BRILLIANT

PROBLEM 0A

Name: _____

Date: _____

What weight will the fourth scale display?

- ◯ 32
- ◯ 35
- ◯ 36
- ◯ 40

BRILLIANT

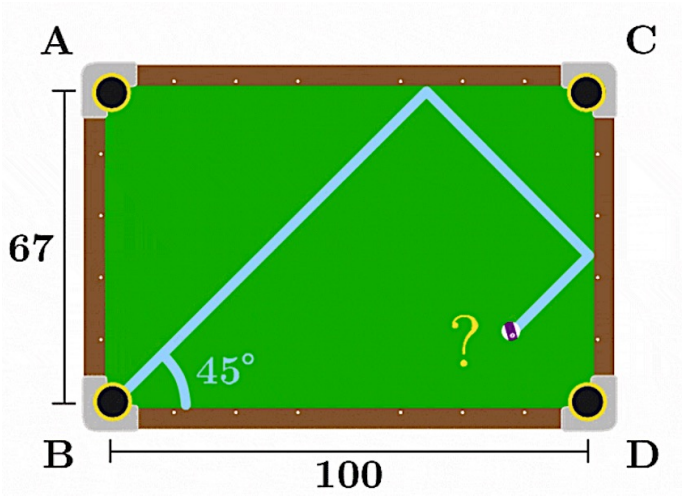
PROBLEM 0B

Name: _____

Date: _____

Which pocket will the ball end up in?

Assume that the ball is shot at a 45 degree angle directly from the corner of the table and that it will only land in a pocket if the center of the ball meets the corner of the pocket *exactly*. Model the ball as a point mass on a frictionless table



- ○ A
- ○ B
- ○ C
- ○ D
- ○ The ball will never land in a pocket

BRILLIANT

PROBLEM 1

Name: _____

Date: _____

Exactly one of these chests contains gold, but only one of the four statements is true. Which chest must contain the gold?

A

The gold is in here.

B

The gold is in chest A or D.

C

The gold is **not** in here.

D

The gold is in here.

- ◯ Chest A
- ◯ Chest B
- ◯ Chest C
- ◯ Chest D

BRILLIANT

PROBLEM 2

Name: _____

Date: _____

Can an even number, divided by another even number, times another even number ever equal an odd number?

$$\frac{\text{Even}}{\text{Even}} \times \text{Even} = \text{Odd}$$

- ◯ Yes
- ◯ No

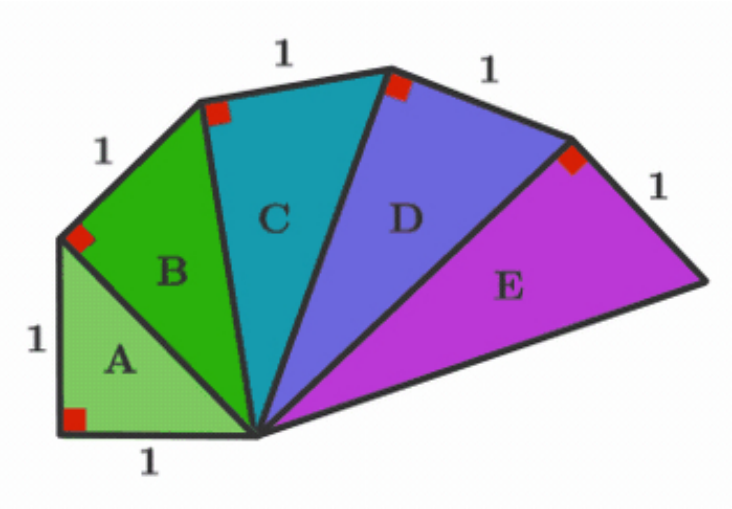
BRILLIANT

PROBLEM 3

Name: _____

Date: _____

Which triangle has an area of 1?



- ◯ A
- ◯ B
- ◯ C
- ◯ D
- ◯ E

BRILLIANT

PROBLEM 4

Name: _____

Date: _____

All of these coins have one gold side and one silver side. You are only allowed to flip over pairs of adjacent coins. For which of these arrangements of 9 coins is it possible to make the entire row gold?

Arrangement A:

Arrangement B:

- ◯ Only A
- ◯ Only B
- ◯ It's possible for both
- ◯ It's impossible for both

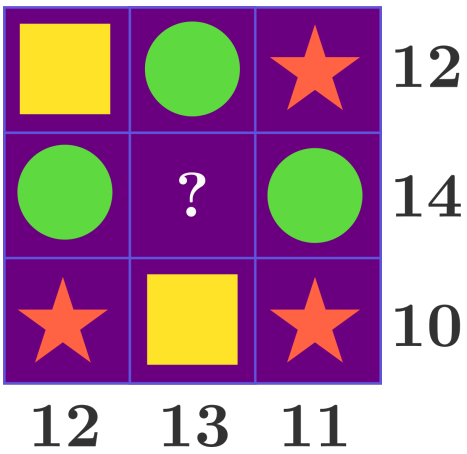
BRILLIANT

PROBLEM 5

Name: _____

Date: _____

Each shape in this puzzle represents a numerical value. The number next to each row or column represents the sum of all of the values in that row or column. Can the center of the grid be filled in with one of the three shapes? If so, which one?



- ○ Circle
- ○ Star
- ○ Square
- ○ None of the shapes work

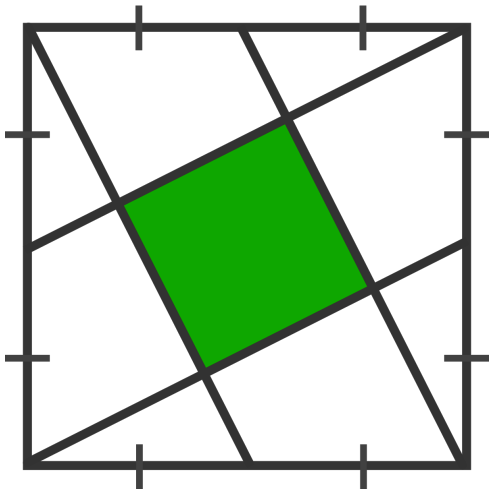
BRILLIANT

PROBLEM 6

Name: _____

Date: _____

A square has line segments connecting corners to midpoints, as shown. What fraction of the larger square is colored green?



- ◯ $\frac{1}{5}$
- ◯ $\frac{2}{5}$
- ◯ $\frac{1}{4}$
- ◯ $\frac{1}{3}$

BRILLIANT

PROBLEM 7

Name: _____

Date: _____

If each letter represents a different nonzero digit, what must Z be?

$$\begin{array}{r} XX \\ YY \\ +\quad ZZ \\ \hline XYZ \end{array}$$

- ◯ 6
- ◯ 7
- ◯ 8
- ◯ 9

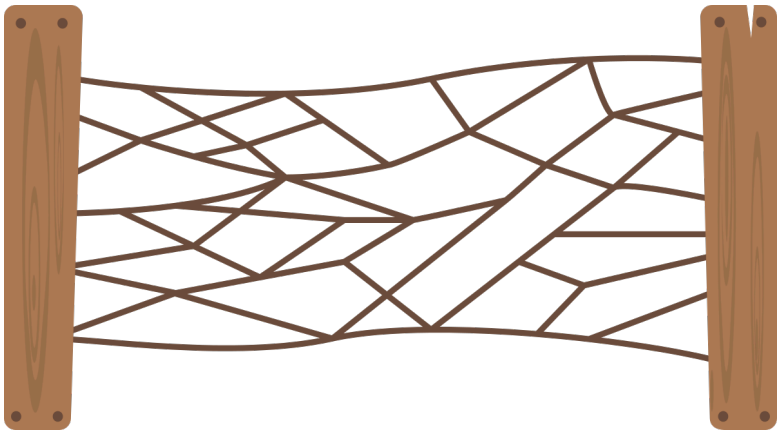
BRILLIANT

PROBLEM 8

Name: _____

Date: _____

What is the least number of cuts that must be made in order to completely cut through this rope fence? Note: The knots where multiple ropes meet are too thick to cut through.



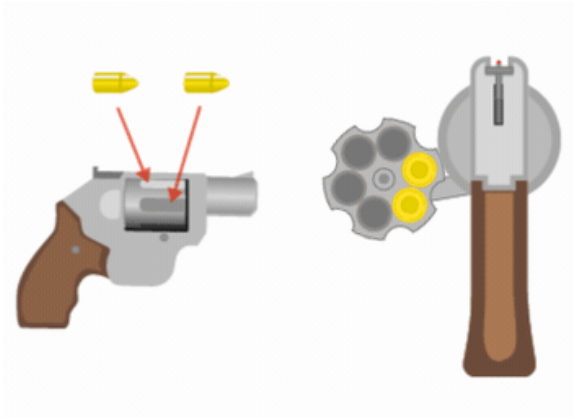
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ 8

BRILLIANT

PROBLEM 9

Name: _____

Date: _____



- ◯ Just fire
- ◯ Spin then fire
- ◯ Bond's survival is equally likely either way

Agent Bond has been captured and is about to be killed by his enemy, Scaramanga. Scaramanga takes a six-chamber revolver and places two bullets next to one another, as shown above. He spins and locks the cylinder so a random chamber is on top, aims at Bond, and fires ... nothing happens. He then tells Bond that he will fire once more and if Bond is still standing afterwards he is free to go. Scaramanga gives Bond two options either he fires again right away or spins the cylinder of the revolver so a random chamber is on top and then fires. **Which option makes it more likely that agent Bond will survive?** Note: After firing, a gun automatically rotates the cylinder by one position to fire from the next chamber over.

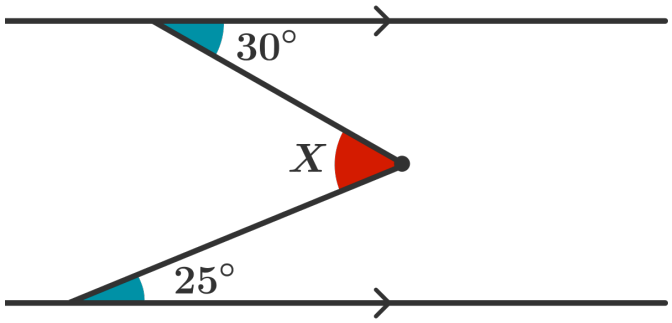
BRILLIANT

PROBLEM 10

Name: _____

Date: _____

Find the measure of $\boldsymbol{X}$.



- ◯ 40°
- ◯ 45°
- ◯ 50°
- ◯ 55°
- ◯ 60°

BRILLIANT

PROBLEM 11

Name: _____

Date: _____

Suppose the alternating pattern below continues for 998 sentences before ending with one unique sentence. If sentence 1 is true, what do you know about Y?

1) The next sentence is true.
2) The next sentence is false.
3) The next sentence is true.
4) The next sentence is false.

