

“Math is Cool” Championships -- 2025-26

High School

Mental Math Solutions

	Answer	Solution
1	375	What is one hundred twenty-five times three? $125 \times 3 = 375$
2	5 [values of x]	How many integer values of x satisfy the following inequality: The absolute value of x is less than the square root of five $ x < \sqrt{5}$ The square root of 5 is a little more than 2 but less than 3, so the following values of x will work: -2, -1, 0, 1, 2.
3	117	What is the sum of the integers from three to fifteen, inclusive? Sum from 1 to 15 = $(15)(16)/2 = (15)(8) = (30)(4) = 120$. Subtract off 1 and 2: $120 - 1 - 2 = 117$.
4	7 [units]	A right triangle has a leg length of two units, and a hypotenuse length of square root of fifty-three units. In units, what is the length of the other leg? $2^2 + 7^2 = 4 + 49 = 53$
5	-4 [=x]	Solve for x in the following equation: Negative eight x plus twenty-one equals fifty-three $-8x + 21 = 53$ $-8x = 32$ $x = -4$
6	25 [percent]	When a fair coin is flipped four times, what is the probability as a percent that there are exactly three heads? There are $2^4 = 16$ total possibilities There are $4!/(3!1!) = 4$ ways to arrange HHHT. $4/16 = 25\%$
7	108 [faces]	A three by three Rubik's cube is made of twenty-seven smaller cubes. How many of the small cube faces are NOT visible from the outside of the Rubik's cube? There are a total of $6 \times 27 = 162$ of these “smaller” faces. From the outside, we can see $9 \times 6 = 54$ of these faces. Therefore, we cannot see $162 - 54 = 108$ of these “smaller” faces

8	90 [mph]	<p>Aditya starts the first leg of his two hundred and fifty mile road trip by driving one hundred miles at an average rate of thirty miles per hour. If he wants to average fifty miles per hour throughout the whole trip, how many miles per hour does he have to average during the second leg of his trip?</p> <p>250 miles at an average speed of 50 mph = $250/50 = 5$ hours of driving.</p> <p>Leg 1: 100 miles at 30 mph = $100/30 = 3\frac{1}{3}$ hours</p> <p>Therefore, Aditya needs to cover the remaining 150 miles in $1\frac{2}{3}$ hours.</p> <p>$150/(5/3) = 150(3/5) = 90$ miles per hour.</p>
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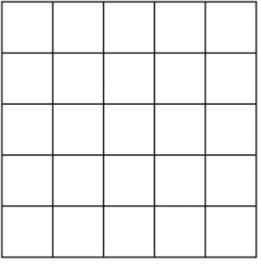
“Math is Cool” Championships -- 2025-26

High School

Individual Test Solutions

	Answer	Solution
1	100320 [feet]	How many feet are in 19 miles? 1 mile = 5280. 19 miles = $5280 * 19 = 100320$ feet.
2	494 [sq. ft.]	Royal paints a wall at a rate of 76 square feet per hour and finishes painting the neighbor's wall in 390 minutes. How many square feet is the neighbor's wall? 390 minutes = 6.5 hours. $6.5 * 76 = 494$ sq feet
3	117600 [ways, or orders]	In how many different ways can Malia pick 3 of the 50 U.S. states to visit for her next trip? The order in which she visits the states matters. $50P3 = 50 * 49 * 48 = 117600$
4	3 [= minimum]	What is the minimum function value of the following function: $F(x) = x^2 - 6x + 12$ The function is minimized at the vertex, where $x = 3$. $f(3) = 3$
5	8 [= A]	A circle with radius 6 units contains 7 circles of radius 2 units, all mutually tangent, as shown. The shaded area in square units which is inside the large circle but outside the smaller circles can be written as $A\pi$. What is A? The larger circle has an area of 36π . The smaller circles each has an area of 4π . $36 - 7 \cdot 4 = 8\pi$.
6	8 [= A]	The Utah Jazz are down 0-2 in a best-of-5 game series against the Trailblazers. If the Jazz have a 50% probability of winning each game, the probability that they win the series can be written as simplified fraction $1/A$. What is A? The Jazz need to win 3 games in a row. $0.5^3 = 1/8$. A = 8.
7	31 [= next term]	What is the next term in the following sequence? 7, 11, 13, 17, 19, 23, 29, ... This is a list of primes. The next largest prime is 31.
8	140 [degrees]	What is the measurement in degrees of one interior angle of a regular nonagon? The outer angle of a regular n-gon = $360/n$. Therefore, an inner angle of a regular nonagon = $180 - 360/9 = 140$ degrees

