Math Field Day 2023
Mad Hatter 6-8

CSU Fresno
www.fresnostate.edu/csm/math/

15 April 2023

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 2023

CSU Fresno

Part I

Part I:
Problems 1-15

Part I:
Problems
16-30

- This part of the exam consists of 30 problems.
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Math Field
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Rules and Scoring

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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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- 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!*

Which of the following rectangles is *impossible*?

Rectangle	A	B	C	D	E
Area (in m^2)	25	25	16	16	9
Perimeter (in m)	29	20	16	20	9

Ⓐ Rectangle A

Ⓑ Rectangle B

Ⓒ Rectangle C

Ⓓ Rectangle D

Ⓔ Rectangle E

During the Mario Kart Circuit, Luigi drove at an average speed of 70 mph for the first 30 minutes. For the next 20 minutes, Luigi had an average speed of 40 mph. During the final 10 minutes, Luigi's average speed was 60 mph. What was Luigi's average speed (in mph) for the entire hour?

A $54.\overline{3}$ **B** $56.\overline{6}$ **C** $58.\overline{3}$ **D** 60 **E** $62.\overline{6}$

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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

Part I:
Problems
16-30

What is the area of an equilateral triangle with side length 2 units?

Ⓐ $\frac{3\sqrt{3}}{2}$

Ⓑ 2

Ⓒ $2\sqrt{2}$

Ⓓ $2 + \sqrt{2}$

Ⓔ $\sqrt{3}$

The five starting players on the Funky Dunkers basketball team have heights (in feet and inches)

$$4'11'' \qquad 5'4'' \qquad 5'8'' \qquad 5'8'' \qquad 5'11''$$

What is the mean height of the starting five players? (Remember that $12'' = 1'$.)

A $5'4''$ **B** $5'5''$ **C** $5'6''$ **D** $5'7''$ **E** $5'8''$

Which of the following statements is FALSE?

- **A** Any two circles are similar.
- **B** Any two squares are similar.
- **C** Any two rectangles are similar.
- **D** Any two spheres are similar.
- **E** Any two cubes are similar.

There are 15 cats and 11 dogs in a math class. If an animal is selected at random to get a treat, what is the probability that a dog will be selected?

(A) $\dfrac{4}{26}$ (B) $\dfrac{11}{26}$ (C) $\dfrac{11}{15}$ (D) $\dfrac{15}{11}$ (E) $\dfrac{26}{11}$

Tom Nook makes a profit of 5 Bells for each wallpaper he sells, 2 Bells for each tool he sells, and $\frac{1}{2}$ Bell for each flower he sells. Today he sold 7 items and made a profit of 17 Bells. Assuming he sold at least one of each item type, which of the following statements must be TRUE?

A Tom sold an odd number of flowers.

B Tom sold an even number of tools.

C Tom sold an odd number of wallpapers.

D Tom sold more wallpapers than tools.

E Tom sold the same number of flowers as wallpapers.

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Part I

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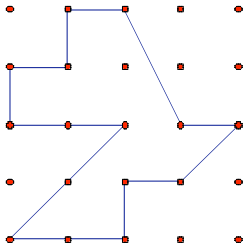Problem 9
Problem 10
Problem 11
Problem 12
Problem 13
Problem 14

Part I:
Problems
16-30

Chewbacca travels 48 inches with each stride. Leia moves 24 inches with each of her strides. If Chewbacca and Leia each start walking along a 1 mile path and both take the same number of strides, how many feet behind will Leia be when Chewbacca completes the mile?

A 1663

C 3298

E 5280

B 2640

D 3616

A string has been cut into 4 pieces, all of different lengths. The length of each piece is 2 times the length of the next smaller piece. What fraction of the original string is the longest piece?

A $\dfrac{8}{15}$ **B** $\dfrac{2}{5}$ **C** $\dfrac{1}{2}$ **D** $\dfrac{6}{13}$ **E** $\dfrac{5}{8}$

In the picture below, if the area of the rectangle is 2688 cm^2 then what is the length X ?
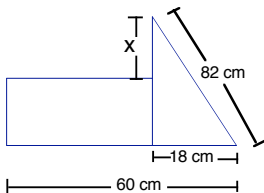
A 16 cm **C** 26 cm **E** 54 cm

B 9 cm **D** 42 cm

We sold 380 tickets to this weekend's butter churning competition. That was 25% more than we sold last year. How many tickets did we sell last year?

