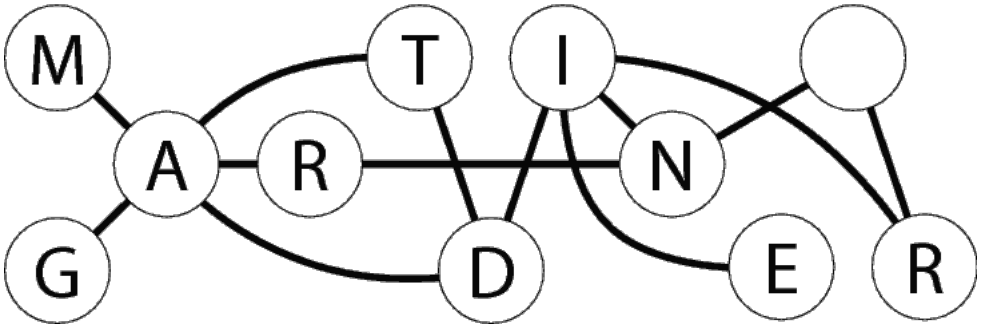


Photo Martin Gardner by Alex Bellos in 2008 in Norman

Born in Tulsa in 1914 and passed away in Norman in 2010.

Stage 1

Stage 1, Round 1 (2 Questions, 3 Minutes)

1. Say a circle of radius r has area A square units and circumference C units. If the circle's radius is increased by 1 unit, then its new area is

$$A + C + w.$$

What is w?

2. If x is twice the square of half of the square root of 2018, what is $x - 10$?

Stage 1, Round 2 (Blitz Round, 3 Minutes)

a. If we write the number A in base 3 it is 11. What is A?

b. If $\sec(\theta) = 5/4$, then what is $\sin(\theta)$?

c. If you have a square birthday cake and make three distinct, vertical, straight cuts through the cake, what is the fewest number of pieces you can make?

d. Let $x = 2018^4$. Which of the following numbers is closest to x?

(a) 16,000

(b) 16,000,000

(c) 16,000,000,000

(d) 16,000,000,000,000

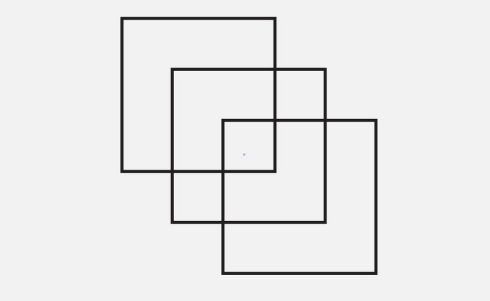
e. Which is more likely: rolling a six with a fair die or getting three heads in row when flipping a fair coin?

Stage 1, Round 3 (3 Questions, 5 Minutes)

1. Hot dog buns are sold in packs of 8. Hot dogs are sold in packs of 6. Say you want to buy enough packs of buns and hot dogs so you have exactly one bun for each hot dog. What is the fewest[1] number of hot dogs you can buy?

2. A *palindromic polynomial* is a polynomial $p(x) = a_n x^n + a_{n-1}x^{n-1} + \cdots a_1 x + a_0$ where $a_{n-k} = a_k$ for $k = 0, \ldots, n$. If $p(x)$ is a degree 3 palindromic polynomial with $p(0) = 2$ and $p(1) = 2$, then what is $p(x)$?

3. How many squares are in the following image?



[1] Greater than zero!

Lunch!

Stage 2

Stage 2, Round 1 (Blitz Round, 3 Minutes)

a. At a dinner party with three Sooners and three Cowboys, if every Sooner shakes hands with every Cowboy, how many handshakes happen?

b. If a square doubles in circumference, the new square's area is what multiple of the old square's area?

c. What is 2018 in base 3?

d. Consider the sequence $a_1 = 2, a_2 = -3, a_3 = 4, a_4 = -5, a_5 = 6, a_6 = -7, \ldots$.

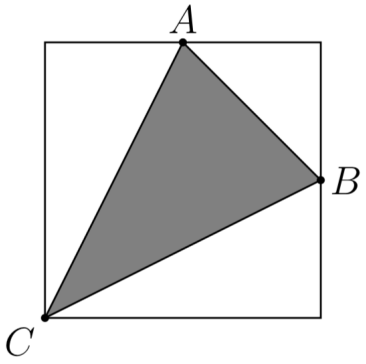
If you continue this sequence, what is a_{10}?

e. To be eligible to win the Fields Medal, you must be younger than what age?