9	0 [x-int]	How many x-intercepts does the following equation have? $y = x^2 - 4x + 14$ The discriminant = $16 - 14^2 < 0$. Therefore, there are no real solutions and therefore no x-intercepts.
10	1235	Evaluate: $3^5 - 2^5 + 4^5$ $3^5 - 2^5 + 4^5 = 1235$
11	110 [ways]	On a Board of Directors of 11 people, in how many ways can one president and one vice president be selected? $11P2 = 110$
12	210 [$^\circ$]	In degrees, for what value of angle θ in the third quadrant does $\sin(\theta) = -0.5$? Assume $0^\circ < \theta < 360^\circ$. $\sin(210 \text{ degrees}) = -0.5$
13	5 [= x]	The mean of the following set of numbers is equal to $2x$. What is the value of x ? $\{1, 2, 2, 3, 4, 4, 5, 13, 39, 32, x\}$ $1+2+2+3+4+4+5+13+39+32 = 105$ $(105 + x)/11 = 2x \Rightarrow x = 5$
14	80 [students]	At Pullman High School, 30% of the 800 students play tennis and 80% of the students swim. If every student at PHS plays at least either tennis or swims, how many students play both sports? $800 * 0.3 = 240$ students play tennis $800 * 0.8 = 640$ students swim $240 + 640 - 800 = 80$ students play both sports.
15	-593 [= 100 th term]	Find the 100 th term of the arithmetic sequence with first term 100 and second term 93. $d = -7$ $a_n = a_1 + (n - 1)d = 100 + (99)(-7) = -593$
16	6 [= gcd]	What is the greatest common divisor of 210 and 144? The prime factorization of 210 = $2 * 3 * 5 * 7$ The prime factorization of 144 = $2^4 * 3^2$ gcd = $2 * 3 = 6$
17	28 [sq. units]	In square units, what is the area of the triangle with vertices A, B and C as follows? A(4, 4), B(11, 4), C(-11, -4)? Line segment AB = 7 The perpendicular distance from C to AB equals 8. $A = 7*8/2 = 28$

18	55 [squares]	<p>How many squares of any size are in the following figure, which is composed of a grid of unit squares.</p> <p>Count them:</p> <p>1x1: 25 2x2: 16 3x3: 9 4x4: 4 5x5: 1 Sum = 55</p> 
19	7 [= ones digit]	<p>What is the ones digit of 7^{2025}?</p> <p>Powers of 7 repeat ones digits 7,9,3,1 in that order, as is: $7^1 = 7$, $7^2 = 49$ (ends in 9), $7^3 = 343$ (ends in 3), and $7^4 = 2401$ (ends in 1).</p> <p>$2026 \equiv 2 \pmod{4}$, therefore, 7^{2026} ends in a 9.</p>
20	60 [units]	<p>Two sides of a triangle have lengths 7.4 and 4.3 units. The third side of a triangle has an integer length. What is the sum of all the possible lengths of this third side, in units?</p> <p>The third side must be greater than the difference of 7.4 and 4.3 and less than the sum of 7.4 and 4.3.</p> <p>Therefore, this means the third side can equal 4 through 11.</p> <p>The sum of 4 through 11 = 60</p>
21	135 [= A + B]	<p>Nora is taking a 10 question True/False test. She must answer every question, and each question has either T or F as an answer. If she randomly guesses every question, the probability that she gets at least 8 correct out of 10 can be written as a simplified fraction A/B. What is $A + B$?</p> <p>Probability of getting 10 right: $(\frac{1}{2})^{10} = 1/1024$</p> <p>Probability of getting 9 right: $(10C9) * (\frac{1}{2})^9 * (\frac{1}{2}) = 10/1024$</p> <p>Probability of getting 8 right: $(10C8) * (\frac{1}{2})^8 * (\frac{1}{2})^2 = 45/1024$</p> <p>$(1+10+45)/1024 = 56/1024 = 7/128 = A/B$</p> <p>$A + B = 135$</p>
22	159 [= det]	<p>What is the determinant of the following 3x3 matrix?</p> <p>Determinant = $2*(3*1-6*2) - 5*(4*1-6*7) + 1*(4*2-3*7) = 159$</p> $\begin{bmatrix} 2 & 5 & 1 \\ 4 & 3 & 6 \\ 7 & 2 & 1 \end{bmatrix}$

