Student Name: _____

Welcome to the Third Annual Harrison Chen Memorial Math Competition!

Please observe the following information for the competition.

- Scoring. All problems will be worth one point. This means that the most difficult problems will be worth the same as the more straightforward problems. Your goal is to get as many correct as you can within the 60 minutes allowed.
- Answer Key. You **MUST** write the answer in the answer key provided. If you do not, no credit will be given, so make sure you write down your answer in the key as soon as you finish a problem!
- Work. You **MUST** show work in order to receive credit for a problem. Do not solve problems in your head! If you do not explain how you arrived at an answer, no credit will be given.

- Tiebreakers. In the event of a tie score ONLY, tiebreak points will be awarded. Question 1 will be worth 1 tiebreak point, Question 2 will be worth 2 tiebreak points, Question 3 will be worth 3 tiebreak points, and so on until Question 12, which will be worth 12 tiebreak points.
- Pencils. We have provided pencils for you to use. If you need additional pencils, ask.
- Erasers. Because you only have 60 minutes to solve these problems, we strongly recommend that you do not erase any work. If you try something and it doesn't lead to the correct answer, that's fine! Just leave the work on the page and keep going. Neatness does not count for this set of problems.

- Calculators. You may not use calculators of any kind for this contest. If you brought one to the contest, give it to the TA, who will return it to you when the contest is complete.
- Scratch Paper. You should have enough space to solve a problem directly where the question is written. If you still need more paper for your work, raise your hand and it will be provided.

- Food. No food in the contest room. All students will receive a snack ticket which can be used once the contest finishes.
- Bathroom. Because you have only 60 minutes for 12 problems, we strongly urge you to use the bathroom before or after – not during – the contest. If you must use the bathroom, raise your hand and inform the TA.

- Definitions. If you do not understand what a word means, raise your hand and ask the TA quietly. **You may not ask for any help/hints on how a problem should be solved.** You may only ask questions if you do not know a specific word. Part of the challenge is reading the problems and figuring out what method must be used to solve them.
- Suggestion. Read the questions CAREFULLY before you solve, because sometimes one word can change the entire solution!
- Time. You will be allowed 60 minutes for the competition. Do not open this booklet until time starts. Once time begins, if you finish early, you have two options: check your work (strongly suggested), or turn in the contest early and be dismissed for the remaining time. If you leave early, you may not return to change any answers, so don't leave early unless you know you are completely finished.

Thank you for participating! Remember to HAVE FUN with these challenging (and somewhat ridiculous) problems.

Answer Key (DO NOT DETACH THIS PAGE)

#1	#2	#3
#4	#5	#6
#7	#8	#9
#10	#11	#12

Audrey Lai Smooth and Steady Senior Division

Remember: SHOW WORK to receive credit!

#1. Ophelia collects photos of exotic birds. If you take the total number of bird photos she has and divide it by 7, then subtract 8, then multiply by 9, and finally add 10, you get 109. What is the number of bird photos in Ophelia's collection?

#2. While traveling on her favorite motorcycle Samosa, Grandma Sinko takes a short trip from Fremont to Palo Alto to visit David Harrison Chen. Grandma Sinko averages 84 kilometers per hour and 400 revolutions (tire rotations) per minute. In meters, what is the circumference of one of Samosa's tires?

#3. The product of five consecutive prime numbers is 85,085. What is the sum of these five numbers?

#4. Great Uncle Venkatesh is elected President of Oochistan. His first act as President is to sell his country to Grandma Sinko for $79,833,600. Upon receiving payment, he sets aside all of this money so that Arthur can establish AIT (Arthur Institute of Technology) when he graduates from college.

One day, Audrey asks Great Uncle Venkatesh if he would like to invest his money. "OK," he agrees. He hands over the entire amount to Audrey and tells her to invest it for him (an unwise decision given Audrey's utter lack of investment knowledge).

Audrey chooses random stocks one at a time. First, she invests everything in Kavya's Koalas, but that investment loses 90% of its value in one week. She takes what is left and puts all of it in Kriti's Kryptons, but that loses 8/9 of its value in a month. Audrey again takes what is left and invests in Nathaniel's Nothings, but that stock goes down 87.5% in two days.

Expecting her luck to turn around at some point, Audrey buys Ophelia's Ostriches using the remaining money, but that loses 6/7 of its value in a week. Her next investment (again using everything left over) in Brian's Bananas loses 5/6 of its value in a month.

Getting desperate, Audrey buys Sude's Supplejacks, Pratham's Prophylls, Maya's Macedoines, and Bidipta's Billfish – one stock at a time – in consecutive weeks, always investing the maximum amount available. But her losses continue: Sude's Supplejacks goes down 80%, Pratham's Prophylls goes down 75%; Maya's Macedoines decreases by 2/3; Bidipta's Billfish loses half its value.

At this point, Audrey gives up and cashes out. In dollars, how much money is left for Arthur to establish AIT?

#5. Let w, x, y, and z represent distinct integers. If w, x, and y are greater than 0 but less than 20 and $w^4 + x^3 + y^2 + z = 25{,}331$, what is the least possible value of z?