A 304 **B** 285 **C** 95 **D** 190 **E** 250

A store had a sale on t-shirts: for every two t-shirts purchased at the regular price, a third t-shirt would cost $1. If Tom bought twelve t-shirts for $120.00, what was the regular price for one t-shirt?

Ⓐ $10.00

Ⓑ $12.00

Ⓒ $13.50

Ⓓ $14.50

Ⓔ $15.00

If the dots are spaced one unit apart then what is the area (in square units) of the pictured polygon?

A 6.5 **B** 7.0 **C** 7.5 **D** 8.0 **E** 8.5

When you convert the base ten number 2023 into base 5, what will be the digit in the units place?

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

What is the smallest positive integer $x > 100$ such that every number formed by rearranging the digits of x is prime?

A 101 **B** 103 **C** 113 **D** 117 **E** 127

Bulbasaur, Charizard, and Snorlax just finished playing a video game. Bulbasaur scored 5,450 points, Charizard got 70% of Bulbasaur's score, and Snorlax finished with 200% of Charizard's score. What percent of Bulbasaur's score was Snorlax's score?

A 140% **B** 150% **C** 85% **D** 130% **E** 120%

Snuffles the dog is tied to the corner of a square building by a 20 foot leash as shown. What is the total area (in square feet) that Snuffles is able to roam?
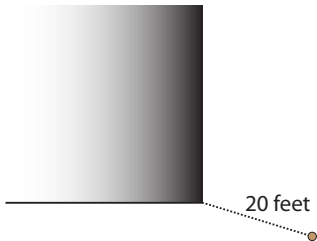
20 feet

A 100π

B $100\sqrt{2}\pi$

C $100\sqrt{3}\pi$

D 300π

E 400π

If the coordinates of three vertices of a parallelogram are

$$A(1,1), \qquad B(2,4), \quad \text{and} \quad C(-5,1)$$

then what is the area of the parallelogram?

A 36 **B** 48 **C** 72 **D** 9 **E** 18

For a cube, how many different paths are there from one corner to the opposite corner that travel along exactly three edges?

A 1   **B** 3   **C** 6   **D** 8   **E** 12

If $n! = 1 \cdot 2 \cdot 3 \cdot 4 \cdots n$ then the ones digit of the number

$$1! + 2! + 3! + \cdots + 2023! \text{ is} \ldots$$

A 1

B 3

C 5

D 9

E None of these

Four identical circles are touching as shown. What is the shape whose vertices are the centers of the circles?
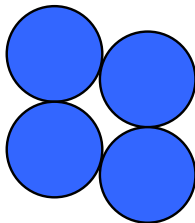
A trapezoid

B square

C rectangle

D kite

E rhombus

If the pattern continues which row will contain the number 2023 ?

A 27   **B** 35   **C** 37   **D** 45   **E** 53

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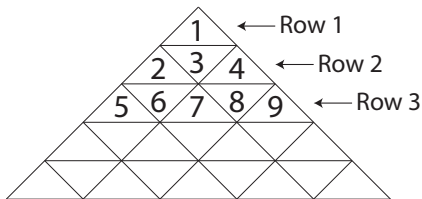Problem 24
Problem 25
Problem 26
Problem 27
Problem 28
Problem 29
Problem 30

If a circle is inscribed in a right triangle with
legs 6 and 8 then what will be the radius of the circle?

A $\sqrt{2}$

B 2

C $\sqrt{3}$

D 3

E None of these

If you add up the first one hundred positive odd integers

$$1 + 3 + 5 + 7 + \text{ ninety-six more numbers...}$$

what do you get?