23	5 [= Shivali's position]	<p>Ten students are lined up in the hallway, from shortest to tallest. Their positions are numbered from 1 (shortest) to 10 (tallest). Given the following clues, Shivali is in which number position?</p> <ol style="list-style-type: none"> 1. Ella is taller than Anna. 2. Anna is taller than Kavin. 3. Kavin is taller than Theo. 4. Ashwin is taller than Kavin but shorter than Anna. 5. Isabelle is standing between Shivali and Sarah. 6. Sarah is shorter than Ella but taller than Isabelle. 7. Vedant is standing between Ella and Aiden. 8. Aiden is standing next to Sarah. <p>Seven students are standing between Vedant and Theo.</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; width: 50%;">Short</td><td style="text-align: center; width: 50%;">Tall</td></tr> </table> <p>Clues 1-4:</p> <table style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <tr> <td style="text-align: center;">Theo</td><td style="text-align: center;">Kavin</td><td style="text-align: center;">Ashwin</td><td style="text-align: center;">Anna</td><td style="text-align: center;">Ella</td></tr> </table> <p>Clues 5+6: Shivali Isabelle Sarah (all below Ella)</p> <p>Clue 8: Sarah Aiden</p> <p>Clue 7: Sarah Aiden Vedant Ella</p> <p>Combine:</p> <table style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <tr> <td style="text-align: center;">Theo</td><td style="text-align: center;">Kavin</td><td style="text-align: center;">Ashwin</td><td style="text-align: center;">Anna</td><td style="text-align: center;">Shivali Isabella Sarah Aiden Vedant Ella</td></tr> <tr> <td style="text-align: center;">1</td><td style="text-align: center;">2</td><td style="text-align: center;">3</td><td style="text-align: center;">4</td><td style="text-align: center;">5</td></tr> </table> <p>Key:</p> <ul style="list-style-type: none"> 1 = Theo 2 = Kavin 3 = Ashwin 4 = Anna 5 = Shivali 6 = Isabelle 7 = Sarah 8 = Aiden 9 = Vedant 10 = Ella 	Short	Tall	Theo	Kavin	Ashwin	Anna	Ella	Theo	Kavin	Ashwin	Anna	Shivali Isabella Sarah Aiden Vedant Ella	1	2	3	4	5
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24	13 [sq units]	<p>Triangle ABC has side AB = 13 units, side BC = 14 units, and $\sin B = 1/7$. What is the area in square units of triangle ABC?</p> $\text{ABC} = \frac{1}{2} * AB * BC * \sin(\angle B) = 13 * 14 * 0.5 * 1/7 = 13$																	

25	-4 [= $p^2 + q^2$]	The quadratic function $f(x) = 2x^2 - 6x + 13$ has roots p and q. What is the value of $p^2 + q^2$? From Vieta's formulas: $pq = c/a = 13/2$ $p + q = -b/a = -6/2 = -3$ $p^2 + q^2 = (p + q)^2 - 2pq = (-3)^2 - 2(13/2) = 9 - 13 = -4$
26	6 [= sum of values of x]	Find the sum of all values of x that satisfy this equation: $\log_2\left(\frac{1}{2}(x^2 - 6x)\right) = \log_3(27)$ $\log_2\frac{1}{2} + \log_2((x^2 - 6x)) = 3$ $\log_2((x^2 - 6x)) = 4$ $x^2 - 6x = 16$ $x^2 - 6x - 16 = 0$ $(x - 8)(x + 2) = 0$ $x = 8, -2$ $8 - 2 = 6$
27	33 [degrees F]	Crozito measures the average temperature for every month of 2025. Through the end of November, the average temperature across 11 months is 45 °F. After December, the average temperature across 12 months is 44 °F. If every month is given the same weight in Crozito's calculations, what was the average temperature in December, in degrees F? Sum up until November = $45 * 11 = 495$ $(495+D)/12 = 44 \rightarrow D = 33$
28	4 [= $a + b + c$]	The formula of the quadratic equation that passes through the points $(-3, 0)$, $(4, 49)$, and $(1, 4)$ can be written in simplest terms as $f(x) = ax^2 + bx + c$. What is $a + b + c$? Plugging in the points, we get $9a - 3b + c = 0$ $16a + 4b + c = 49$ $a + b + c = 4$ Solving the system of equations, we get $(a, b, c) = (2, 5, -3)$. $a + b + c = 2 + 5 + (-3) = 4$

