

**Science Bowl Practice Questions – Math**

1. Short Answer: What is the volume of a sphere of radius "R"?

ANSWER:  $(4/3) \pi R^3$

2. Short Answer: What is the surface area of a sphere of radius "r"?

ANSWER:  $4 \pi R^2$  or  $12.566 \times R^2$

3. Short Answer: How many degrees are there in  $\pi$  radians?

ANSWER: 180 DEGREES

4. Short Answer: Using an x-y coordinate axis, the figure represented by the equation  $[x^2/36] + [y^2/16] = 1$  is centered about what x-y coordinate point?

ANSWER: (0,0)

5. Short Answer: An ellipse is represented by the equation  $[x^2/36] + [y^2/16] = 1$ . What is the length of the major axis of this ellipse?

ANSWER: 12

6. Short Answer: Using an x-y coordinate axis, a parabola is given by the equation  $y = x^2$ . Give the x-y coordinates of the focal point for this parabola.

ANSWER: (0,1/4)

7. Short Answer: Using an x-y coordinate axis, a parabola is represented by the equation  $x^2 = 6y$ . The vertex of this parabola is at what coordinate point?

ANSWER: (0,0) or  $x = 0, y = 0$

8. Short Answer: For a right triangle, the  $\sin(A)$  is  $3/5$ . To what value is the  $\tan(A)$  (read: tangent of A) equal?

ANSWER:  $3/4$

9. Multiple Choice: The  $\tan(-A)$  (read: tangent of the angle minus A) is equal to which of the following?

- w)  $\tan(A)$  (read: tangent of the angle A)
- x)  $-\tan(-A)$  (read: minus the tangent of the angle minus A)
- y)  $-\tan(A)$  (read: minus the tangent of the angle A)
- z) none of the above

ANSWER: Y --  $-\tan(A)$  (read: minus the tangent of the angle A)

10. Multiple Choice: The cotangent of the angle A is equal to which of the following?

- w)  $\cot(-A)$  (pron: cotangent of the angle minus A)
- x)  $-\cot(-A)$  (pron: minus the cotangent of the angle minus A)
- y)  $-\cot(A)$  (pron: minus the cotangent of the angle A)
- z) none of the above

ANSWER: X --  $-\cot(-A)$

11. Multiple Choice: The  $\tan(180^\circ + A)$  (read: tangent of the quantity 18 degrees plus A) is equal to which of the following?

- w)  $\tan(A)$
- x)  $-\tan(A)$
- y)  $\tan(-A)$
- z) none of the above.

ANSWER: W --  $\tan(A)$

12. Multiple Choice: The  $\sin(2A)$  (read: the sine of angle 2A) is equal to which of the following relationships?

- w)  $\sin(A) - \cos(A)$  (read: sine of A minus the cosine of A)
- x)  $3\sin(A) / \cos(A)$  (read: 3 times the sine of A divided by the cosine of A)
- y)  $2 \sin(A) \cos(A)$  (read: 2 times the sine of A times the cosine of A)
- z)  $\tan(A) - 1$  (read: tangent of A minus 1)

ANSWER: Y -- 2 TIMES THE  $\sin(A)$  TIMES THE  $\cos(A)$

13. Multiple Choice: The  $\sin^2(A/2)$  (read: sine squared of angle A divided by 2) is equal to which of the following relationships? Is it:

- w)  $(1/2)[1 - \cos(A)]$  (read: 1/2 times the quantity one minus the cosine of the angle A)
- x)  $(1/2)[1 - \sin(A)]$  (read: 1/2 times the quantity one minus the sine of the angle A)
- y)  $2 \sin(A) \cos(A)$
- z) none of the above

ANSWER: W --  $(1/2)[1 - \cos(A)]$

14. Short Answer: For what value of the angle "A" is the  $\cos(A)$  equal to the  $\sin(A)$ ?

ANSWER:  $45^\circ$  or  $\pi/4$  RADIANS or  $(45^\circ + n \text{ times } 180^\circ)$

15. Short Answer: Given that the  $\log_{10}(3) = .477$ , what is the  $\log_{10}$  of 300?

ANSWER: 2.477

16. Short Answer: What is the  $\log_{5}(1/25)$  equal to?

ANSWER: -2

17. Short Answer: Find  $x$  if  $\log_{5}(x) = -2$ .

ANSWER:  $1/25$  or .04

18. Short Answer: Given that the  $\log_{10}(2) = .301$ , what is the  $\log_{10}(8)$  equal to?

ANSWER: .903

19. Short Answer: Given that the  $\log_{10}(2) = .30$  and that the  $\log_{10}(3) = .48$ , what is the  $\log_{10}(1.5)$  equal to?

