

MATHEMATICS

1. MATHEMATICS

Writer: Ashneel Das

Toss Up: Short Answer

How many non empty subsets are there of the set {1,2,6,9}?

Bonus Answer: 15

Bonus: Short Answer

What are the roots of x^4-5x^2+4 ?

Bonus Answer: 1,-1,4,-4

2. MATHEMATICS

Writer: Ivan Zhang

Toss Up: Short Answer

What number is a factor of $y^3 + 10y^2 + 123y + 5$?

Bonus Answer: 1, -1

Bonus: Short Answer

What is the area of an equilateral triangle inscribed in a circle with a radius of 6?

Bonus Answer: $(27\sqrt{3})$

3. MATHEMATICS

Writer: Ashneel Das

Toss Up: Multiple Choice

What is the height of an equilateral triangle with side length 4?

W) 8

X) 4

Y) $2\sqrt{3}$

Z) $4\sqrt{3}$

Toss Up Answer: Y

Bonus: Short Answer

What is the area of an isosceles right triangle with hypotenuse $10\sqrt{2}$?

Bonus Answer: 50

4. MATHEMATICS

Writer: Aaron Gee

Toss Up: Multiple Choice

Which of the following has the largest amplitude?

W) $9\sin(x) - 2$

X) $2\cos(6x) + 5$

Y) $\cos(2x)$

Z) $4\sin(10x)$

Toss Up Answer: W

Bonus: Short Answer

What power of 10 is closest to 255?

Bonus Answer: 10 to the 16

5. MATHEMATICS

Writer: Zoe Orlin

Toss Up: Short Answer

What is the derivative of x^2 ?

Bonus Answer: $2x$

Bonus: Short Answer

What is the derivative of $42x^2$

Bonus Answer: $84x$

6. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

For all positive integers n , what is the degree of the polynomial $(x^2 - 3)^{(2n)}$ in terms of n .

Bonus Answer: $4n$

Bonus: Short Answer

State the solutions, in increasing value, for the equation $(x+1)^3 - x^3 - x^2 = 0$

Bonus Answer: (Only accept the answers read in this order): -1 , $-1/2$

7. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

Compute $100^2 - 98 \cdot 102$

Bonus Answer: 4

Bonus: Multiple Choice

The absolute value of $n^2 - (n+x)(n-x)$, where n and x are positive integers, is always:

W) $-(x^2)$

X) n^2

Y) $2 \cdot x \cdot n$

Z) x^2

Bonus Answer: Z

8. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

Find the product of all primes less than 11.

Bonus Answer: 210

Bonus: Multiple Choice

Find the number of triangular numbers less than 2016.

W) 58

X) 60

Y) 62

Z) 64

Bonus Answer: Y

9. MATHEMATICS

Writer: Calvin Aw

Toss Up: Multiple Choice

Which three numbers satisfy the Pythagorean Theorem?

W) 1, 1, and $\sqrt{3}$

X) 3, 4, and 5.01

Y) $\pi/3$, $\pi/4$, $\pi/5$

Z) $1/3$, $1/4$, $5/12$

Toss Up Answer: Z

Bonus: Short Answer

Triangle ABC has side lengths of 10, 10, and $10\sqrt{2}$. State all distinct median lengths of the triangle in increasing value.

Bonus Answer: $5\sqrt{2}$, $5\sqrt{5}$ (only accept the numbers said in that order).

10. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

What is the full name of the French mathematician who invented the Cartesian coordinate plane?

Bonus Answer: Rene Descartes (You may also accept Descartes Rene, but do not accept Descartes or Rene)

Bonus: Short Answer

What is the name of the value of x in the ordered pair (x,y)

Bonus Answer: Abscissa

11. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

Find the limit of $(x^2 - x - 2)/(x + 1)$ as x approaches -1.

Bonus Answer: -3

Bonus: Short Answer

Find the limit of $(x^2 + 6x + 5)/x^3$ as x approaches infinite

Bonus Answer: 0

12. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

There are 27 people in a party. If 16 people wanted ice cream and 17 people wanted chocolate, at most how many people wanted only ice cream?

Bonus Answer: 10

Bonus: Short Answer

How many non congruent rectangles are there with an area of 324 and positive integer side lengths?

Bonus Answer: 8

13. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

If $x^5 - 4x^4 + 3x^2 - 2x + 1 = 0$, find the sum of all five of the roots.

Bonus Answer: 4

Bonus: Short Answer

If polynomial $P(x)$ leaves a remainder of 5 when divided by $x-1$ and a remainder of 7 when divided by $x+1$, find the remainder when $P(x)$ is divided by x^2-1 .

Bonus Answer: $-x+6$

14. MATHEMATICS

Writer: Calvin Aw

Toss Up: Multiple Choice

Which of the following shapes is always cyclic?

W) A parallelogram

X) A rhombus

Y) An obtuse triangle

Z) A pentagon

Toss Up Answer: Y

Bonus: Short Answer

In a triangle with side lengths 10, $10\sqrt{3}$, and 20, find the length of the angle bisector which intersects the side of length $10\sqrt{3}$.

Bonus Answer: $20\sqrt{3}/3$

15. MATHEMATICS

Writer: Janine Goh

Toss Up: Short Answer

In what type of triangle is the angle bisector, the altitude and the median the same line?

Bonus Answer: Isosceles or equilateral triangle

Bonus: Short Answer

Find the other roots of $x^3 + 6x^2 - 13x - 42$ if one of them is -2

Bonus Answer: -7, 3

16. MATHEMATICS

Writer: Hussain Waris

Toss Up: Multiple Choice

A set is countable:

W) If and only if it is finite.

X) If and only if a surjection can be made between the set and the natural numbers.

Y) If it has the same cardinality as some subset of the natural numbers.

Z) If it has the same cardinality as some subset of the real numbers.

Toss Up Answer: Y

Bonus: Short Answer

Who was the famous German mathematician that invented Set Theory and effectively proved the uncountableness of the reals?

Bonus Answer: Georg Cantor (accept Cantor)

17. MATHEMATICS

Writer: Ashneel Das

Toss Up: Short Answer

What is $64x^3 + 27y^3$ factored in simplest form?

Bonus Answer: $(4x+3y)(16x^2-12xy+9y^2)$

Bonus: Short Answer

If i is the square root of -1 , what is the value of i^{97} ?

Bonus Answer: i

18. MATHEMATICS

Writer: Ashneel Das

Toss Up: Short Answer

If Robert can paint a fence in 12 hours and George can paint a fence in 6 hours how long will they take to paint the fence together?

Bonus Answer: 4 hours

Bonus: Multiple Choice

What is the coefficient of the 3rd term in the expansion of $(x+y)^7$

W) 1

X) 7

Y) 21

Z) 35

Bonus Answer: Y

19. MATHEMATICS

Writer: Andrew Chen (Senior)

Toss Up: Multiple Choice

Simplify the following expression: $(x^3+27)/(x+3)$ if $x=12$

W) 125

X) 117

Y) 136

Z) 109

Toss Up Answer: X

Bonus: Short Answer

Find all the real solutions of $x^4-18=-2$

Bonus Answer: $x=2, x=-2$

20. MATHEMATICS

Writer: Andrew Chen (Senior)

Toss Up: Short Answer

What is the sum of the interior angles of a nonagon?

Bonus Answer: 1260 degrees

Bonus: Short Answer

How many edges does an octahedral prism have?

Bonus Answer: 24 edges

21. MATHEMATICS

Writer: Jessica Titensky

Toss Up: Short Answer

Convert CD from hexadecimal to decimal

Bonus Answer: 205

Bonus: Short Answer

Convert CD from hexadecimal to binary

Bonus Answer: 11001101

22. MATHEMATICS

Writer: Jessica Titensky

Toss Up: Short Answer

What is the slope of the tangent line to $e^{(2x)}$ at $x=3$

Bonus Answer: $2e^6$

Bonus: Short Answer

What is the slope of the tangent line to $\ln(2x)$ at $x=3$

Bonus Answer: $1/3$

23. MATHEMATICS

Writer: Jessica Titensky

Toss Up: Short Answer

What is the area of the circle $x^2+y^2=6\pi^2$ in terms of π

Bonus Answer: 6π

Bonus: Short Answer

What is the area of the circle $x^2-4x+y^2-6y-2=0$ in terms of π

Bonus Answer: 15π

24. MATHEMATICS

Writer: Jessica Titensky

Toss Up: Short Answer

How many distinct roots does x^3-6x^2+32 have

Bonus Answer: 2

Bonus: Short Answer

What is the remainder when x^3-6x^2+32 is divided by $x-1$

Bonus Answer: 27

25. MATHEMATICS

Writer: Jessica Titensky

Toss Up: Short Answer

How many seconds are in a day

Bonus Answer: 86400

Bonus: Multiple Choice

How many days are in a second

W) $1.16 \cdot 10^{-3}$

X) $1.16 \cdot 10^{-4}$

Y) $1.16 \cdot 10^{-5}$

Z) $1.16 \cdot 10^{-6}$

Bonus Answer: Y

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26. MATHEMATICS

Writer: Jessica Titensky

Toss Up: Short Answer

What is $\tan(\arcsin(9/41))$

Bonus Answer: 9/40

Bonus: Short Answer

What is $\sin(\operatorname{arccot}(\tan(\arccos(3/5))))$

Bonus Answer: 3/5

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27. MATHEMATICS

Writer: Jessica Titensky

Toss Up: Short Answer

What is the amplitude of $y=4\sin(5x+3)$

Bonus Answer: 4

Bonus: Short Answer

What is the period of $y=4\sin(5x+3)$ rounded to the nearest 100th

Bonus Answer: 1.26

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28. MATHEMATICS

Writer: Andrew Chen

Toss Up: Short Answer

Prime factorize 273.