29	14 [days, or day number]	<p>Tiana discovers a magical jar that doubles the amount of money it gives her each day. On day number 1, the jar gives her 1 cent, and on day number 2, the jar gives her 2 cents. On which day number will the total amount of money she has received exceed \$100?</p> <p>$100 = 10,000$ cents.</p> <p>By looking at the first few days, we can see that the cumulative sum is equal to $2^n - 1$. For $2^{10} = 1024$, so on the 10th day the total amount = 1023 cents. It will take 14 days for the total to be greater than 10000 cents.</p> <table border="1"> <thead> <tr> <th>Day (n)</th><th>Cents received</th><th>Cumulative sum</th></tr> </thead> <tbody> <tr><td>1</td><td>1</td><td>1</td></tr> <tr><td>2</td><td>2</td><td>3</td></tr> <tr><td>3</td><td>4</td><td>7</td></tr> <tr><td>4</td><td>8</td><td>15</td></tr> <tr><td>5</td><td>16</td><td>31</td></tr> <tr><td>6</td><td>32</td><td>63</td></tr> <tr><td>7</td><td>64</td><td>127</td></tr> <tr><td>8</td><td>128</td><td>255</td></tr> <tr><td>9</td><td>256</td><td>511</td></tr> <tr><td>10</td><td>512</td><td>1023</td></tr> <tr><td>11</td><td>1024</td><td>2047</td></tr> <tr><td>12</td><td>2048</td><td>4095</td></tr> <tr><td>13</td><td>4096</td><td>8191</td></tr> <tr><td>14</td><td>8192</td><td>16383</td></tr> </tbody> </table>	Day (n)	Cents received	Cumulative sum	1	1	1	2	2	3	3	4	7	4	8	15	5	16	31	6	32	63	7	64	127	8	128	255	9	256	511	10	512	1023	11	1024	2047	12	2048	4095	13	4096	8191	14	8192	16383
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30	60	<p>What is the smallest integer that has more factors than 48?</p> <p>$48 = 2^4 * 3$, therefore it has $5*2 = 10$ factors.</p> <p>The smallest number with 11 factors is $2^{10} = 1024$.</p> <p>The smallest number is 12 factors = $2^2 * 3 * 5 = 60$.</p> <p>Can check all numbers less than 60, none work.</p>																																													

31

$$6 [= c + d + e]$$

The equations of the smaller circles are as follows:

$$(x - 2)^2 + (y - 2)^2 = 4 \text{ (on right)}$$

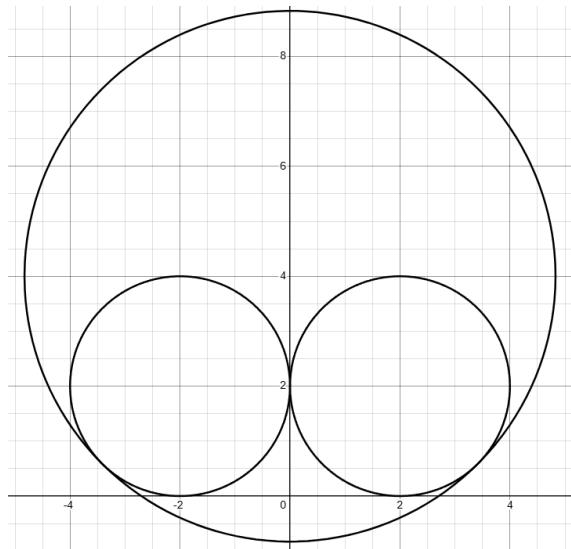
$$(x + 2)^2 + (y - 2)^2 = 4 \text{ (on left)}$$

The larger circle, centered at $(0, 4)$, is internally tangent to both of the smaller circles. The equation for this circle can be written as:

$$x^2 + y^2 + ax + by = c\sqrt{d} + e$$

where a, b, c, d and e are integers.

What is $c + d + e$?



We can draw a line starting from $(0, 4)$ that passes through $(2, 2)$. This line, $y = 4 - x$, intersects the right-most circle at $(2 + \sqrt{2}, 2 - \sqrt{2})$, the point of tangency between the two circles. Therefore, the radius of the large circle can be found using the distance formula between the points $(0, 4)$ and $(2 + \sqrt{2}, 2 - \sqrt{2})$.

Therefore the radius of the large circle equals $2\sqrt{3 + 2\sqrt{2}}$.

$$\text{And } r^2 = 12 + 8\sqrt{2}$$

Write the equation of the large circle:

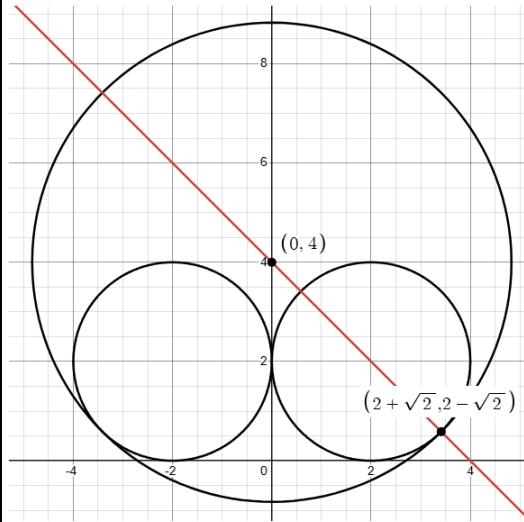
$$x^2 + (y - 4)^2 = 12 + 8\sqrt{2}$$

Expand and put into form that was given in the problem:

