Buzzer Round

yeeee fellas!

Rules

- The following three events will happen simultaneously: one, the question will appear on the screen, two, the quizmaster will start reading the question, and three, the buzzers will go live

- The fastest team to hit their buzzer gets to answer

- Once a buzzer is pressed, the QM will stop reading immediately, mic will be brought to the team that buzzed and they must give their answer

- If they answer correctly, they get full points (+30)

- If they answer incorrectly or dont answer immediately, they'll incur a penalty (-15) points, and the question passes to the team which was the 2nd fastest

- If the next team buzzes and answers incorrectly as well, or if nobody gets the correct answer within 90 seconds of opening the question, the question passes to the audience

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Question 1

Given a set of points in Euclidean space, the geometric median is the unique point which minimizes the sum of distances to these points. A triangle's geometric median is called its Torricelli point. Consider a triangle with sides 13,14 and 15. Determine the angle subtended by the side of length 13 at the Torricelli point of the triangle.

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Answer

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

PS: Evangelista Torricelli was an Italian physicist best known for the invention of the barometer.

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Question 2

Find the largest positive integer ‘n’ such that

$$\sum_{i=1}^{n} i$$

divides

$$\sum_{i=1}^{n^2} i$$

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Answer

1

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Question 3

Determine

$$\lim_{x \to 0^+} (2x)^{\left((3x)^{(4x)}\right)}$$

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Answer

0

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Question 4

Given a (not necessarily meaningful) word made using the lowercase English alphabet, it is called *freaky* if between any 2 identical letters in it there are no 2 identical letters. Find the maximum possible length of a *freaky* word.

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Answer

78

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Question 5

What is the given paper about?

3 Properties of [redacted]

3.1 Basic Constructions

In order to understand [redacted] construction, we will need to understand some of the most basic folds that can be created. The following is the definition given by Auckly and Cleveland of [redacted] pair. This definition is the basis of what we mean by "[redacted]" in this paper:

Definition 3.1. *$\{\mathcal{P}, \mathcal{L}\}$ is an* [redacted] ***pair*** *if $\mathcal{P}$ is a set of points in $\mathbb{R}^2$ and $\mathcal{L}$ is a collections of lines in $\mathbb{R}^2$ satisfying:*

a) *The point of intersection of any two non-parallel lines in $\mathcal{L}$ is a point in $\mathcal{P}$.*

b) *Given any two distinct points in $\mathcal{P}$, there is a line $\mathcal{L}$ going through them.*

c) *Given any two distinct points in $\mathcal{P}$, the perpendicular bisector of the line segment with given end points is a line in $\mathcal{L}$.*

d) *If L_1 and L_2 are lines in $\mathcal{L}$, then the line which is equidistant from L_1 and L_2 is in $\mathcal{L}$.*

e) *If L_1 and L_2 are lines in $\mathcal{L}$, then there exists a line L_3 in $\mathcal{L}$ such that L_3 is the mirror reflection of L_2 about L_1.*

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Answer

Origami

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Question 6

For how many numbers ‘n’ between 1 and 69 (both inclusive) is the fraction

$$\frac{n^2+4}{n+5}$$

in reduced form?

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Answer

67

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Question 7

Consider a polynomial $P(x)$ with positive coefficients such that

$$P(1) \geq 3.5$$

Find the minimum value of

$$P(x)P\left(\frac{1}{x}\right)$$

over the positive reals

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Answer

$$12.25$$

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Question 8

Let $S(n)$ denote the sum of the digits of the integer n. If $S(n) = 2027$, what is the smallest possible value of $S(n + 1)$?

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Answer

3

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Question 9

Find the remainder when

$$243^{243^{242^{241^{\cdots^{1}}}}}$$

is divided by 5.

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Answer

3

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Question 10

Approximately 80,000 marriages took place in New York last year. Estimate the probability that for at least one of these couples, both partners were born on June 31.

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Answer

0

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Question 11

This algorithm used in arithmetic geometry determines whether a “given set of sections provides a basis for the Mordell-Weil group of an elliptic surface E→S, where S is isomorphic to the projective line”.

In 2021 one of the co-authors remarked that “...a few weeks after we met, we realized that we had to write a joint paper because the combination of our last names, in the usual alphabetical order, is remarkably obscene.”

ID the algorithm.

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Answer

Cox-Zucker Machine

Question 12

The number 452668172 can be converted into the square of a certain even integer N by changing one of its digits. Give the digit to be changed and its new value.

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Answer

Last digit should be changed from 2 to 6

Final

Consider all matrices with 4 rows and 4 columns, with 0s on the main diagonal and with elements chosen from $\{-1, 1\}$ elsewhere. What is the probability of the determinant of a randomly chosen matrix amongst these being 0?


THANK YOU!