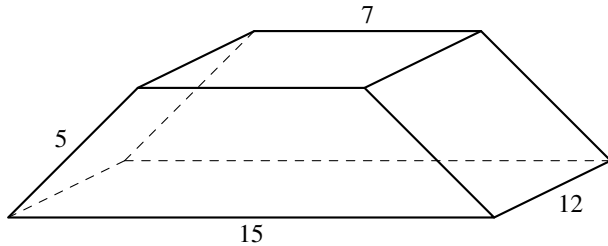
    A. 312
    B. 344
    C. 372
    D. 396
    E. 408

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. $\dfrac{x}{y} = 1$ 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. $\dfrac{13}{6}$ B. $\dfrac{7}{3}$ C. $\dfrac{23}{9}$ D. $\dfrac{5}{3}$ E. $\dfrac{17}{9}$

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 $m\widehat{STP} = 3(m\widehat{PR})$, $m\widehat{RS} = m\widehat{TP} - 12°$, and $m\widehat{PR} = m\widehat{RS}$. Find $m\angle TQS$.
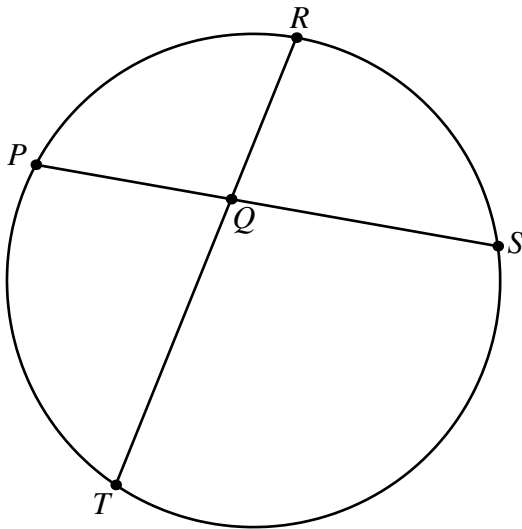
   A. $92°$
   B. $98°$
   C. $102°$
   D. $108°$
   E. $112°$

21. $\displaystyle\lim_{x \to 4} \frac{x - 4}{2 - \sqrt{x}} =$

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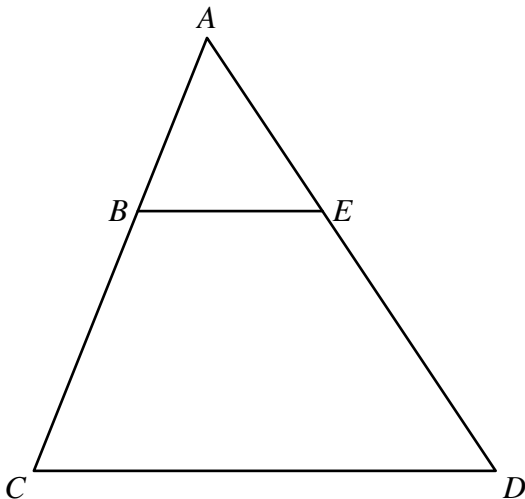
   A. 12
   B. 9
   C. 8
   D. 10
   E. 6

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

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

    A. $\dfrac{211}{500}$ 6   B. $\dfrac{234}{550}$ 6   C. $\dfrac{232}{550}$ 6   D. $\dfrac{232}{500}$ 6   E. $\dfrac{234}{555}$ 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.
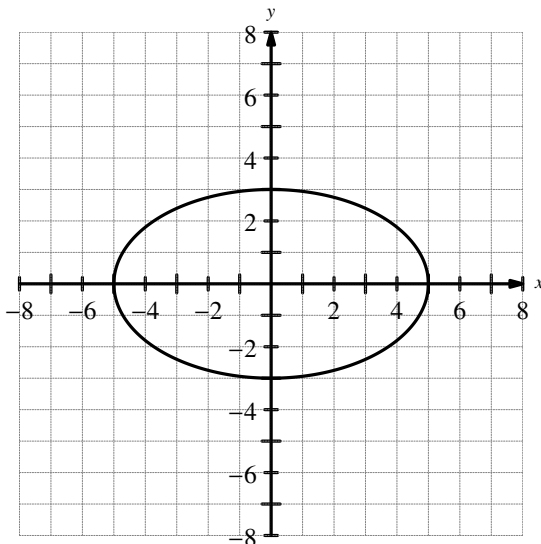
    A. $25x^2 + 16y^2 = 400$
    B. $16x^2 + 25y^2 = 400$
    C. $25x^2 + 9y^2 = 225$
    D. $9x^2 + 25y^2 = 225$
    E. $16x^2 + 9y^2 = 144$

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 $\dfrac{(n + 3)!}{n!} \leq 200$?

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 $\dfrac{A}{x + 3} + \dfrac{B}{x - 4} = \dfrac{6x - 38}{x^2 - x - 12}$, 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 $L = 10 \log\left(\dfrac{I}{I_0}\right)$, 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 $\dfrac{dy}{dx}$.

  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 $f(x) = \dfrac{4x^2 - 3x - 2}{x - 5}$?

  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