

# DAN AND COBY AND TIFFANY'S MATH PACKET

*Challenging mathematics packet with an emphasis on applied math.*

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**Lewis Carroll’s “The Mad Gardener’s Song” includes a reference to this mathematical technique. That technique is an extension of the “rule of three” as introduced by Cocker’s Arithmetick. In Euclidean geometry, it is equivalent to considering ratios between similar triangles. It can be used to solve the problem: If 6 (\*) builders can build 8 houses in 100 days, how many days would it take 10 builders to build 20 houses at the same rate? For 10 points, name this algebraic technique used to solve the general equation  $a/b = c/d$ . ANSWER: cross multiplication [accept cross your heart; do NOT accept or prompt on “cross product”]**  
<Zhou, Algebra>

**A T-ara song with a title one letter off from the name of this concept is the first on their *Again* EP. The construct referenced by that song as well as its negative appear in a reference work on these objects. Another unrelated concept is obtained by reversing the words in the name of these objects and refers to a method of specifying a sequence of characters in a text file. Addition and subtraction may be formalized as (\*) walking up and down this construct, which is usually horizontal. The Cantor set is constructed by removing sections from a part of this object. For 10 points, name these objects, two of which form the axes of the Cartesian plane. ANSWER: number line**  
<Zhou, Algebra>

**This concept is idempotent and monotonic. It should preserve symmetries that already exist between its domain and range. With finite precision (or a discrete domain), this translates to removing bias. The (\*) table-maker’s dilemma arises when attempting to apply it to transcendental numbers. “Ill-conditioned” problems generally result in a high level of error due to this process. The accuracy of the output of this procedure can be quantified using the machine epsilon. It is frequently indicated using a wavy equals sign. For 10 points, name this procedure that can be done “by chop” or “to nearest”. ANSWER: rounding**  
<Zhou, Algebra>

**The dice of Toscanella were used to challenge the so-called “4 versus 6 dispute”, which centers around the assignment of huθ and śa in this framework that is theorized to originate from tally marks, a theory which superseded the older, hand signal hypothesis, as well as the idea that they were based on the Greek Attic numerals. The unicode characters from 10300 to (\*) 1032F includes the symbols central to this system. For 10 points, name this numerical system that includes symbols like , , and used by a pre-Roman civilization. ANSWER: Etruscan numerals**  
<Zhou, Other>

**On page 76 of this work, Theorem 5.1 is missing a factor of one-half. Solution 11.17 in this work constructs an incircle at A0 touching BC. The preface to this work features the following Euclid quote: “Give him (\*) threepence, since he must make gain out of what he learns.” Each chapter of this work is structured as having a theoretical portion of theorems and tools, examples of applications of these tools, and a set of several practice problems. Other popular works by the same author include *evan nekkoya v2* and *Napkin*. For 10 points, name this math textbook with 248 illustrations. ANSWER: Euclidean Geometry in Mathematical Olympiads [or EGMO]**  
<Zhou, Geometry>

**In their later years, this mathematician also dabbled in chemistry, and they elucidated the structure of galacidalacidesoxyribonucleic acid. This mathematician included quintic equations along with the phrase “queue d’aronde” in their study of fold bifurcations in the “swallowtail.” While studying catastrophe theory, this mathematician proclaimed that (\*) Perpignan station in France is the center of the universe. This mathematician’s most famous work was inspired by a piece of Camembert cheese melting in the sun. For 10 points, name this mathematician, perhaps best known for their depiction of time with dripping clocks.**

ANSWER: Salvador Dali

<Ni, Mathematicians>

***Description acceptable.* Stanislas Dehaene found that adults are around 60 milliseconds slower to answer this question than for related questions, providing evidence against the mental calculation hypothesis. A University of Michigan study highlighted the predictive power of teachers’ ability to correctly answer this question and the test scores of their students. The answer to this question can be found by considering the (\*) point-in-polygon test. In 1977, one driving restriction in Paris led to widespread confusion because of the ambiguity of this question. Common responses to this question include claiming its central number is “special,” “not a real number,” or “neither.” For 10 points, name this supposed trick question which considers the parity of a certain special number.**

ANSWER: Is zero odd or even?