#6. Each of the digits 1 through 9 is to be placed, 1 per box, in the figure below, replacing the nine letters such that all of the following statements are true:

- A + B + C = 17
- T ÷ U – V = 1
- X ÷ Y – Z = 0
- A + T – X = 4
- B ÷ U × Y = 12
- C × V ÷ Z = 27

A	B	C
T	U	V
X	Y	Z

What is the value of the product Y×A×Z ?

#7. Great Uncle Venkatesh travels to Rome to negotiate a trade agreement with the Emperor Nachocheesius. At first, Nachocheesius is not willing to agree to any terms, so Great Uncle Venkatesh makes the following offer. "Emperor Nachocheesius, on whatever day of the month you select, I will provide you with that many pounds of cheese. For example, if you call me on August 1, I will bring you 1 pound of cheese. If you call me on August 2, I will bring you 2 pounds of cheese, and so on all the way until August 31."

Emperor Nachocheesius agrees to these terms, but only on the condition that Great Uncle Venkatesh can fly back to Rome immediately when called and provide the exact amount of cheese. Great Uncle Venkatesh realizes that he needs to have his cheese pre-cut into blocks, but he doesn't have room in his refrigerator for 31 different sized blocks of cheese, nor would he be able to transport that much cheese on the airplane anyway. "I've got it!" he shrieks suddenly. "Using 5 different size blocks of cheese, I will be able to cover any day of the month that Nachocheesius calls, provided I can add blocks together to make the desired number of pounds."

Indeed, Great Uncle Venkatesh can do exactly as he stated. What is the product of these five different cheese blocks (by weight in pounds)?

#8. How many different combinations of pennies, nickels, dimes, and quarters use exactly 48 coins to make $1.00?

#9. Audrey rolls four 6-sided dice (numbered 1 through 6). What is the probability that the sum of the numbers she rolls is 7? Express your answer as a fraction in lowest terms.

#10 (**Hard**). Audrey, Bidipta, and Maya wish to create a math problem involving the first letters of their names. They settle upon the following cryptarithm:

$$\begin{array}{r} B\ A\ M \\ +\ B\ M\ A \\ \hline M\ A\ B \end{array}$$

The letters A, B, and M represent different digits, and BAM, BMA, and MAB are three-digit numbers. What three-digit number does BAM represent?

#11 (**Really Hard**). José and Ricardo have a conversation after both talking to Matty separately. They try figuring out what Matty's favorite pizza is. Matty has given them a list of 13 possible options:

- Thin Crust with Veggies
- Thick Crust with Pepperoni
- Thin Crust with Cheese
- Gluten-Free Crust with Veggies
- Deep Dish Crust with Ham
- Thin Crust with Bacon
- Gluten-Free Crust with Cheese
- Thin Crust with Ham
- Thick Crust with Pineapple
- Deep Dish Crust with Cheese
- Thick Crust with Ham
- Thin Crust with Pineapple
- Gluten-Free Crust with Pineapple

José knows the type of crust, while Ricardo knows the type of topping, and that is all they know.
José states, "I don't know what Matty's favorite is, but I'm sure you don't know either."
Ricardo replies, "Really! I originally didn't know, but now I do!"
José comments, "Well then, so do I!"

What is Matty's favorite pizza?

#12 (**Crazy**). Mr. G. LOVES Jolly Ranchers. *(Note: this is extremely amusing as I dislike Jolly Ranchers.)* In a contest against the mathematical genius Carl Friedrich Gauss, both contestants will reach into a bag and pull out Jolly Ranchers with no replacement until the bag is emptied. If the Jolly Rancher is red (watermelon or cherry), it must be eaten with mustard. If it is a sad berry (blueberry), it must be eaten with ketchup. If it is a Granny Smith (green apple; Grandma Sinko is insulted that it isn't called Granny Sinko), it must be eaten alone. If the Jolly Rancher is any other color, it must be eaten with a mystery spice (clove, peppermint, spearmint, or licorice). The scoring is simple: for every Jolly Rancher consumed, the contestant scores one point; for every Jolly Rancher spit out or uneaten, they lose one point. Each contestant picks the same number of Jolly Ranchers from the bag. The highest score at the end of the game wins; in the event of a tie, whoever ate the first Jolly Rancher wins the contest.

Because of his finicky tastes, Mr. G. refuses to eat anything that has to do with watermelon or ketchup. Nevertheless, he recognizes that Gauss presents a formidable challenge. Therefore, Mr. G. selects not only the first Jolly Rancher from the bag, but all of his Jolly Ranchers before Gauss picks his first one. The bag contains 29 blueberries, 33 cherries, 12 grapes, 21 watermelons, and 5 green apples. What is the probability that Mr. G. will guarantee a victory for himself before Gauss eats his first Jolly Rancher?

For this problem, the probability must be expressed as a fraction in the form 1/P, in which P represents the non-calculated product of all applicable prime numbers. Once you have determined P, give the sum of the total number of powers as your answer. Example: if you determine that the probability is $1 / (2^6 \times 3^1 \times 7^3)$, your answer would be 10 (that is, 6+1+3).