1. Evaluate $-3^2 - (-2 - 2^{-1})^2$.

a) $-61/4$ b) $-11/4$ c) $11/4$ d) $61/4$ e) 0

2. Which of the following numbers is the largest?

a) 10^{100} b) 20^{80} c) 30^{60} d) 40^{40} e) 50^{20}
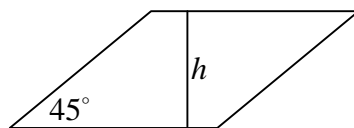
3. Ten women meet. All shake hands with each other. How many handshakes are there?

a) 2^{10} b) 10^2 c) 45   d) 50   e) None listed.

4. What is the sum of the cube roots of 125?

a) 0   b) 5   c) 15   d) 25   e) None listed.

5. What is the area of the rhombus drawn below?

a) $A = \dfrac{2h\sqrt{2}}{3}$ b) $A = h^2$ c) $A = h^2\sqrt{2}$ d) $A = \dfrac{h^2\sqrt{2}}{2}$ e) $A = \dfrac{h^2\sqrt{3}}{4}$

6. Which number satisfies $|3x - 4| \leq x + 1$?

a) $x = -2$ b) $x = -1$ c) $x = 0$ d) $x = 1$ e) None listed.

7. The sum $a + b$, the product ab and the difference of squares $a^2 - b^2$ of two positive numbers, a and b, is the same nonzero number. What is b?

a) 1   b) $\dfrac{1 + \sqrt{5}}{2}$ c) $\sqrt{3}$ d) $\dfrac{7 - \sqrt{5}}{2}$ e) 8

8. How many positive two-digit integers have an odd number of positive divisors?

a) 3   b) 4   c) 5   d) 6   e) 7

9. An athlete covers three consecutive miles by swimming the first, running the second, and cycling the third. He runs twice as fast as he swims and cycles one and a half times as fast as he runs. He takes ten minutes longer than he would if he cycled the whole three miles. How many minutes does it take?

a) 16   b) 22   c) 30   d) 46   e) 70

10. If $\sin A = \dfrac{3}{5}$ and $\sin B = \dfrac{5}{13}$, what is the smallest possible positive value of $\sin(A + B)$?

a) $\dfrac{16}{65}$ b) $\dfrac{3}{13}$ c) $\dfrac{64}{65}$ d) $\dfrac{56}{65}$ e) None listed.

11. Find a solution to $5^{7x-6} = 25^{2x}$.

   a) $x = 0$ b) $x = 1$ c) $x = 2$ d) $x = 5$ e) $x = \pi$
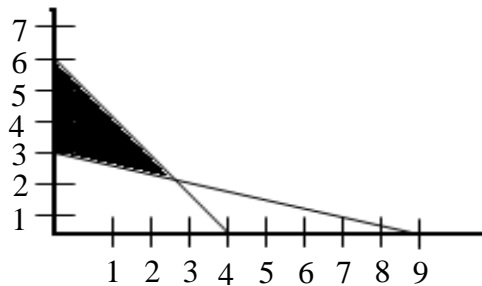
12. The side lengths of a rectangular picture are integers. How many different size pictures can be put into a 1.5 inch wide frame such that the area of the picture equals the area of the frame? (Note: A 9" x 15" frame is the same as a 15" x 9" frame.)

   a) 1   b) 5   c) 2   d) 3   e) 0

13. How many sequences of consecutive positive integers sum to 45?

   a) 2   b) 1   c) 3   d) 6   e) 10

14. The <u>shaded</u> region in the following diagram is represented by which system of inequalities?

a) $\begin{array}{l} 3x+2y \geq 12 \\ x+3y \geq 9 \end{array}$ b) $\begin{array}{l} 3x+2y \geq 12 \\ x+3y \leq 9 \end{array}$ c) $\begin{array}{l} 3x+2y \leq 12 \\ x+3y \geq 9 \end{array}$ d) $\begin{array}{l} 3x+2y \leq 12 \\ x+3y \leq 9 \end{array}$ e) None listed.