ANSWER: .18

20. Multiple Choice: The trigonometric function  $\cos(2A)$  (read: cosine of the angle  $2A$ ) is equal to which of the following relationships?

w)  $1 - [\sin(A)]^2$  (read: one minus the sine squared of  $A$ )

x)  $[\cos(A)]^2 - [\sin(A)]^2$  (read: cosine squared of angle  $A$  minus the sine squared of angle  $A$ )

y)  $2[\sin(A)][\cos(A)]$  (read: 2 times the sine of  $A$  times the cosine of  $A$ )

z) none of the above

ANSWER: X --  $[\cos(A)]^2 - [\sin(A)]^2$

21. Short Answer: Find the equation of the line that passes through the point  $(1,2)$  and is perpendicular to the line  $y = 2x + 1$ .

ANSWER:  $Y = -(1/2)x + 2.5$  or  $y - 2 = (-1/2)(x - 1)$

22. Multiple Choice: A "reunion of broken parts" is the meaning of the root of what word:

w) algebra

x) calculus

y) mathematics

z) none of the above

ANSWER: W -- ALGEBRA

23. Short Answer: In what number base does  $1 + 2 = 10$ ?

ANSWER: BASE 3

24. Short Answer: How is the number 14 represented in the hexadecimal system?

ANSWER: E

25. Short Answer: If an electronic circuit operates in 100 nanoseconds, how many operations can it perform in one second?

ANSWER: 10 MILLION or  $10^7$

26. Short Answer: What is the imaginary unit "i" when raised to the power 10?

ANSWER: -1

**Science Bowl Practice Questions****Math - 4**

27. Short Answer: If both  $x$  and  $y$  are functions of time, what is the derivative of the PRODUCT of  $x$  and  $y$  with respect to time equal to?

ANSWER:  $x[dy/dt] + y[dx/dt]$  or  $y[dx/dt] + x[dy/dt]$

28. Short Answer: If  $x = t^4$  (read:  $t$  raised to the fourth), what is the second derivative of  $x$  with respect to  $t$  equal to?

ANSWER:  $12t^2$  (read:  $12t$  squared)

29. Short Answer: In calculus, what is the indefinite integral of the  $\sin(U)dU$  equal to?

ANSWER:  $-\cos(U) + \text{CONSTANT}$

30. Short Answer: Two off-axis lines are perpendicular if and only if the product of their slopes is equal to what?

ANSWER:  $-1$

31. Short Answer: Give the equation of one of the circles which satisfy the following criteria: a circle with a radius of 8 which is tangent to the  $y$ -axis and whose center lies on the  $x$ -axis.

ANSWER:  $(x - 8)^2 + (y)^2 = 8^2$  or  $(x + 8)^2 + (y)^2 = 8^2$

32. Short Answer: What is the sum of the first 100 positive integers?

ANSWER: 5050

33. Short Answer: What is the name given to the radius of a circle that can be inscribed in any regular polygon?

ANSWER: APOTHEM

34. Short Answer: The universal set  $U$  contains the elements  $\{1,2,3,4,5\}$ . Set  $A$  contains the elements  $\{1,3\}$ . What elements does the set  $A'$  (read:  $A$  prime) contain?

ANSWER:  $\{2,4,5\}$

35. Short Answer: Two fair coins are tossed and at least one is a head. What is the probability that both coins are heads?

ANSWER: 1/3

36. Multiple Choice: The polar equation,  $r = 3\sin(3t)$ , (read: r equals 3 times the sine of angle 3t) represents which of the following graphs? Is it the graph of a:

- w) cardioid (pron: car-dee-oiz)
- x) three-leaved rose
- y) Archimedian-spiral
- z) limacon (pron: lee-ma-son)

ANSWER: X -- THREE-LEAVED ROSE

37. Multiple Choice: The polar equation,  $r = 3 - 2\cos(t)$ , (read: r equal 3 minus 2 times the cosine of the angle t) represents which of the following graphs? Is it the graph of a:

- w) cardioid
- x) three-leaved rose
- y) Archimedian-spiral
- z) limacon (pron: lee-ma-son)

ANSWER: Z -- LIMACON

38. Short Answer: The ratio of 2 positive numbers is 3 to 8 and their product is 864. What are the two numbers?

ANSWER: 18,48

39. Short Answer: Name the famous mathematician/physicist who was born in the year Galileo died.

ANSWER: (ISAAC) NEWTON

40. Short Answer: A wheel is rolling without slipping on a flat surface. If the diameter of the wheel is 1 meter, how far does the hub of the wheel move when the wheel turns once?