$$x^2 + y^2 + 0x + (-8y) = 8\sqrt{2} + (-4)$$

$$C = 8, d = 2, e = -4$$

$$8 + 2 + (-4) = 6$$

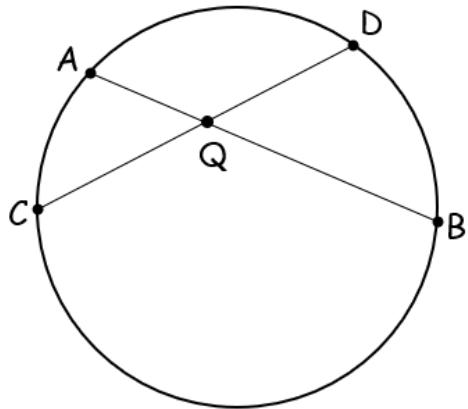


32	59 [hot dogs]	<p>Pullman High School's concession stand sells hot dogs in packages of 7 and 11. What is the greatest number of hot dogs that cannot be purchased using only these pack sizes?</p> <p>Use the chicken McNugget theorem. The largest number you cannot buy is $11 * 7 - 11 - 7 = 77 - 18 = 59$</p>
33	44 [ways]	<p>Five students each have an assigned seat, but they randomly choose seats without knowing the assignments. In how many ways can they all sit such that no one ends up in their assigned seat?</p> <p>This is a derangement problem. The derangement sequence is defined by:</p> <p>$D(n) = (n - 1) * [D(n - 1) + D(n - 2)]$, with $D(1) = 0$ and $D(2) = 1$. This can be used to find the derangement sequence, with $D(5) = 44$.</p> <p>0, 1, 2, 9, 44.</p> <p>Alternatively, derangements can be solved using the Principle of Inclusion-Exclusion (PIE). The reader is encouraged to explore this solution on their own! 😊</p>
34	40 [base 10]	<p>The number $23A2B_7$ (base 7) is divisible by 23 (base 10). If A is odd, what is the value of AB_7 (base 7) in base 10?</p> <p>$23A2B$ in base 7 = $2 * 2401 + 3 * 343 + 49A + 14 + B$. Simplify to $5845 + 49A + B$.</p> <p>Taking mod 23, we get the following equation:</p> <p>$3 + 3A + B \equiv 0 \pmod{23}$. Since A and B are in base 7, we know that they must be digits between 0 and 6. Additionally, since A is odd, we know that A must be 1, 3, or 5.</p> <p>A = 1: $B = -6 = 17 \pmod{23} \rightarrow$ Doesn't work</p> <p>A = 3: $B = -12 = 11 \pmod{23} \rightarrow$ Doesn't work</p> <p>A = 5: $B = -18 = 5 \pmod{23} \rightarrow B = 5$.</p> <p>Therefore, $(A, B) = (5, 5)$. 55 base 7 = $5 * 7 + 5 = 40$.</p>
35	560 [ordered quadruples (a, b, c, d)]	<p>How many ordered quadruples (a, b, c, d) of non-negative integers satisfy the following equation?</p> <p>$a + b + c + d = 13$</p> <p>This is a classic stars and bars problem. We have to arrange 13 stars and 3 bars, and the number of stars between each of the bars is equivalent to the values of a, b, c, and d.</p> <p>$16C3 = 560$</p>

36	70	<p>Evaluate the following:</p> $7 + \frac{42}{9 - \frac{351}{18 + \frac{7}{1 - \frac{428}{603}}}}$ <p>Start from the bottom of the fraction and work up: $1 - 428/603 = 175/603$, and $7/(175/603) = 603/25$ $18 + 603/25 = 1053/25$, and $351/(1053/25) = 25/3$ $9-25/3 = 2/3$, and $42/(2/3) = 63$ $7 + 63 = 70$</p>
37	173 [= A + B]	<p>Imbert is drawing cards from a standard 52-card deck, one at a time with replacement. If he draws 5 cards, the probability that he draws exactly three cards of one suit can be written as simplified fraction A/B. What is $A + B$?</p> <p>We will call the suits A, B, C, & D.</p> <p>Case 1) AAABB $4 * 3 * 5!/(3!2!) * (\frac{1}{4})^5 = 15/128$</p> <p>Case 2) AAABC $4 * 3C2 * 5!/3! * (\frac{1}{4})^5 = 15/64$</p> <p>$15/64 + 15/128 = 45/128$</p> <p>Therefore, $A + B = 45 + 128 = 173$</p>

3825 [= $x + y$]

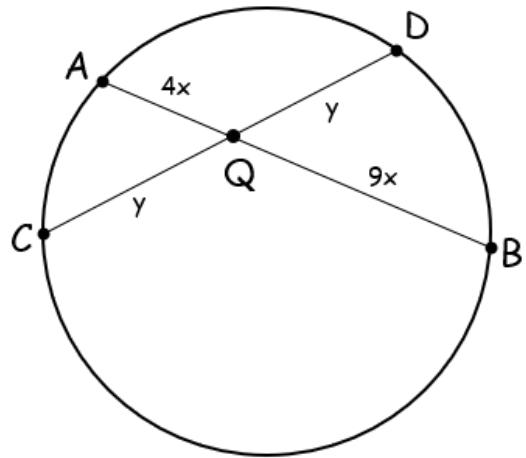
In the following circle, $AQ : QB = 4 : 9$, and $CQ : QD = 1 : 1$. $AB : CD$ can be written in simplest terms as $x:y$. What is $x + y$?