15. Which set of numbers cannot represent the sides of a triangle?

a) 3, 4, 5   b) 3, 4, 7   c) 4, 5, 6   d) 4, 5, 7   e) 4, 5, 8

16. If $f(x)$ is any polynomial, the remainder when $f(x)$ is divided by $(x-2)$ is 4 and the remainder when $f(x)$ is divided by $(x-3)$ is 7. What is the remainder when $f(x)$ is divided by $x^2 - 5x + 6$?

a) $3x - 2$ b) 11   c) 28   d) $3x + 2$ e) None listed.

17. Convert the base 7 repeating decimal $0.\overline{25}_7$ to a base 10 fraction.

a) $\dfrac{1}{4}$ b) $\dfrac{25}{99}$ c) $\dfrac{25}{49}$ d) $\dfrac{19}{49}$ e) $\dfrac{19}{48}$

18. How many solutions exist for the equation $(x!)^2 - 7(x!) + 6 = 0$?

a) 0   b) 1   c) 2   d) 3   e) More than 3.

19. The exact value of $\tan 30° - \sin 30°$ is equal to a number that is included in one of the following groups of numbers. Which one?

a) $\sqrt{3} - 1, 1, -\dfrac{1}{2}$

b) $-\dfrac{\sqrt{3}}{6}, \dfrac{\sqrt{3}-1}{2}, 0.077$

c) $\dfrac{\sqrt{3}-1}{6}, \sqrt{2}+1, 2$

d) $\dfrac{2\sqrt{3}-3}{6}, \dfrac{\sqrt{2}-3}{6}, 1$

e)   1

20.   If the radius of a circle inscribed on an equilateral triangle is equal to $\dfrac{16\sqrt{3}}{3}$, then one side of the triangle is equal to

a)   16   b)   32   c)   48   d)   64   e) $4\sqrt{3}$

21. Suppose b is a solution to quadratic equation $x^2 - x - 2 = 0$. Evaluate b^3.

a) $b+1$ b) $3b+2$ c) $2b+3$ d) $2b+2$ e) $3b$

22. If x is positive, what is the least value of $x + \dfrac{9}{x}$?

a)   2   b)   3   c)   4   d)   5   e)   6

23. Two friends agree to meet at a mall between noon and 1 a.m. What is the probability they arrive within 10 minutes of one another?

a) $\dfrac{25}{36}$ b) $\dfrac{11}{36}$ c) $\dfrac{1}{36}$ d) $\dfrac{1}{6}$ e) None listed.

24. If it takes 12 gallons of paint to paint the exterior of an 800-gallon fuel tank, how many gallons of paint are necessary to paint a similarly shaped 2700-gallon fuel tank?

a) 40.5   b) 144   c) 30   d) 27   e) None listed.

25. If $ab + ac + bc = 11$ and $abc = 19$, what is the value of $\dfrac{1}{a} + \dfrac{1}{b} + \dfrac{1}{c}$?

a) $\dfrac{11}{19}$ b) $\dfrac{19}{11}$ c) $\dfrac{23}{11}$ d) $\dfrac{11}{23}$ e) None listed.

26. The sum of seven consecutive integers is 77. What is the value of the smallest even number?

a) 2   b) 4   c) 6   d) 8   e) 10

27. Suppose Alice spent $2/5$ of her money at a store and loaned $2/3$ of the remainder to a friend. If she still has $2.50, how much did she have to start with?

a) $6.75   b) $18.33   c) $12.75   d) $15.50   e) $12.50

28. The area of an annular region bounded by two concentric circles is 5π. The difference between the radii of the circles is 1. What is the radius of the smaller circle?