…

997) The next sentence is true.
998) The next sentence is false.
999) $Y \geq 5$

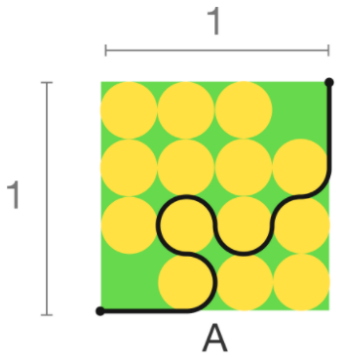
- ◯ $Y \geq 5$
- ◯ $Y < 5$

BRILLIANT

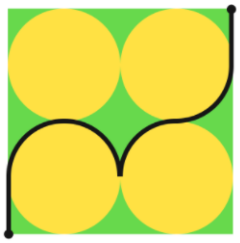
PROBLEM 12

Name: _____

Date: _____



A



B

C

In which figure is the black path the **shortest**?

- ○ A
- ○ B
- ○ C
- ○ Error: they are all the same length

BRILLIANT

PROBLEM 13

Name: _____

Date: _____

Is it possible to fill each square in with an arithmetic operation $(+, -, \times, \div)$ so that this becomes a true equation?

$$10 \square 10 \square 10 \square 10 = 101$$

- ◯ Yes
- ◯ No

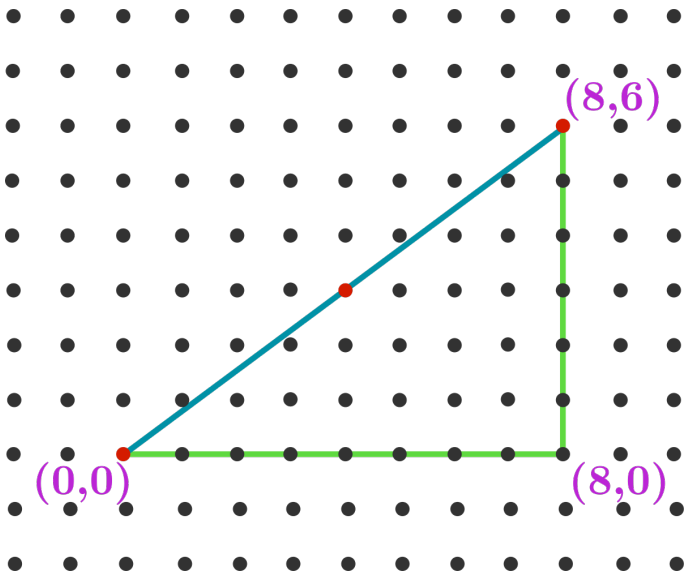
BRILLIANT

PROBLEM 14

Name: _____

Date: _____

In the image below, 3 dots from the grid (marked red) lie on the hypotenuse of a right triangle. If the corners of the triangle were instead at (0,0), (1200,0), and (1200,1000), how many dots from the grid would lie on the triangle's hypotenuse?



Your answer:

BRILLIANT

PROBLEM 15

Name: _____

Date: _____

If each letter represents a different nonzero digit, what must ***S*** be?

$$\begin{array}{cccc} & S & E & E \\ + & E & Y & E \\ \hline & Y & E & S \end{array}$$

- ◯ 2
- ◯ 4
- ◯ 6
- ◯ 8

BRILLIANT

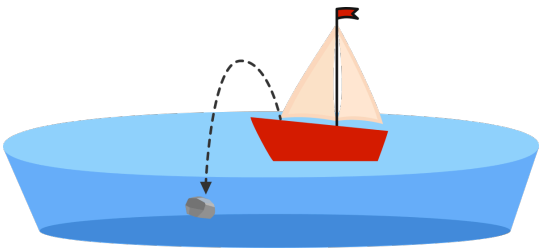
PROBLEM 16

Name: _____

Date: _____

A man stuck in a small sailboat on a perfectly calm lake throws a stone overboard. It sinks to the bottom of the lake.

When the water again settles to a perfect calm, is the water level in the lake higher, lower, or in the same place compared to where it was before the stone was cast in?



- ◯ The water level is lower.
- ◯ The water level rises.
- ◯ The water level stays the same.

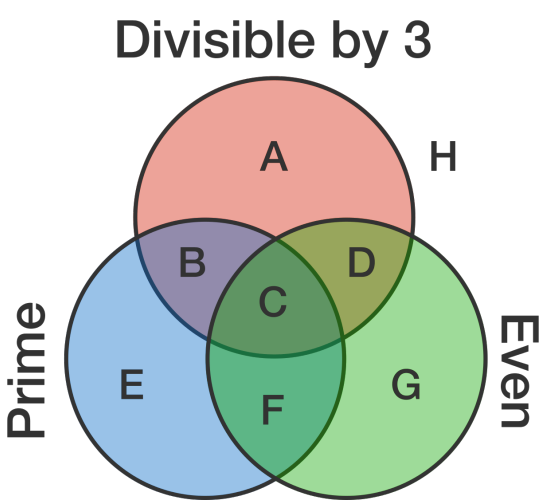
BRILLIANT

PROBLEM 17

Name: _____

Date: _____

If this Venn diagram is filled with all positive integers, how many of the regions marked with a letter will be empty?



- ○ 0
- ○ 1
- ○ 2
- ○ 3

BRILLIANT

PROBLEM 18

Name: _____

Date: _____

If you wrote down all whole numbers from 1 to 1000...

1,2,3,4,…,999, 1000,

...which digit would appear the least?

- ◯ 0
- ◯ 1
- ◯ 5
- ◯ 9
- ◯ Every digit appears the same number of times.

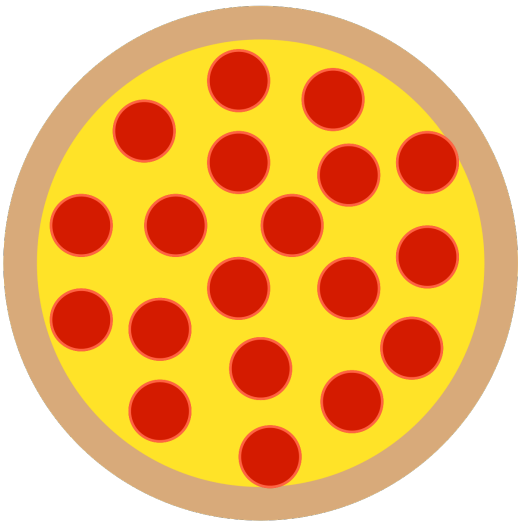
BRILLIANT

PROBLEM 19

Name: _____

Date: _____

What is the maximum number of pieces you can divide a circular pizza into with 4 cuts? (All cuts must be distinct straight lines from one point on the edge of the pizza to another point on the edge of the pizza, and you may not move the pizza slices.)



- ○ 8
- ○ 10
- ○ 11
- ○ 12
- ○ 16

BRILLIANT

PROBLEM 20

Name: _____

Date: _____

What is the last digit of:

$$3^{10000}?$$

- ◯ 1
- ◯ 3
- ◯ 5
- ◯ 7
- ◯ 9

BRILLIANT

PROBLEM 21

Name: _____

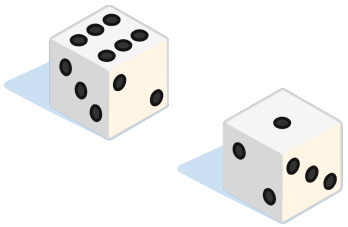
Date: _____

A: You roll two dice 5 times and, every time, one of the two comes up as 1 and the other as 6.

B: You roll 10 dice all at once. 5 come up as 1s and the other 5 come up as 6s.

Assume the dice are standard, six-sided, and fair.

Which is more likely?



- ◯ Situation A
- ◯ Situation B
- ◯ The two situations are equally likely

BRILLIANT

PROBLEM 22

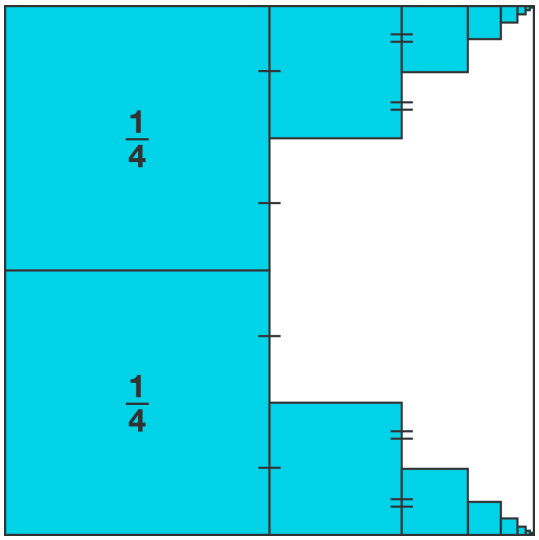
Name: _____

Date: _____

The left half of a square is occupied by two smaller blue squares as shown, each a quarter the area of the original large square.

To the right of both squares there is a succession of blue squares, each one connecting to the midpoint of the previous square as shown.

When this process is repeated many times, approximately how much of the original large square is shaded blue?



- ○ $\frac{1}{2}$
- ○ $\frac{2}{3}$
- ○ $\frac{3}{4}$
- ○ $\frac{5}{6}$

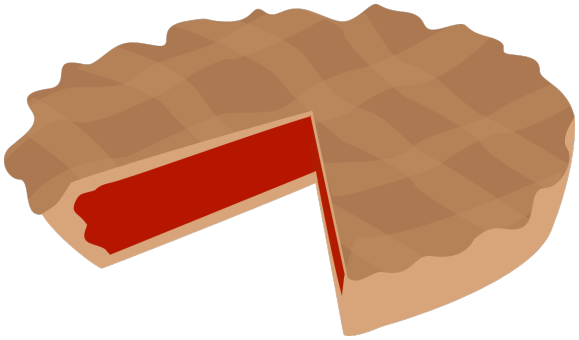
BRILLIANT

PROBLEM 23

Name: _____

Date: _____

It takes 5 cooks 5 hours to bake 5 pies. Assuming no change of rate, how many hours will it take 10 cooks to bake 10 pies?



- ◯ 1
- ◯ 2
- ◯ 5
- ◯ 10

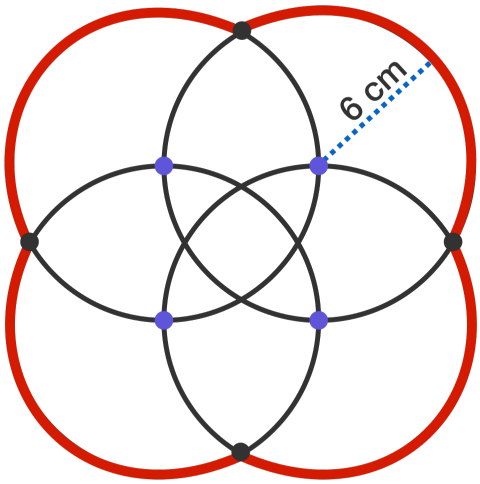
BRILLIANT

PROBLEM 24

Name: _____

Date: _____

Four congruent circles, each with radius 6 cm, intersect as shown (their centers are marked in purple). What is the perimeter of the entire figure (marked in red)?



- ◯ 16π cm
- ◯ 18π cm
- ◯ 20π cm
- ◯ 22π cm
- ◯ 24π cm

BRILLIANT

PROBLEM 25

Name: _____

Date: _____

The positive number X is divisible by 42, and is composed of only 1s and 0s when written in base 10. What's the smallest number that X might be?

