Math Field Day 2024
Mad Hatter 6-8

CSU Fresno

www.fresnostate.edu/csm/math/

20 April 2024

Welcome to Fresno State!

The Mad Hatter Marathon is a competition in rapid computation and problem solving. You will find that you do not have time to solve every problem. After a few minutes you may feel "mentally out of breath." Do not let this discourage you. Your fellow contestants feel the same way. That is why this contest is called *Mad Hatter Marathon!*

The Mad Hatter Marathon is divided into two problem solving periods, each lasting 45 minutes. Between the two periods there will be a 15 minute break.

Part I

Math Field
Day 2024

CSU Fresno

Part I

Part I:
Problems 1-15

Part I:
Problems
16-30

- This part of the exam consists of 30 problems.

- The problems will be shown one at a time.

- You will have ninety seconds to solve the problem shown.

- After ninety seconds a new problem will be shown.

- You may move to a new question without solving the old one.

As soon as you have solved the problem mark your answer in the corresponding space on the Scantron form.

Part I

Math Field
Day 2024

CSU Fresno

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Problems 1-15

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Part I

Math Field
Day 2024

CSU Fresno

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Problems 1-15

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Part I

Math Field
Day 2024

CSU Fresno

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Problems 1-15

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Part I

Math Field
Day 2024

CSU Fresno

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Part I

Math Field
Day 2024

CSU Fresno

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Rules and Scoring

Math Field
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Part I

Part I:
Problems 1-15

Part I:
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16-30

You may use pencil and scratch paper to do calculations, but **calculators are not allowed.**

Your score is the total number of correct answers, so give the best answer that you can in the time available for each problem. There is no penalty for guessing.

Reminders

Math Field
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CSU Fresno

Part I

Part I:
Problems 1-15

Part I:
Problems
16-30

- Please turn off any devices that could make noise, such as cell phones, beepers, watches, etc.
- If your pencil breaks or needs sharpening, stay in your seat and raise your hand.
- Keep your eyes on your own paper. Keep your Scantron flat on your desk. Contestants caught cheating will be disqualified.

Ready... Set... Go!

Prepare to begin the *Mad Hatter Marathon!*

Part I - Problem 1

Math Field
Day 2024

CSU Fresno

Part I

Part I:
Problems 1-15

Problem 1
Problem 2
Problem 3
Problem 4
Problem 5
Problem 6
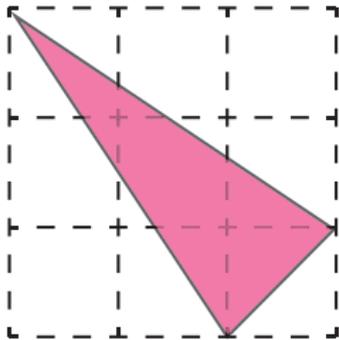Problem 7
Problem 8
Problem 9
Problem 10
Problem 11
Problem 12
Problem 13
Problem 14
Problem 15

Part I:
Problems
16-30

Nine times $\heartsuit$ is equal to 9999 divided by 3.

What is the value of $\heartsuit$?

(A) $270.\overline{3}$

(B) 333

(C) $370.\overline{3}$

(D) $666.\overline{6}$

(E) 999

Harry and Marv rob a pet store and Buzz drives the getaway car. They get away with $123 and split the loot in a 3 : 2 : 1 ratio. What is the value of the *smallest* share?

Ⓐ   Ⓑ $21 $21.50   Ⓔ

      $20.50   Ⓒ   Ⓓ $23 $23.50

☺ is a positive integer such that

$$1 \times 2 \times 3 \times 4 \times \cdots \times ☺ < 2024$$

What is the largest number that ☺ could be?

Ⓐ 6

Ⓑ 7

Ⓒ 8

Ⓓ 9

Ⓔ None of these

Today is Saturday 20 April. What day of the week will it be 2024 days from today?