Bonus Answer: $3 \cdot 7 \cdot 13$

Bonus: Multiple Choice

Which of the following numbers is a root of unity?

W) $1 + i$

X) $1/2 + (1/2)(\sqrt{3})(i)$

Y) $3 + 4i$

Z) $(1/2)(\sqrt{2}) + (3/2)(\sqrt{2})(i)$

Bonus Answer: X

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29. MATHEMATICS

Writer: Andrew Chen

Toss Up: Short Answer

How many ways are there to distribute 4 identical blue balls and 3 identical red balls among 3 people?

Bonus Answer: 315 (accept $21 \cdot 15$)

Bonus: Short Answer

What are all possible shapes that are yielded by inverting a circle across another circle?

Bonus Answer: circle, line

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30. MATHEMATICS

Writer: Ashneel Das

Toss Up: Multiple Choice

How many zeroes does the equation $x^3 + 6x^2 + 11x + 6 = 0$ have?

- W) 1
- X) 2
- Y) 3
- Z) 4

Toss Up Answer: Y

Bonus: Short Answer

Find the solution(s) of the following system of linear equations: $2x + 4y = 6$, $x + 2y = 5$

Bonus Answer: No solutions

31. MATHEMATICS

Writer: Jason Weng

Toss Up: Multiple Choice

If x is positive, what is the minimum value of $2x + (2/x)$?

- W) 1
- X) 2
- Y) 3
- Z) 4

Toss Up Answer: Z

Bonus: Multiple Choice

What is $f(15)$ if $f(x) = 2\sin(x)\cos(x)$, where x is in degrees?

- W) $(\sqrt{3})/2$
- X) $1/(\sqrt{3})$
- Y) $1/2$
- Z) 1

Bonus Answer: Y

32. MATHEMATICS

Writer: Hanna Yang

Toss Up: Short Answer

$(mn)^2 - p^2$

Bonus Answer: $(mn - p)(mn + p)$

Difference of Squares

Bonus: Short Answer

Factor $a^4 + 4b^4$

Bonus Answer: $(a^2 + 2b^2 + 2ab)(a^2 + 2b^2 - 2ab)$

Solution:

$a^4 + 4b^4 = a^4 + 4a^2b^2 + 4b^4 - 4a^2b^2$

$(a^2 + 2b^2)^2 - (2ab)^2 = (a^2 + 2b^2 + 2ab)(a^2 + 2b^2 - 2ab)$

Difference of Squares

(This is also the Sophie Germain Identity)

33. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

$f(x) = x^4 + 5x^8 + 7x^6 + 5$ Which of the following is true about $f(x)$?

- W) $f(x)$ is odd, only
- X) $f(x)$ is even, only
- Y) $f(x)$ is neither odd nor even
- Z) $f(x)$ is both even and odd

Toss Up Answer: X

Bonus: Short Answer

Simplify: $\cos(\sin^{-1}(3/5))$

Bonus Answer: 4/5

Solution:

Draw a 3-4-5 right triangle and find the angle that $\sin^{-1}(3/5)$ is equal to. Then, take its cosine.

34. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

Which of the following types of symmetry does $x^2 + (y-1)^2 = 36$ have?

- W) Y-axis symmetry, only
- X) X-axis symmetry, only
- Y) Both x and y axis symmetry
- Z) Neither x nor y axis symmetry

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following types of symmetry does $x^2 - y^2 = 36$ have?

- W) Y-axis symmetry, only
- X) X-axis symmetry, only
- Y) Both x and y axis symmetry
- Z) Neither x nor y axis symmetry

Bonus Answer: Y

35. MATHEMATICS

Writer: Jason Weng

Toss Up: Multiple Choice

What is the area of an equilateral triangle with side lengths 2?

- W) 1
- X) $\sqrt{3}$
- Y) $\sqrt{6}$
- Z) 2

Toss Up Answer: X

Bonus: Multiple Choice

If the roots of $P(x) = 64x^2 - 24x + 2$ are A and B, what is the harmonic mean of A and B in simplest fractional form?

- W) $1/3$
- X) $1/6$
- Y) $1/12$
- Z) $1/24$

Bonus Answer: X

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36. MATHEMATICS

Writer: Jason Weng

Toss Up: Multiple Choice

Given $P(x) = x^2 + ax + b$ and $P(1) = 9$, what is $a + b$?

- W) 8
- X) 10
- Y) 9
- Z) 1

Toss Up Answer: W

Bonus: Multiple Choice

Factor the following completely: $(4x^4) - (20x^2) + 16$

- W) $(x+1)(x-1)(x+2)(x-2)$
- X) $(x+1)(x+1)(x-2)(x-2)$
- Y) $4(x+1)(x-1)(x+2)(x-2)$
- Z) $4(x+1)(x+1)(x-2)(x-2)$

Bonus Answer: Y

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37. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

Simplify: $(24 \cdot 63) / (72 \cdot 21)$

- W) 1
- X) 3
- Y) 7
- Z) $1/3$

Toss Up Answer: W

Bonus: Short Answer

Simplify $(333(x^4 - x^2)) / (9(x^2 + 2x + 1)(x^2))$

Bonus Answer: $(x-1)/((37)(x+1))$

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38. MATHEMATICS

Writer: Hanna Yang

Toss Up: Short Answer

Compute: $\sqrt{(3 \cdot 4 \cdot 5 - 60)^2}$

Bonus Answer: 0

Bonus: Short Answer

Compute $(34/17 - 2 + 5) \cdot (96 + -144) \cdot (1/(46 - 130/5))$

Bonus Answer: -12

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39. MATHEMATICS

Writer: Hanna Yang

Toss Up: Short Answer

What is the slope of a line parallel to $45x=9y+5$?

Bonus Answer: 5

Bonus: Multiple Choice

How many vertical asymptotes does $f(x)=(x^2+2x+1)/(x^3-x)$ have?

W) 0

X) 1

Y) 2

Z) 3

Bonus Answer: Y

40. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

Which of the following is true?

W) -1 is congruent to 1 modulo 5

X) -1 is congruent to 2 modulo 5

Y) -1 is congruent to 3 modulo 5

Z) -1 is congruent to 4 modulo 5

Toss Up Answer: Z

Bonus: Short Answer

Which is larger, 8^{10} or 3^{30}

Bonus Answer: 3^{30}

41. MATHEMATICS

Writer: George Zhou

Toss Up: Short Answer

What is the solution for square root of the quantity $x+5$ equals $x+3$

Bonus Answer: -1 *(do not except: [-1 and -4] or [-3])

Bonus: Short Answer

In a certain language of a certain people of a certain world, to frack a number is to find the average of the number and its square. For example, the frack of 2 is 3 since it is the average of 2 and 2 squared. what is the frack of 100?

Bonus Answer: 2020

42. MATHEMATICS

Writer: Shamaul Dilmohamed

Toss Up: Multiple Choice

The sum $(1+3+3^2+... 3^n)$ is equal to which of the following?

W) $2 * 3^n$

X) $4 * 3^n$

Y) $(3^{(n+1)}+1)/2$

Z) $(3^{(n+1)}-1)/2$

Toss Up Answer: Z

Bonus: Short Answer

In space, what is the graph of the equation $x^2 = y$?

Bonus Answer: A parabolic cylinder

43. MATHEMATICS

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What is the name for the rule that states that when you have a limit of indeterminate form as a fraction, it is equal to the limit of the derivative of the numerator over the derivative of the denominator?

