2023 CHANTILLY MATH COMPETITION
ELEMENTARY SCHOOL DIVISION
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Participant Information

(a) Participant Name

(b) Participant Grade Level

(c) Participant Email Address

(d) School Name

RULES/INFORMATION

- Participants will have 90 minutes for the exam.

- Outside resources such as calculators, mobile devices, textbooks are not allowed.

- Collaboration of any form is not allowed.

- This exam consists of 25 free response questions.

- The problems will be in order of increasing difficulty in each section, but you may occasionally find some later questions easier, depending on experience.

- Each problem in each section will be worth 5, 5, 6, 6, and 8 points respectively.

- The advanced problems are worth 8 points.

- The answers to the problems are guaranteed to be integers.

ARITHMETIC & NUMBER THEORY

Question 1

Which digit of 3.141592 is in thousandth place?

Question 2

What is the sum of the first 26 natural numbers? That is, what is $1 + 2 + 3 + \ldots + 26$ or, to put it another way, what is $(1 + 26) + (2 + 25) + (3 + 24) + \ldots + (13 + 14)$?

Question 3

Find $\left(2 \circ \dfrac{1}{3 \circ 6} \right)$ where

$$a \circ b := \frac{1}{a} + \frac{1}{b}$$

Question 4

A prime number is a whole number greater than one that is only divisible by 1 and itself. For example, 2 and 3 are prime. Prime factorization is the process of breaking up a number into its prime factors e.g $24 = 2 \cdot 2 \cdot 2 \cdot 3 = 2^3 \cdot 3$, $30 = 2 \cdot 3 \cdot 5$. Calculate the prime factorization of 1296.

(a) How many 2's are in the prime factorization of 1296?

(b) How many are 3's are in the prime factorization of 1296?

Question 5

Which 3 consecutive numbers add to 52623?

_____ , _____ , _____

ALGEBRA

Question 6

A vending machine gives John three cookies for each coin he put into it. How many coins did John put in if he got 18 cookies?

_____

Question 7

Chris has a magic box. When Chris gives the box a number (input), the box gives him a new number (output). Some of these numbers are shown below. What number will Chris get when he gives the box the number 7?

Input	Output
0	1
1	4
2	7
3	10
7	?

_____

Question 8

If
$$\bigstar + 15 = \bigstar + \bigstar + \bigstar + 5$$
what is the value of $\bigstar$?

_____

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Question 9

Sofia currently has $18,000.00 in her bank account. Given that Sofia earns $16.50 an hour and that she has worked 800 hours since she started the bank account, how much money did she begin with?

_____ dollars

Question 10

James gets paid $15.00 an hour. William gets paid $20.00 an hour and he always works 5 hours less than James. How many hours will James have to work until he and William have the same amount of money? Assume both William and James start with 0 dollars.

_____ hours

GEOMETRY

Question 11

The distance between Joshua's house and CHS is a straight 16 miles. Joshua starts from his house and travels in the direction of CHS for $\frac{1}{2}$ of the way. He then reverses his direction and travels $\frac{1}{4}$ of the previously traveled distance backwards. What is Joshua's current distance from his house?
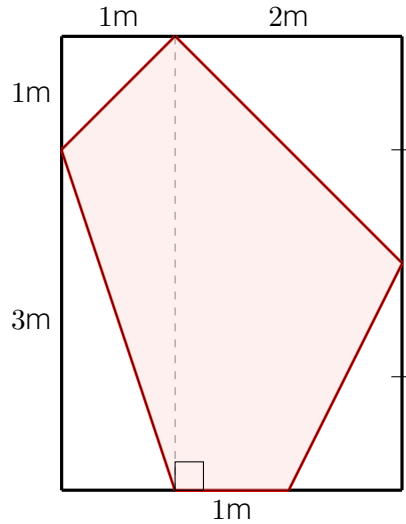
_____ miles