A 10,000

B 10,100

C 9,990

D 9,900

E 9,998

The line is 20 units long and tangent to the inner circle.
What is the area (in square units) of the blue region?
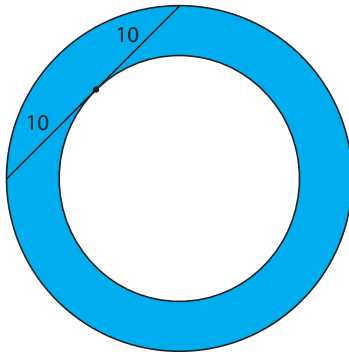
A 20π

B $20\sqrt{2}\pi$

C 50π

D $50\sqrt{2}\pi$

E 100π

Suppose that $x + y = 3$ and $x^2 + y^2 = 7$. Then

$$x^4 + y^4 = \ldots$$

A 49   **B** 51   **C** 45   **D** 64   **E** 47

A rectangle has perimeter 10 and diagonal $\sqrt{15}$. What is its area?

Ⓐ 5　　　　　Ⓑ 10　　　　Ⓒ 15　　　　Ⓓ 20　　　　Ⓔ 25

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Problem 20
Problem 21
Problem 22
Problem 23
Problem 24
Problem 25
Problem 26
Problem 27
Problem 28
Problem 29
Problem 30

A circle expands outward and its circumference increases by 20%. By what percent does the area increase?

A 20%

B 22%

C 40%

D 44%

E None of these

A serving size of Grandpa Joe's Ketchup Soda
is 225 milliliters. If Wallace buys a 2 liter bottle of the soda
then how many servings will Wallace have?

A $80/9$

B 18

C $15/2$

D 12

E None of these
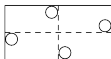
A rectangular piece of paper is folded in half from bottom to top, and then folded again from left to right as shown. A hole is punched in the upper left corner of the folded paper as shown. What will the punched paper look like when it is unfolded?
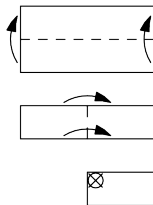
(A)   (B)   (C)   (D)   (E)
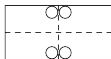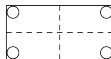
Whew! You've reached the end of Part I.

- 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
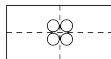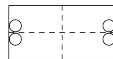Day 2023

CSU Fresno

Part II

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Ready... Set... Go!

Prepare to restart the *Mad Hatter Marathon!*

Crazy Dave chews two packs of Meatball Bubble Gum every day. If each package of gum costs $2.25 then how much will Dave spend on the gum this year?

A $1534.50

B $1539.00

C $1642.50

D $1647.00

E None of these

Lando always wears pants, shirt and a cape (even to bed!) If he has eight different pants, eleven different shirts and three different capes, how many different ensembles can he wear?

A 22   **B** 82   **C** 174   **D** 188   **E** 264

Steve's farm of mutant animals has three-legged dingoes and five-legged wallabees. If in one pen, his toddler counts 83 legs and 23 heads, how many wallabees are in the pen?

A 7

B 9

C 12

D 16

E 17

The graph shows the average daily high and low temperatures for each month. During which month is the sum of the average daily high and low temperatures the largest?

Average min and max temperatures in Pune, India   Copyright © 2023 weather-and-climate.com

A April

B May

C July

D August

E September

Neytiri has one of each type of coin in her pocket. If two coins are taken out at random what is the probability that the total will be greater than 40 cents?

A 30% **B** 33.3̄% **C** 50% **D** 60% **E** 66.6̄%

Part II - Problem 6

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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
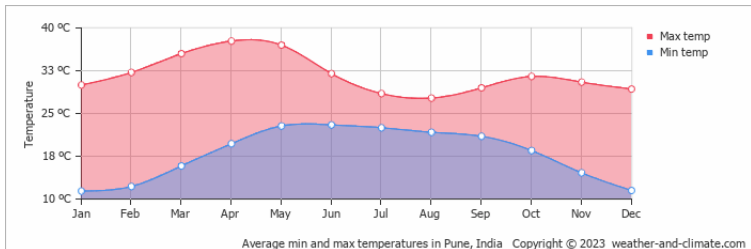Problem II-9
Problem II-10
Problem II-11
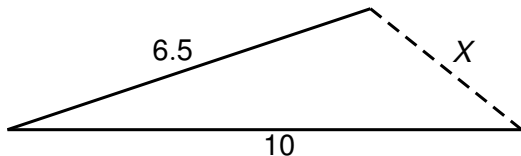Problem II-12
Problem II-13
Problem II-14
Problem II-15

Part II:
Problems
16-30

The End

Which of the following is the smallest whole number that could be the length x ?