Your answer:

BRILLIANT

PROBLEM 26

Name: _____

Date: _____

Given x can be any real number, what is the smallest possible value of y?

$$y = \Big|\Big|\big|x - 10\big| + 10\Big| - 10\Big| + 10$$

- $y = -10$
- $y = 0$
- $y = 10$
- $y = 20$
- y can be less than -10

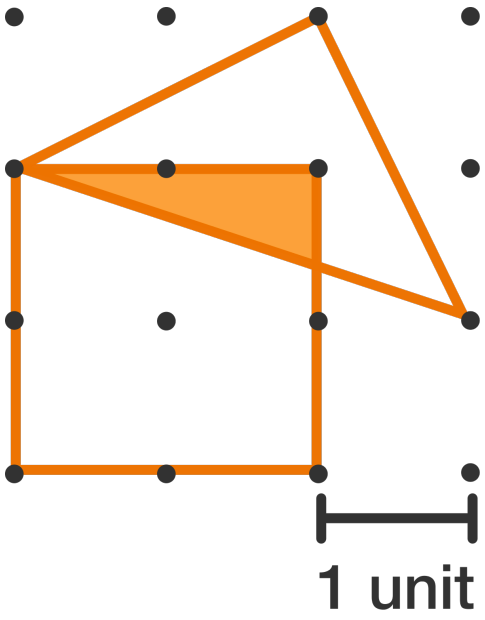
BRILLIANT

PROBLEM 27

Name: _____

Date: _____

The dots in the grid below are all equally spaced. In square units, what is the area of the region shaded orange?



- ○ $\frac{1}{3}$
- ○ $\frac{1}{2}$
- ○ $\frac{2}{3}$
- ○ $\frac{3}{4}$

BRILLIANT

PROBLEM 28

Name: _____

Date: _____

Suppose Iris, Jana and Karim are playing a game. There are three green hats and two pink hats available. The players are blindfolded and each person is given a hat to wear such that when their blindfold is removed they can't see their own hat.

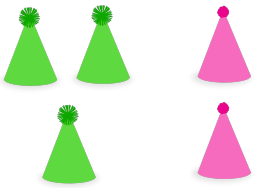
All the blindfolds are then removed, so all the players can see each other.

Iris says, "I don't know what color hat I'm wearing."

Jana then says, "I don't know what color hat I'm wearing."

What color hat is Karim wearing?

- ○ Green
- ○ Pink
- ○ There isn't enough information to know for certain



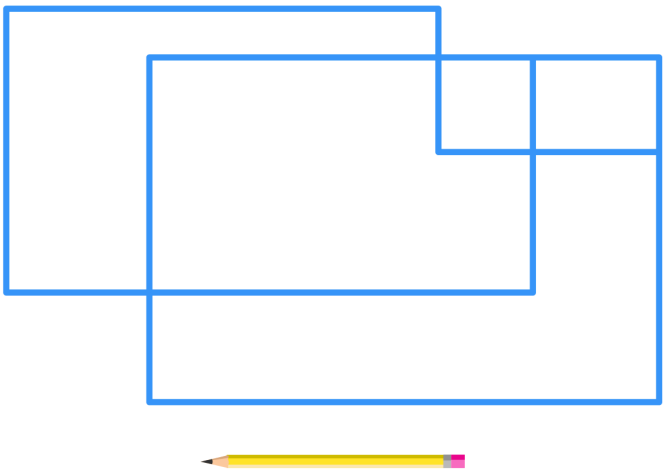
BRILLIANT

PROBLEM 29

Name: _____

Date: _____

Starting with your pencil at a location of your choice on the two-dimensional figure, is it possible to trace this entire figure without lifting your pencil or redrawing a line? (Crossing at an intersection is ok.)



Yes

No

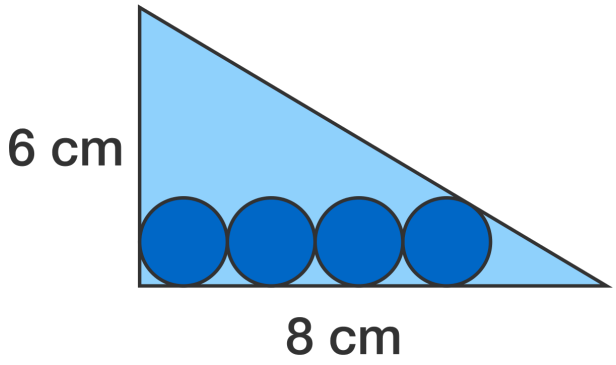
BRILLIANT

PROBLEM 30

Name: _____

Date: _____

A right triangle contains four congruent circles that touch the sides as shown. What is the radius of each circle?



- ○ 0.5 cm
- ○ 0.6 cm
- ○ 0.7 cm
- ○ 0.8 cm

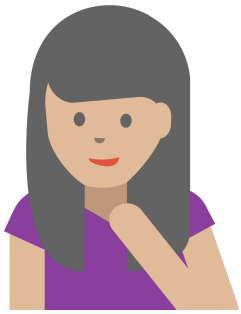
BRILLIANT

PROBLEM 31

Name: _____

Date: _____

I'm thinking of two positive whole numbers that multiply to 1000, neither of which contain the digit 0. What is the sum of these 2 numbers?



- ◯ 110
- ◯ 133
- ◯ 254
- ◯ 1001

BRILLIANT

PROBLEM 32

Name: _____

Date: _____

A full jar of honey weighs 750 grams, and the same jar two-thirds full weighs 550 grams. What is the weight of the empty jar in grams?

- ◯ 100 grams
- ◯ 150 grams
- ◯ 200 grams
- ◯ 250 grams

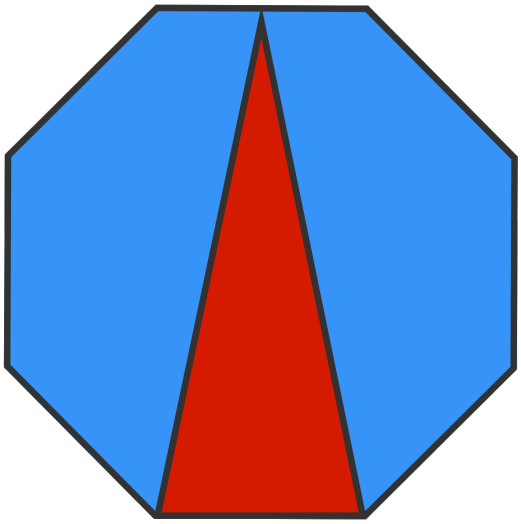
BRILLIANT

PROBLEM 33

Name: _____

Date: _____

What fraction of the regular octagon is shaded red?



- ○ $\frac{1}{8}$
- ○ $\frac{1}{4}$
- ○ $\frac{5}{16}$
- ○ $\frac{3}{8}$

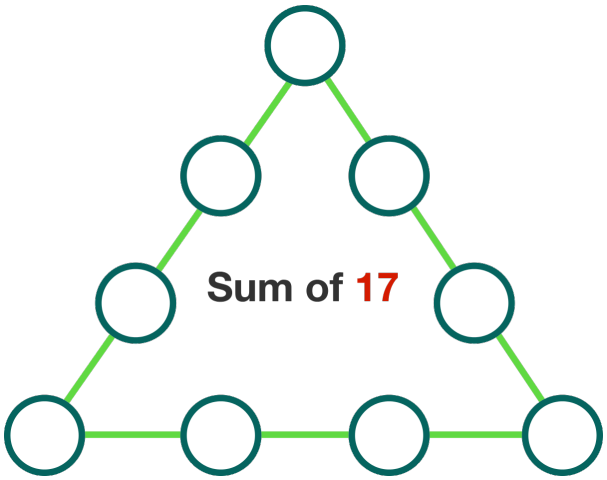
BRILLIANT

PROBLEM 34

Name: _____

Date: _____

Each of the integers from 1 to 9 is to be placed in one of the circles in the figure so that the sum of the integers along each side of the figure is 17. Determine the sum of the three integers placed in the corners.



Your answer:

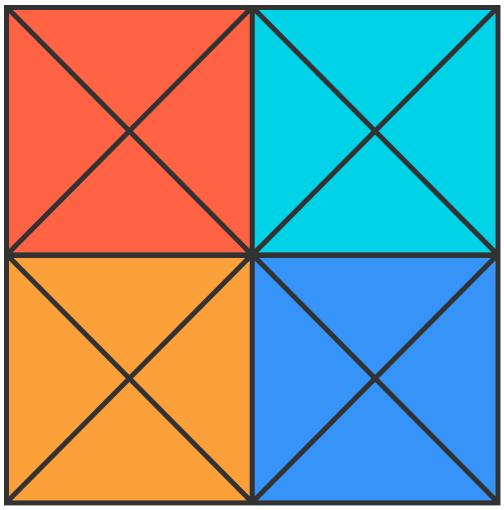
BRILLIANT

PROBLEM 35

Name: _____

Date: _____

How many triangles are there in this figure?



- ○ 24
- ○ 32
- ○ 44
- ○ 48

BRILLIANT

PROBLEM 36

Name: _____

Date: _____

Six out of the seven "□"s below contain addition signs, and the remaining "□" contains a subtraction sign.
Where should the subtraction sign go to make the equation true?

$$1 \square 2 \square 3 \square 4 \square 5 \square 6 \square 7 \square 8 = 30$$

- ◯ Between the 1 and 2
- ◯ Between the 2 and 3
- ◯ Between the 3 and 4
- ◯ Between the 4 and 5
- ◯ Between the 5 and 6
- ◯ Between the 6 and 7
- ◯ Between the 7 and 8

BRILLIANT

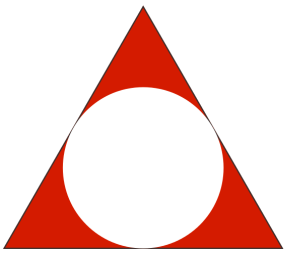
PROBLEM 37

Name: _____

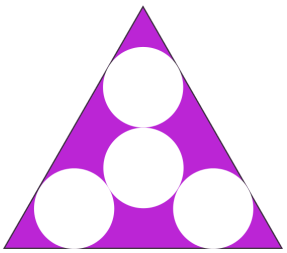
Date: _____

If the two triangles below are congruent, equilateral triangles, which is greater, the total area of the three red regions or the total area of the six purple regions?

A



B



- ○ The total red area is greater
- ○ The total purple area is greater
- ○ There is an equal amount of red and purple area

BRILLIANT

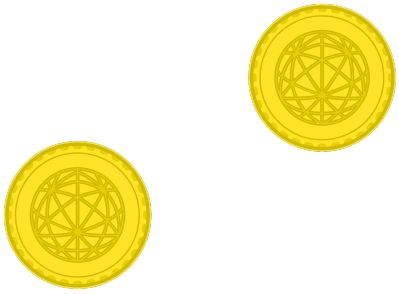
PROBLEM 38

Name: _____

Date: _____

You have two coins that look identical, but one of them is fair and the other is weighted. The weighted coin has a $\frac{3}{4}$ chance of flipping heads and a $\frac{1}{4}$ chance of flipping tails.