   a) 2   b) 3   c) 4   d) 5   e) 6

29. The ratio of $125^5 : 5^{11}$ is equal to?

   a) 5^{-6} b) 5^{16} c) 25^2 d) 5^2 e) 125

30. A standard deck of 52 cards contains 13 hearts. Twenty-six cards have already been dealt, eight of which are hearts. If you are dealt 13 of the remaining cards, what is the probability that you will get exactly 2 of the remaining 5 hearts? (Round your answer.)
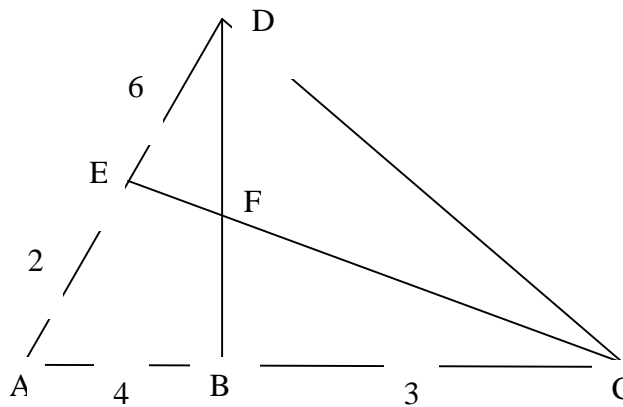
   a) 22%   b) 26%   c) 30%   d) 34%   e) 38%

31. Let $f(x) = \dfrac{x-1}{x+1}$ and let $f^{(n)}(x)$ denote the n-fold composition of f with itself. That is,

   $f^{(1)}(x) = f(x)$ and $f^{(n)}(x) = f\left(f^{(n-1)}(x)\right)$.   Which of the following is $f^{(2008)}(x)$?

   a) $-\dfrac{1}{x}$ b) $-\dfrac{x+1}{x-1}$ c) x d) $\dfrac{1-x}{1+x}$ e) $\dfrac{x-1}{x+1}$

32. Given the triangle not drawn to scale as shown. $AB = 4$, $BC = 3$, $DE = 6$, $AE = 2$.
    Find $EF : FC$.

a) 8:7   b) 7:8   c) 2:5   d) 1:1   e) None listed.

33. Today is Tuesday. What day of the week will it be in 10,000 days?

a) Wednesday   b) Thursday   c) Friday   d) Saturday   e) Monday

34. Suppose a rectangle has area 12 and diagonal of length 5. Find the perimeter of rectangle.

a) 14   b) 17   c) 15   d) 8   e) 7

35. In a right triangle the area is 30 and the sum of the squares of the three sides is 338. What
    are the lengths of the legs?

a) {6, 10}   b) {4, 15}   c) {1, 30}   d) {5, 12}   e) {8, 7.5}

36. Suppose -2 is a root of polynomial $P(x) = -x^3 + 2x^2 - ax - 4$. It follows that

a) $a = -6$ b) $a = -2$ c) $a = 2$ d) $a = 6$ e) Cannot determine.

37. A big cake is purchased for a party and 10 or 11 people are expected to come. What is the minimal number of pieces (perhaps of different sizes) you need to divide the cake into, if exactly 10 guests attend or exactly 11 guests attend?

a) 11   b) 20   c) 30   d) 55   e) 110

38. If we divide 344 by d the remainder is 3 and if we divide 715 by d the remainder is 2. Which of the following is true about d ?

a) $10 \le d \le 19$ b) $20 \le d \le 29$ c) $30 \le d \le 39$ d) $40 \le d \le 49$ e) $50 \le d \le 59$

39. A quadrilateral $ABCD$ has vertices with coordinates $A(0,0)$, $B(6,0)$, $C(5,4)$ and $D(3,6)$. What is its area?

a) 18   b) 19   c) 20   d) 21   e) 22

40. A point (x, y) is selected at random from the rectangular region bounded by $0 \le x \le 2$ and $0 \le y \le 1$. What is the probability that $x < y$?

a) $\dfrac{1}{5}$ b) $\dfrac{1}{4}$ c) $\dfrac{1}{3}$ d) $\dfrac{1}{2}$ e) $\dfrac{2}{3}$

41. The numbers a, b, c are integers. The parabola $y = x^2 + ax + b$ and the line $y = cx$ have one point in common. Which of the following is certainly true?

a) $a = 0$ b) $a - c$ is even   c) $b = 0$ d) $|c| \geq |a|^2 = |b|^2$ e) $c > 1$