Bonus Answer: L'hospital's rule

Bonus: Short Answer

What famous function, named after a mathematician, takes the infinite sum of the reciprocals of the natural numbers raised to an argument?

Bonus Answer: Riemann zeta function

44. MATHEMATICS

Writer: Raafiul Hossain

Toss Up: Multiple Choice

A statement about a relationship between natural quantities. The statement has been tested many times, and has not been contradicted. What is it?

W) Fact

X) Hypothesis

Y) Law

Z) Theory

Toss Up Answer: Y

Bonus: Multiple Choice

A framework that includes many well-tested and verified hypotheses about one or more aspects of the natural world.

W) Fact

X) Hypothesis

Y) Law

Z) Theory

Bonus Answer: Z

45. MATHEMATICS

Writer: Raafiul Hossain

Toss Up: Short Answer

The surface area of a sphere is how many times the area of a circle?

Bonus Answer: 4

Bonus: Short Answer

What is the area of a cone?

Bonus Answer: $(\pi)r^2h$

46. MATHEMATICS

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What type of number is defined as a number that is not a root of a polynomial with rational coefficients?

Bonus Answer: Transcendental numbers

Bonus: Short Answer

Of the following, which of these numbers of transcendental? π , e , i , ϕ , $e \text{ times } i$, $2^{\sqrt{2}}$

Bonus Answer: π , e , $e \text{ times } i$, $2^{\sqrt{2}}$

47. MATHEMATICS

Writer: Siam Muquit

Toss Up: Short Answer

Given $y = |x - 6|$, what is the derivative at $x = 6$?

Bonus Answer: The derivative does not exist

Bonus: Short Answer

Find the derivative of x^3 / x^2

Bonus Answer: 1

48. MATHEMATICS

Writer: Ahmad Alnasser

Toss Up: Short Answer

Find the derivative of: $4x^3 + 18x + 2$

Bonus Answer: $8x^2 + 18$

Bonus: Short Answer

At what point is the slope of the tangent line to the parabola $y = 3x^2 + 5x + 23$ equal to 0?

Bonus Answer: $(-5/6, 441/36)$

49. MATHEMATICS

Writer: Ahmad Alnasser

Toss Up: Short Answer

Write an equation for a sine function with an amplitude of $5/3$, a period of $\pi/2$, and a vertical shift of 4 units up.

Bonus Answer: $y = (5/3)\sin(4x) + 4$

Bonus: Short Answer

Two large and 1 small pumps can fill a swimming pool in 4 hours. One large and 3 small pumps can also fill the same swimming pool in 4 hours. How many hours will it take 4 large and 4 small pumps to fill the swimming pool.

Bonus Answer: 1 hour and 40 minutes

50. MATHEMATICS

Writer: Yevgeniy Gorbachev

Toss Up: Multiple Choice

If a regular hexagon has a side length of 2, what is its area?

W) $3\sqrt{6}$

X) $6\sqrt{3}$

Y) $\sqrt{18}$

Z) $6\sqrt{2}$

Toss Up Answer: X

Bonus: Multiple Choice

If $f(x)$ is $(\ln(x^2))/(e^x)$, what is $f'(x)$ in simplest form?

W) $((x^2)/2x) + \ln(x^2)/(e^{2x})$

X) $((2/x) - \ln(x^2))/(e^2)$
Y) $(\ln(4/x))/(e^{2x})$
Z) $((2x/(x^2)) - \ln(x^2))/(e^{2x})$

Bonus Answer: X

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51. MATHEMATICS

Writer: George Zhou

Toss Up: Multiple Choice

$3^{12} = 27^x$. What is the value of x?

W) $x=12$

X) $x=4$

Y) $x=6$

Z) $x=3$

Toss Up Answer: X

Bonus: Short Answer

$3^{12} + 3^{11} + 3^{10} = b \cdot 3^a$ What is the positive difference between the product and the sum of a and b?

Bonus Answer: 107

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52. MATHEMATICS

Writer: George Zhou

Toss Up: Multiple Choice

Donald Trump has $10x+5$ apples where $x=3$. How many apples does he have if he eats two of them?

W) 35

X) 39

Y) 30

Z) 33

Toss Up Answer: Z

Bonus: Short Answer

Donald Trump has a tower consisting of $0.00405 \cdot 10^{45}$ grams of gold. How many kilograms of gold is in his tower?
Express in scientific notation.

Bonus Answer: $4.05 \cdot 10^{39}$ (kilograms of gold)

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53. MATHEMATICS

Writer: Aaron Gee

Toss Up: Short Answer

What is the volume of a sphere of radius "R"?

Bonus Answer: $(\frac{4}{3}) \pi R^3$

Bonus: 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.

Bonus Answer: (0, 1/4)

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54. MATHEMATICS

Writer: Aaron Gee

Toss Up: 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?

Bonus Answer: (0,0)

Bonus: Short Answer

For a right triangle, the $\sin(A)$ is $3/5$. To what value is the $\tan(A)$ equal?

Bonus Answer: $3/4$

55. MATHEMATICS

Writer: Ahmad Alnasser

Toss Up: Short Answer

Describe the expression $2 \log_3 x + \log_3 5$ as a single logarithmic expression

Bonus Answer: $\log_3 (5x^2)$

Bonus: Short Answer

Solve the equation $2|3x - 2| - 3 = 7$

Bonus Answer: $x = (7/3), -1$

56. MATHEMATICS

Writer: Siam Muquit

Toss Up: Multiple Choice

How many roots (real or complex) does $x^4 - x^3 - 9x^2 + 7x + 14 = 0$ have?

W) 1

X) 2

Y) 3

Z) 4

Toss Up Answer: Z

Bonus: Short Answer

Find all real roots of $x^4 - x^3 - 9x^2 + 7x + 14 = 0$

Bonus Answer: -1, 2, $\pm \sqrt{7}$

57. MATHEMATICS

Writer: Shihab Karim

Toss Up: Multiple Choice

If the diameter of a circle is 6 inches, what is the area of the circle?

W) 36π

X) 9π

Y) 12π

Z) 6π

Toss Up Answer: X

Bonus: Short Answer

Find the equation of the line that passes through the point (3,4) and is perpendicular to the line $y = 3x - 2$?

Bonus Answer: $y = -(1/3)x + 5$

58. MATHEMATICS

Writer: Shihab Karim

Toss Up: Short Answer

What is the imaginary unit "i" when raised to the power 30?

Bonus Answer: -1

Bonus: Short Answer

What is the sum of the first 50 positive integers?

Bonus Answer: 1275

59. MATHEMATICS

Writer: Henry Zheng

Toss Up: Short Answer

What is the 5th term in the geometric progression whose first three terms are 64, 16, 4?

Bonus Answer: 1/4 or 0.25

Bonus: Short Answer

Giving your answer in centimeters to the nearest whole number, if one leg of an isosceles right triangle is 100 centimeters long, how long is the hypotenuse?

Bonus Answer: 141

60. MATHEMATICS

Writer: Henry Zheng

Toss Up: Short Answer

Solve the following equation for x: $-3|x| = -15$ (read as: minus 3 times the absolute value of x equals minus 15).

Bonus Answer: 5 and -5

Bonus: Short Answer

One-half of a number added to one third of the same number is 68 less than the number. What is the number?

Bonus Answer: 408

61. MATHEMATICS

Writer: Henry Zheng

Toss Up: Short Answer

If a 6-foot tall person who is standing next to a vertical pole casts a shadow of 8 feet and the pole casts a shadow of 40 feet, how many feet tall is the pole?

Bonus Answer: 30

Bonus: Short Answer

Solve the following equation for x: $(x+9) / (x+10) = 20 / 18$ (read as: the quantity x plus nine over the quantity x plus ten is equal to twenty over eighteen)

Bonus Answer: -19

62. MATHEMATICS

Writer: Henry Zheng

Toss Up: Multiple Choice

Which of the following numbers is evenly divisible by 4?

W) 1722

X) 2636

Y) 4114

Z) 6126

Toss Up Answer: X

Bonus: Short Answer

Rounded to the nearest centimeter, if side A of a right triangle measures 2 centimeters and side B measures 10 centimeters, what is the length of the hypotenuse?

Bonus Answer: 10

63. MATHEMATICS

Writer: Henry Zheng

Toss Up: Multiple Choice

What is the product of the following 2 values: (1) the greatest common divisor of 7 and 14; and (2) the least common multiple of 7 and 14?