Let $AQ = 4x$, $QB = 9x$, $CQ = y$, $QD = y$.

By power of a point, $(4x)(9x) = (y)(y)$, therefore $6x = y$.

$CD = 2y = 12x$. Therefore, $AB:CD = 13:12$, $x + y = 25$



39	7 [distinct real solutions]	<p>How many distinct real solutions are there to the following equation?</p> $(((x^2 - 1)^2 - 2)^2 - 3)^2 = 4$ <p>The degree of the polynomial is 16, so there must be 16 total solutions, so that is the upper limit. However, some may be complex, or repeated roots.</p> <p>Start by taking the square root of both sides:</p> $(((x^2 - 1)^2 - 2)^2 - 3)^2 = 4$ $((x^2 - 1)^2 - 2)^2 - 3 = \pm 2$ $((x^2 - 1)^2 - 2)^2 = 1 \text{ or } 5$ <p>Take the square root of both sides again:</p> $(x^2 - 1)^2 - 2 = \pm\sqrt{1} \text{ or } \pm\sqrt{5}$ $(x^2 - 1)^2 - 2 = -1, 1, -\sqrt{5}, \text{ or } \sqrt{5}$ $(x^2 - 1)^2 = 1, 3, 2 - \sqrt{5}, \text{ or } 2 + \sqrt{5}$ <p>Eliminate $2 - \sqrt{5}$ because it is negative.</p> <p>Take the square root of both sides again:</p> $x^2 - 1 = -1, 1, -\sqrt{3}, \sqrt{3}, \text{ or } \pm\sqrt{2 + \sqrt{5}}$ $x^2 = 0, 2, 1 - \sqrt{3}, 1 + \sqrt{3}, \text{ or } 1 \pm \sqrt{2 + \sqrt{5}}$ <p>Eliminate $1 - \sqrt{3}$ and $1 - \sqrt{2 + \sqrt{5}}$ because they are negative.</p> <p>$x^2 = 0$ gives 1 (distinct) real solution, $x = 0$</p> <p>$x^2 = 2$ gives 2 real solutions</p> <p>$x^2 = 1 + \sqrt{3}$ gives 2 real solutions</p> <p>$x^2 = 1 + \sqrt{2 + \sqrt{5}}$ gives 2 real solutions</p> <p>Total = 7 distinct real solutions.</p>
40	6 [= sum]	<p>A sequence of numbers begins as follows. Starting with the third term, each term is equal to the term preceding it minus the term preceding that one. What is the sum of the first 2025 terms of the sequence?</p> <p>1, 3, 2, -1, ...</p> <p>Write a few more terms of the sequence:</p> <p>1, 3, 2, -1, -3, -2, 1, 3, 2, ...</p> <p>Notice that it starts to repeat itself after 6 terms, and will repeat as such infinitely.</p> <p>The sum of each block of 6 terms is 0.</p> <p>$2025/6 = 337 \text{ r } 3$, therefore the sum will be $1 + 3 + 2 = 6$</p>

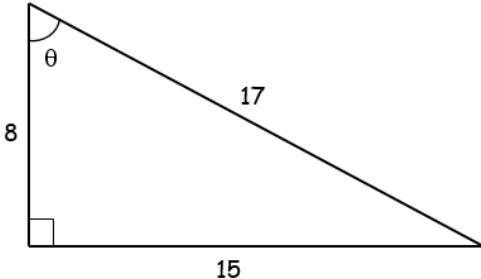
“Math is Cool” Championships -- 2025-26

High School

Multiple Choice Solutions

9/ 10th	11/ 12th	Answer	Solution
1	1	D	<p>The numbers 2, 13, -4, $\frac{4}{5}$, x, and y have a mean of 12.8. What is the mean of the two numbers x and y?</p> <p>A) 13.0 B) 15.8 C) 30 D) 32.5 E) Answer not given</p> $2 + 13 + (-4) + \frac{4}{5} = 11.8$ $(11.8 + x + y)/6 = 12.8$ $X + y = 65$ $(x + y)/2 = 65/2 = 32.5$
2		D	<p>In which quadrant do the following two lines intersect?</p> <ol style="list-style-type: none">1. $8x + 3y = 20$2. $-4y = x + 5$ <p>A) Quadrant 1 B) Quadrant 2 C) Quadrant 3 D) Quadrant 4 E) The lines do not intersect.</p> <p>Solving, we get that</p> $X = -4y - 5 \text{ and}$ $X = (20-3y)/8$ <p>$X = \frac{95}{29}, y = -\frac{60}{29}$.</p> <p>Since $x > 0$ and $y < 0$, the lines intersect in the 4th quadrant.</p>