<Zhou, Philosophy>

**Doreen Virtue authors a popular introductory textbook for this system that controversially assigns neutral, rather than positive, properties to one of its foundational entities, a claim that was later contradicted by a 2021 Mystic Michaela paper. Within certain frameworks, concatenation of their namesake objects is equivalent to the convolution of their properties. Other frameworks limit membership within this system to (\*) three and four digit repdigits. Numbers within this framework may sometimes be used to manifest their associated properties. For 10 points, name these numbers that seemingly appear repeatedly within your life.**

ANSWER: angel numbers

<Zhou, Applied>

**Since you are now studying geometry and trigonometry, I will give you a problem. A ship sails the ocean. It left Boston with a cargo of wool. It grosses 200 tons. It is bound for Le Havre. The mainmast is broken, the cabin boy is on deck, there are 12 passengers aboard, the wind is blowing East-North-East, the clock points to a quarter past three in the afternoon. It is the month of May. How (\*) old is the captain? It may help to know that the captain owns 26 sheep and 10 goats. For 10 points, what is 6 squared?**

ANSWER: 36 [or thirty-six]

<Zhou, Number Theory>

**The original creator of these objects is often credited with coining the term “bit” and “software”; that man conames a lemma with (\*) Teichmuller, along with a “honestly significant difference test” and a quantile-defined lambda distribution. Their aforementioned inventor critiqued the statistical methodology of the Kinsey scale and he sometimes conames an inference technique to estimate the variance of a statistic with Quenouille usually called jackknifing. A man of the same name as the creator of these plots names a window function that becomes a Hann window when its alpha parameter is zero. For 10 points, name these objects, invented by a man who conames an FFT algorithm with Cooley.**

ANSWER: box and whisker plots [or boxplot]

<Zhou, Statistics>

**In 2018, Market Track and InfoScout announced a merger between the two companies to form a company which shares its name with these numbers. In a Farey sequence of order  $2n-1$ , the first  $n$  of these numbers (excluding 0) are all 1. In Taylor series expansions, the  $n$ th of these numbers is given by (\*) an  $n$ th derivative of the function. If these numbers exceed their counterparts, their pairing is said to be improper. For 10 points, name these numbers, commonly written above denominators in fractions.**

ANSWER: **numerators**

<Zhou, Number Theory>

*Two answers required.* **One work by Leila Gharani on these two functions utilizes a “Misty Wash” app to highlight their ability to solve problems unsolvable by a related function; that work is titled “How to use [these functions] (the right way)”. Changing the value of the namesake type parameter of one of these functions allows it to perform its function either (\*) “to exact”, “next smallest”, or “next largest”. Nesting one of these functions inside the other allows for advanced searching. For 10 points, name these two Excel functions often contrasted with VLOOKUP.**

ANSWER: **INDEX/MATCH** [prompt on partial]

<Zhou, Applied>

*Two answers required.* **A gif showing a transformation between these two objects was nominated as a Wikipedia featured picture because “it caught my eye, I thought it looked cool.” As of November 13, 2021, that gif is shown alongside a similar gif of a transformation between a sphere and a cow named Spot. That gif is able to show a smooth deformation between these two objects because they have the same (\*) Euler characteristic. A common joke in mathematics is that topologists cannot tell the difference between these two objects. For 10 points, name these two objects, both of which can be purchased at Krispy Kreme.**