W) 21

X) 49

Y) 98

Z) 196

Toss Up Answer: Y

Bonus: Short Answer

Multiply the following complex numbers, giving your answer in standard $a + bi$ form: $(6 + 3i)(4 + i)$

Bonus Answer: $21 + 18i$

64. MATHEMATICS

Writer: Henry Zheng

Toss Up: Short Answer

By words or number, name all of the following 3 statements that are TRUE for the function, $f(x) = -3x^2 - 2x - 2 = 0$:

1) there are no real zeros

2) the graph is a parabola opening downward

3) the graph has no x-intercepts

Bonus Answer: All or 1,2,3

Bonus: Short Answer

Factor the following expression completely over integers: $x^4 - 16$

Bonus Answer: $(x - 2)(x + 2)(x^2 + 4)$

65. MATHEMATICS

Writer: Henry Zheng

Toss Up: Multiple Choice

What trigonometric ratio is equal to $1/2$?

W) $\sin 60$

X) $\sin 30$

Y) $\cos 30$

Z) $\sin 30$ degrees

Toss Up Answer: Z

Bonus: Short Answer

What is the probability of rolling a 1 on 3 die rolls?

Bonus Answer: 1/216

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66. MATHEMATICS

Writer: Henry Zheng

Toss Up: Short Answer

What is the probability of rolling a even number on an 8 sided die labeled 1 through 8?

Bonus Answer: 1/2

Bonus: Short Answer

What is the probability of rolling an even number on an 8 sided die labeled 1 through 8 and rolling an odd number on a 7 sided die labeled 1 through 7 in simplest fractional form?

Bonus Answer: 2/7

=====

67. MATHEMATICS

Writer: Henry Zheng

Toss Up: Short Answer

Given a rectangular box with side lengths of 5, 5, and 5, what is the surface area of the box?

Bonus Answer: 150 units squared (ACCEPT: 150)

Bonus: Multiple Choice

The length, in inches, of a box is 3 inches less than twice its width, in inches. Which of the following gives the length, L inches, in terms of the width, W inches, of the box?

W) $L = .5W + 3$

X) $L = W - 3$

Y) $L = 2W + 3$

Z) $L = 2W - 3$

Bonus Answer: Z

=====

68. MATHEMATICS

Writer: Henry Zheng

Toss Up: Short Answer

What is the value of x when $2x + 3 = 3x - 4$?

Bonus Answer: 7

Bonus: Multiple Choice

What is the greatest common factor of 42, 126, and 210?

W) 2

X) 6

Y) 21

Z) 42

Bonus Answer: Z

=====

69. MATHEMATICS

Writer: Henry Zheng

Toss Up: Multiple Choice

How many irrational numbers are there between 1 and 6?

- W) 3
- X) 7
- Y) 10
- Z) infinitely many

Toss Up Answer: Z

Bonus: Short Answer

In the standard (x,y) coordinate plane, 3 vertices of a rectangle are (2,1), (-1,-1), and (6,5). What is the last vertex of the rectangle?

Bonus Answer: (3, -7)

70. MATHEMATICS

Writer: George Papastefanou

Toss Up: Short Answer

What is the tangent of $(27(\pi)/4)$

Bonus Answer: -1

Bonus: Short Answer

With a 5 percent compound interest rate, how long, to the nearest year, will it take a sum of money to double?

Bonus Answer: 14 years

71. MATHEMATICS

Writer: Elias Milborn

Toss Up: Short Answer

What is the probability of, in no particular order, flipping exactly 2 heads and 2 tails when flipping 4 coins?

Bonus Answer: 3/8 (accept .375 or 37.5%)

Bonus: Short Answer

Given a circle centered at 1,2 what is the slope of a tangent line which passes through the point (3,3)

Bonus Answer: -2

72. MATHEMATICS

Writer: Siam Muquit

Toss Up: Multiple Choice

What is the derivative of the curve $y = x^3$ at the origin?

- W) 0
- X) 3
- Y) 2
- Z) 3/2

Toss Up Answer: W

Bonus: Short Answer

Find dy/dx of $y = \sin^2 x$

Bonus Answer: 2 (sin x) (cos x)

73. MATHEMATICS

Writer: Jason Weng

Toss Up: Multiple Choice

For the function $f(x) = (x^2)/(x)$, what is the limit as x approaches 0?

- W) 0

- X) 1
Y) infinity
Z) There exist no limit.

Toss Up Answer: W

Bonus: Short Answer

What is the line called that connects two points of a function, generally associated with average rate of change?

Bonus Answer: Secant line

74. MATHEMATICS

Writer: Jason Weng

Toss Up: Short Answer

What is the equation for the axis of symmetry of $(3x^2) - 6x + 4$?

Bonus Answer: $x = 1$ (Don't accept 1 by itself)

Bonus: Multiple Choice

Which of the following is equivalent to $3 \pmod{4}$?

- W) $32 \pmod{4}$
X) $-16 \pmod{4}$
Y) $-13 \pmod{4}$
Z) $0 \pmod{4}$

Bonus Answer: Y

75. MATHEMATICS

Writer: Banpreet Singh

Toss Up: Multiple Choice

An angle must lie in which two quadrants of the Cartesian coordinate plane for its cosecant to be negative?

- W) one and two
X) two and three
Y) three and four
Z) four and one

Toss Up Answer: Y

Bonus: Short Answer

According to the Fundamental Theorem of Algebra, how many roots in the complex number system must a 7th degree polynomial have?

Bonus Answer: At least 1 (accept 1 as an answer)

76. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

For which of the following values of x is $(x^2+x+4)/x$ an integer?

- W) 1
X) 4
Y) 3
Z) 5

Toss Up Answer: X

Bonus: Short Answer

Find the remainder when $343x^3+49x^2+14x+1$ is divided by $7x - 1$.

Bonus Answer: 5

=====

77. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

What do the numbers in the n th row of Pascal's Triangle sum to?

Give your answer in terms of n .

W) $2n$

X) 2^n

Y) n^2

Z) n^3

Toss Up Answer: X

=====

Bonus: Multiple Choice

Find the number of ordered pairs (a,b) , where a and b are nonnegative integers, such that $a+b=10$.

W) 100

X) 10

Y) 11

Z) 12

Bonus Answer: Y

=====

78. MATHEMATICS

Writer: Justin Lam

Toss Up: Short Answer

Factor the following equation: $x^3 + 8 (x^2) + 8x + 64$

Bonus Answer: $(x + 8) (x + 8) (x^2 + 8)$ or $(x^2 + 8) [(x + 8)^2]$

=====

Bonus: Multiple Choice

Which of the following is a primitive Pythagorean triple?

W) 9 , 12 , 15

X) 10 , 24 , 26

Y) 3 , 4 , 5

Z) 16 , 30 , 34

Bonus Answer: Y

=====

79. MATHEMATICS

Writer: Justin Lam

Toss Up: Multiple Choice

Which of the following are prime factors of the number 5304?

W) 19

X) 7

Y) 5

Z) 13

Toss Up Answer: Z

=====

Bonus: Short Answer

What integer satisfies the equation $y = x^3 - 1$ [Read as: x to the third power subtracted by 1] when $y = 0$?

Bonus Answer: $x = 1$

(Explanation: The factors of the equation is $y = (x - 1)(x^2 + x + 1)$. We want to find an integer solution, so we take the factor $x - 1$ and set it to zero. By adding one to both sides, we see that $x = 1$.)

=====

80. MATHEMATICS

Writer: Justin Lam

Toss Up: Short Answer

On which point does $y = 10x + 8$ and $y = x + 5$ intersect?

Bonus Answer: $(-1/3, 14/3)$

=====

Bonus: Short Answer

How many roots does the cubic equation $y = x^3 - 4x^2 + 4x$ have?

Bonus Answer: It has 2 roots.

(Explanation: It intersects the x -axis twice, once at $x = 0$ and once at $x = 2$.)

=====

81. MATHEMATICS

Writer: Justin Lam

Toss Up: Short Answer

What is the volume of a sphere if the radius is 7 inches? (use $22/7$ for π) You may either use fractions or decimals rounded to the nearest hundredth as your answer.

Bonus Answer: $V = 4312/3$ cubic inches

or $V = 1437.33$ cubic inches

(they must include the correct units)

=====

Bonus: Short Answer

Find the surface area of a rectangular prism if the length is 2 inches, the width is 3 inches, and the height is 2 inches.

Bonus Answer: $V = 32$ square inches

(they must include the correct units)

=====

82. MATHEMATICS

Writer: Nten Nylam

Toss Up: Multiple Choice

A card is randomly drawn from a 52 card deck, what is the probability that the card is either a spade or a 4?