Unfortunately, you've forgotten which coin is which! You decide to keep flipping them together, one in each hand, until you get a flip where one coin shows heads and the other shows tails. Then you'll assume that the coin showing heads is the weighted coin. If you do this, what's the probability you'll correctly identify the coins?



- ○ $\frac{3}{8}$
- ○ $\frac{5}{8}$
- ○ $\frac{1}{2}$
- ○ $\frac{3}{4}$

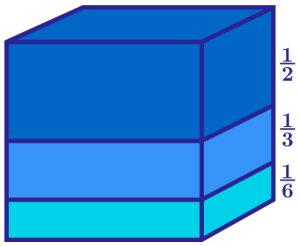
BRILLIANT

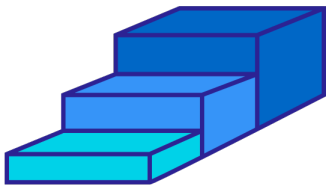
PROBLEM 39

Name: _____

Date: _____

A unit cube with side lengths of 1 is cut into cuboids as shown, with the pieces placed adjacent to form a staircase. The total surface area of the original unit cube is 6. What is the total surface area of the new figure?





- ○ 8
- ○ 9
- ○ 10
- ○ 11

BRILLIANT

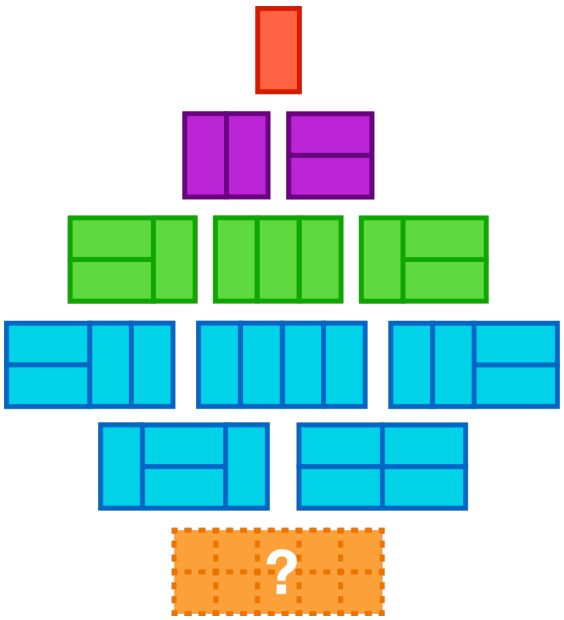
PROBLEM 40

Name: _____

Date: _____

How many ways are there to tile a 5x2 area with 1x2 domino tiles?

Note: The diagram below illustrates that there's one way to tile a 1x2 area, 2 ways to tile a 2x2 area, 3 ways to tile a 3x2 area, and 5 ways to tile a 4x2 area.



- ○ 7
- ○ 8
- ○ 9
- ○ 10
- ○ 11

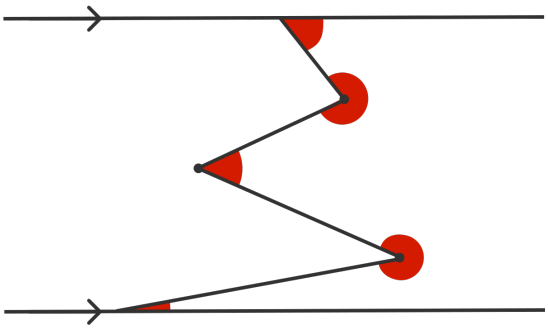
BRILLIANT

PROBLEM 41

Name: _____

Date: _____

What is the sum of the red angles?



- ○ 540°
- ○ 720°
- ○ 900°
- ○ There isn't enough information to determine

BRILLIANT

PROBLEM 42

Name: _____

Date: _____

You have two containers, one which can hold 11 liters of water and the other of which can hold 13 liters. You also have access to a sink with a faucet. You can do any of these three things as many times as you like:

- Fill one of the containers to the top with water.
- Completely empty one of the containers into the sink.
- Pour the contents of one container into another until the second container is full (or until the first container is empty).

Given these conditions, is it possible to measure out exactly 8 liters?

○ Yes

○ No

BRILLIANT

PROBLEM 43

Name: _____

Date: _____

If each letter represents a different nonzero digit, what must D be?

$$\begin{array}{r} H\ A\ D \\ H\ A \\ +\quad\quad H \\ \hline A\ H\ A \end{array}$$

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5

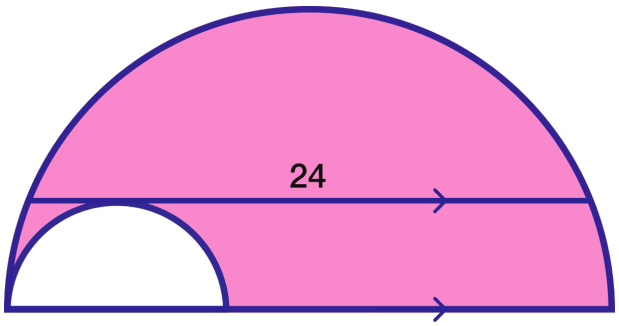
BRILLIANT

PROBLEM 44

Name: _____

Date: _____

What is the pink area in square units?



- 36π
- 40π
- 48π
- 56π
- 72π

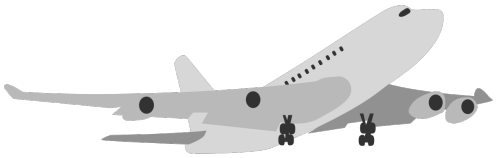
BRILLIANT

PROBLEM 45

Name: _____

Date: _____

There are 100 people in line to board a plane with 100 seats. The first person has lost their boarding pass, so they take a random seat. Everyone that follows takes their assigned seat if it's available, but otherwise takes a random unoccupied seat. What is the probability the last passenger ends up in their assigned seat?



- ○ $\frac{1}{101}$
- ○ $\frac{1}{50}$
- ○ $\frac{1}{100}$
- ○ $\frac{1}{2}$
- ○ $\frac{3}{4}$

BRILLIANT

PROBLEM 46

Name: _____

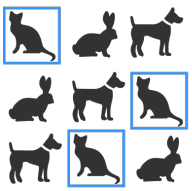
Date: _____

At Step 101, how many cats will there be in the 9th row?

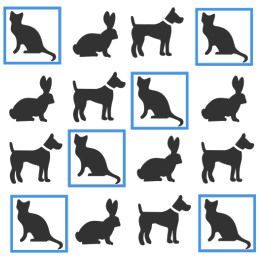
Step 1

Step 2

Step 3



Step 4



- ○ 32
- ○ 33
- ○ 34
- ○ 35

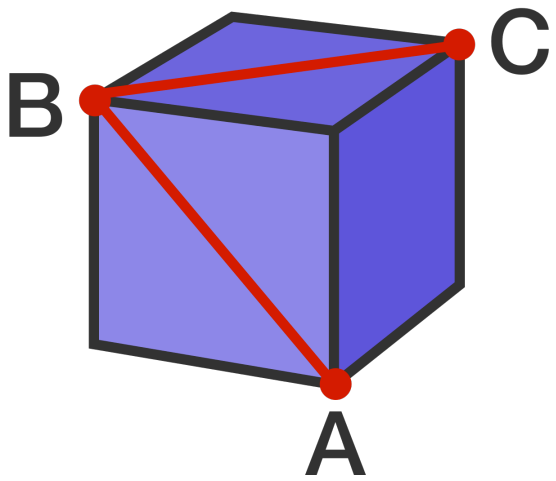
BRILLIANT

PROBLEM 47

Name: _____

Date: _____

A three-dimensional cube is shown below. What is the measure of $\angle ABC$ in degrees?



Your answer:

BRILLIANT

PROBLEM 48

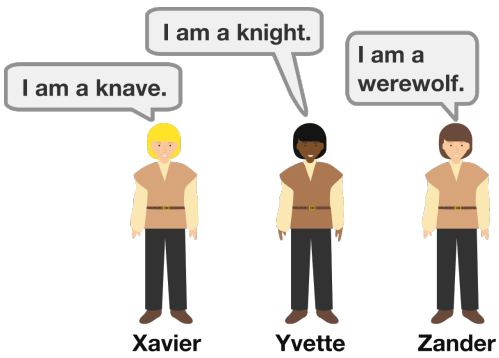
Name: _____

Date: _____

On a particular island, there live knights, who can only tell the truth, knaves, who can only lie, and werewolves, who can also only lie.

You come across a particular trio of native islanders named Xavier, Yvette, and Zander. They each make a statement.

If you know that amongst these three there is one werewolf, one knave, and one knight, then what must be true about Zander?



- ◯ Zander is a knight
- ◯ Zander is a knave
- ◯ Zander is a werewolf
- ◯ There isn't enough information to determine what type Zander is

BRILLIANT

PROBLEM 49

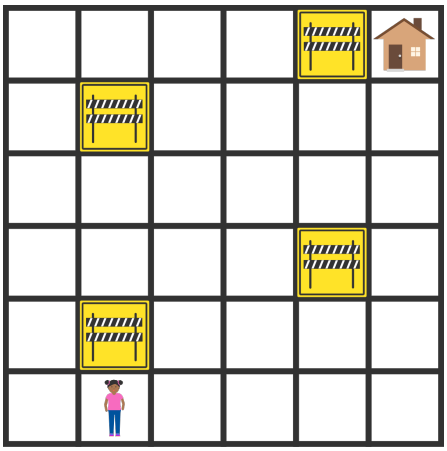
Name: _____

Date: _____

Zara is finding her way home, but she wants to take a route that visits her neighborhood as much as possible. From any square on the map shown, she can move up, down, left, or right a square (not diagonally).

She also wants to visit every empty square exactly once, entirely avoid the squares marked with "under construction" signs, and she wants her trip to end at her house.

Is it possible for her to do this?



- ◯ Yes, the trip is possible
- ◯ No, she has to revisit at least one of the squares at least once

BRILLIANT

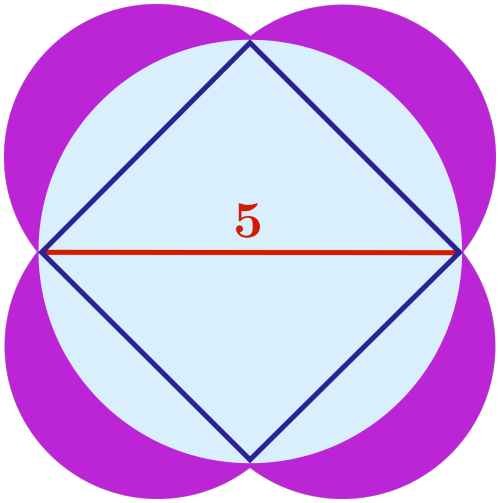
PROBLEM 50

Name: _____

Date: _____

The four sides of a square are used as diameters to define four overlapping, congruent circles. Then, a larger circle is drawn so that it passes through all four corners of the square. The length of the square's diagonal is 5.

What is the total area of the regions shaded **purple**?