Stage 2, Round 2 (3 Questions, 5 Minutes)

1. If you factor the positive integers m and n into primes, the only primes you need are 2 and 3. Furthermore, say 2 and 3 both evenly divide m and n. If m does not evenly divide n and n does not evenly divide m, what is the smallest m can be?

2. The picture below is a square which has side length of 4 units. If A and B are at the midpoints of their respective sides, what is the area of the shaded triangle?



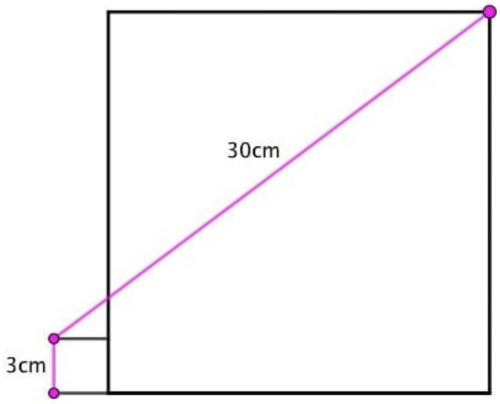
3. Say you have a chocolate bar which is made up of smaller squares arranged into a 3×4 grid. Say you want to break it into individual squares and are not allowed to break more than one bar at a time (ie. you aren't allowed to stack bars together or anything tricky like that).

   What is the fewest number of breaks you'll need to use?

Stage 3

Stage 3, Round 1 (3 Questions, 5 Minutes)

1. In the following image, what the area of the larger square?



2. If $x + \dfrac{1}{x} = 11$, then what is $x^2 + \dfrac{1}{x^2} =$?

3. If you are allowed to stretch, squish, bend, rotate and otherwise deform all you like, but you are *not* allowed to cut or glue together, then which of the following Greek letters can be deformed into ρ?

$$\alpha\ \beta\ \chi\ \delta\ \epsilon\ \phi\ \gamma\ \eta\ \iota\ \kappa\ \lambda\ \mu\ \nu\ \ \pi\ \theta\ \sigma\ \tau\ \xi\ \psi\ \zeta$$

Stage 3, Round 2 (2 Questions, 5 Minutes)

1. A *Sum-to-Product function* is a function from the real numbers to the real numbers such that

$$f(a+b) = f(a)f(b)$$

for any real numbers a and b. For all of the following questions, assume f is a Sum-to-Product function[2]:

(a) If $f(2) = 3$, then what is $f(6)$?

(b) If $f(3) = -8$, then what is $f(1)$?

(c) If f has at least two different outputs, then what is $f(0)$?

2. A *Covering Sequence* of length k is a string of 0's and 1's such that every possible combination of k 0's and 1's occurs as a substring of adjacent numbers. For example, if $k = 2$, then 11001 is a Covering Sequence since 11, 10, 00, and 01 all occur as substrings. It so happens this is the shortest possible Covering Sequence when $k = 2$.

How long is the shortest possible Covering Sequence when $k = 3$?

[2]But the function is possibly different for each question!

The End!

Spot Prize I (Word Search!)

Name:_____ **School:**_____

S X G S Q P Y A F A P C H F A Z F A R E B O D G Y S E V T P Y S
Z M D D C D U N C X S T U D P V V E H M M Z W B Y R I Z K Z H E
Y Y H Q E R C Z P N L X L P P O H I O Z R G C Z G G N M X F F G
T W R O Y S Z S Z P N K I L N T A U P T P K S N M J N E P S K E
N H M P S R H P P L V B M H E E D G F V G G N O C U O O H A H R
O N O I T A T U M R E P K O V A L E V S K Y Y R Y K M R Q E N M
E T A T S K O A F D J R N O S L I E M A G I C M L H I W X I S A
I W B R Y F R Q I F J G A R D N E R S D S E M A C G A A T G O N
R D R T D T E O H B L X F G B V D Q Q K M P H N G J F R J D N R
Q X I C Q L I Y K D T E B S I V U R U O A O H L X L A W V I I O
T D S T H I B L C S M D D L V A C J R Y M X R E E M E N R M A T
I N I T B V F D I G Y R O K R P A D D A H E I X R T W Y G P W N
L L B K I I W H X B A O F E U O N Y D B A T A O L I U W O N U A
Y E M R H R L T T C A A B Z J I O D G L D G Q Z A P C L J J C C
Q Q T R E L L U M A M B X W L P T Z I A O V V S I N O A S U I Q
E L C R I C O S I Z M Z O A O U T T Y N Q I I V M X Z E L A F E
D D D B W B R I C J E M P R L C Y S C W Z H R Q O E I J G J V N
Y M M E Z Y R Z Q A W O B N P B Y I L E B M T K N R Y R A M V O
D M V T I Z A N D T B J Y X G A D W W A Z U U J Y A E R T X U A
J Z J X Z M C D P R I N T A X M Z E Z B D X A Y L G E G M A J O
I U C O Z F E W O X W M V A B O X L N W Q K L S O H L A Y M M J
D K Z N U G I E X A X B S I X I M U U J K X V H P Y U W F D P O