W) $4/13$

X) $7/52$

Y) $17/52$

Z) $2/13$

Toss Up Answer: W

=====

Bonus: Short Answer

What is the value of $(10! / 3!) \times 0!$

Bonus Answer: 604,800

=====

83. MATHEMATICS

Writer: Nten Nylam

Toss Up: Multiple Choice

What is the range of $f(x) = x^2$

W) All real numbers greater than 0

X) All real numbers

Y) All real numbers greater than or equal to 0

Z) All real numbers except -1

Toss Up Answer: Y

Bonus: Short Answer

1/3 of a number plus twice half of a number equals 36. What is the number?

Bonus Answer: 27

84. MATHEMATICS

Writer: Nten Nylam

Toss Up: Multiple Choice

What is the sum of $5 - 3i$ and the conjugate of $3 + 2i$?

W) $2-i$

X) $2-5i$

Y) $8-i$

Z) $8-5i$

Toss Up Answer: Z

Bonus: Short Answer

Multiply the following complex numbers, giving the product in $a+bi$ form: $(2 + 3i)$ and $(4 + 5i)$

Bonus Answer: $-7 + 22i$

85. MATHEMATICS

Writer: Janine Goh

Toss Up: Short Answer

What is the quadratic formula?

Bonus Answer: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Bonus: Short Answer

Solve for y if $x = \frac{5}{6}y + \frac{116}{3}y + \frac{4}{2}$ in terms of x

Bonus Answer: $y = \frac{(x-2)}{78}$

86. MATHEMATICS

Writer: Nten Nylam

Toss Up: Short Answer

A 1081 degree angle will lie in which quadrant in the Cartesian coordinate system?

Bonus Answer: Quadrant 1 (also accept 1 or first)

Bonus: Short Answer

Multiply $3x^2 - 4xy + y^2$ by $-3xy^2$

Bonus Answer: $-9x^3y^2 + 12x^2y^3 - 3xy^4$

87. MATHEMATICS

Writer: Aaron Gee

Toss Up: Multiple Choice

If an arc of 60° on circle 1 has the same length as an arc of 45° on circle 2, what is the ratio of the area of circle 1 to the area of circle 2?

W) 9:16

X) 9:15

Y) 4:3

Z) 2:5

Toss Up Answer: W

Bonus: Short Answer

What is the reciprocal of the complex number $2 + i$?

Bonus Answer: $(2/5) - (1/5)i$

88. MATHEMATICS

Writer: Ivan Zhang

Toss Up: Multiple Choice

A function with the zero $1 + 23i$ must have a multiplicity of at least?

W) 1

X) 23

Y) 4

Z) 2

Toss Up Answer: Z

Bonus: Short Answer

Find the zeros of the function: $0 = x^4 - 81$

Bonus Answer: $3i, -3i, 3, -3$

89. MATHEMATICS

Writer: Andrew Chen (Senior)

Toss Up: Short Answer

A square is inscribed within a circle with a radius of 2.5 cm. To the nearest tenths place what is the area of the square?

Bonus Answer: 12.5 cm^2

Bonus: Multiple Choice

Given the parabola $y = 4x^2 + 2x - 10$ what is the equation of the line tangent to it at the point $(0, -10)$?

W) $y = 2x + 10$

X) $y = 2x - 5$

Y) $y = 5x - 8$

Z) $y = 2x - 10$

Bonus Answer: Z

90. MATHEMATICS

Writer: Ashneel Das

Toss Up: Multiple Choice

How many roots does the equation $x^4 + 3x^3 + 2x^2 + 9x + 14 = 0$ have?

W) 1

X) 2

Y) 3

Z) 4

Toss Up Answer: Z

Bonus: Short Answer

What is the limit of $(1 - 1/n)$ as n goes to infinity?

Bonus Answer: 1

91. MATHEMATICS

Writer: Benjamin Avrahami

Toss Up: Short Answer

In simplest form, express the surface area to volume ratio of a cube with side length s .

Bonus Answer: $6:s$

Bonus: Short Answer

Calculate the harmonic mean of the first two perfect numbers and 10.

Bonus Answer: $4 * \sqrt{105}$

92. MATHEMATICS

Writer: Shamaul Dilmohamed

Toss Up: Multiple Choice

In the Christmas carol "The 12 Days of Christmas", the singer says that for every day of Christmas, their significant other gives them a quantity of a new gift equal to the current day of Christmas, plus the previous gifts given. For example, on the second day onward, the singer receives 2 turtledoves on each day until the end of Christmas. What is the greatest quantity of a single gift given during the 12 days?

W) 36

X) 40

Y) 42

Z) 48

Toss Up Answer: Y

Bonus: Short Answer

How many total gifts are given in the 12 days of Christmas?

Bonus Answer: 364

93. MATHEMATICS

Writer: Brian Lim

Toss Up: Short Answer

What is the value of $\sqrt{20 + \sqrt{20 + \sqrt{20 + \dots}}}$?

[Read as "the nested radical expression square root 20 plus square root 20 + square root 20 repeating"]

Bonus Answer: 5

Bonus: Short Answer

How many asymptotes are in the graph of $y = \frac{(x^4 + 1)}{(x^3 + 3x^2 - 9x - 27)}$?

Bonus Answer: 3

94. MATHEMATICS

Writer: Benjamin Avrahami

Toss Up: Multiple Choice

What is the smallest positive 'taxicab' number?

W) 87

X) 91

Y) 95

Z) 100

Toss Up Answer: X

Bonus: Short Answer

To what power do you have to raise any number for it to be 0, 1, or -1 in mod 7?

Bonus Answer: 3

=====

95. MATHEMATICS

Writer: Mohammed Haque

Toss Up: Short Answer

How many degrees are in a 79-gon

Bonus Answer: 13860 degrees

=====

Bonus: Multiple Choice

The sum of the measures of the exterior angles of n-gon is _____

W) 720 degrees

X) 360 degrees

Y) 1440 degrees

Z) non of the above

Bonus Answer: X

=====

96. MATHEMATICS

Writer: Yevgeniy Gorbachev

Toss Up: Short Answer

What is the integral from 1 to 4 of $4x^3$?

Bonus Answer: 255

=====

Bonus: Multiple Choice

What is $d/dx \tan x / \sec x$, in simplest form?

W) $\sec^2 x - \tan x$

X) $\sec^2 x - \tan^2 x$

Y) $\sec^3 x - \tan^2 x \sec x$

Z) $(\sec x - \tan x)^2$

Bonus Answer: X

=====

97. MATHEMATICS

Writer: Ahmad Alnasser

Toss Up: Multiple Choice

Which of the following the derivative with the highest degree?

W) X^2 (x squared)

X) 20

Y) 104

Z) 3x

Toss Up Answer: W

=====

Bonus: Short Answer

Find $y' = dy/dx$ for $x^3 + y^3 = 4$. (x cubed + y cubed)

Bonus Answer: $-x^2/y^2$ (negative x squared over y squared)

=====

98. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

In interval notation, find the domain of $\frac{1}{\sqrt{x^2+5x+4}} \geq 0$ (1 over the square root of x^2+5x+4 is greater than or equal to 0.)

Bonus Answer: $(-\infty, -4) \cup (-1, \infty)$

Bonus: Short Answer

If $x^2+7x-5=0$, find $(\sqrt{1} + \sqrt{2})^2$

Bonus Answer: 49

99. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

Compute the number of diagonals in a convex 30-sided polygon.

Bonus Answer: 435

Bonus: Short Answer

Find the number of way 30 people can shake hands if each person shakes hands with everyone else, excluding themselves.

Bonus Answer: 435

100. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

An arithmetic progression has 10 terms. Find the maximum distance between any 2 terms if the minimum value for any term is 0 and the maximum is 100, inclusive.

Bonus Answer: 99

Bonus: Short Answer

Find the number of factors of $967 \cdot 515$

Bonus Answer: 8

101. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

If $2x+y=5$ and $2y+x=6$, find $(x-y)^2$

Bonus Answer: 1

Bonus: Short Answer

Given a 3-4-5 right triangle, find the area of its inscribed circle.

Bonus Answer: π

102. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

Express 122121 base 3 in base 9.

Bonus Answer: 577

Bonus: Short Answer

1011101 base 2 is what in base 7?

Bonus Answer: 151

103. MATHEMATICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

Which of the following sets has the greatest cardinality?

W) The set of all real numbers

X) The set of all integers

Y) The set of all rational numbers

Z) They all have the same cardinality

Toss Up Answer: Z

Bonus: Short Answer

If set A has a cardinality of 5, set B has a cardinality of 6, and set A and B are disjoint sets, what is the cardinality of the union of set A and B?

Bonus Answer: 11

104. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

What is the area of an isosceles triangle with legs 15 and altitude 12?