A Sunday

B Monday

C Tuesday

D Wednesday

E None of these

Part I - Problem 5

Math Field
Day 2024

CSU Fresno

Part I

Part I:
Problems 1-15
Problem 1
Problem 2
Problem 3
Problem 4
Problem 5
Problem 6
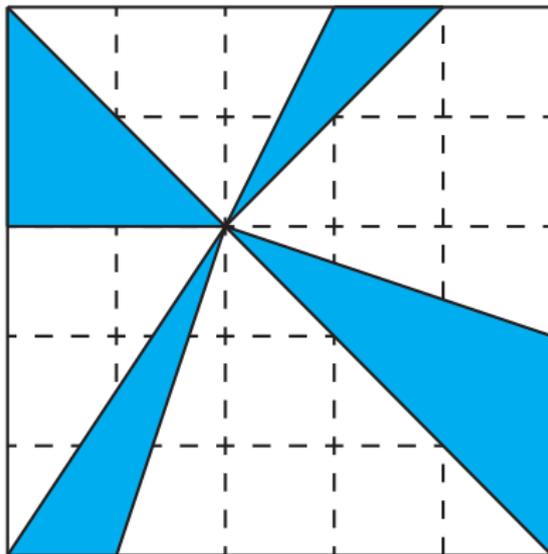Problem 7
Problem 8
Problem 9
Problem 10
Problem 11
Problem 12
Problem 13
Problem 14
Problem 15

Part I:
Problems
16-30

Groot starts with a 98 cm licorice rope and a 56 cm licorice rope. Groot wants to cut all the licorice into equal-length pieces. Into what lengths should he cut the ropes so that the pieces are as *long as possible* with none left over?

A 7cm

B 14cm

C 21cm

D 28cm

E None of these

What is the area of the triangle pictured in the 3×3 grid below?

A $\dfrac{5}{3}$ **B** 2 **C** 3 **D** $\dfrac{5}{2}$ **E** $\dfrac{10}{3}$

What is the mean of the five numbers:

$$1^5 \qquad 2^4 \qquad 3^3 \qquad 4^2 \qquad 5^1$$

A $2.5^{2.5}$

B 2^3

C 3^3

D 5^3

E 13

The number 2024 is 24% of what number?

A $4857.\overline{6}$ **C** 6298   **E** $8433.\overline{3}$

B 5640   **D** $6616.\overline{6}$

What percentage of the 5×5 square is colored?

A 20%   **B** 25%   **C** 30%   **D** 33%   **E** 40%

Which of the following Filipino postages **cannot** be paid exactly using only 17 cent and 12 cent stamps?

A 75 cents   **C** 89 cents   **E** 104 cents
B 81 cents   **D** 99 cents

Mr. Muffins walks for 30 mins at a speed of 5 mph. The next hour, he walks at a speed of 4 mph. The final 30 mins, he walks at a speed of 3 mph.

What was Mr. Muffins's average speed during the trip?

A $3.\overline{6}$ mph

B 4 mph

C $4.\overline{3}$ mph

D 4.5 mph

E $4.\overline{6}$ mph

Which number occurs most often in the following array:

$$\frac{1}{16}$$

$$\frac{1}{8} \quad \frac{4}{16}$$

$$\frac{1}{4} \quad \frac{3}{8} \quad \frac{6}{16}$$

$$\frac{1}{2} \quad \frac{2}{4} \quad \frac{3}{8} \quad \frac{4}{16}$$

$$1 \quad \frac{1}{2} \quad \frac{1}{4} \quad \frac{1}{8} \quad \frac{1}{16}$$

(A) $\frac{1}{2}$ **(B)** $\frac{1}{16}$ **(C)** $\frac{1}{8}$ **(D)** $\frac{1}{4}$ **(E)** $\frac{3}{8}$

Rocket Bus begins with 64 riders. Half of the riders get out at every stop. How many stops will be made until there is only one rider left?