- HENRY
- SEGERMAN
- OKSTATE
- COWBOYS
- LEWIS
- CARROLL
- SPHERICAL
- GREG
- MULLER
- HEXAFLEXAGON
- DR MATRIX
- CANTOR
- EMMY
- NOETHER
- MARTIN
- GARDNER
- SHUFFLE
- CARDS
- PERMUTATION
- MAGIC
- PROBABILITY
- 3DPRINT
- MATH
- PUZZLE
- TULSA
- NORMAN
- OKLAHOMA
- POLYNOMIAL
- VIRTUAL
- REALITY
- PALINDROME
- SQUARE
- CIRCLE
- SONIA
- KOVALEVSKY

Spot Prize I (Word Search!)

Name:_____ **School:**_____

S X G S Q P Y A F A P C H F A Z F A R E B O D G Y S E V T P Y S
Z M D D C D U N C X S T U D P V V E H M M Z W B Y R I Z K Z H E
Y Y H Q E R C Z P N L X L P P O H I O Z R G C Z G G N M X F F G
T W R O Y S Z S Z P N K I L N T A U P T P K S N M J N E P S K E
N H M P S R H P P L V B M H E E D G F V G G N O C U O O H A H R
O N O I T A T U M R E P K O V A L E V S K Y Y R Y K M R Q E N M
E T A T S K O A F D J R N O S L I E M A G I C M L H I W X I S A
I W B R Y F R Q I F J G A R D N E R S D S E M A C G A A T G O N
R D R T D T E O H B L X F G B V D Q Q K M P H N G J F R J D N R
Q X I C Q L I Y K D T E B S I V U R U O A O H L X L A W V I I O
T D S T H I B L C S M D D L V A C J R Y M X R E E M E N R M A T
I N I T B V F D I G Y R O K R P A D D A H E I X R T W Y G P W N
L L B K I I W H X B A O F E U O N Y D B A T A O L I U W O N U A
Y E M R H R L T T C A A B Z J I O D G L D G Q Z A P C L J J C C
Q Q T R E L L U M A M B X W L P T Z I A O V V S I N O A S U I Q
E L C R I C O S I Z M Z O A O U T T Y N Q I I V M X Z E L A F E
D D D B W B R I C J E M P R L C Y S C W Z H R Q O E I J G J V N
Y M M E Z Y R Z Q A W O B N P B Y I L E B M T K N R Y R A M V O
D M V T I Z A N D T B J Y X G A D W W A Z U U J Y A E R T X U A
J Z J X Z M C D P R I N T A X M Z E Z B D X A Y L G E G M A J O
I U C O Z F E W O X W M V A B O X L N W Q K L S O H L A Y M M J
D K Z N U G I E X A X B S I X I M U U J K X V H P Y U W F D P O

- HENRY
- SEGERMAN
- OKSTATE
- COWBOYS
- LEWIS
- CARROLL
- SPHERICAL
- GREG
- MULLER
- HEXAFLEXAGON
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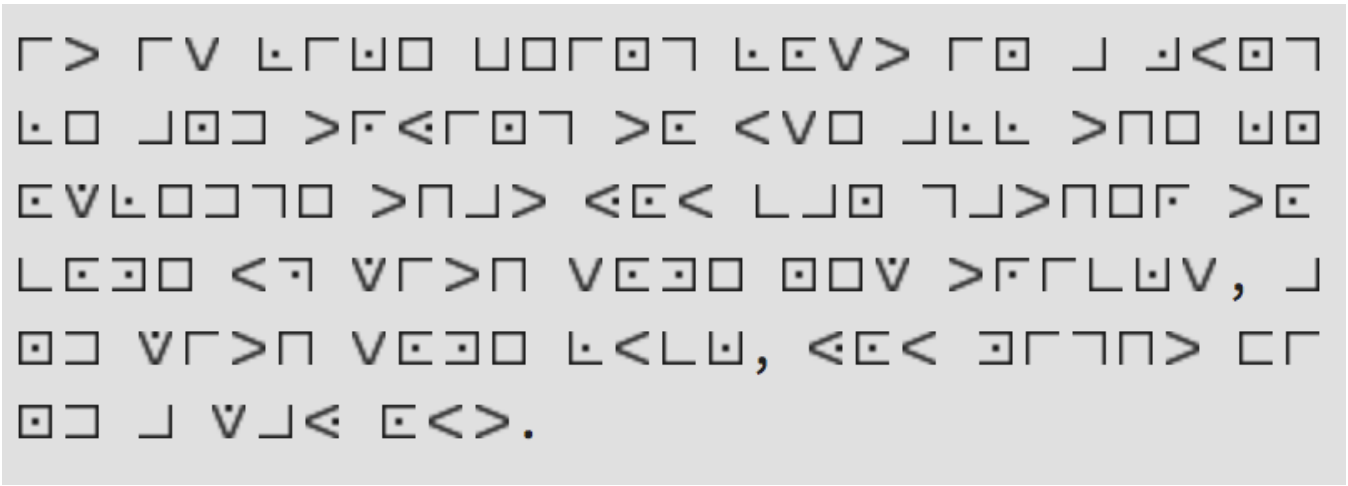
- PALINDROME
- SQUARE
- CIRCLE
- SONIA
- KOVALEVSKY