Bonus Answer: 108

Bonus: Short Answer

Find the area of a triangle if 2 of its sides are 3 and 6, and its included angle is 30 degrees.

Bonus Answer: $9\sqrt{3}/2$

105. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

If Bill can come up with 5 math questions in 1 hour, how many math questions can he come up with in 12 minutes?

Bonus Answer: 1

Bonus: Short Answer

Find the area of a triangle with side lengths 9, 7, and 6.

Bonus Answer: $2\sqrt{110}$

106. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

Factor $x^2 + y^2 + z^2 + 2xy + 2yz + 2xz$

Bonus Answer: $(x+y+z)^2$

Bonus: Short Answer

Factor $x^2(z-y) + y^2(x-z) + z^2(y-x)$

Bonus Answer: $(x-y)(y-z)(z-x)$ (or any other answer involving multiplying 2 of the binomials by -1)

107. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

Find the sum of the first 6 Fibonacci numbers

Bonus Answer: 20

Bonus: Short Answer

Find the sum of all the numbers in the first 7 rows of the Pascal Triangle

Bonus Answer: 127

108. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

What was the first name of the person who discovered the Fibonacci Sequence?

Bonus Answer: Leonardo

Bonus: Short Answer

What is the full name of the man who invented the Power of a Point?

Bonus Answer: Jacob Steiner

109. MATHEMATICS

Writer: Elias Milborn

Toss Up: Multiple Choice

What are the solutions for x in the following equation: $x^2 - 2x = 8$?

- W) 0
- X) 0 and -2
- Y) 4 and -2
- Z) -4 and 2

Toss Up Answer: Y

Bonus: Multiple Choice

The sum of the squares of reciprocals of all positive integers equals which of the following?

- W) $\pi^{1/2}$ (read as square root of pi)
- X) $\pi/3$
- Y) $\pi^{2/6}$
- Z) $\pi^{3/12}$

Bonus Answer: Y

110. MATHEMATICS

Writer: Elias Milborn

Toss Up: Multiple Choice

Which of the following is an accurate representation of the inverse of $f(x) = x^3 - 5$?

- W) $x^3 - 5$
- X) $(x - 5)^3$
- Y) $(x - 5)^{(1/3)}$
- Z) $1/(x-5)^3$

Toss Up Answer: Y

Bonus: Short Answer

The three sides of a triangle are 5cm, 6cm, and 8cm. What is the cosine of the smallest angle in reduced fractional form?

Bonus Answer: 25/32

111. MATHEMATICS

Writer: Elias Milborn

Toss Up: Short Answer

Giving your answer as up, down, left, or right, the graph of the equation $x = 5y - 8y^2 - 1$ opens in which direction

Bonus Answer: left

Bonus: Short Answer

If chord AB is 8 units from the center of a circle O with a radius of 17, what is the length of chord AB?

Bonus Answer: 30

112. MATHEMATICS

Writer: Elias Milborn

Toss Up: Short Answer

On a blueprint, if $\frac{3}{4}$ of an inch represents 1 foot, then 2 inches will represent what distance, in feet, expressed as the most reduced simple fraction?

Bonus Answer: $\frac{8}{3}$

Bonus: Short Answer

Assuming that the probability of A is 0.3, the probability of B is 0.3, and the probability of A union B is 0.5, providing your answer as decimals to the nearest 10th, what are the probabilities respectively of A intersection B and the complement of the quantity A union B?

Bonus Answer: 0.1 and 0.5

113. MATHEMATICS

Writer: Larry Wong

Toss Up: Short Answer

What is the sum of the coefficients of $(x + 1)$ to the 6th power?

Bonus Answer: 64

Bonus: Short Answer

What is the height of a triangle with an area of 64 and a base of 5?

Bonus Answer: 25.6

114. MATHEMATICS

Writer: Larry Wong

Toss Up: Short Answer

If $3x - y = 12$, what is the value of $8^x/2^y$?

Bonus Answer: 2^{12} or 4096

Bonus: Short Answer

What is the argument of $2 + 2i$?

Bonus Answer: 45

115. MATHEMATICS

Writer: Larry Wong

Toss Up: Short Answer

How many x intercepts in $y = X^2 + 1$?

Bonus Answer: 0

Bonus: Short Answer

How many degrees are in $\pi/3$ radians?

Bonus Answer: 60

=====

116. MATHEMATICS

Writer: Larry Wong

Toss Up: Short Answer

What is the volume of a sphere?

Bonus Answer: $\frac{4}{3} \pi r^3$

Bonus: Short Answer

what is the sum of the 7th row of Pascal's triangle?

Bonus Answer: 128

=====

117. MATHEMATICS

Writer: Larry Wong

Toss Up: Short Answer

What is the center of a circle with the equation $X^2 + Y^2 = 69$?

Bonus Answer: (0,0)

Bonus: Short Answer

What is the area of an ellipse with axis lengths of 5 and 3, in terms of π ?

Bonus Answer: 15π

=====

118. MATHEMATICS

Writer: Larry Wong

Toss Up: Short Answer

The figure represented by the equation $[x^2/36] + [y^2/16] = 1$ is centered about what x-y coordinate point?

Bonus Answer: (0,0)

Bonus: Short Answer

In a right triangle, $\sin(A)$ is $\frac{3}{5}$, what is $\tan(A)$?

Bonus Answer: $\frac{3}{4}$

=====

119. MATHEMATICS

Writer: Larry Wong

Toss Up: Short Answer

What is the sum of coefficients of $(1+x^7)^7$?

Bonus Answer: 128

Bonus: Short Answer

Find x if $\log_{\text{base } 5}(x) = -2$.

Bonus Answer: $\frac{1}{25}$

=====

120. MATHEMATICS

Writer: Larry Wong

Toss Up: Short Answer

What is 15 in base 2?

Bonus Answer: 1111

Bonus: Short Answer

What is 14 in hexadecimal?

Bonus Answer: E

=====

121. MATHEMATICS

Writer: Larry Wong

Toss Up: Short Answer

What is the sum of the first 100 positive odd integers?

Bonus Answer: 10000

Bonus: Short Answer

How many degrees are in an interior angle of a Hexacontagon?

Bonus Answer: 174

=====

122. MATHEMATICS

Writer: Larry Wong

Toss Up: Short Answer

The first 4 terms of an arithmetic sequence are p , 9, $3p-9$, and $3p+q$. What is the 2010th term of this sequence?

Bonus Answer: 8041

Bonus: Short Answer

How many sides are in a Hexacontagon?

Bonus Answer: 60

=====

123. MATHEMATICS

Writer: Larry Wong

Toss Up: Short Answer

How many prime number are even?

Bonus Answer: 1

Bonus: Short Answer

A horizontal line splits a circle with the equation of $x^2 + y^2 = 66$, what is the equation of the line?

Bonus Answer: $y = 0$

=====

124. MATHEMATICS

Writer: Larry Wong

Toss Up: Short Answer

What is the value of 125 to the $\frac{2}{3}$ power?

Bonus Answer: 25

Bonus: Short Answer

What is the argument of $1 + \sqrt{3}i$?

Bonus Answer: 60

=====

125. MATHEMATICS

Writer: William Xiang

Toss Up: Short Answer

Find the first derivative of $10x^3 + 3x^2 + 3$ in the simplest form.

Bonus Answer: $30x^2 + 6x$

Bonus: Short Answer

How many points of inflection does the graph $x^3 + 5$ have?

Bonus Answer: 1

=====

126. MATHEMATICS

Writer: William Xiang

Toss Up: Short Answer

Find the integral of $2x^3 + 2$ with respect to x in simplest terms.

Bonus Answer: $(x^4)/2 + 2x$

Bonus: Multiple Choice

Which of the following is a conic section?

- W) Cylinder
- X) Triangle
- Y) Hyperbola
- Z) Asymptote

Bonus Answer: Y

=====

127. MATHEMATICS

Writer: Aaron Gee

Toss Up: Multiple Choice

Solve the following equation for x :

$$x^2 - 20x + 19 = 0$$

- W) 9, 10
- X) 10 and 9
- Y) 21 and 19
- Z) 19 and 1

Toss Up Answer: Z

Bonus: Short Answer

Convert log base 4 of 53 into a base 10 expression:

Bonus Answer: $\log 53 / \log 4$

=====

128. MATHEMATICS

Writer: Aryan Bhatt

Toss Up: Short Answer

What is the sum of the roots of the polynomial $f(x) = 3x^2 - 5x + 5$?