Ⓐ 4　　Ⓑ 5　　Ⓒ 6　　Ⓓ 7　　Ⓔ 8

Math Field
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Part I

Part I:
Problems 1-15

Problem 1
Problem 2
Problem 3
Problem 4
Problem 5
Problem 6
Problem 7
Problem 8
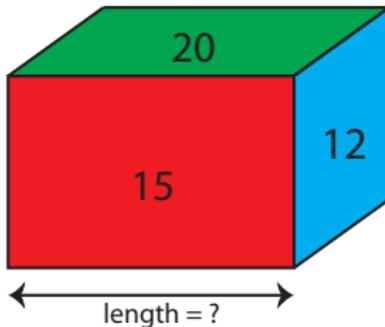Problem 9
Problem 10
Problem 11
Problem 12
Problem 13
Problem 14
Problem 15

Part I:
Problems
16-30

The sides of the box have areas as labeled (measured in square units). What is the length of the box?

A 1   **B** 2   **C** 3   **D** 4   **E** 5

The city of Ding Dong, Texas has 202,300 residents and had a total of 2023 car accidents last year. If there are 20,230 total cars in the city, which of the following is the correct accident rate?

A 1 accident per 1,000 cars

B 10 accidents per 1,000 cars

C 10 accidents per 100 cars

D 1 accident per 10,000 cars

Shrek eats one yellow M&M every 7 seconds and one red M&M every 11 seconds. Approximately how many total M&Ms will Shrek eat during the 2 hours of this Mad Hatter Marathon?

A 1495   **B** 1683   **C** 1765   **D** 1829   **E** 1913

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Part I

Part I:
Problems 1-15

Part I:
Problems
16-30
Problem 16
Problem 17
Problem 18
Problem 19
Problem 20
Problem 21
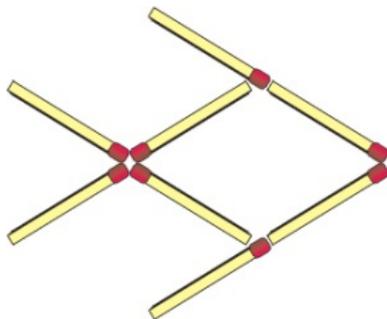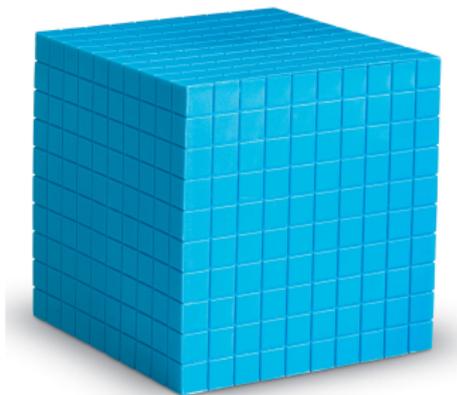Problem 22
Problem 23
Problem 24
Problem 25
Problem 26
Problem 27
Problem 28
Problem 29
Problem 30

Pictured are eight matchsticks arranged to make a "fish" that is heading right. In order to make the fish head left, what is the *minimum* number of sticks that must be moved?

Ⓐ 2　　Ⓑ 3　　Ⓒ 4　　Ⓓ 5　　Ⓔ 6

Suppose you completely slice this *solid* $10 \times 10 \times 10$ cube into $1 \times 1 \times 1$ cubes. You then glue some of the smaller cubes together to make a *hollow* cube. What will be the dimensions of the largest possible *hollow* cube?

- (A) $13 \times 13 \times 13$
- (B) $15 \times 15 \times 15$
- (C) $17 \times 17 \times 17$
- (D) $20 \times 20 \times 20$
- (E) $33 \times 33 \times 33$

Suppose that you roll two regular six-sided dice and the sum of *face-down* sides is EIGHT. What is the sum of all the other sides?