ANSWER:  $\pi$  METERS or 3.14 METERS

41. Short Answer: Exactly how many of the prime numbers are even?

ANSWER: 1

42. Short Answer: Give two trigonometric functions which are NEGATIVE in BOTH the third and fourth quadrants.

ANSWER: SINE and COSECANT

43. Short Answer: An 8 meter length of rope is placed along the circumference of a circle whose diameter is 16 meters. At the circle's center, how many radians are subtended by the 8 meter length of rope?

ANSWER: 1

44. Short Answer: How many vertices does a tetrahedron have?

ANSWER: FOUR

45. Short Answer: What term is used to describe a triangle that has three UNEQUAL sides?

ANSWER: SCALENE

46. Short Answer: What is the slope of the straight line whose x-intercept is +4 (read: plus 4) and whose y-intercept is +8 (read: plus 8)?

ANSWER: -2 (read: minus 2)

47. Short Answer: The relation between y and x is given by the equation " $y = \text{ABS}(4 - x)$ " (read: y equals the absolute value of the quantity 4 minus x). If y equals 6, give all possible values for X.

ANSWER: 10 AND -2

48. Short Answer: The relationship between y and x is given by the equation,  $y = x^2 + 7x + 14$  (read: y equals x squared plus 7 x plus 14). For what values of x will y equal +2?

ANSWER: -4 AND -3

49. Short Answer: The relationship between y and x is given by the equation:  $y = x^2 - 2x + 8$ . For what value of x is y a minimum?

ANSWER: 1

50. Short Answer: A straight line is plotted on an XY coordinate axis. The line intercepts the y axis at 3 and makes an angle of 45 degrees with respect to the x axis. Give the equation for this line.

ANSWER:  $y = x + 3$  or  $y = -x + 3$

51. Short Answer: A straight line intersects a circle in the first and second quadrants for x values of +3 and -3. The equation of the circle is " $x^2 + y^2 = 25$ ". What is the EQUATION of the straight line?

ANSWER:  $y = 4$

52. Short Answer: Twelve socks are in a drawer; 4 are red, 7 are blue, and 1 is green. What is the maximum number of socks that you can pull out and only have 2 matching pairs?

ANSWER: 7

53. Short Answer: The scale on a blueprint of a bicycle says one half inch equals 1 foot. What will be the actual DIAMETER of the bicycle wheel if they are drawn with a RADIUS of  $\frac{3}{4}$  inches.

ANSWER: 3 FEET (accept 36 inches)

54. Short Answer: What is the value of 125 to the two-thirds power?

ANSWER: 25

55. Short Answer: What is the value of the integral from 1 to e of  $du/u$  (read: d u divided by u), where e is the base of the natural logarithm?

ANSWER: 1

56. Short Answer: What is the slope of the curve  $y = x^3 - 6x + 2$  when it crosses the y axis?

ANSWER: -6

57. Short Answer: What is the area bounded by the curve  $y = x^2$  and the axis between  $x = 1$  and  $x = 2$ ?

ANSWER:  $7/3$  (or 2 and  $1/3$  or 2.333)

58. Short Answer: What is the slope of the curve  $y = \ln x$  (read: y equals the natural logarithm of x) at  $x = 2$ ?

ANSWER:  $1/2$

59. Short Answer: Name the two discoverers of the fundamental theorem of calculus. Last names only are acceptable.

ANSWER: (SIR ISAAC) NEWTON AND (BARON VON) LEIBNITZ

60. Multiple Choice: The equation:  $[(x - 2)^2/6] - [(y - 3)^2/5] = 2$  defines which of the following? (read: the quantity x minus 2 squared divided by 6 MINUS the quantity y minus 3 squared divided by 5 equals 2)