Bonus Answer: $5/3$

Bonus: Short Answer

completely factor $2x^4 - 16x^2 + 32$

Bonus Answer: $2(x+2)(x+2)(x-2)(x-2)$

=====

129. MATHEMATICS

Writer: Aaron Gee

Toss Up: Short Answer

Subtract the following complex numbers, giving your answer in standard form: $(11 - 4i) - (-3 + 3i)$

Bonus Answer: $12 - 7i$

Bonus: Short Answer

Solve the following inequality for x , giving your answer in fractional form, $\frac{1}{3}x + \frac{2}{3}$ is less than $\frac{5}{6}x - 2$.

Bonus Answer: x is greater than $\frac{16}{3}$

130. MATHEMATICS

Writer: Aaron Gee

Toss Up: Short Answer

If you roll 2 fair dice simultaneously, what is the probability, given as a fraction, that you will roll the number 6 on AT LEAST one die?

Bonus Answer: $\frac{11}{36}$

Bonus: Short Answer

Find the sum of all interior angles, in degrees, in a regular polygon having 14 sides

Bonus Answer: 2160 degrees

131. MATHEMATICS

Writer: Aaron Gee

Toss Up: Short Answer

What function is the inverse of $y = 3x + 4$?

Bonus Answer: $y = x - \frac{4}{3}$

Bonus: Short Answer

Giving your answer as an ordered pair, find the solution of the system of the following 2 equations: $2x + 3y = 8$, and $3x - 2y = -1$

Bonus Answer: (1,2)

132. MATHEMATICS

Writer: Steven Litvack-Winkler

Toss Up: Multiple Choice

Find the points of intersection of the following curves:

$$y = \sqrt{x^2 - x + 29}$$

$$y = x + 2$$

W) (5,7)

X) $(\sqrt{2} - 1, \sqrt{2} + 1)$

Y) $(\sqrt{29} - 1, \sqrt{29} + 1)$

Z) (2,4)

Toss Up Answer: W

Bonus: Multiple Choice

Which of the following expressions is not divisible by 9

W) $5^3 + 7^3$

X) $4^5 + 2^5$

Y) $10^3 - 7^3$

Z) $9^7 - 6^7$

Bonus Answer: W

133. MATHEMATICS

Writer: Hussain Waris

Toss Up: Multiple Choice

What conic section is described by the following: the intersection of a cone and some plane parallel to that cone's side such that that intersection is non-empty?

- W) Circle
- X) Parabola
- Y) A point
- Z) Ellipse

Toss Up Answer: X

Bonus: Short Answer

Respectively, give the vertex and the focus of the following parabola: $(y - 3)^2 = 8(x - 5)$?

Bonus Answer: vertex: (5,3); focus: (7,3)

134. MATHEMATICS

Writer: Hussain Waris

Toss Up: Multiple Choice

Which of the following best characterizes every transcendental number?

- W) Irrational
- X) A linear combination of e or pi in which the coefficients are non-zero
- Y) A real number that is not a root of any non-zero polynomial with rational coefficients
- Z) e or pi

Toss Up Answer: W

Bonus: Short Answer

Which of the following numbers are transcendental numbers: 1) e; 2) $\sqrt{2}$; 3) i^i ; 4) pi?

Bonus Answer: e, i^i , pi [Accept any permutation of 1, 3, and 4]

135. MATHEMATICS

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136. MATHEMATICS

Writer: Henry Zheng

Toss Up: Multiple Choice

What is the least positive integer with exactly six factors?

- W) 6
- X) 12

Y) 18

Z) 24

Toss Up Answer: X

Bonus: Short Answer

Giving your answer as one, two, three, or four, in what quadrant will theta terminate if sine theta and secant theta are both negative?

Bonus Answer: 3

137. MATHEMATICS

Writer: Andrew Chen

Toss Up: Short Answer

A square is inscribed in a circle, which is inscribed in a unit square. What is the area of the smaller square?

Bonus Answer: 1/2

Bonus: Short Answer

What is the remainder when 7^{420} is divided by 3?

Bonus Answer: 1

138. MATHEMATICS

Writer: Andrew Chen

Toss Up: Short Answer

What is the magnitude of the quantity $(i + 1)^{10}$?

Bonus Answer: 32

Bonus: Short Answer

If the sum of the interior angles of a polygon is 18 thousand degrees, how many sides does it have?

Bonus Answer: 102

139. MATHEMATICS

Writer: Andrew Chen

Toss Up: Short Answer

Alice flips a coin until it lands up heads. To the nearest tenth, what is the expected number of flips she will make?

Bonus Answer: 2

Bonus: Multiple Choice

What is the name of the curve traced by a fixed point on a circle that is rolling around fixed circle of the same radius? It also appears in the Mandelbrot set.

W) cardioid

X) nephroid

Y) cycloid

Z) hyperellipse

Bonus Answer: W

140. MATHEMATICS

Writer: Andrew Chen

Toss Up: Short Answer

What is the area of the ellipse given by the formula $x^2 + \frac{1}{4}y^2 = 1$?

Bonus Answer: 2π

Bonus: Short Answer

How many faces does the dual polyhedron of the octahedron have?

Bonus Answer: 6

141. MATHEMATICS

Writer: Andrew Chen

Toss Up: Short Answer

How many zeros are at the end of the number 25 factorial?

Bonus Answer: 6

Bonus: Short Answer

What is the largest amount of money one can have, in cents, without being able to make change for a dollar? Half dollars don't count.

Bonus Answer: 119

142. MATHEMATICS

Writer: Benjamin Avrahami

Toss Up: Short Answer

What is the volume of a hole 2 meters by 2 meters by 2 meters after 1 cubic meter of dirt has been added to it?

Bonus Answer: 1 cubic meter

Bonus: Multiple Choice

Avogadro's number is approximately $6.022 \times 10^{\text{what power}}$

W) -23

X) -11

Y) 11

Z) 23

Bonus Answer: Z

143. MATHEMATICS

Writer: Benjamin Avrahami

Toss Up: Short Answer

If the capstone is taken off the Great Pyramid of Giza, then it is no longer a pyramid but a what?

Bonus Answer: A frustum

Bonus: Multiple Choice

Which one of these is Euclid's parallel postulate?

W) If a line intersects one of two parallel lines, both of which are coplanar with the original line, then it will also intersect with the other line.

X) If a line segment intersects two straight lines forming two interior angles on the same side that sum to less than two right angles, then the two lines, if extended indefinitely, meet on the side on which the angles sum to less than two right angles.

Y) In a plane, given a line and a point not on it, exactly one line parallel to the given line can be drawn through the point.

Z) For any acute angle A and any point D in the interior of angle A, there exists a line through D and not through A which intersects both sides of angle A.

Bonus Answer: X

=====

144. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

Which of the following is a triangular number?

W) 2

X) 6

Y) 9

Z) 11

Toss Up Answer: X

=====

Bonus: Short Answer

What is the greatest common factor of 456 and 460?

Bonus Answer: 4

=====

145. MATHEMATICS

Writer: Hanna Yang

Toss Up: Short Answer

What is the smallest even triangular number?

Bonus Answer: 6

=====

Bonus: Multiple Choice

If p and q are inversely proportional, and $p = 7$ when $q = 24$, then find p when $q = 12$.

W) 3.5

X) 7

Y) 12

Z) 14

Bonus Answer: Z

=====

146. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

If 8 moles dig 8 holes in 8 years, how many holes can 4 moles dig in 1461 days?

W) 1

X) 2

Y) 4

Z) 8

Toss Up Answer: X

=====

Bonus: Short Answer

If 9 moles dig 24 holes in 10 days, how many holes can 3 moles dig in 5 days?

Bonus Answer: 4

=====

147. MATHEMATICS

Writer: Hanna Yang

Toss Up: Short Answer

What is the name of the principle that states that 5 avocados cannot be placed in 4 holes without 2 of them being placed in the same one?

Bonus Answer: Pigeonhole Principle

Bonus: Short Answer

In triangle ABC with integer side lengths, $AB = 7$, $BC = 14$, and $AC < 9$. Find AC.

Bonus Answer: 8 (Triangle Inequality)

148. MATHEMATICS

Writer: Ivan Zhang

Toss Up: Multiple Choice

What is the square root of 2 (to the nearest tenths)?

W) 1.7

X) 1.5

Y) 1.3

Z) 1.4

Toss Up Answer: Z

Bonus: Short Answer

What is the equation of a circle with circumference 6π that is positioned 3 points above the x axis and 4 points before the y axis?

Bonus Answer: $(x-4)^2 + (y+3)^2 = 9$

149. MATHEMATICS

Writer: Ivan Zhang

Toss Up: Multiple Choice

What is asymptote of the function: $f(x) = 1/x$?