A 30　　**B** 33　　**C** 34　　**D** 37　　**E** 38

A round table seats 21 people. What is the maximum number of knights that can sit at the table given that any two knights must be separated by at least one squire?
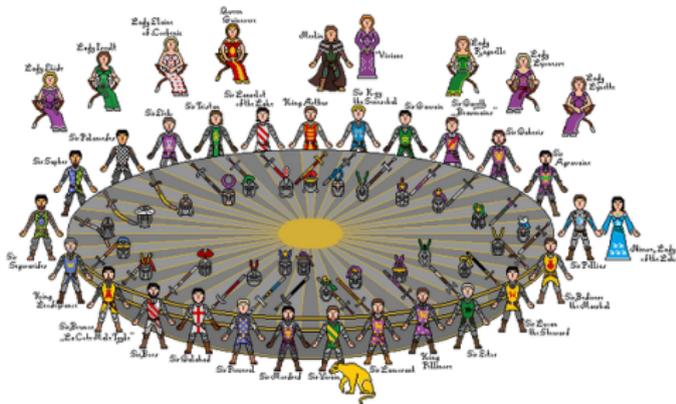
A 8   **B** 9   **C** 10   **D** 11   **E** 12

Mario can eat a whole pizza in 20 minutes. Leonardo can eat one in 5 minutes, and Michelangelo can do it in 4 minutes. If they all begin eating one pizza at the same time, how long will the pizza last?

- (A) 96 seconds
- (B) 100 seconds
- (C) 2 minutes
- (D) 160 seconds
- (E) 1 minute

A Pet VR headset costs \$350. If you buy in bulk quantities of 10 or more, you get a 20% discount on each headset. At what quantity does it become **more** costly to buy singly rather than just buying a 10-pack?

Ⓐ 9 Ⓑ 8 Ⓒ 7 Ⓓ 6 Ⓔ 5

If each edge of the prism is doubled, then by what factor will the volume increase?
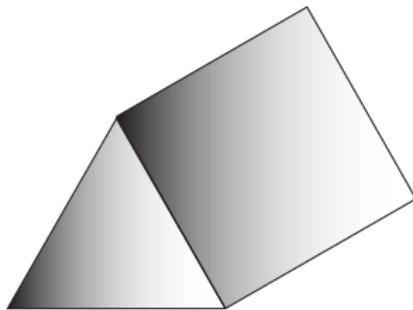
A 2   **B** 4   **C** 6   **D** 8   **E** 16

What is the maximum digit sum for the digits showing on this digital clock during the AM times?

(A) 16   (B) 20   (C) 21   (D) 23   (E) 36

Charlene wants to mail a package that weighs 14 ounces. The postmaster tells her that the postage costs $1.34 for the first ounce and $0.95 for each additional ounce. How much will Charlene have to pay in postage?

Ⓐ $11.96

Ⓒ $13.30

Ⓔ $14.64

Ⓑ $13.21

Ⓓ $13.69

500 nickels have the same value as how many quarters?

A 100 **B** 250 **C** 50 **D** 75 **E** 200

$28 \times 5 - 25 \times 4 + 16 \times 3 = ...$

A 140   **B** 48   **C** 64   **D** 75   **E** 88

In the number line pictured, what is the best estimate for the value of X?

A 0.26   **B** 0.206   **C** 0.266   **D** 0.236   **E** 0.226

A parking garage charges $2.50 for the first hour and $1.75 for each additional hour or part of an hour. How much will it cost Berta to park in the garage for $5\frac{1}{2}$ hours?

A $10.50   **C** $11.75   **E** $11.25

B $12.00   **D** $12.75

At a national math competition, competitors receive 4 points for each correct answer and lose 1 point for each blank or incorrect answer. If there are 40 questions and Alma scored 20 points then how many problems did she get correct?

A 6 **B** 9 **C** 12 **D** 15 **E** 16

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Problems
16-30

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Problem 19
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Problem 21
Problem 22
Problem 23
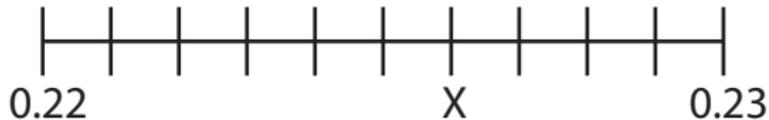Problem 24
Problem 25
Problem 26
Problem 27
Problem 28
Problem 29
Problem 30

Whew! You've reached the end of Part I.