Your answer:

BRILLIANT

PROBLEM 51

Name: _____

Date: _____

Which is largest?

$$\frac{1110}{1111}, \frac{2221}{2223}, \frac{3331}{3334}$$

- ◯ $\frac{1110}{1111}$
- ◯ $\frac{2221}{2223}$
- ◯ $\frac{3331}{3334}$
- ◯ They are all the same

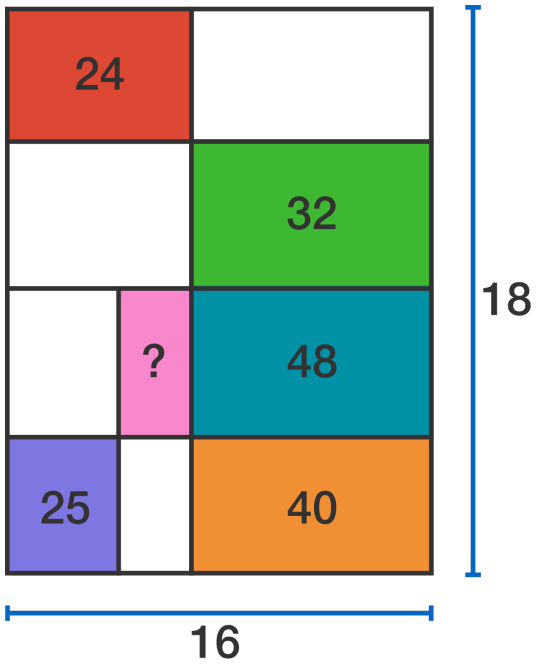
BRILLIANT

PROBLEM 52

Name: _____

Date: _____

A 16 x 18 rectangle is cut into smaller rectangles. Some of the areas of the pieces are given above. (The figure is not drawn to scale.) What is the area of the pink rectangle?



- 15
- 16
- 17
- 18

BRILLIANT

PROBLEM 53

Name: _____

Date: _____

If each letter represents a different nonzero digit, what must ***A*** be?

$$\begin{array}{cccc} M & A & R & S \\ & M & A & R \\ & & M & A \\ + & & & M \\ \hline G & R & A & M \end{array}$$

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5

BRILLIANT

PROBLEM 54

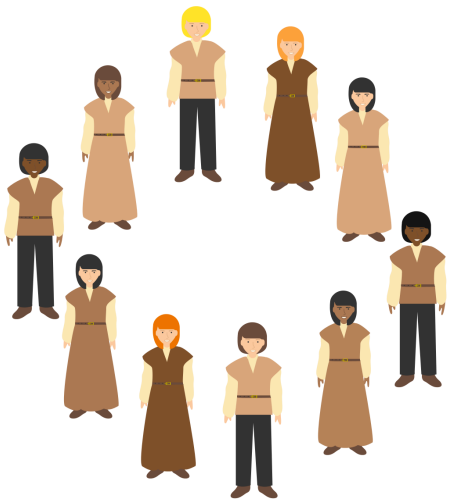
Name: _____

Date: _____

On a certain island there live only knights, who always tell the truth, and knaves, who always lie.

One day you find 10 island natives standing in a circle. Each one states: "Both people next to me are knaves!"

Of the 10 in the circle, what is the minimum possible number of knights?



○ 0 ○ 3

○ 1 ○ 4

○ 2 ○ 5

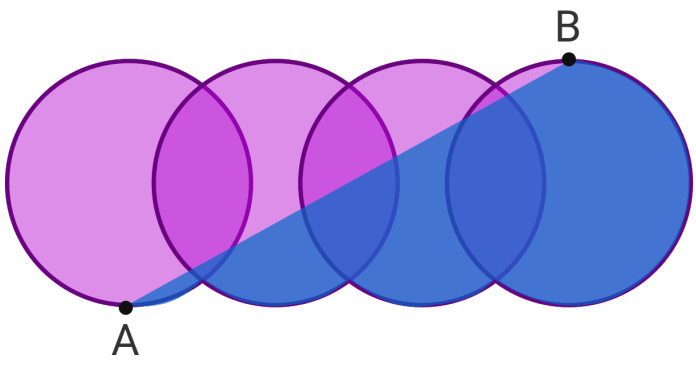
BRILLIANT

PROBLEM 55

Name: _____

Date: _____

What is the area of one of the circles?



- 6.6
- 5π
- 6π
- 14
- 16.5

Facts:

- These four congruent circles are aligned horizontally.
- The area of the entire blue shaded portion of the figure is 22.
- The area of the overlap between each pair of congruent circles is 4.
- A is the lowest point on the left-most circle and B is the highest point on the right-most circle.

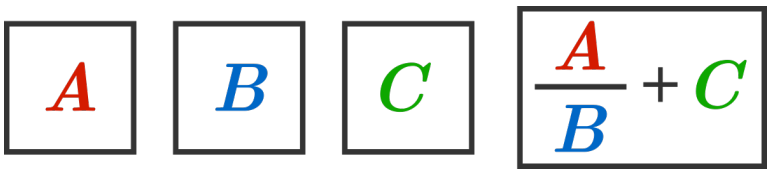
BRILLIANT

PROBLEM 56

Name: _____

Date: _____

If all four of these values are integers that are divisible by 3 then what statement must be true?



- ◯ A is divisible by 9
- ◯ B is divisible by 9
- ◯ C is divisible by 9
- ◯ A and B are both divisible by 9
- ◯ A, B, and C are all divisible by 9

BRILLIANT

PROBLEM 57

Name: _____

Date: _____

You have a calculator with 4 buttons as shown; they multiply the current value shown on the calculator by 2, divide the current value by 3, add 5 to the current value, or subtract 7 from the current value.

If the screen starts at 6, what is the fewest button presses you need to make to get a value of 1?

- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5

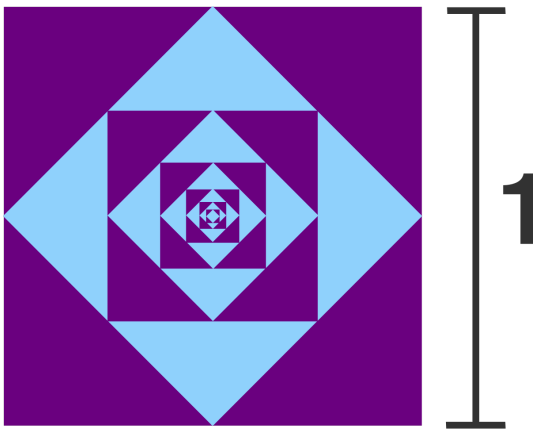
BRILLIANT

PROBLEM 58

Name: _____

Date: _____

Starting with a unit square, a series of smaller squares is made by repeatedly connecting the midpoints of the sides of each square in turn. Given how the pattern is shaded, approximately what total area is shaded purple?



- ○ $\frac{1}{2}$
- ○ $\frac{5}{8}$
- ○ $\frac{2}{3}$
- ○ $\frac{3}{4}$

BRILLIANT

PROBLEM 59

Name: _____

Date: _____

Katherine and Zyan are playing a game using strange dice. Each die is a cube with six sides. Katherine's die has sides numbered 3, 3, 3, 3, 3, and 6. Zyan's die has sides numbered 2, 2, 2, 5, 5, and 5.

To play the game, Katherine and Zyan roll their dice at the same time and whoever rolls the higher value wins. If they play many times, who will win more frequently, Katherine or Zyan?

Katherine's Die:
3, 3, 3, 3, 3, 6

Zyan's Die:
2, 2, 2, 5, 5, 5

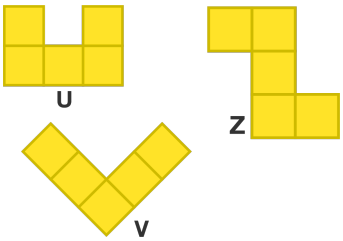
- ◯ Katherine
- ◯ Zyan
- ◯ Both are equally likely to win

BRILLIANT

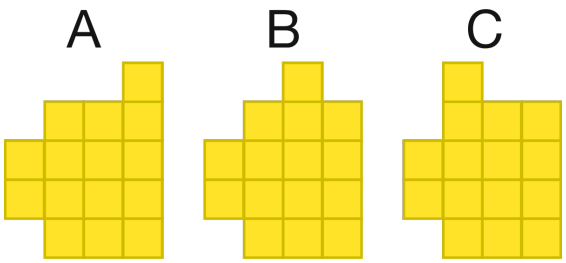
PROBLEM 60

Name: _____

Date: _____



Using all three of the pentominoes above, they can be assembled into one of the shapes below (rotations and reflections are allowed). Which one?



○ A

○ B

○ C

BRILLIANT

PROBLEM 61

Name: _____

Date: _____

If each letter represents a different nonzero digit, what must ***B*** be?

$$\begin{array}{cccccc} & & B & E & S & T \\ \times & & & & 9 & 9 \\ \hline & B & E & E & 5 & 5 & 1 \end{array}$$

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5

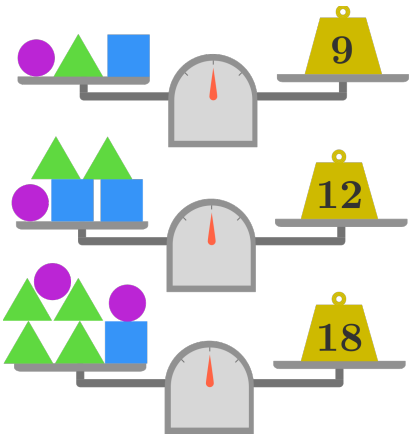
BRILLIANT

PROBLEM 62

Name: _____

Date: _____

All the scales shown are perfectly balanced. What is the weight of one triangle?



- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ Cannot be determined

BRILLIANT

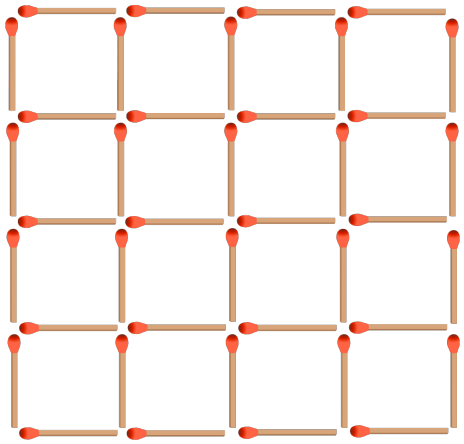
PROBLEM 63

Name: _____

Date: _____

The diagram above shows 40 matchsticks arranged in a square grid.

What is the fewest number of matchsticks that need to be removed so that there are no squares (of any size) remaining?



- ◯ 6
- ◯ 7
- ◯ 8
- ◯ 9
- ◯ 10

BRILLIANT

PROBLEM 64

Name: _____

Date: _____

How many of these eight numbers are prime?

$A = 8! + 3$
$B = 8! + 4$
$C = 8! + 5$
$D = 8! + 6$
$E = 8! + 7$
$F = 8! + 8$
$G = 8! + 9$
$H = 8! + 10$

- ◯ 0
- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4

BRILLIANT

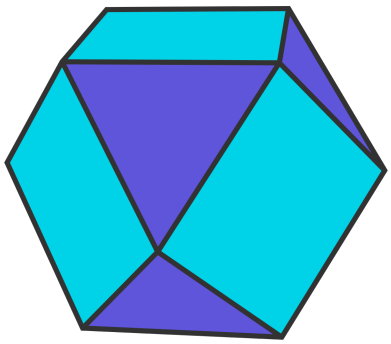
PROBLEM 65

Name: _____

Date: _____

A **cuboctahedron** is a three dimensional polyhedron where at each vertex there are two squares and two equilateral triangles arranged as shown. Which of these numbers is greater?