ANSWER: **doughnut** and **coffee cup**

<Zhou, Advanced>

**The Archimedean twin circles are inscribed in a figure defined by three of these shapes. Inverting this shape about a point in its interior yields the convex hull of the union of two circles. In a Farey diagram with the number line drawn in, there are a shit ton of these shapes that are made if the order of the Farey diagram is high enough, and I could probably tell you exactly how many, but it’s literally (\*) 4 in the morning and I’m honestly not sure why I’m still writing this tossup. Thales’ theorem states that a triangle inscribed in one of these shapes has a 90 degree angle. For 10 points, name this shape, which consists of a diameter and an arc that measures 180 degrees.**

ANSWER: **semicircle**

<Zhou, Geometry>

**The expression  $0.125 - 0.01$  is an example of an operation with a property closely related to this set of numbers. One of these numbers was the first to be demonstrated to be a counterexample to the Collatz conjecture while another was the second; those numbers are 3 and 22. Zero is a rare example of an exceptional number that is also one of these numbers. They are closely related to challenging data structures like trees. For 10 points, name these numbers that possess their namesake characteristic due to their (\*) properties.**

ANSWER: **special** numbers [prompt on challenging before mention; do not accept or prompt on “exceptional” or “magic”]

<Zhou, Number Theory>

**Bonus 7 of the 2014 National Science Bowl finals centers around this problem. Leetcode Problems 36 and 37 center around this problem. In the April/May 2012 issue of a magazine run by the MAA, Gary McGuire provided a lower bound on the information that must be contained within a formulation of this problem in order for it to have a unique solution. Cages with their associated (\*) sums written in the corners are introduced in the “killer” variety of this problem. One strategy for approaching this problem is the rule of 45, which states that certain sets of values in this problem sum up to 45. For 10 points, name this problem, solutions to which are 9 by 9 grids where no value appears twice in a row, column, or block.**

ANSWER: **sudoku**

<Zhou, Applied>

The cyclotomic polynomial of this order is the first eighth-degree cyclotomic polynomial. In a triangle, the Kimberling center named for this number is known as the first isodynamic point. This number is the third non-unity term in the continued fraction representation of pi. A (\*) **puzzle named after this number can be shown to be impossible to solve from its classical starting position by a parity invariance argument. The smallest (\*) composite Mersenne number is, for 10 points, what number, which is equivalent to F in hexadecimal?**

ANSWER: **15** (no power at the beginning—punishment for actually being good at math)

<Zhou, Other>

**Clifford Christopher Cocks, whose cryptography work paved the way for RSA encryption, earned this award in 1968. Terence Tao became one of the youngest people to win this award in 1987, doing so at the age of 12. In 1992, China became the first team to win its namesake competition (\*) without earning any of these awards. Adam Ardeishar and Gopal Goel are notable recent earners of, for 10 points, what award at a prestigious high school competition whose earners did worse than gold medalists?**

ANSWER: **International Math Olympiad Silver Medal** [or **IMO Silver**]

<Zhou, Other>

**With digits, one hundred of these objects were the subject of ten numerical approximation problems published in 2002. A probabilistic convolution tree may improve on the traditional dynamic programming solution to a classic problem that involves constructing fractions of these objects. A riddle involving three (\*) guests and a hotel is often named for the “missing” one of these objects. Frobenius sometimes co-names a class of problems about fractions of these objects, specific examples of which include the McNugget problem. For 10 points, name these objects, a million of which were refused by Grigori Perelman for solving the Poincare conjecture Millennium Prize Problem.**

ANSWER: **dollars**

<Zhou, Other>

**Alexander’s horned sphere is a counterexample to a 3-dimensional generalization of this statement. The most difficult part of proving this statement is in the case of “badly behaved” examples of its namesake objects. The Schoenflies theorem strengthens this result, which was mechanically checked by a 2005 proof in the Mizar system. One proof of this theorem uses the method of proof by (\*) “fucking obviousness” and concludes by calling this theorem a “trivial ass bich.” For 10 points, name this theorem, which roughly states that every non self-intersecting, planar, and continuous loop divides its plane into an inside and an outside.**

ANSWER: **Jordan curve theorem** [or **JCT**]

<Zhou, Theorems>