Spot Prize II (Break the Code!)

Name:_____ **School:**_____

While exploring the OU campus, you discover the statue of Omar Khayyam. Tucked behind his ear is the note shown below:



Your friend thinks this must be an ancient Persian code where each symbol stands for a letter of the alphabet. Fortunately your friend is versed in the mysterious arts and is able to tell you □ is "E" and > is "T". Can you crack the code before time runs out?

Spot Prize II (Break the Code!)

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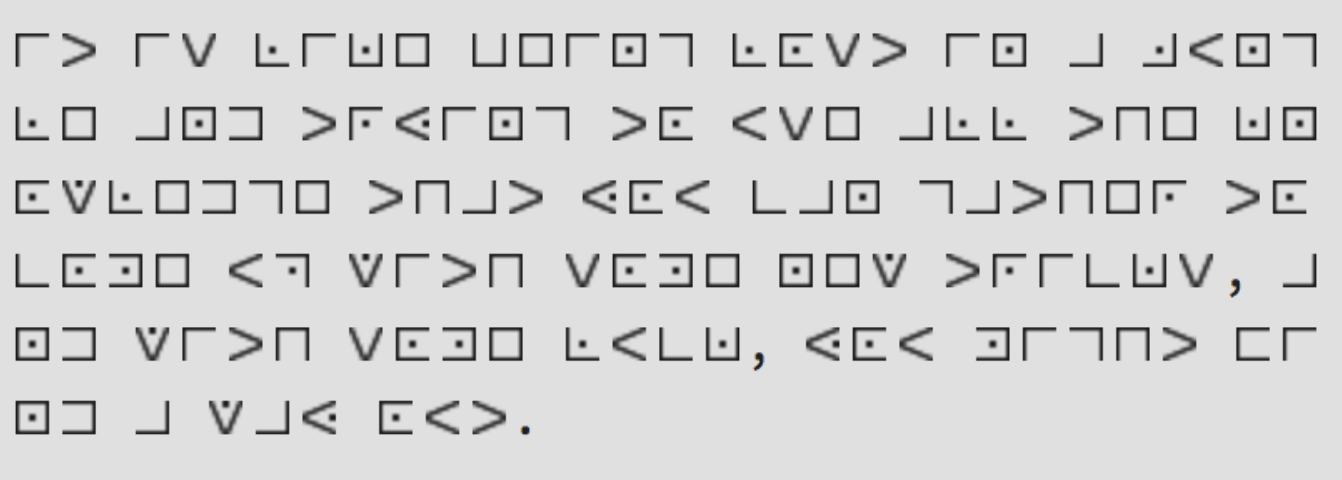

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Lunch Problem

Name:_____ **School:**_____

Due after lunch at the door to the Math Bowl. Write your solution on the back.

While sitting in a boring History class you start wondering about parentheses. Specifically, if you are going to multiply n numbers, how many ways can you insert parentheses to match up pairs of numbers to be multiplied, while also having a valid mathematical expression?

For example, when $n = 2$, then there is only one way: (ab). When $n = 3$, then there are two ways: $((ab)c)$ and $(a(bc))$. When $n = 4$, there are 5 ways:

$$(((ab)c)d),\ ((a(bc))d),\ ((ab)(cd)),\ (a((bc)d)),\ \text{and}\ (a(b(cd))).$$

1. How many ways are there to insert parentheses if you have $n = 4$ and $n = 5$?
2. How about if $n = 6$ and $n = 7$?
3. Formulate a formula for the number of valid ways to insert parentheses when there are n numbers, for arbitrary n. Your answer should be a formula involving n. Bonus points if you can explain why your formula must be correct.