- Please make sure your full name and school name are on your Scantron form.
- Pass your Scantrons in.
- You may leave your belongings here during the break.
- Part II will begin in **15 minutes**.

Mad Hatter - Part II

Math Field
Day 2024

CSU Fresno

Part II

Part II:
Problems 1-15

Part II:
Problems
16-30

The End

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Mad Hatter - Part II

Math Field
Day 2024

CSU Fresno

Part II

Part II:
Problems 1-15

Part II:
Problems
16-30

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Mad Hatter - Part II

Math Field
Day 2024

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Part II

Part II:
Problems 1-15

Part II:
Problems
16-30

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Ready... Set... Go!

Prepare to restart the *Mad Hatter Marathon!*

Part II - Problem 1

Math Field
Day 2024

CSU Fresno

Part II

Part II:
Problems 1-15

Problem II-1
Problem II-2
Problem II-3
Problem II-4
Problem II-5
Problem II-6
Problem II-7
Problem II-8
Problem II-9
Problem II-10
Problem II-11
Problem II-12
Problem II-13
Problem II-14
Problem II-15

Part II:
Problems
16-30

The End

Start with a positive number then square your number. Now add 1 to the result and take the square root of the sum. Finally, subtract 1 from what you have. Your final result will be:

A always equal to the starting number

B always smaller than the starting number

C always larger than the starting number

D sometimes larger, sometimes smaller, but never equal to the starting number

E sometimes larger, sometimes smaller, and sometimes equal to the starting number

Part II - Problem 2

Math Field
Day 2024

CSU Fresno

Part II

Part II:
Problems 1-15

Problem II-1
Problem II-2
Problem II-3
Problem II-4
Problem II-5
Problem II-6
Problem II-7
Problem II-8
Problem II-9
Problem II-10
Problem II-11
Problem II-12
Problem II-13
Problem II-14
Problem II-15

Part II:
Problems
16-30

The End

A Pythagorean triple is a set of three numbers x, y, z such that $x^2 + y^2 = z^2$. Which of the following are Pythagorean triples?

$$\text{I. } x = 1, y = 2, z = 3$$
$$\text{II. } x = 2, y = 3, z = 4$$
$$\text{III. } x = 3, y = 4, z = 5$$

A I only

B II only

C III only

D I, II and III are all Pythagorean triples

E None of them are Pythagorean triples

Part II - Problem 3

Math Field
Day 2024

CSU Fresno

Part II

Part II:
Problems 1-15

Problem II-1
Problem II-2
Problem II-3
Problem II-4
Problem II-5
Problem II-6
Problem II-7
Problem II-8
Problem II-9
Problem II-10
Problem II-11
Problem II-12
Problem II-13
Problem II-14
Problem II-15

Part II:
Problems
16-30

The End

The nine squares are to be filled so that each row and each column contains the numbers 1, 2, and 3. What number goes in the location marked "**X**"?

2		
	1	**X**

Ⓐ 1

Ⓑ 2

Ⓒ 3

Which of the following is between $\frac{7}{18}$ and $\frac{1}{2}$?

A $\frac{1}{4}$
B $\frac{4}{9}$
C $\frac{2}{3}$
D $\frac{5}{16}$
E $\frac{7}{13}$

Part II - Problem 5

Math Field
Day 2024

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Part II

Part II:
Problems 1-15

Problem II-1
Problem II-2
Problem II-3
Problem II-4
Problem II-5
Problem II-6
Problem II-7
Problem II-8
Problem II-9
Problem II-10
Problem II-11
Problem II-12
Problem II-13
Problem II-14
Problem II-15

Part II:
Problems
16-30

The End

Donkey Kong and Diddy Kong are on a collision course.
Each is driving a car headed straight for the other. Donkey
Kong is traveling 50 miles per hour and Diddy Kong is
traveling 70 miles per hour. How far apart will the two cars
be one minute before they collide?