W) $y = 0$

X) $x = 0$

Y) $x = 0, y = 1$

Z) $x = 0, y = 0$

Toss Up Answer: Z

Bonus: Short Answer

Plugging the divergent series, $1 + 2 + 3 + 4 + \dots$, into the Riemann Zeta Function results in which number?

Bonus Answer: $-1/12$

150. MATHEMATICS

Writer: Larry Wong

Toss Up: Short Answer

What is the distance in space between the points with coordinates $(-3, 6, 7)$ and $(2, -1, 4)$?

Bonus Answer: 9.11

Bonus: Multiple Choice

The diameter and height of a right circular cylinder are equal. If the volume of the cylinder is 2, what is the height of the cylinder?

W) 1.37

X) 1.08

Y) 0.86

Z) 0.8

Bonus Answer: W

151. MATHEMATICS

Writer: Larry Wong

Toss Up: Multiple Choice

If $\log_x (1/8) = -3/2$, then x is equal to

W) -4

X) 4

Y) $1/4$

Z) 10

Toss Up Answer: X

Bonus: Multiple Choice

f is a function such that $f(x) < 0$. The graph of the new function g defined by $g(x) = |f(x)|$ is a reflection of the graph of f

W) on the y axis

X) on the x axis

Y) on the line $y = x$

Z) on the line $y = -x$

Bonus Answer: X

152. MATHEMATICS

Writer: Nten Nylam

Toss Up: Short Answer

What is the greatest common factor of $12x^3 + 171x^2 + 516x$

Bonus Answer: $3x$

Bonus: Short Answer

If 50% of x is equal to 25% of y , and 40% of y is equal to 60% of z , then what percent of z is x ?

Bonus Answer: 75%

153. MATHEMATICS

Writer: Banpreet Singh

Toss Up: Short Answer

What is the derivative of $\tan(x)$

Bonus Answer: $\sec^2(x)$

Bonus: Short Answer

What is the derivative of $\ln(x)$

Bonus Answer: $1/x$

154. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

Find the sum of the first six positive perfect squares.

Bonus Answer: 91

Bonus: Short Answer

Find the sum of the first 7 positive cubes.

Bonus Answer: 784

155. MATHEMATICS

Writer: Nten Nylam

Toss Up: Short Answer

What is the value of $(11! - 10!)/9!$?

Bonus Answer: 100

Bonus: Short Answer

Baker 1 bakes a batch of cupcakes every 20 minutes, Baker 2 bakes a batch of cupcakes every 30 minutes. Together, how many batches of cupcakes can they bake in 5 hours?

Bonus Answer: 25 batches (NOTE: accept 25)

156. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

What is the probability, in fractions, that after rolling two six-sided die, the sum of the numbers shown on top is 7?

Bonus Answer: $1/6$ (one-sixth or one over six is acceptable)

Bonus: Short Answer

Mr. SciBowl flips 2017 coins. What is the probability that exactly 50% of the coins show a heads?

Bonus Answer: 0

157. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

For natural numbers m and n , if 6 divides m evenly and 8 divides n evenly, what is the largest integer that divides mn evenly?

Bonus Answer: 48

Bonus: Short Answer

For natural numbers m and n , if mn is divisible by 48 and m is divisible by 6, what is the largest integer n is divisible by.

Bonus Answer: 1

158. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

If $A+B+C=10$ and $A-B-C=-6$, compute $B+C$

Bonus Answer: 8

Bonus: Short Answer

Given a right triangle with legs 12 and 16, find the length of the altitude to the hypotenuse.

Bonus Answer: $48/5$ or 9.6

159. MATHEMATICS

Writer: Mohammed Jamil

Toss Up: Short Answer

Find how many different 4-digit numbers can be formed from the digits 1, 3, 5, 6, 8 and 9 if each digit may be used only once.

Bonus Answer: 360

Bonus: Short Answer

A true or false test has six questions. If a person guesses the answers, how many different ways are there to answer the test?

Bonus Answer: 64

160. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

Let a and b be positive numbers. Find the maximum value of ab if $a+b=8$.

Bonus Answer: 16

Bonus: Short Answer

Let a , b , and c be positive numbers. Find the minimum value of $a+b+c$ if $abc=27$.

Bonus Answer: 9

161. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

If $4^x=256$, find x^4 .

Bonus Answer: 256

Bonus: Short Answer

If $5^x = 300$, find 5^{x-2} [5 to the power of the quantity x minus 2]

Bonus Answer: 12

162. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

What is the most descriptive name for a quadrilateral whose sides are all congruent to one another?

Bonus Answer: Rhombus

Bonus: Short Answer

Given a cyclic quadrilateral whose sides are 5 units long and one of its diagonals is $5\sqrt{2}$ units long, find the other diagonal.

Bonus Answer: $5\sqrt{2}$

163. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

If $(x-1)(x+1)=15$, find x^2 .

Bonus Answer: 16

Bonus: Short Answer

Find all the roots of the cubic: x^3-25x

Bonus Answer: -5, 0, and 5 (in no particular order)

164. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

How many distinct arrangements of the letters in SCIENCE are there?

Bonus Answer: 1260

Bonus: Short Answer

How many diagonals are in a regular decagon?

Bonus Answer: 35

165. MATHEMATICS

Writer: Ashneel Das

Toss Up: Short Answer

If $f(x) = 5$ what is $f'(x)$?

Bonus Answer: 0

Bonus: Short Answer

If $f(x) = 5x^3 + 10x^2 + 7x + 4$, what is $f'(x)$?

Bonus Answer: $15x^2 + 20x + 7$

166. MATHEMATICS

Writer: Ashneel Das

Toss Up: Multiple Choice

Solve the following equation for x: $3|x-3| = 6$

W) 1

X) 5

Y) 1 and 5

Z) 0

Toss Up Answer: Y

Bonus: Short Answer

Three times a number is 6 less than 4 times the same number. What is the number?

Bonus Answer: 6

167. MATHEMATICS

Writer: Ashneel Das

Toss Up: Short Answer

Solve for x in the equation: log base 2 of x = 64

Bonus Answer: 6

Bonus: Short Answer

If $\frac{3x}{4} + \frac{5x}{8} = 10$, what is x?

Bonus Answer: 80/11

168. MATHEMATICS

Writer: Ashneel Das

Toss Up: Multiple Choice

Which of the following best describes the roots of the function $f(x) = x^2 + 4x + 6$

W) Real and Equal

X) Real and Unequal

Y) Complex and equal

Z) Complex and unequal

Toss Up Answer: Z

Bonus: Short Answer

If $f(x) = 2x^2 + 6x + 12$, what is $f'(x)$?

Bonus Answer: $4x + 6$

169. MATHEMATICS

Writer: Steven Litvack-Winkler

Toss Up: Multiple Choice

Triangle ABC is similar to triangle DEF. If triangle ABC has an area of 27, triangle DEF has an area of 3, and $AC=12$, then compute DF.

- W) 9
- X) 36
- Y) $2\sqrt{3}$
- Z) 4

Toss Up Answer: Z

Bonus: Multiple Choice

What is the area, in terms of π , of a cone if the slant height is 13 and the radius of the base is 5.

- W) 10π
- X) 20π
- Y) 30π
- Z) $10\sqrt{3}\pi + 20$

Bonus Answer: X

170. MATHEMATICS

Writer: Steven Litvack-Winkler

Toss Up: Multiple Choice

For real numbers x and y on the closed interval from 0 to 1, let $a=xy$ and $b=(1-x)(1-y)$. Find the maximum value over all choices of x and y for the minimum of a and b .

- W) 0
- X) $1/4$
- Y) $1/2$
- Z) 1

Toss Up Answer: X

Bonus: Short Answer

One definition of the Cantor set is the set of all numbers x between 0 and 1 such that x has only the digits 0 and 2 in its base 3 representation. Which of the following numbers is in the Cantor set.

- I. $1/4$
- II. $1/2$
- III. $5/26$
- IV. $7/10$

Bonus Answer: 4 only

171. MATHEMATICS

Writer: Steven Litvack-Winkler

Toss Up: Short Answer

Find $x/y + y/x$ in simplest form if $x=7$ and $y=3$

Bonus Answer: 58/21

Bonus: Short Answer

Positive integers a and b satisfy $ab \mid a^2 + 4ab + 4b^2$ [" a b divides a squared plus four a b plus four b squared"]. The smallest possible value of $a+b$ is 2, which occurs when $a=b=1$ [" a equals b equals 1"]. What is the second smallest possible value of $a+b$?

Bonus Answer: 6: $a=4$, $b=2$