A 3   **B** 4   **C** 5   **D** 6   **E** 7

Round to two decimal places:

$$\sqrt{10} + \sqrt{10} + \sqrt{10} + \sqrt{10} + \sqrt{10} - \sqrt{50}$$

A 14.61   **C** 10.76   **E** 0.00

B 12.93   **D** 8.74

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Part II

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Problem II-3
Problem II-4
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Problem II-9
Problem II-10
Problem II-11
Problem II-12
Problem II-13
Problem II-14
Problem II-15

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The End

If ♣ is a non-zero real number then which of the following must be negative?

A $-♣$

B $-\dfrac{♣}{♣}$

C $-♣^3$

D All of the above must be negative

E None of the above must be negative

Evaluate

$$20 - \left(3 \times 2^3 - 5 \right).$$

A -191

B 1

C 11

D 131

E None of these

What is the mean number of letters in the English words for the first ten counting numbers?

ONE   TWO   THREE   FOUR $\cdots$ TEN

A 3.3

B 3.5

C 3.7

D 3.9

E 4.1

If the second Saturday of a month is a one digit even number then the date of the fourth Monday of the same month will be the...

THIS CUTE FLUFF IS LIVING THE
BEST DAMN LIFE AND I AM CRYING.

JUNE

A 22nd   **B** 23rd   **C** 24th   **D** 25th   **E** 26th

How many non-congruent triangles have integer side lengths and a total perimeter of 8 units?

A zero

B one

C two

D three

E four

Mister Bojangle's candy basket is filled with bubble gum and lollipops each of which is either cherry flavored or grape flavored.

If 20% of the candy basket is lollipops and 40% of the bubble gum is grape, then what percentage of the candy basket is cherry bubble gum?

A 40% **B** 48% **C** 52% **D** 60% **E** 66%

The Réaumur scale is an alternative temperature scale to the Fahrenheit scale. Suppose we have the following equivalences:

Fahrenheit	Réaumur
77	20
167	60

Assuming that Réaumur and Fahrenheit are linearly related, how many Réaumur degrees is equal to 257 degrees Fahrenheit?

Ⓐ 88   Ⓑ 100   Ⓒ 112   Ⓓ 120   Ⓔ 132

During its trip to the planet Iota Geminorum, six tribbles
stowed away on the Starship Enterprise.

If the population of tribbles doubles every day, in how many
days will the tribble population top 2023 tribbles?

(A) 13   (B) 17   (C) 5   (D) 15   (E) 9

Suppose that $x > y$ and that

$$x + \frac{1}{x} = 2023 + \frac{1}{2023}$$
$$y + \frac{1}{y} = 2023 + \frac{1}{2023}$$

Which is a possible value of $x \cdot y$?

A 1

B $\frac{1}{2023}$

C 2023

D All of the above

E (B) and (C) but not (A)

Part II - Problem 17

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Problem II-26
Problem II-27
Problem II-28
Problem II-29
Problem II-30

The End

Assume that the line *AB* is
parallel to the line *CD* and
that the lines have the
lengths shown in the figure.
If the distance between *AB*
and *CD* is 10, then what is
the combined area of the two
triangles?

Ⓐ 26   Ⓑ 28   Ⓒ 24   Ⓓ 27   Ⓔ 25

A vampire has come to town. Each month a vampire sucks blood from two humans and creates two new vampires. After 6 months how many vampires will be in town?

Ⓐ 48　　Ⓑ 1458　　Ⓒ 96　　Ⓓ 81　　Ⓔ 729

Part II - Problem 19

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Part II

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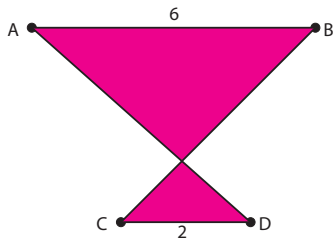Problem II-24
Problem II-25
Problem II-26
Problem II-27
Problem II-28
Problem II-29
Problem II-30

The End

Suppose that

$$y > 0 \qquad\qquad x > y \qquad\qquad z \neq 0$$

Which of the following inequalities is NOT always true?