A 2 miles   **C** 3.25 miles   **E** $1.\overline{57}$ miles

B 1.5 miles   **D** 1 mile

Stimpy walks 18 inches with each step. Ren walks 15 inches with each step. If Stimpy walks one mile and Ren takes the same number of steps as Stimpy, what distance will Ren have walked when Stimpy completes his mile?

A 1760 feet   **C** 870 feet   **E** None of these

B 4400 feet   **D** 3620 feet

On one floor of a building there are three apartments. In each apartment lives two pets. One apartment has a cat and a dog, one apartment has two dogs, and the last apartment has two cats. If you walk into one apartment at random and see a dog, what is the probability that the other pet in the apartment is also a dog?

A $\frac{1}{6}$ **B** $\frac{1}{4}$ **C** $\frac{1}{3}$ **D** $\frac{1}{2}$ **E** $\frac{2}{3}$

Which of the following has the greatest number of factors?

A 4   **B** 18   **C** 30   **D** 35   **E** 49

$$(10 \div 1) + (20 \div 2) + (30 \div 3) + (40 \div 4) = X \div 5$$

What is the value of X?

A 200 **B** 100 **C** 80 **D** 40 **E** 8

Part II - Problem 10

Math Field
Day 2024

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Part II
Part II:
Problems 1-15
Problem II-1
Problem II-2
Problem II-3
Problem II-4
Problem II-5
Problem II-6
Problem II-7
Problem II-8
Problem II-9
Problem II-10
Problem II-11
Problem II-12
Problem II-13
Problem II-14
Problem II-15

Part II:
Problems
16-30

The End

Last Saturday, Amelie sold her paintings at a local flea market. In the morning she sold one-third of the paintings. She sold one-fourth of the remaining paintings in the afternoon. When the market closed she had 9 paintings left. How many paintings did she bring to the market with her that morning?

A 24   **B** 16   **C** 20   **D** 26   **E** 18

A room has six doors. In how many ways is it possible to enter by one door and leave by a different door?

A 11   **B** 12   **C** 15   **D** 30   **E** 36

Part II - Problem 12

Math Field
Day 2024

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Part II

Part II:
Problems 1-15

Problem II-1
Problem II-2
Problem II-3
Problem II-4
Problem II-5
Problem II-6
Problem II-7
Problem II-8
Problem II-9
Problem II-10
Problem II-11
Problem II-12
Problem II-13
Problem II-14
Problem II-15

Part II:
Problems
16-30

The End

Sonia Sotomayor has 14 days to read a 603-page Supreme Court decision before the Court reconvenes. If she reads 288 pages of the decision in the first nine days, how many pages per day must she then read, on average, in order to finish reading the case on time?

A 17   **B** 23   **C** 32   **D** 43   **E** 63

$$(2+3) \times 7 + 2 \times (5+1) - (3 \times 4) = ...$$

A 16   **B** 21   **C** 35   **D** 52   **E** 176

Which of the numbers

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

is less than its reciprocal?

A -2

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

C 1

D 2

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

Five people enter a wrestling tournament in which each person must wrestle every other person exactly once. What is the total number of wrestling matches that will occur?

Ⓐ 8　　　Ⓑ 10　　　Ⓒ 12　　　Ⓓ 15　　　Ⓔ 25

Part II - Problem 16

Math Field
Day 2024

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Part II

Part II:
Problems 1-15

Part II:
Problems
16-30

Problem II-16
Problem II-17
Problem II-18
Problem II-19
Problem II-20
Problem II-21
Problem II-22
Problem II-23
Problem II-24
Problem II-25
Problem II-26
Problem II-27
Problem II-28
Problem II-29
Problem II-30

The End

Two 600 ml pitchers contain orange juice. One pitcher
is 1/3 full and the other is 2/5 full. Water is added to fill each
pitcher completely, then both pitchers are poured into one
large container. What fraction of the mixture in the large
container is orange juice?