42. Two fair dice are thrown, at least one face shows a 3. Find the conditional probability that the sum of the faces is 8 or 9.

a) $\dfrac{4}{36}$ b) $\dfrac{4}{8}$ c) $\dfrac{4}{12}$ d) $\dfrac{4}{72}$ e) $\dfrac{4}{11}$

43. $1 + 2 + 4 + 8 + 16 + \ldots + 16384 =$

a) 27673   b) 27637   c) 32677   d) 32676   e) 32767

44. Let ABC be an isosceles triangle such that the base has length $|AB| = 1$ and the side angles be $\angle ABC = \angle BAC = 45°$. Points M and N are the images of orthogonal projections of the middle point of the base AB onto the arms BC and AC, respectively. Draw the situation. Find the area of the quadrilateral ABMN.

a) 1/8   b) 1/16   c) 3/8   d) 3/4   e) 3/16

45. Given the numbers: $a = (-2)^{12}$, $b = (-2)^{11}$, $c = 2^{10}$. Numbers that are ordered from the smallest to the largest are

a) c, b, a b) a, b, c c) c, a, b d) b, c, a e) Cannot be ordered.

46. If $x = \sin \alpha$ then the following expression $\dfrac{\sqrt{1-x^2}}{x}$ can be simplified to

a) $\sin \alpha$ b) $\cos \alpha$ c) $\tan \alpha$ d) $\cot \alpha$ e) Cannot be determined.

47. Find a solution to $\log_2(x+1) - \log_2(x-1) = 3$.

a) $x = \dfrac{1}{3}$ b) $x = \dfrac{9}{5}$ c) $x = \dfrac{4}{7}$ d) $x = \dfrac{3}{2}$ e) $x = \dfrac{9}{7}$

48. Three advertisements for real estate agents are placed in each of three local newspapers. The following table shows the number of inquiries resulting from each advertisement. There were 200 inquiries in total.

	Good Houses	Cute Cottages	Sell Well
Star	18	23	17
Herald	24	17	30
News	16	26	29

The probability that an inquiry, chosen at random, was for "Cute Cottages" is

a) .09   b) 1   c) .17   d) .66   e) .33

49. What is the value of the expression $\dfrac{\sqrt{3}+\sqrt{5}}{\sqrt{8+2\sqrt{15}}}$?

a) $\sqrt{2}$ b) 1   c) $\dfrac{1}{2}$ d) 3   e) None listed.

50. Find the area of the region bounded by the positive x and y-axes and the graph of $y = -2|x-3|+8$.

a) 25   b) 36   c) 47   d) 31   e) 14

51. Given two parallel lines of distance 1 apart and a circle of radius 2. The circle is tangent to one of the lines and cuts the other line. The area of the circular cap between the two parallel lines is $\dfrac{a\pi}{3} - b\sqrt{3}$. Find the sum of the two integers a and b.

a) 3   b) 4   c) 5   d) 6   e) 7

52. Find the fraction $\dfrac{a}{b}$, in reduced form, such that if 4 is added to the numerator and 3 is subtracted from the denominator, the result is $\dfrac{39}{5}$, whereas if 3 is subtracted from the numerator and 4 is added to the denominator the result is $\dfrac{8}{3}$.

a) $\dfrac{35}{9}$ b) $\dfrac{35}{8}$ c) $\dfrac{53}{9}$ d) $\dfrac{-16}{9}$ e) $\dfrac{11}{3}$

53. Given the 3 statements

       I) $x^0 = 1$ for all real numbers x.

       II) $|x|$ is always positive for any real number x.

       III) $\sqrt{x^2} = x$ for all real numbers x.

    Which statements are true?

a) I and II only   b) I and III only   c) II and III only   d) All are true.   e) None are true.

54. What is the sum of $\dfrac{1}{1\cdot 3} + \dfrac{1}{3\cdot 5} + \dfrac{1}{5\cdot 7}\ldots + \dfrac{1}{301\cdot 303}$?

a) $\dfrac{302}{303}$ b) $\dfrac{151}{303}$ c) $\dfrac{150}{303}$ d) $\dfrac{151}{302}$ e) None listed.