	2	B	<p>Which of the following best approximates the value of $f(g(1))$?</p> <p>A) -7 B) -5 C) 0 D) 2 E) -2 Looking at the graph, $g(1) = 0$. Therefore, $f(g(1)) = f(0) = -5$.</p>
	3	B	<p>What is the circumference of a circle circumscribed about a square of side length 8?</p> <p>A) $4\pi\sqrt{2}$ B) $8\pi\sqrt{2}$ C) 8π D) 12π E) Answer not given. Use the Pythagorean Theorem to find that the diagonal of the square, which equals the diameter of the circle, equals $8\sqrt{2}$. Therefore the radius of the circle equals $4\sqrt{2}$. $\text{Circumference} = 2\pi r = 2\pi \cdot 4\sqrt{2} = 8\pi\sqrt{2}$</p>

	3	C	<p>For the right triangle shown here, find the value of $\sin \theta + \cos \theta$.</p>  <p>A) 1 B) 35/8 C) 23/17 D) 5/3 E) Answer not given.</p> <p>SOH CAH TOA:</p> <p>The value of $\sin \theta = 15/17$</p> <p>The value of $\cos \theta = 8/17$</p> <p>$\sin \theta + \cos \theta = (15+8)/17 = 23/17$</p>
4	4	D	<p>How many positive factors does the number 2160 have?</p> <p>A) 28 B) 16 C) 32 D) 40 E) Answer not given.</p> <p>$2160 = 2^4 * 3^3 * 5$,</p> <p>Therefore, it has a total number of $(4+1)(3+1)(1+1) = 5 * 4 * 2 = 40$ factors.</p>
5		A	<p>Which of the following linear equations is perpendicular to the line through the points $(-6, 5)$ and $(2, 3)$?</p> <p>A) $4y - 16x = 23$ B) $13x - 3y = 10$ C) $x + 4y = -6$ D) $y = -4x + 10$ E) Answer not given.</p> <p>The slope through the 2 points is: $m = (3 - 5)/(2 - (-6)) = -1/4$</p> <p>Therefore the slope of the perpendicular line will = 4, which is only true for equation A.</p>
	5	C	<p>The expression $((2x)^{-1} + y)^{-1}$ is equivalent to which of the following?</p> <p>A) $\frac{1+2xy}{2x}$ B) $\frac{2xy+1}{y}$ C) $\frac{2x}{1+2xy}$ D) $\frac{y}{2xy+1}$ E) Answer not given.</p> $ \begin{aligned} ((2x)^{-1} + y)^{-1} &= \\ \left(\frac{1}{2x} + y\right)^{-1} &= \\ \left(\frac{1+2xy}{2x}\right)^{-1} &= \\ \frac{2x}{1+2xy} \end{aligned} $

6	D	<p>Rows 0 through 5 of Pascal's Triangle are shown here, where the top row is Row 0. What is the sum of all entries in Row 8 of Pascal's Triangle?</p> <table style="margin-left: auto; margin-right: auto;"> <tr><td>1</td></tr> <tr><td>1</td><td>1</td></tr> <tr><td>1</td><td>2</td><td>1</td></tr> <tr><td>1</td><td>3</td><td>3</td><td>1</td></tr> <tr><td>1</td><td>4</td><td>6</td><td>4</td><td>1</td></tr> <tr><td>1</td><td>5</td><td>10</td><td>10</td><td>5</td><td>1</td></tr> </table> <p>A) 122 B) 126 C) 254 D) 256 E) Answer not given.</p> <p>The sum of all the entries of the nth row is equal to 2^n.</p> <p>Therefore, the entries in the 8th row sum to $2^8 = 256$.</p> <p>Alternatively, generate additional rows down to Row 8: 1 8 28 56 70 56 28 8 1, and add the numbers.</p>	1	1	1	1	2	1	1	3	3	1	1	4	6	4	1	1	5	10	10	5	1
1																							
1	1																						
1	2	1																					
1	3	3	1																				
1	4	6	4	1																			
1	5	10	10	5	1																		
6	A	<p>What is the sum of the following series?</p> $-2 + 13 + 28 + 43 + \dots + 1168 + 1183$ <p>A) 47240 B) 46057 C) 48438 D) 48453 E) Answer not given.</p> <p>The common difference of this arithmetic sequence is 15. $1185/15 = 79$, so have to add 15 a total of 79 times to get from -2 to 1183, so a total of $n = 80$ terms.</p> $S_{80} = \frac{80(-2 + 1183)}{2}$ $= 47240$																					
7	C	<p>How many times does Posey have to roll a standard 6-sided die until the expected value of the sum of the rolled numbers exceeds 50?</p> <p>A) 13 B) 14 C) 15 D) 16 E) Answer not given.</p> <p>The expected value of a single roll is $(1+2+3+4+5+6)/6 = 3.5$. $3.5 * 14 < 50 < 3.5 * 15$.</p> <p>Therefore, the dice must be rolled 15 times.</p>																					

8

8

C

At 12 a.m. on Christmas Eve (December 24), Dominic remarks that "In 1,000,000 seconds, it'll be my birthday!" What is the date of Dominic's birthday?