A. The number of triangular faces
B. The number of square faces



- ○ A
- ○ B
- ○ A and B are equal

BRILLIANT

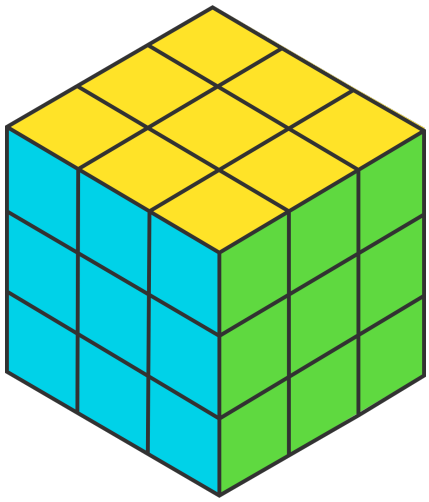
PROBLEM 66

Name: _____

Date: _____

27 unit cubes are packed together to create this 3 x 3 x 3 cube. Each face of a unit cube has an area of 1.

If all 8 of the corner cubes are removed, by how much will the surface area of the figure increase?



- ◯ 0
- ◯ 4
- ◯ 8
- ◯ 16
- ◯ 24

BRILLIANT

PROBLEM 67

Name: _____

Date: _____

If each letter represents a different nonzero digit, what is ***M***?

$$\begin{array}{cccc} M & A & R & T \\ + \quad T & R & A & M \\ \hline R & A & M & A \end{array}$$

- ◯ 5
- ◯ 6
- ◯ 7
- ◯ 8
- ◯ 9

BRILLIANT

PROBLEM 68

Name: _____

Date: _____

Sara needs to trek from an oasis to a destination 10 miles away across a barren desert.

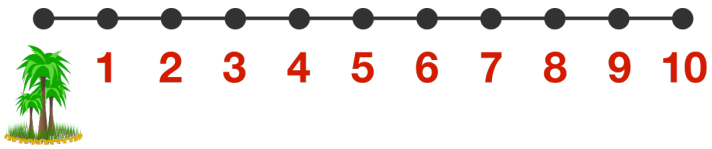
The facts:

• Crossing one mile of desert requires using 1 gallon of water.

• Sara can only carry 6 gallons of water at a time.

• Sara can drop a water cache (of any amount of water from the supply she is carrying at that moment) at any of the nine stops along the route, and then pick up any part of the cache on a later trip.

What's the minimum number of times Sara must leave the oasis in order to cross the entire 10 mile span of desert?



○ 3 ○ 6

○ 4 ○ 7

○ 5

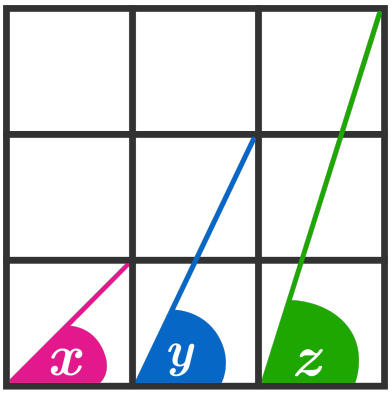
BRILLIANT

PROBLEM 69

Name: _____

Date: _____

The big square below is divided into nine congruent squares. What is the sum of the measures of the three shaded angles?



$x + y + z = ?$

- 150°
- 175°
- 180°
- 210°

BRILLIANT

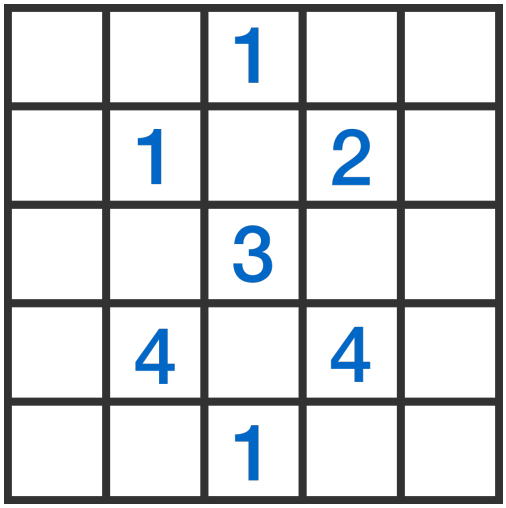
PROBLEM 70

Name: _____

Date: _____

The grid shown has some squares that contain mines and some that are safe; every square with a number is safe. In addition, the numbers indicate how many of the adjacent squares (vertically, horizontally, or diagonally) have mines.

How many mines are there on the grid?



- ◯ 5
- ◯ 6
- ◯ 7
- ◯ 8
- ◯ 9
- ◯ 10

BRILLIANT

PROBLEM 71

Name: _____

Date: _____

Amy and Blake are each dealt two cards from a standard, 52-card deck. Amy's cards are known, Blake's cards are unknown. In which of these two scenarios is it more likely that Blake has a pair?

- ◯ Scenario 1
- ◯ Scenario 2
- ◯ It is equally likely both cases

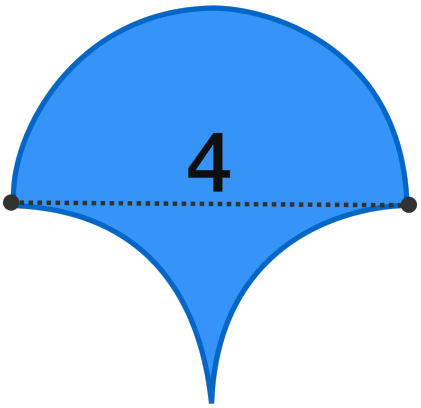
BRILLIANT

PROBLEM 72

Name: _____

Date: _____

What is the area of the blue figure?



- ◯ $8-\pi$
- ◯ $8-2\pi$
- ◯ 8
- ◯ $8+2\pi$

BRILLIANT

PROBLEM 73

Name: _____

Date: _____

Ali and Zoe reach into a bag that they know contains nine lottery balls numbered 1-9. They each take one ball out to keep and they look at it secretly. Then, they make the following statements, in order:

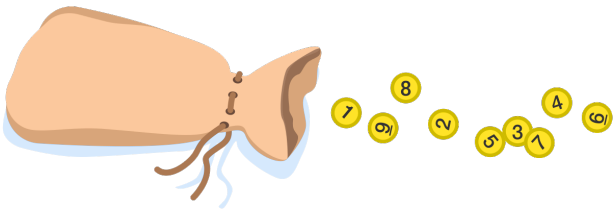
Ali: "I don't know whose number is bigger."

Zoe: "I don't know whose number is bigger either."

Ali: "I still don't know whose number is bigger."

Zoe: "Now I know that my number is bigger!"

Assuming Ali and Zoe are perfectly logical, **what is Zoe's smallest possible number?**



- ◯ 4
- ◯ 7
- ◯ 5
- ◯ 8
- ◯ 6

BRILLIANT

PROBLEM 74

Name: _____

Date: _____

A strobogrammatic number is one where (with certain fonts) the number looks the same when rotated 180 degrees (an example is shown above, the year 1961). The possible digits are 0, 1, 6, 8, and 9.

When is the next year (after 2017) that will be strobogrammatic?

0 1 2 3 4
5 6 7 8 9

Your answer:

BRILLIANT

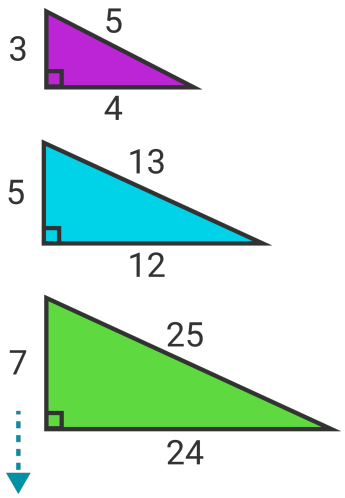
PROBLEM 75

Name: _____

Date: _____

True or False:
Every odd number greater than 1 is the smallest member of a primitive Pythagorean triple**.**

Definitions:
A "*Pythagorean triple*" is a set of three whole numbers which can be the three side lengths of a right triangle.
"*Primitive*" means the three numbers don't have a common factor. For example, the Pythagorean triple is not primitive because all three numbers are divisible by 2.



○ True

○ False

BRILLIANT

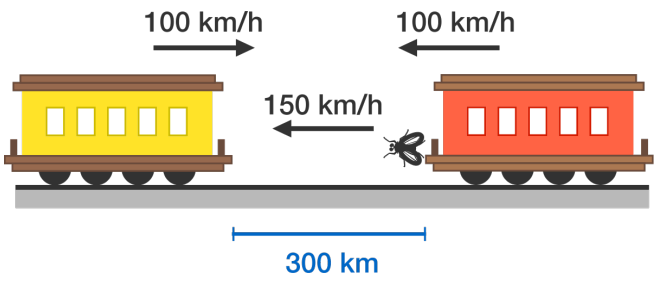
PROBLEM 76

Name: _____

Date: _____

Two trains, each traveling at a speed of 100 km/h, are headed towards each other on a straight track. At the exact moment the trains are 300 km apart, a super-fast fly on the front of one train begins flying back and forth between the two trains at a speed of 150 km/h.

What is the total distance the fly will have traveled before getting crushed between the trains?



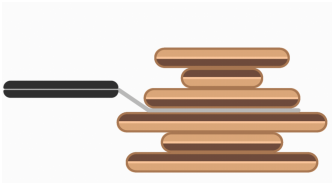
- ○ 200 kilometers
- ○ 225 kilometers
- ○ 250 kilometers
- ○ 275 kilometers
- ○ 300 kilometers
- ○ 450 kilometers

BRILLIANT

PROBLEM 77

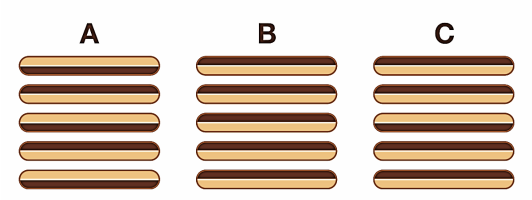
Name: _____

Date: _____



A chef wants to flip all of the pancakes in a 5-pancake stack so that the darker side of each pancake is face-down. The chef uses a series of flips, where at each flip the chef inserts a spatula and simultaneously flips all the pancakes above it.

If the chef flips each stack in the most efficient way possible, which one of these three stacks of pancakes requires the most flips?



- ○ A
- ○ B
- ○ C
- ○ They all require the same number of flips

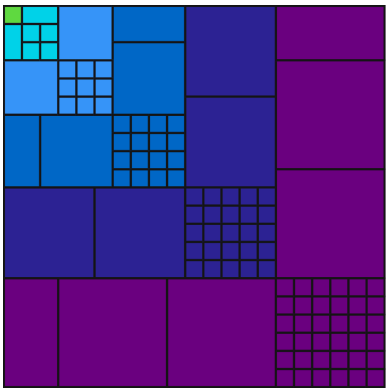
BRILLIANT

PROBLEM 78

Name: _____

Date: _____

What equation does this image correspond to?



