The Excel Math Competition



April 2025

- 1. This is a 45 minute individual exam.
- 2. No collaboration is allowed.
- 3. The first 10 questions are worth [5] points each and are multiple choice.
- 4. The last 5 questions are worth [10] points each and are short response.
- 5. Each of the final 5 questions have answers which are positive integers between 000 and 999, inclusive.
- 6. The questions are arranged in roughly ascending difficulty.
- 7. If you believe a question is seriously flawed, or have an answer which is not one of the listed answers, there will be a 10-minute dispute period after the test, after which no disputes will be accepted.
- 8. In the event of a dispute, **leave the question blank** and let your proctor know after the testing time ends.
- 9. All disputes will be considered on an individual-by-individual basis, so no student will receive credit if they did not submit a dispute, except for in the case of a question being thrown out.

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1 [5]

Welcome to ExcelAcademe's April Middle School competition! Also, Happy Easter! In the spirit of the season, compute the product of the area and eccentricity of the 2-D Easter egg with the equation $\frac{x^2}{9} + \frac{y^2}{25} = 1$

a) 8π b) 10π c) 12π d) 14π e) 16π

2 [5]

Joey has six video games on his shelf right now. From left to right, their starting order is as follows: *Zombie Apocalypse 360, Bay Harbor Banker, Hawk 2, Baa High: Sheep Simulator, FIFA 25, and Solder Soldier.* He decides to rearrange the shelf so that no game is in its original place. How many ways are there to do this?

a) 263 b) 264 c) 265 d) 266 e) 720

3 [5]

Enart has a fair coin which comes up heads half the time, and tails the other half. However, when Enart flips the coin while on the bed, the bounciness effects the coin, and it starts flipping heads 70% of the time, and tails the other 30%. Assuming Enart flips the coin a total of 100 times, how many flips should he do while on the bed so that his total expected number of heads flipped is 64?

a) 60 b) 62 c) 64 d) 68 e) 70

$4 \quad [5]$

Somehow, Alex Oahz has spilled his Monster Energy White Ultra all over Ryabby Khabby's calculator, and it has started doing calculations in base-2! the calculator now displays the calculation $1011011_2 \cdot 110111_2 \cdot 101_2$. Find the number of 1's in the result of this expression when it is expressed in base-2

5 [5]

How many asymptotes are present in the following function: $\frac{2x^4 + 5}{x^4 + x^3 - 7x^2 - 6x + 2}$ a) 2 b) 3 c) 4 d) 5 e) 6

6 [5]

Mr. Bbrics has decided to give the entire class a pop-final exam! The odd thing is, it consists of only one question:

A function F(x) is both even and odd. Find F(2025)

Help Spoonya out by solving this problem (and don't tell period 7 there's a test!)

a) -2025 b) 0 c) 2025 d) 5050 e) Not enough information

7 [5]

A terrifying disease known as Destructive Immune Health is ravaging the world. Fortunately, scientists have developed a test to detect D.I.H. and hopefully stop its spread. Unfortunately, the test is a bit inaccurate: it has a 10% false positive rate and a 5% false negative rate. Assuming that only 5% of the population actually has the disease, how many positive test results should be expected out of a group of 10,000 randomly selected people?

a) 1000 b) 1400 c) 1425 d) 1450 e) 1525

8 [5]

Ken and Tony's Taco Stand has been destroyed by a tsunami! All of the menus and prices for each item were lost in the fire. Fortunately, there are only three items for sale at the Taco Stand: small, medium, and large tacos. Tony found only three receipts which survived the tsunami, and they say the following:

Receipt 1: 4 small tacos, 5 medium tacos, 7 large tacos — cost: \$5.34

Receipt 2: 6 small tacos, 3 medium tacos, 8 large tacos — cost: \$5.60

Receipt 3: 5 small tacos, 9 medium tacos, 2 large tacos — cost: \$4.34

How many cents does one small taco, one medium taco, and one large taco cost?

a) 92 b) 93 c) 94 d) 95 e) 96

Rishan and Kha LOVE playing their own dice game. The rules are simple: if Rishan rolls a prime number on a standard six-sided die, he wins. If Kha rolls a perfect square, he wins instead. They keep playing until somebody wins. If Rishan rolls first, the probability that Kha wins is x. If Kha rolls first, the probability that Rishan wins is y. Find $\frac{x}{y}$

a)
$$\frac{1}{2}$$
 b) $\frac{2}{3}$ c) 1 d) $\frac{3}{2}$ e) 2

10 [5]

A circle is circumscribed about a square which is circumscribed about a regular octagon of side length 1. The square's sides are each parallel to two of the octagon's sides. The

area of such a circle can be written as $\pi(a + b\sqrt{c})$ where c is not divisible by the square of any integer. What is c(a + b)?

a) 1 b) 3 c) 5 d) 7 e) 9

11 [10]

Find the number of zeroes at the end of the base 7 representation of 2025!

$12 \quad [10]$

The ratio between the number of diagonals and the exterior angle measure in degrees of a regular n-gon is less than 1. What is the maximum n that achieves this?

13 [10]

David is designing a robot that needs to travel to the finish line on the coordinate plane to win the robotics Worlds competition. The robot starts at the origin and needs to make it to the point (8, 8). It can only move one unit at a time, either up or to the right. David's devious rivals want to sabotage him, and spill oil on the track at points (1, 2)and (5, 6). If David's robot touches the oil, it will slide off the track and be disqualified. The number of ways David's robot can travel to its destination successfully is x. Find the first three digits of x

14 [10]

Define a function for all positive real numbers as follows: $f(x) = \frac{3-x}{x+7}$

Now, define $g(x) = f^{-1}(x)$ as the inverse of f(x). Find $-6\sum_{i=1}^{4} g(i)$

$15 \quad [10]$

In the plane, David, Ishaan, and Hank are positioned at the points (0,0), (4,0), (0,4), respectively. Each of these fine gentlemen, every second, move one unit in a random direction along the coordinate axis they are situated upon. David can move along either the x or y axis, but not diagonally. They will each stop to eat some food and recuperate once they hit the origin (David stops when he's hit the origin after a positive number of seconds). The probability that they all stop within 6 seconds is $\frac{a}{b}$ in most simplified form. Find a