- w) ellipse
- x) hyperbola
- y) spiral
- z) parabola

ANSWER: X -- HYPERBOLA

61. Short Answer: What is the distance between the points P and Q if their cartesian coordinates are (5, 5, 1) and (1, 5, -2)? (read: 5 comma, 5 comma, 1 and 1 comma, 5 comma, minus 2)

ANSWER: 5

62. Short Answer: What are the cartesian coordinates of the point of intersection of the two lines  $x - y = 5$  and  $x + y = 1$ ? (read: x minus y equals 5 and x plus y equals 1)

ANSWER: (3, -2) (accept  $x = 3$  and  $y = -2$  but not  $x = -2, y = 3$ )

63. Short Answer: What is the slope of the line  $2x + 3y = 7$ ? (read: 2 x plus 3 y equals 7)

ANSWER:  $-2/3$  or -0.667

64. Short Answer: Express the product of the following complex numbers in the form  $a + bi$  (read: a plus b i) where a and b are real:  $4 + 2i$  and  $2 + 5i$  (read: 4 plus 2 i and 2 plus 5 i)

ANSWER:  $-2 + 24i$  (read: minus 2 plus 24 i)

65. Short Answer: In the complex plane, what are the roots of the equation  $x^2 + 4x + 8 = 0$ ? (read: x squared plus 4 x plus 8 equals 0)

ANSWER:  $-2 - 2i$  and  $-2 + 2i$

66. Multiple Choice: If  $\log_x 81 = 6$  (read: the log base x of 81 equals 6), then x is equal to:

w) 3

x) 9

y)  $1/3$

z)  $9^{1/3}$  (read: the cube root of 9)

ANSWER: Z --  $9^{1/3}$  (read: the cube root of 9)

67. Multiple Choice; Matrix C is the product of matrix A times matrix B Which of the following must be TRUE.

w) The number of rows of A equals the number of rows of B.

x) The number of columns of A equals the number of columns of B.

y) The number of rows of A equals the number of columns of B.

z) The number of columns of A equals the number of rows of B.

ANSWER: Z -- THE NUMBER OF COLUMNS OF A EQUALS THE NUMBER OF ROWS

68. Short Answer: For which values of X from the set of real numbers does the following inequality hold:  
 $8x - 6 < 2x + 6$  (read: 8 x minus 6 is less than 2 x plus 6)

ANSWER:  $X < 2$  (read: X less than 2)

69. Short Answer: To what value does the infinite series  $1/4 + 1/8 + 1/16 + \dots$  converge? (read: one fourth plus one eighth plus one sixteenth, etc.)

ANSWER:  $1/2$

70. Short Answer: If  $(\sin(3x) + \cos(3x))^2 = 2$  (read: the quantity sine x plus cosine 3 x squared equals 2) then what does  $3\sin(3x) \cos(3x)$  (read 3 sine 3 x cosine 3 x) equal?

ANSWER:  $3/2$

71. Short Answer: If  $\theta = 30^\circ$ , what is  $\csc^2 \theta - \cot^2 \theta$  equal to? (read: If theta equals 30 degrees, what is cosecant squared theta minus cotangent squared theta equal to?)

ANSWER: 1

72. Short Answer: A woman is 22 years older than her daughter. Nine years ago she was twice as old as her daughter. What are their present ages?

ANSWER: THE WOMAN IS 53 YEARS OLD, THE DAUGHTER IS 31 YEARS OLD.

73. Short Answer: What is the period of the function  $t = \cos 4s$ ? (read: t equals the cosine of 4 s)

ANSWER:  $\pi/2$  (or  $1/2 \pi$ )



**Science Bowl Practice Questions**

**Math - 9**

74. Short Answer: What is the amplitude of the curve  $y = -1.5 \sin x$  (read: y equals minus 1 point 5 sine x)?

ANSWER: 1.5 (do NOT accept -1.5)

75. Multiple Choice: Which of the following functions is NOT a transcendental function? Is it:

- w) trigonometric
- x) algebraic
- y) logarithmic
- z) exponential

ANSWER: X -- ALGEBRAIC

76. Short Answer:  $y = 3x^2 + 4x + 2$  (read: y equals 3 x squared plus 4 x plus 2). What is the value of the derivative of y at  $x = 1$ ?