A $\frac{9}{25}$ **B** $\frac{11}{30}$ **C** $\frac{23}{60}$ **D** $\frac{13}{40}$ **E** $\frac{17}{35}$

Part II - Problem 17

Math Field
Day 2024

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Part II

Part II:
Problems 1-15

Part II:
Problems
16-30

The symbol ✠ represents the numerical operation

$$a ✠ b = a^b - b^a$$

What is the value of $2 ✠ 5$?

A 7   **B** 36   **C** 34   **D** 42   **E** 24

How many of the fifteen positive factors of 400 are divisible by 4?

A 4   **B** 8   **C** 9   **D** 10   **E** 12

The longest side of the triangle is a diameter of the circle shown. What is the total area of the shaded portions (measured in square units)?
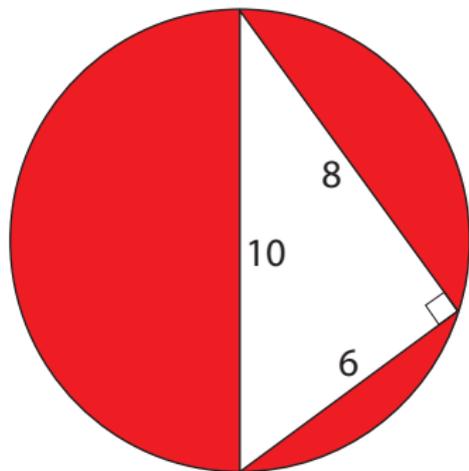
A $25\pi - 24$ **C** $100\pi - 80$ **E** $48\pi - 100$

B $50\pi - 48$ **D** $24\pi - 60$

Kay earns points for exercising according to the following table:

EXERCISE	DISTANCE	POINTS EARNED
Swimming	1/2 mile	4
Walking	4 miles	5
Biking	15 miles	6

Using the chart, how many points did Kay earn for 45 miles of biking, 3.5 miles of swimming, and 20 miles of walking?

Ⓐ 225　　Ⓑ 50　　Ⓒ 225　　Ⓓ 127　　Ⓔ 71

$$\frac{4}{7}, \quad \frac{7}{8}, \quad \frac{4}{10}, \quad \frac{11}{10}, \quad \frac{1}{10}, \quad \frac{8}{18}$$

How many of the six fractions listed above are closer to 1 than they are to zero?

A 1   **B** 2   **C** 3   **D** 4   **E** 5
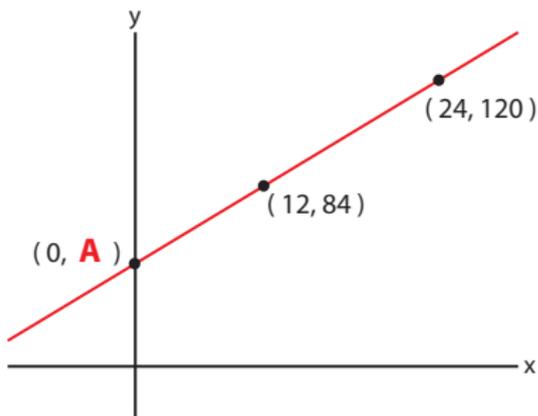
Pictured is a straight line. What is the value of **A** ?

A 84   **B** 12   **C** 26   **D** 48   **E** 50

What is the remainder when 3^{2024} is divided by 5?

A 0   **B** 1   **C** 2   **D** 3   **E** 4

What is the 25th digit after the decimal point in the decimal representation of 1/7?

Ⓐ 1   Ⓑ 2   Ⓒ 4   Ⓓ 7   Ⓔ 8

If $X \diamond Y$ means $\frac{X+Y}{2}$ then $(5 \diamond 9) \diamond 13$ is ...