- $1^3+2^3+3^3+4^3+5^3+6^3 = 1^2+2^2+3^2+4^2+5^2+6^2$
- $1^3+2^3+3^3+4^3+5^3+6^3 = (1+2+3+4+5+6)^3$
- $1^3+2^3+3^3+4^3+5^3+6^3 = (1+2+3+4+5+6)^2$

BRILLIANT

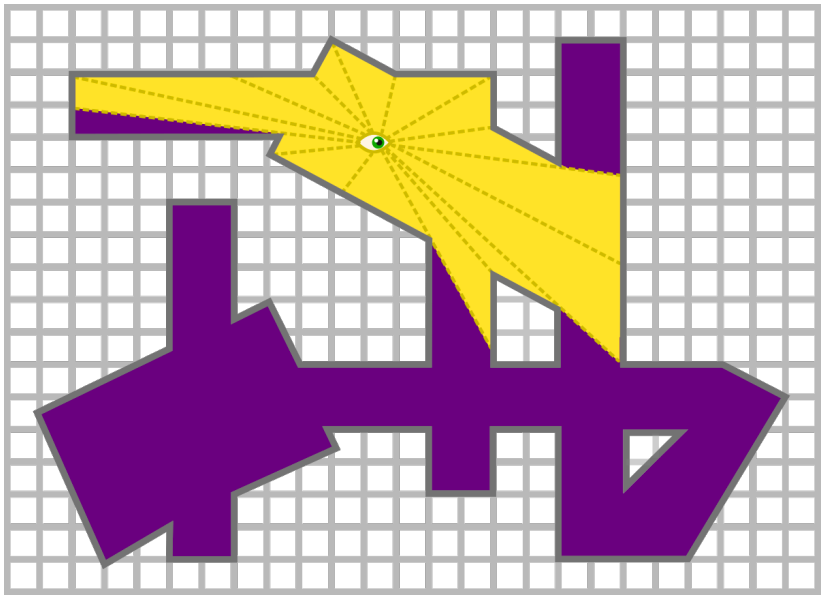
PROBLEM 79

Name: _____

Date: _____

The purple figure below is the floor plan of a gallery, and an example is shown of what could be seen by a single guard who cannot see through walls but who can look 360° around. Your job is to position some number of guards in the gallery such that *every* location in this gallery is in view of at least one of the guards.

What is the fewest number of guards that you can use to guard the entire gallery?



- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6

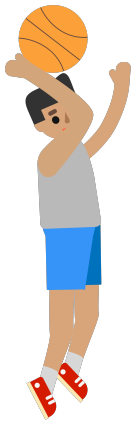
BRILLIANT

PROBLEM 80

Name: _____

Date: _____

Which of these statements about John is more likely to be true?



- ◯ John is over 7 feet tall
- ◯ John is a professional basketball player and is over 7 feet tall

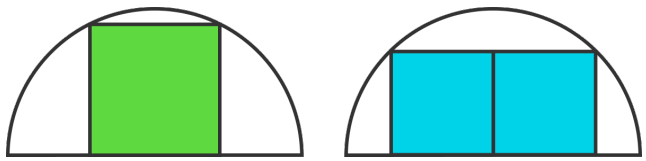
BRILLIANT

PROBLEM 81

Name: _____

Date: _____

Two identical semicircles circumscribe one square and a rectangle composed of two squares, respectively. What is the ratio of the green area to the blue area?



- ○ $4:5$
- ○ $5:4$
- ○ $3:4$
- ○ $1:1$

BRILLIANT

PROBLEM 82

Name: _____

Date: _____

If each letter represents a different nonzero digit, what is A?

$$\begin{array}{cccccc} & & & A & A & A \\ \times & & & & B & C \\ \hline & A & 0 & A & 0 & A \end{array}$$

$$\begin{array}{cccc} & & A & A \\ + & & C & A \\ \hline & & B & D \end{array}$$

- ◯ 5
- ◯ 6
- ◯ 7
- ◯ 8
- ◯ 9

BRILLIANT

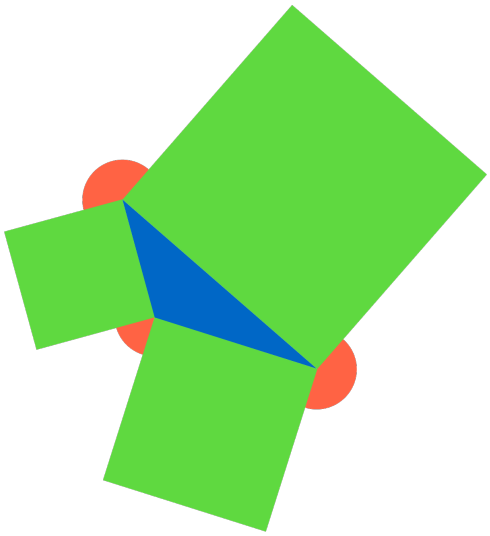
PROBLEM 83

Name: _____

Date: _____

Three squares are added to the sides of a triangle as shown. Is the following statement true or false?

"The sum of the three red angles will always equal 360° regardless of the type of triangle drawn."



○ True

○ False

BRILLIANT

PROBLEM 84

Name: _____

Date: _____

For how many ordered pairs of numbers ***(a,b)*** is it true that:

$$a + b = a \times b = \frac{a}{b}?$$

- ◯ 0
- ◯ 1
- ◯ 2
- ◯ 4
- ◯ Infinitely many pairs

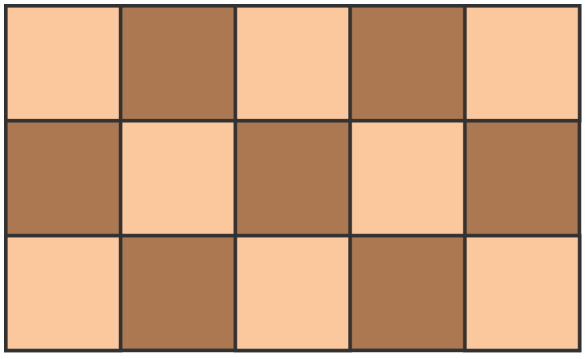
BRILLIANT

PROBLEM 85

Name: _____

Date: _____

What is the **least number of unit squares that you need to remove** from this 5 by 3 checker board in order to make it impossible for anyone to put an "X" in 3 remaining squares to make a connected vertical, horizontal, or diagonal set of 3 (a set that looks like a "win" in a standard Tic Tac Toe game)?



- ○ 5
- ○ 6
- ○ 7
- ○ 8

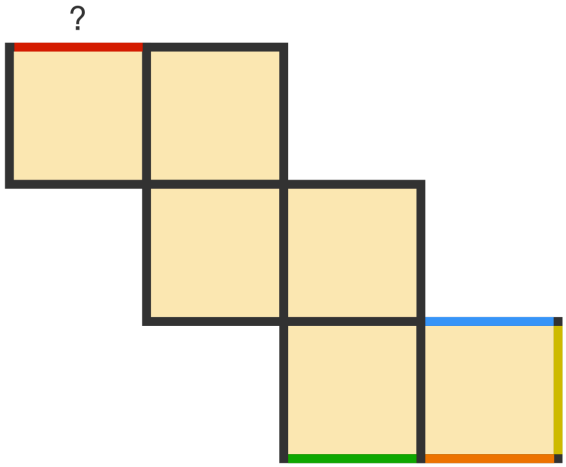
BRILLIANT

PROBLEM 86

Name: _____

Date: _____

The figure above can be folded into a cube. When the cube is formed, which edge will the red one be in contact with?



- ○ Blue
- ○ Orange
- ○ Yellow
- ○ Green

BRILLIANT

PROBLEM 87

Name: _____

Date: _____

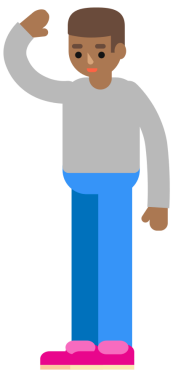
The road you are traveling on splits, with one fork heading to the City of Lies, and the other to the City of Truth, but you don't know which is which. You want to go to the City of Truth. A person who lives in one of the cities stands at the fork.

We know that:

• People who live in the City of Lies always lie.

• People who live in the City of Truth always tell the truth.

What one question could you ask the person to determine which way to go?



- ◯ Will the road to the right take me to the City of Truth?
- ◯ Which city do you live in?
- ◯ Which road do you take to go home?
- ◯ None of these questions would help you know which way to go

BRILLIANT

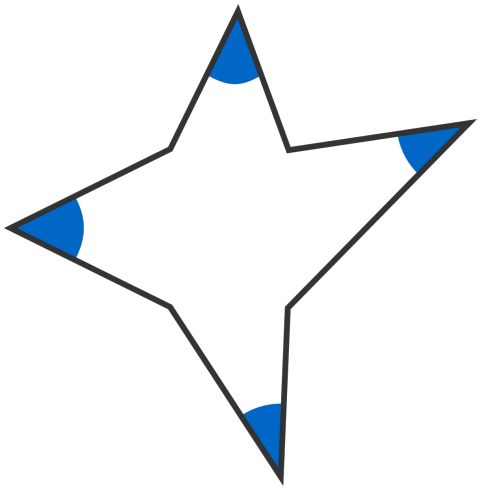
PROBLEM 88

Name: _____

Date: _____

Below is a simple octagon (that is, one where the sides don't intersect) where 4 of the internal angles (marked in blue) are acute.

Given **any** simple octagon, what's the **maximum** possible number of acute internal angles?



- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ 8

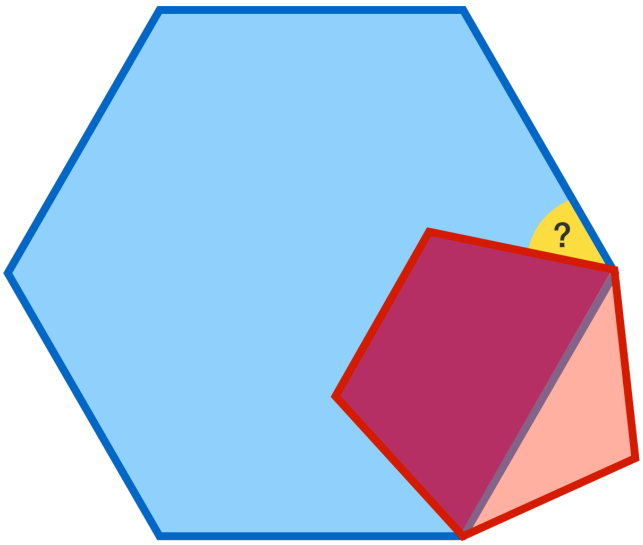
BRILLIANT

PROBLEM 89

Name: _____

Date: _____

Two vertices of a regular pentagon, in red, intersect with two vertices of a regular hexagon, in blue. What is the measure of the yellow angle?