ANSWER: 10

77. Short Answer:  $y = 4x + 3$ . What is the value of the integral of y from  $x = 0$  to  $x = 1$ ? (read: y equals 4 x plus 3)

ANSWER: 5

78. Short Answer: A circle with a radius of 2 is defined by the equation  $x^2 + y^2 - 2y = 3$ . What are the coordinates in the cartesian coordinate system of the center of this circle?

ANSWER: 0,1 or  $x = 0, y = 1$

79. Short Answer: The polar coordinates of a point are  $(3, p/2)$  (read: 3 comma p over 2). What are the cartesian coordinates of this point?

ANSWER: 0,3 or  $x = 0, y = 3$

80. Short Answer: The area bounded by the race track at your high school is a rectangle with semicircles at each end. The radius of the circular parts is 30 yards and the perimeter of the area bounded by the track is 40 yards. Within ten yards, how long is each straight section of the track?

ANSWER: 106 YARDS (accept 96 to 116)

81. Short Answer: The population of a near-by town was 10,000 in January, 1990. It is estimated that the population will increase by 10% each year. What will be population of the town in January, 1992.

ANSWER: 12,100

82. Multiple Choice: A fractal is a type of:

- w) fraction
- x) geometric shape
- y) geologic fault
- z) differential equation

ANSWER: X -- GEOMETRIC SHAPE

83. Short Answer: For which values of  $x$  from the set of real numbers does the following inequality hold:  
 $4x + 5 < x + 11$  (read: 4 x plus 5 is less than x plus 11)

ANSWER:  $x < 2$  (read: x LESS THAN 2)

84. Short Answer: If two sides of a quadrilateral are parallel and the other two sides are equal but NOT parallel, the quadrilateral is known as a:

- w) parallelogram
- x) triangle
- y) square
- z) trapezoid

ANSWER: Z – TRAPEZOID

85. Short Answer: A student finds that the numerical values for the area and the volume of a sphere are equal. What is the radius for this sphere?

ANSWER: 3 (no units specified)

86. Short Answer: A customer purchased a candy bar costing \$0.78 and was 3 cents short of having the exact amount without breaking a \$1 bill. How much change did the customer have after the \$1 bill was broken?

ANSWER: \$0.97

87. Short Answer: A number minus its reciprocal is 14 larger than the original number. What was the number?

ANSWER:  $-1/14$

88. Short Answer: A curve represented by the equation  $y = -5x^2$  intersects the line  $y = -20$  at two points. What is the straight-line distance between the two intersections?

ANSWER: 4

89. Short Answer: Solve this indefinite integral:  $\int 2/x \, dx$  (read: the integral of 2 over x, dx).

ANSWER:  $2 \ln x + \text{CONSTANT}$

90. Short Answer: What is the volume of a right circular cone with radius r and height h?

ANSWER:  $(1/3)\pi r^2 h$

91. Short Answer: What is  $81^{1/4}$  (read: 81 to the one-fourth power)?

ANSWER: 3

92. Short Answer: Where does the graph of cotangent of x cross the x-axis?

ANSWER:  $x = \pi/2, 3\pi/2, 5\pi/2 \dots$  or ODD INTEGERS OF  $\pi/2$

93. Short Answer: A biker goes EAST for 4 miles, NORTH for 12, EAST for another 4 and SOUTH for 6. What is the magnitude of the displacement?

ANSWER: 10 MILES

94. Multiple Choice: What type of numbers are included in the real number line that are not included in the rational number line?

- w) whole numbers
- x) integers
- y) irrational numbers
- z) fractional numbers

ANSWER: Y -- IRRATIONAL NUMBERS

95. Multiple Choice: A square matrix which has all zeros below the main diagonal is called:

- w) upper triangular
- x) singular
- y) lower triangular
- z) invertable

ANSWER: W -- UPPER TRIANGULAR

96. Short Answer: Express the binary number 10010 as a decimal number.

ANSWER: 18

97. Short Answer: Express the decimal number 27 in Base 16 (Hexadecimal).

ANSWER: 1B

98. Short Answer: What is the limit of the  $\cos(X)$  (read: cosine of X) as X approaches zero?

ANSWER: 1

99. Short Answer: What is the limit of the fraction  $1/x$  as x approaches infinity?

ANSWER: 0

100. Short Answer: What is the limit of the fraction  $x/(x+1)$  as approaches infinity?

ANSWER: 1