Saaket Agrawal

TOSS-UP

1) MATH *Multiple Choice* What is the derivative of the cos (2x)?

W) sin (2x)
X) -sin (2x)
Y) 2 sin (2x)
Z) -2 sin (2x)

ANSWER: Z) -2 sin (2x)

BONUS

1) MATH *Short Answer* What two derivative rules can be used to prove that the derivative of sec x = tan x sec x?

ANSWER: QUOTIENT RULE AND CHAIN RULE

TOSS-UP

2) MATH *Multiple Choice* Which of the following best describes where the absolute maximum would be of a parabola that opens down?

W) axis of symmetry
X) wherever the x value is greatest
Y) the vertex
Z) above the parabola

ANSWER: Y) THE VERTEX

BONUS

2) MATH *Short Answer* Suppose the vertex of a parabola is given by the point (4,6). What is the equation of the axis of symmetry?

ANSWER: X = 4

TOSS-UP

3) MATH *Short Answer* What is the arc length of an arc with an angle of 60 degrees and a radius of 8 centimeters?

ANSWER: $8\pi / 3$ centimeters

BONUS

3) MATH *Short Answer* The distance formula is sometimes referred to as a rewritten version of which theorem?

ANSWER: PYTHAGOREAN THEOREM

TOSS-UP

4) MATH *Short Answer* What is the derivative of y = x with respect to x?

ANSWER: dy/dx = 1 (accept y' = 1)

BONUS

4) MATH *Short Answer* Suppose x is an angle with a measure of 35 degrees. What is the value of $\sin^2 x + \cos^2 x$?

ANSWER: 1

TOSS-UP

5) MATH *Short Answer* What is the area of an equilateral triangle with a side length of 6 centimeters?

ANSWER: $9\sqrt{3}$ square centimeters

BONUS

5) MATH *Short Answer* What is the area of a regular hexagon with a side length of 6 centimeters?

ANSWER: $54\sqrt{3}$ square centimeters

TOSS-UP

6) MATH *Multiple Choice* Consider the rational function $\frac{x^2+5x+6}{x+2}$. Which of the following statements is true?

W) There is a vertical asymptote at x = -2
X) There is a horizontal asymptote at y = -2
Y) There is a point of discontinuity at (-2, 1)
Z) The graph of the function is a parabola

ANSWER: Y) THERE IS A POINT OF DISCONTINUITY AT (-2, 1)

BONUS

6) MATH *Short Answer* What is the equation of the horizontal asymptote of the function $\frac{2x^6+5x^3+91x}{3x^6}$?

ANSWER: y = 2/3

TOSS-UP

7) MATH *Multiple Choice* Which of these is the name of the 3rd derivative of the position function?

W) velocity function
X) snap function
Y) jerk function
Z) acceleration function

ANSWER: Y) JERK FUNCTION

BONUS

7) MATH *Short Answer* An object moves in a straight line according the position function $f(t) = 3t^2 + 2t^3 - 4t$ where the displacement is measured in meters. What is the acceleration of the object when t = 2 seconds?

ANSWER: $30\frac{m}{s^2}$

TOSS-UP

8) MATH *Multiple Choice* The tangent of the quantity (x - 180), where 180 and x are both measured in degrees is equal to which of the following?

W) -tan (x)
X) cot (x)
Y) tan (-x)
Z) tan (x)

ANSWER: Z) TAN (X)

BONUS

8) MATH *Short Answer* In the closed interval $[0,2\pi]$, measured in radians, for what two values of A makes it such that sin A is equal to cos A?

ANSWER: $\frac{\pi}{4}$ and $\frac{5\pi}{4}$

TOSS-UP

9) MATH *Short Answer* A triangle has two angles with measures 30 degrees and 60 degrees with corresponding sides with lengths 3 cm and $3\sqrt{3}$ cm respectively. What is the length of the third side?

ANSWER: 6 cm

BONUS

9) MATH *Multiple Choice* A t-shirt was originally priced at $90. It was sold for $109.80 to a customer. How much of a price increase did the shirt undergo? Give your answer as a percent.

W) 23%
X) 22%
Y) 20%
Z) 30%

ANSWER: X) 22%

TOSS-UP

10) MATH *Short Answer* Solve for x if $\log_x 256 = 4$.

ANSWER: x = 4

BONUS

10) MATH *Short Answer* An exponential function is an inverse of which function?

ANSWER: LOGARITHMIC FUNCTION

TOSS-UP

11) MATH *Multiple Choice* What is the slope of the line perpendicular to the line 2x - 9y = 18?

W) -9/2
X) 2/9
Y) -2/9
Z) 9/2

ANSWER: W) -9/2

BONUS

11) MATH *Short Answer* What is the equation of the line with a slope of 2 which passes through the origin in slope-intercept form?

ANSWER: y = 2x

TOSS-UP

12) MATH *Multiple Choice* What is the value of the imaginary number i raised to the 16th power?

W) 0
X) -1
Y) i
Z) 1

ANSWER: Z) 1

BONUS

12) MATH *Short Answer* The imaginary number was first defined by who?

ANSWER: RAFAEL BOMBELLI

TOSS-UP

13) MATH *Multiple Choice* What is the fifth letter of the Greek alphabet?

W) zeta
X) delta
Y) epsilon
Z) phi

ANSWER: Y) EPSILON

BONUS

13) MATH *Short Answer* Augustin-Louis Cauchy's definition of the limit involves which two Greek letters?