- ◯ 36°
- ◯ 48°
- ◯ 54°
- ◯ 60°

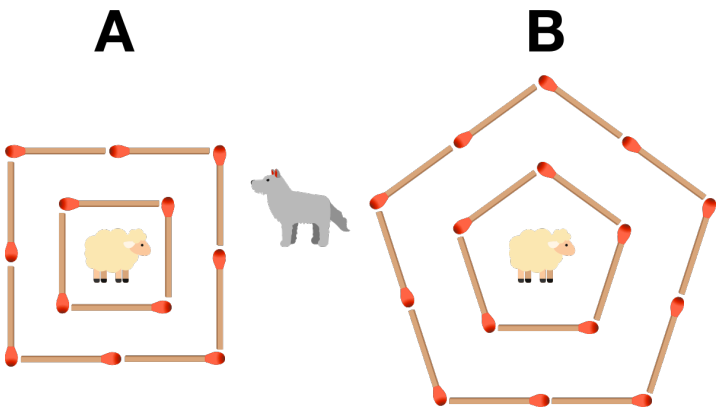
BRILLIANT

PROBLEM 90

Name: _____

Date: _____

Each sheep has two fences (represented by matchsticks) protecting it from the wolf. If two matchsticks are removed at random from each sheep's fencing, which sheep is more likely to survive?



- ○ A
- ○ B
- ○ The two sheep are equally safe

BRILLIANT

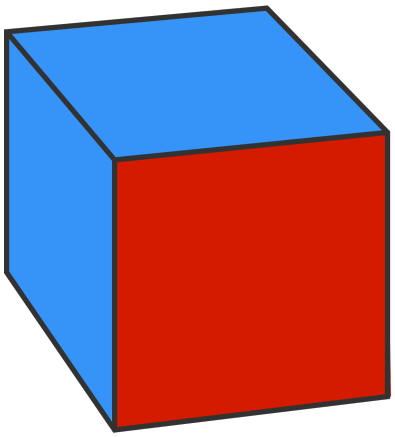
PROBLEM 91

Name: _____

Date: _____

Suppose you take a cube and color all the sides. Each side is colored either red or blue. If two different methods of coloring the sides can be rotated to match, they are considered the same.

In how many different ways can you color the cube?



- ○ 10
- ○ 12
- ○ 14
- ○ 16

BRILLIANT

PROBLEM 92

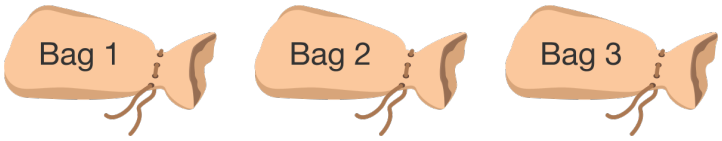
Name: _____

Date: _____

You have three bags that each contain two marbles.

- Bag 1 has two red marbles.
- Bag 2 has two blue marbles.
- Bag 3 has one red marble and one blue marble.

First, you choose a bag at random. Then, from that bag, you choose a marble at random and end up with a red marble. What is the probability that the other marble in the bag is also red?



- ○ $\frac{1}{3}$
- ○ $\frac{1}{2}$
- ○ $\frac{2}{3}$

BRILLIANT

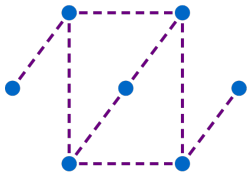
PROBLEM 93

Name: _____

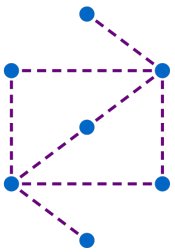
Date: _____

For which of these pictures is it possible to trace a path along the dashed lines (not necessarily all of them) that visits **each dot exactly once**?

A



B



- ◯ Only A
- ◯ Only B
- ◯ Both A and B
- ◯ Neither A nor B

BRILLIANT

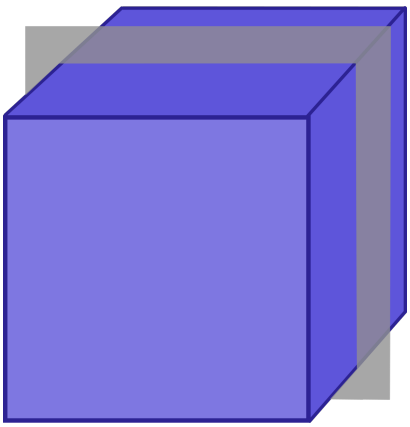
PROBLEM 94

Name: _____

Date: _____

How many of the following 8 shapes can be created by taking a cross section of a cube?

Equilateral Triangle	Scalene Triangle
Isosceles Triangle that is not equilateral	Square
Rectangle that is not a square	Pentagon
Hexagon	Octagon



- ◯ 4
- ◯ 5
- ◯ 6
- ◯ 7
- ◯ 8

BRILLIANT

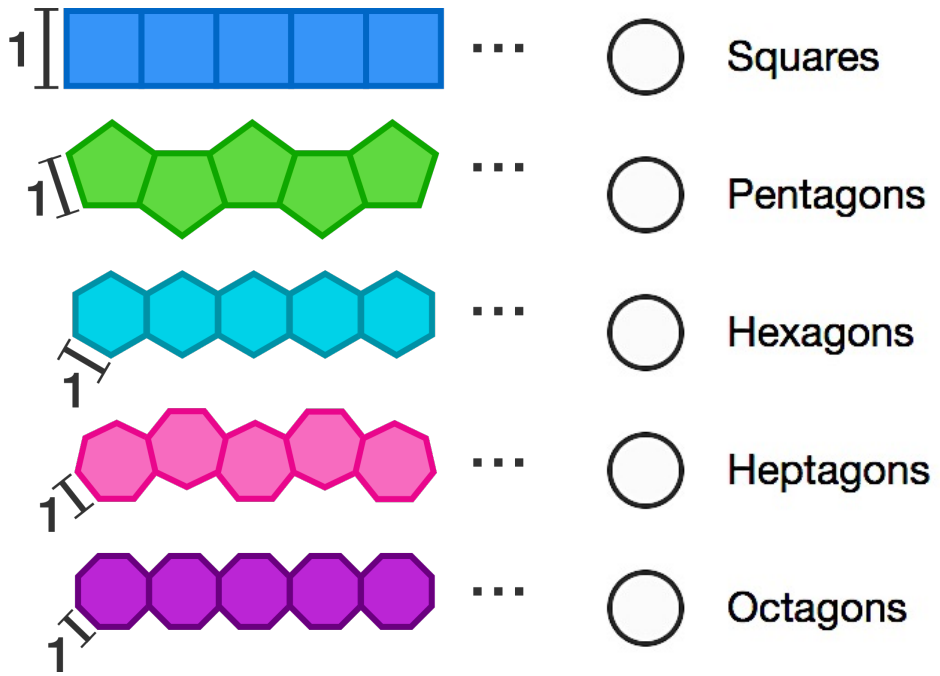
PROBLEM 95

Name: _____

Date: _____

Some chains of regular figures, each with side lengths of 1, are shown above.

Which of the chains can't be extended to have a perimeter of exactly 50?



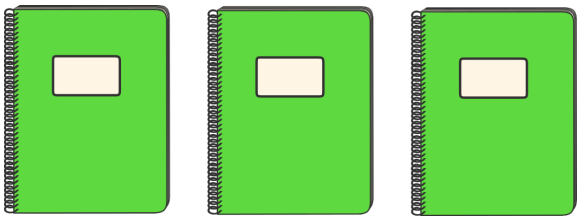
BRILLIANT

PROBLEM 96

Name: _____

Date: _____

Three people all set down their identical notebooks on a table. On the way out, they each randomly pick up one of the notebooks. **What is the probability that none of the three people pick up the notebook that they started with?**



- ○ $\frac{1}{3}$
- ○ $\frac{1}{9}$
- ○ $\frac{2}{9}$
- ○ $\frac{1}{6}$
- ○ $\frac{1}{2}$

BRILLIANT

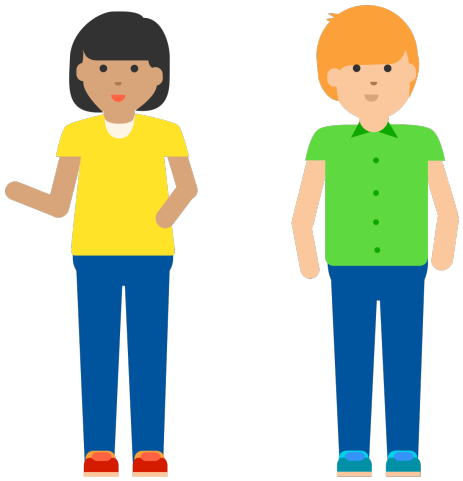
PROBLEM 97

Name: _____

Date: _____

A girl has twice as many sisters as brothers. Each of her brothers has five times as many sisters as brothers. All the children have the same parents.

Assuming there is at least one brother, how many children are in the family?



Your answer:

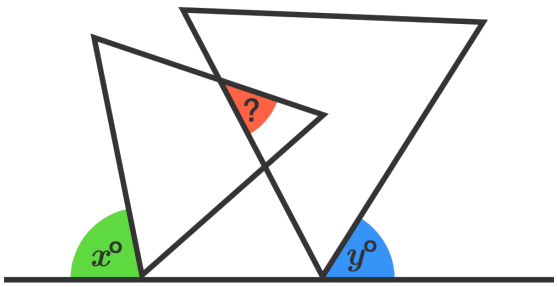
BRILLIANT

PROBLEM 98

Name: _____

Date: _____

Two equilateral triangles overlap as shown. What is the measure in degrees of the red angle?



- $120 - x + y$
- $120 + x - y$
- $180 - 2x + y$
- $180 - x - y$

BRILLIANT

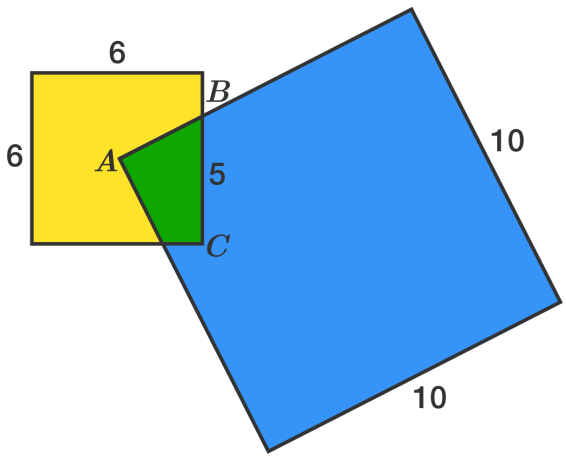
PROBLEM 99

Name: _____

Date: _____

A square of side length 10 is placed so that its corner, ***A,*** is *exactly at the center* of a square of side length 6. The squares intersect at point ***B*** as shown; the length of line segment ***BC*** (connecting ***B*** to a corner of the smaller square) is 5.

What is the area of the green quadrilateral?



- 3
- 6
- 9
- 12

BRILLIANT

PROBLEM 100

Name: _____

Date: _____

The first few powers of 101 all begin with 1, as highlighted by red colors below:

$$\begin{aligned} 101^1 &= 101 \\ 101^2 &= 10201 \\ 101^3 &= 1030301 \\ 101^4 &= 104060401 \\ &\vdots \end{aligned}$$

Is this always the case for *all* positive integer powers of 101?

- ◯ Yes
- ◯ No