55. If the $\sin\beta = \dfrac{2}{7}$ then the positive value of $\sec\beta =$

a) $\dfrac{3\sqrt{5}}{7}$ b) $\dfrac{5\sqrt{3}}{7}$ c) $\dfrac{7}{5\sqrt{3}}$ d) $\dfrac{7}{3\sqrt{5}}$ e) None listed.

56. If z is a complex number and $|z| - z = 3 + 2i$, then the real part of z is?

a) $\dfrac{8}{3}$ b) 3   c) $-\dfrac{5}{6}$ d) -1 e) $\dfrac{4}{5}$

57. A rectangular box has pairs of faces with areas of 15, 18, and 30. Determine its volume.

a) 72   b) 63   c) 85   d) 90   e) None listed.

58. A cylindrical oil tank is 2/5 full. If 18 more liters are added, the tank becomes 5/8 full. What is the capacity of the tank?

a) $\dfrac{80}{3}$ b) 80   c) 40   d) 72   e) None listed.

59. In the trapezoid shown the angles A and B at the side differ by 50 degrees. What is the angle of the shorter base?
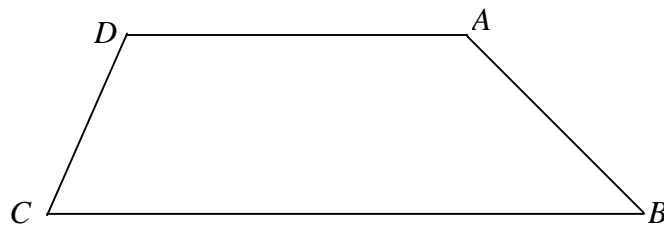
a) 115   b) 120   c) 125   d) 130   e) 65

60. What is the area of the region in the first quadrant defined by $18 \le x + y \le 20$?

a) 36   b) 38   c) 40   d) 42   e) 44

61. If $y = kx$ makes an angle of θ with the x-axis and $y = mx$ makes an angle of 2θ, what is the value of m in terms of k?

a) $2k$ b) $\dfrac{k}{(k+1)}$ c) $4k$ d) $\dfrac{2k}{(1-k^2)}$ e) $\dfrac{2k}{(1+k^2)}$

62. Suppose the average of the three numbers $x, y,$ and z is $3x + 2$. What is the average of y and z?

a) 3   b) $x+1$ c) 5   d) $3x$ e) $4x+3$

63. What is the minimum value of $y = x^2 + 4x + 1$?

a) -2 b) 2   c) -3 d) 3   e) None listed.

64. The Matrix product $\begin{bmatrix} 2 & 1 \\ -1 & 3 \end{bmatrix}\begin{bmatrix} -2 & 3 \\ 0 & 1 \end{bmatrix}$ is equal to

a) $\begin{bmatrix} -4 & 3 \\ 0 & 3 \end{bmatrix}$ b) $\begin{bmatrix} 2 & 1 & -2 & 3 \\ -1 & 3 & 0 & 1 \end{bmatrix}$ c) $\begin{bmatrix} -4 & 7 \\ -2 & 2 \end{bmatrix}$ d) $\begin{bmatrix} -4 & 7 \\ 2 & 0 \end{bmatrix}$ e) None listed.

65. What is the smallest integer in the domain of $f(x) = \dfrac{\sqrt{\log x - 2}}{100x - x^2}$?

a) 2   b) 101   c) 100   d) 1000   e) None listed.

66. If $x > 0$ and $x + \dfrac{1}{x} = \dfrac{49}{16}$, what is the value of $\sqrt{x} + \dfrac{1}{\sqrt{x}}$?

a) 2   b) 2.5   c) $\sqrt{2}$ d) 2.25   e) None listed.

67. If $\log_b 3 = 2^{-3}$ what is the value of b?

a) 6561   b) 6563   c) 6560   d) 6562   e) 6565