

Georgia Institute of Technology High School Mathematics Competition

Ciphering Test

10 March 2018

Can you read this?

This is the font questions will be written in.

Instructions

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- Talking during a question will result in disqualification for the remaining portion of the cipher exam.



We are about to begin!

The first question will begin on the next slide.

Question 1

Compute $\frac{\sin^2(\pi/5) + \cos^2(\pi/5)}{\sec(\pi/8) \csc(\pi/8)}$

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Answer

$$\frac{\sqrt{2}}{4}$$

Question 2

What is the smallest 4 digit number dividing 1,000,000,001?

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Answer

1001.

Question 3

What is the last digit in the base 7 expansion of 3^{100} ?

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Answer

4.

Question 4

Find the smallest integer n greater than 1 such that the last 3 digits of n^2 are the same as the last 3 digits of n .

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Answer

376.

Question 5

If the base of this figure has a width of 1, compute the area of the black region. All depicted triangles are equilateral.



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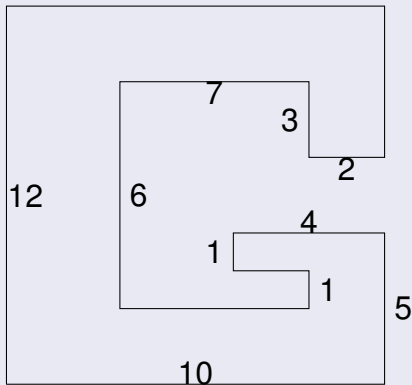


Answer

$$\frac{\sqrt{3}}{6}$$

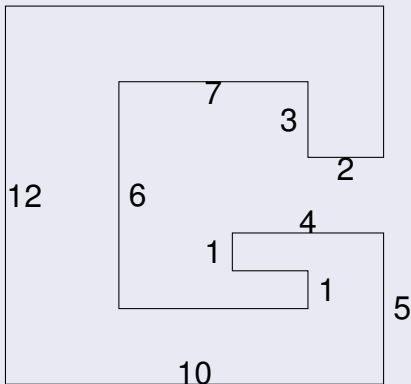
Question 6

Find the perimeter of the following figure (not to scale).



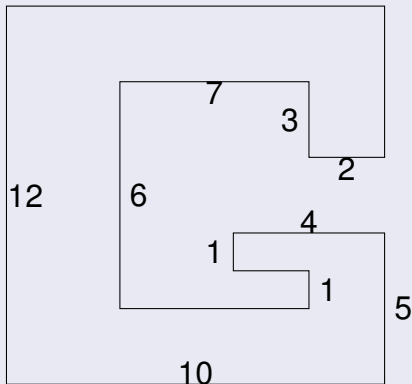
Question 6

Find the perimeter of the following figure (not to scale).



Question 6

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Answer

76.

Question 7

A ball is placed in the middle of the side AB of a rectangular billiard table $ABCD$ with sizes $AB = 4$ and $BC = 3$. The ball is then hit and after hitting the sides BC , CD , DA and AB it lands in C . What is the length of its trajectory?

Question 7

A ball is placed in the middle of the side AB of a rectangular billiard table $ABCD$ with sizes $AB = 4$ and $BC = 3$. The ball is then hit and after hitting the sides BC , CD , DA and AB it lands in C . What is the length of its trajectory?

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Answer

$\sqrt{181}$.

Question 8

Find $\frac{x}{y}$ if $\frac{4x^2 + |x + 5| + 4xy + y^2}{y - 5} = 0$

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Answer

$$-\frac{1}{2}$$

Question 9

The numbers b and c are randomly chosen between $\{1, 2, 3, 4, 5\}$ (with repetition). What is the probability that the equation $x^2 + bx + c$ has real roots?

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Answer

$$\frac{48}{100}$$

Question 10

How many solutions are there to the system of equations:

$$\begin{aligned}y &= \sin x \\ x^2 + y^2 &= 2y\end{aligned}$$

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Answer

2.

That's it!

Time for lunch!