A $x + z > y + z$

B $x - z > y - z$

C $xz^2 > yz^2$

D $\frac{x}{z^2} > \frac{y}{z^2}$

E $xz > yz$

Math Field
Day 2023

CSU Fresno

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

Imagine a room with 33 people. Suppose that 12 of the people speak Spanish, 25 people speak English, and 3 people speak *neither* Spanish nor English.

How many people in the room speak **both** Spanish and English?

Ⓐ 7 　　　 Ⓑ 3 　　　 Ⓒ 6 　　　 Ⓓ 4 　　　 Ⓔ 5

A singles tennis tournament begins with 128 players. How many single-elimination games must be played to determine a champion?

Ⓐ 63   Ⓒ 127   Ⓔ 256

Ⓑ 64   Ⓓ 128

The pictured keyboard has black keys and white keys. What **percentage** of the keys are black?
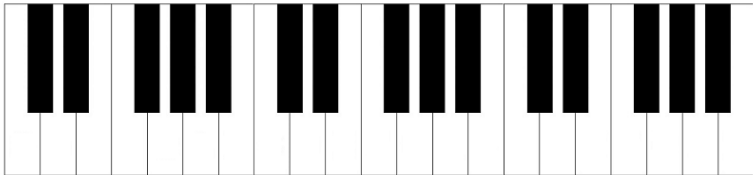
Ⓐ 58.$\overline{3}$ Ⓑ 48.$\overline{6}$ Ⓒ 33.$\overline{3}$ Ⓓ 50   Ⓔ 41.$\overline{6}$

What is the **smallest** positive integer that must be added to 2023 in order to get a number that is divisible by 13?

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

Janet mixes her world-famous hot sauce in a cylindrical jar with a radius of 6 cm and a height of 12 cm. When the mixing jar is full, she divides the sauce into three equal portions and pours the sauce into smaller cylindrical jars that have the same height as the mixing jar.

What is the minimum radius for the smaller jars?

A $2\sqrt{3}$ cm   **C** 4 cm   **E** 6 cm

B $\sqrt{3}$ cm   **D** $4\sqrt{3}$ cm

Which amounts to the greatest area?
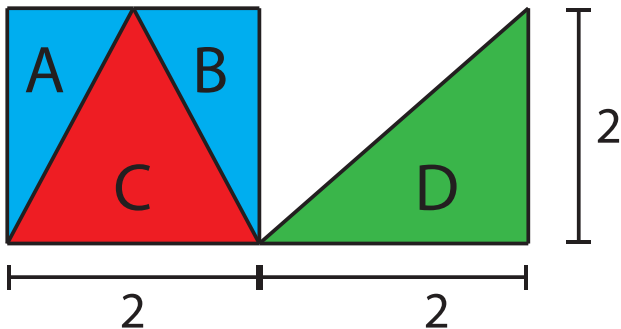
A $A + B$

B C

C D

D All the above have the same area

The odometer currently reads 304395 miles. How many miles must be driven before all the digits are different?

A 117 **B** 124 **C** 152 **D** 168 **E** 228

Part II - Problem 27

Math Field
Day 2023

CSU Fresno

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

If the measures, in degrees, of the three angles of a triangle are x, $x + 10$, and $2x - 6$, the triangle must be...

A right.

B equilateral.

C isosceles.

D scalene.

How many times faster does the second hand of a clock move than the hour hand of the clock?

(A) 240   (B) 600   (C) 720   (D) 1440   (E) 3600

What is the sum of all of the numbers in the table?

16	5	9	4
3	10	6	15
2	11	7	14
13	8	12	1

A 118 **B** 124 **C** 136 **D** 156 **E** 164

How many positive integer numbers are equal to exactly twice the sum of their digits?

A None

B One number

C Two numbers

D Three numbers

E Infinitely many numbers

Mad Hatter - Done!

Math Field
Day 2023

CSU Fresno

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.
- There will be games and other fun activities in Science II, Room 308, from 1:00-2:30.
- The awards ceremony will be in the Sicence 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 2023

CSU Fresno

Part II

Part II:
Problems 1-15

Part II:
Problems
16-30

The End

Part I

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

Part II

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