ANSWER: EPSILON AND DELTA

TOSS-UP

14) MATH *Multiple Choice* The value sin (2x) is equal to which of the following?

W) 1 - tan x
X) 2 sin x tan x
Y) 1 - cos x
Z) 2 sin x cos x

ANSWER: Z) 2 SIN X COS X

BONUS

14) MATH *Short Answer* Consider f(x) = sin x + 1. What is the only root in the closed interval $[0,2\pi]$?

ANSWER: $\frac{3\pi}{2}$

TOSS-UP

15) MATH *Short Answer* Which theorem states that no three positive integers can satisfy the equation $a^n + b^n = c^n$ for any value of n greater than 2?

ANSWER: FERMAT'S LAST THEOREM

BONUS

15) MATH *Short Answer* Fermat proposed this theorem in a book called what?

ANSWER: ARITHMETICA

TOSS-UP

16) MATH *Short Answer* Which conjecture states that every even integer greater than 2 can be expressed as a sum of two prime numbers?

ANSWER: GOLDBACH'S CONJECTURE

BONUS

16) MATH *Multiple Choice* According to the Collatz Conjecture, if you start with any arbitrary positive integer and if you multiply an odd number by 3 then add 1, and if you divide an even number by 2, you will always end up at what number?

W) 0
X) 2
Y) 1
Z) 3

ANSWER: Y) 1

TOSS-UP

17) MATH *Multiple Choice* The equation y = $\sqrt{25 - x^2}$ is an equation of which of the following?

W) ellipse
X) hyperbola
Y) semicircle
Z) circle

ANSWER: Y) SEMICIRCLE

BONUS

17) MATH *Short Answer* The equation y = $\sqrt{25 - x^2}$ has a radius of what?

ANSWER: 5

TOSS-UP

18) MATH *Multiple Choice* What is the 2nd derivative of $7x^4 + 2x^2$? ?

W) 28x
X) 4
Y) $28x^3 + 4x$
Z) $84x^2 + 4$

ANSWER: Z) $84x^2 + 4$

BONUS

18) MATH *Short Answer* The slope of the line tangent to a function is known more commonly as what?

ANSWER: DERIVATIVE OF A FUNCTION

TOSS-UP

19) MATH *Short Answer* What are the two primary topics in calculus?

ANSWER: DIFFERENTIATION AND INTEGRATION

BONUS

19) MATH *Short Answer* What is the area under a curve more commonly referred to as?

ANSWER: INTEGRAL OF THE FUNCTION

TOSS-UP

20) MATH *Multiple Choice* Which of the following accurately describes the relationship between the continuity in a function and the derivative of the function?

W) If a function is continuous in a given interval, the function is also differentiable in that interval
X) If a function is differentiable in a given interval, the function is also continuous in that interval
Y) There is nothing in common between differentiability and continuity
Z) Continuity and differentiability don't exist for a function

ANSWER: X) IF A FUNCTION IS DIFFERENTIABLE IN A GIVEN INTERVAL, THE FUNCTION IS ALSO CONTINUOUS IN THAT INTERVAL

BONUS

20) MATH *Short Answer* Describe the continuity of the function $y = x^2 + x + 2$.

ANSWER: CONTINUOUS EVERYWHERE

TOSS-UP

21) MATH *Multiple Choice* A regular hexagon consists of which of the following?

W) 2 regular trapezoids
X) 6 isosceles triangles
Y) 6 right triangles
Z) 6 equilateral triangles

ANSWER: Z) 6 EQUILATERAL TRIANGLES

BONUS

21) MATH *Short Answer* Suppose there is a bag with 6 marbles. 2 are red, 2 are blue and 2 are green. What is the probability that two reds will be picked consecutively without replacement?

ANSWER: 1/15

TOSS-UP

22) MATH *Multiple Choice* Which of the following sets is the largest?

W) natural numbers
X) decimals
Y) integers
Z) rational numbers

ANSWER: Z) RATIONAL NUMBERS

BONUS

22) MATH *Short Answer* Who is known as the father of trigonometry?

ANSWER: HIPPARCHUS

TOSS-UP

23) MATH *Multiple Choice* If set A is defined as $\{1,2,3\}$ and set B is defined as $\{9,10,11\}$, then what is $A \cup B$ (read as: union of the sets A and B)?

W) $\{1,2,3\}$
X) $\{9,10,11\}$
Y) the set does not exist
Z) $\{1,2,3,9,10,11\}$

ANSWER: Z) $\{1,2,3,9,10,11\}$

BONUS

23) MATH *Short Answer* Which math subject is literally translated to Ancient Greek as "Earth-measuring"?

ANSWER: GEOMETRY

TOSS-UP

24) MATH *Short Answer* : Euler's formula states that e^{ix} is equal to what

ANSWER: cos x + i sin x

BONUS

24) MATH *Short Answer* The law of tangents states that $\frac{a-b}{a+b}$ is equal to what given that the angle opposite to side a is A and the angle opposite to side b is B?

ANSWER: $\frac{\tan[\frac{1}{2}(A-B)]}{\tan[\frac{1}{2}(A+B)]}$

TOSS-UP

25) MATH *Short Answer* Differential calculus and integral calculus are related by which theorem?

ANSWER: FUNDAMENTAL THEOREM OF CALCULUS

BONUS

25) MATH *Short Answer* Who first introduced modular arithmetic?

ANSWER: LEONHARD EULER