Question 12

What is the measure of one internal angle of a regular pentagon?
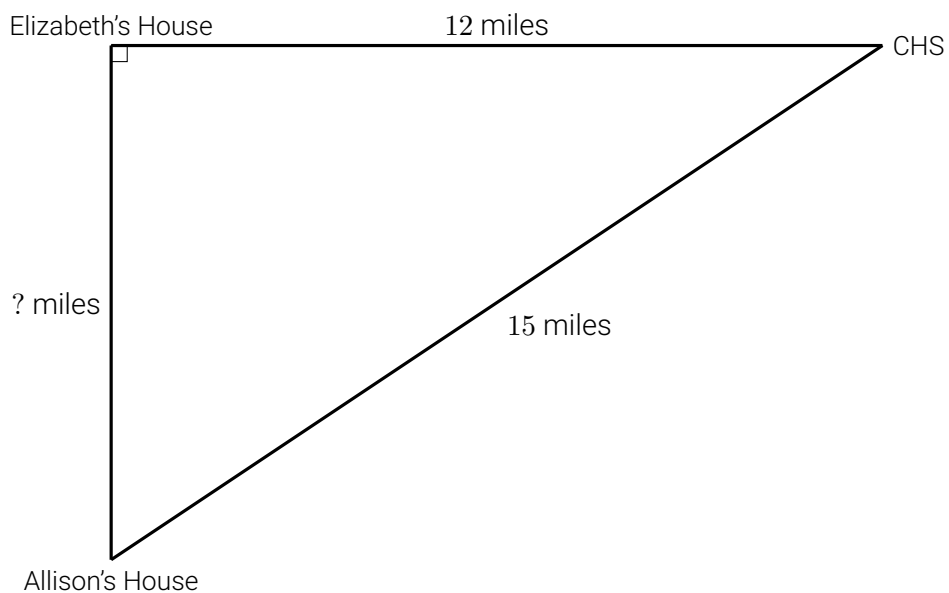
_____ °

Question 13

Given the information in the diagram below, find the area of the red figure in square meters where the dimensions of the outer rectangle are 4m x 3m.


_____ m^2

Question 14

The locations of Allison's house, Elizabeth's house, and CHS are located at the vertices of a right triangle shown below. What is the distance between Allison's house and Elizabeth's house?

_____ miles

Question 15

The radius of the big circle is 6m, and small circles are identical and not overlapping. What is the area of the shaded area in the image shown below? Use the approximation $\pi = 3$.
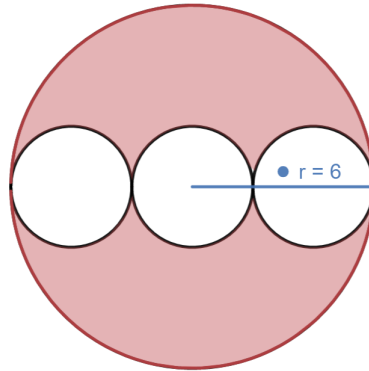
_____ m^2

PROBABILITY & STATISTICS

Question 16

What is the sum of mean, mode, and median of following set of integers?

$$\{2, 3, 3, 3, 5, 5, 6, 7, 7, 9\}$$

_____

Question 17

Consider rolling a 12 sided die. Find the probability that the roll is even. Your answer will be in the form $\frac{p}{q}$ (a fraction). What is $p + q$? To put it another way, what is the sum of numerator and denominator of that probability?

_____

Question 18

Mr. Smith has 6 students. 5 of his students and their scores on the last test are shown below.

| Student	Score
Tim	75
Claire	60
John	80
Michelle	80
Craig	95

What score will Mr. Smith's last student need to get for the class average of all 6 students to be an 80?

_____

Question 19

Molly has a bag of candy consisting of 4 pieces of taffy, 10 pieces of hard candy, and 6 pieces of licorice. If she grabs a piece of candy twice, what is the probability that she gets a piece of taffy first and a piece of hard candy second? Your answer will be in simplest form $\frac{p}{q}$. What is $p + q$? To put it another way, what is the sum of numerator and denominator of that probability?

_____

Question 20

How many ways are there to arrange 6 people around a circular table? Consider two arrangements to be identical if you can get the other by just moving everyone one spot to the left/right.

_____
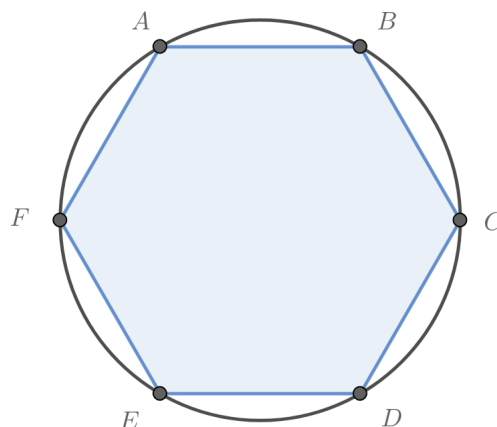
ADVANCED PROBLEMS

Question 21

Megan has two mystery numbers. Megan tells you that the product of the two mystery numbers is 729 and the average of the two mystery numbers is 45. What are the two mystery numbers?

_____

_____

Question 22

Jocelyn writes all the numbers from 1 to 2023 inclusive on a blackboard. How many 2's are on the board?

_____

Question 23

If

$$\star + \circ + \circ = 2 + \square$$
$$\square + \square = 1 + \circ + \circ + \star$$
$$\circ + \circ = 1 + \square$$

what is the value of $\star$?

_____

Question 24

How many positive solutions exist for odd natural numbers n such that $\dfrac{3n+1}{n}$ is an integer?

_____

Question 25

Given

$$\frac{2}{x} = \frac{y}{3} = \frac{x}{y}$$

what is x^3?

_____