Ⓐ 8　　　Ⓑ 16　　　Ⓒ 6　　　Ⓓ 10　　　Ⓔ 24

Part II - Problem 26

Math Field
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Part II
Part II:
Problems 1-15
Part II:
Problems
16-30
Problem II-16
Problem II-17
Problem II-18
Problem II-19
Problem II-20
Problem II-21
Problem II-22
Problem II-23
Problem II-24
Problem II-25
Problem II-26
Problem II-27
Problem II-28
Problem II-29
Problem II-30

The End

A company is considering the installation of a solar power system in order to save on utility bills. The cost of installing the system is \$15,000 and the monthly savings would be \$100. How many years would it take the company to recoup the cost of installing the system?

- **A** $12\frac{1}{2}$ years
- **C** $14\frac{3}{4}$ years
- **E** $12\frac{1}{4}$ years
- **B** $10\frac{1}{4}$ years
- **D** $11\frac{3}{4}$ years

60% of the students at William Shatner Middle School are girls. If there are 450 girls at the school then the total enrollment there is:

A 270   **B** 675   **C** 750   **D** 825   **E** 1125
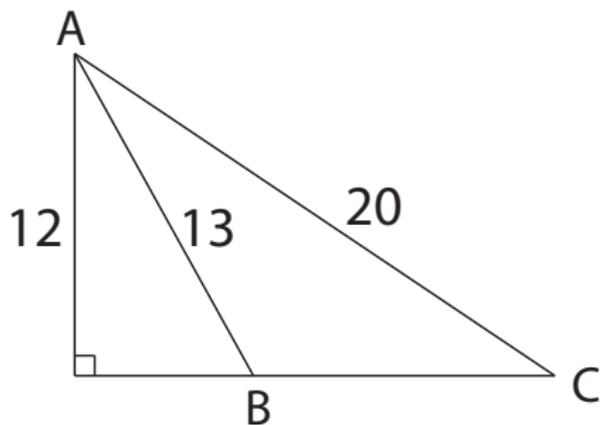
What is the area of triangle ABC?

A 48   **B** 59.5   **C** 64   **D** 66   **E** 72.5

Nico has three books overdue from the library. The fine is 10 cents per book per day. He remembers that he checked out an astronomy book exactly one week earlier than the other two books. If the total fine is $1.90, how long overdue is the astronomy book?

- **A** 4 days
- **B** 9 days
- **C** 11 days
- **D** 14 days
- **E** 17 days

What number is equal to one-fourth of its own reciprocal?

A $\frac{1}{2}$ **B** $\frac{1}{4}$ **C** 2 **D** 4 **E** $\frac{1}{8}$

Math Field
Day 2024

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Part II

Part II:
Problems 1-15

Part II:
Problems
16-30

The End

You made it!

- Please make sure your full name and school name are on your Scantron form.
- Pass your Scantron in.
- Please take your belongings with you.
- **Program change:** Instead of board and card games, there will be a science and math carnival outside the Science 2 Building starting at noon. There will be at least one math science booths of different kinds, with puzzles and other hands-on activities to try.
- The awards ceremony will be in the Science II courtyard beginning at **2:45pm**. If there are any ties, you have to be present to win the tiebreaker. See you there!

Math Field
Day 2024

CSU Fresno

Part II

Part II:
Problems 1-15

Part II:
Problems
16-30

The End

Part I

1	C	6	D	11	B	16	B	21	C	26	A
2	A	7	E	12	D	17	B	22	A	27	E
3	A	8	E	13	C	18	A	23	D	28	E
4	A	9	C	14	E	19	C	24	D	29	E
5	B	10	B	15	C	20	C	25	D	30	C

Part II

1	B	6	B	11	D	16	B	21	C	26	A
2	C	7	E	12	E	17	A	22	D	27	C
3	B	8	C	13	C	18	C	23	B	28	D
4	B	9	A	14	A	19	A	24	A	29	C
5	A	10	E	15	B	20	E	25	D	30	A