- A) January 2nd
- B) January 3rd
- C) January 4th
- D) January 5th
- E) Answer not given.

A day has $24 * 60 * 60 = 86400$ seconds.

Therefore, 1,000,000 seconds in the future is equal to $1000000/86400 = 11.57$ days in the future.

11-something days in the future from 12 a.m. on 12/24 is January 4th.

9

9

B

Two quarter circles are drawn within a square of side length 4 centimeters as shown below. What is the total area of the shaded regions?

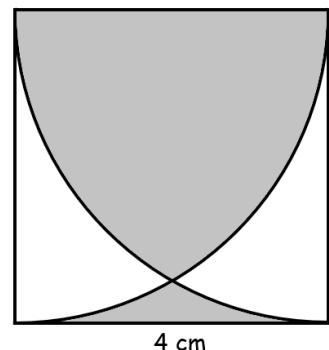
A) $16 - 4\sqrt{3} + \frac{4\pi}{3} \text{ cm}^2$

B) $16 - 8\sqrt{3} + \frac{8\pi}{3} \text{ cm}^2$

C) $8 - 8\sqrt{3} + 3\pi \text{ cm}^2$

D) 1 cm^2

E) Answer not given.



Adding the 2 red lines forms an equilateral triangle with side length 4, and each of the interior angles equal to 60 degrees. Ultimately we want to find area A (blue), so we start by finding the area of the circle sector, areas T + Q (yellow + green).

$$\text{Sector area} = \frac{60}{360} \cdot \pi \cdot 4^2 = \frac{8\pi}{3}$$

Now find the area of triangle T.

$$T \text{ area} = \frac{\sqrt{3}}{4} \cdot 4^2 = 4\sqrt{3}$$

$$\text{Therefore, area of } Q = \frac{8\pi}{3} - 4\sqrt{3}$$

Now find the area of the 30° sector, or area Q + A.

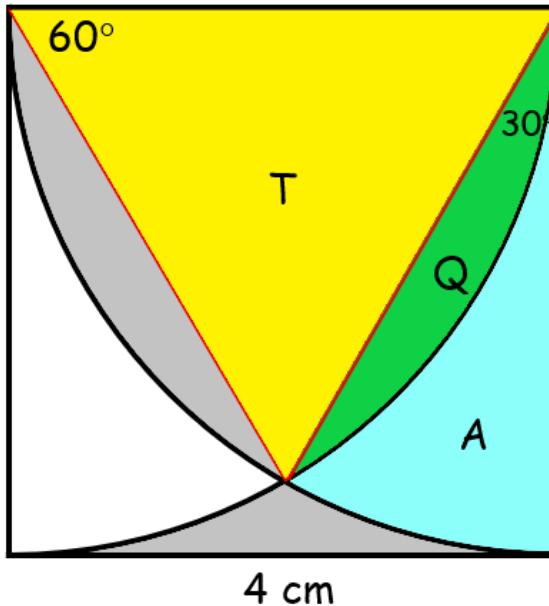
$$\text{Area} = \frac{30}{360} \cdot \pi \cdot 4^2 = \frac{4\pi}{3}$$

Therefore, area A = that sector area minus Q:

$$A = \frac{4\pi}{3} - \left(\frac{8\pi}{3} - 4\sqrt{3} \right) = 4\sqrt{3} - \frac{4\pi}{3}$$

The original shaded area will equal the area of the square (16) minus 2A:

$$\text{Area} = 16 - 2 \left(4\sqrt{3} - \frac{4\pi}{3} \right) = 16 - 8\sqrt{3} + \frac{8\pi}{3}$$



10**10****D**

Harley has three marbles that are different colors: red, green and blue. Harley randomly selects a non-empty subset of the marbles and puts them in a bag. Jack then draws three marbles from the bag, one at a time with replacement. Their colors are red, blue and red. What is the probability that the only marbles in the bag are red and blue?

- A) $\frac{11}{54}$ B) $\frac{1}{2}$ C) $\frac{35}{432}$ D) $\frac{27}{35}$
E) Answer not given.

All possible subsets are: R, G, B, RG, RB, GB, or RGB. Out of these, only RB and RGB are possible in the scenario described. Therefore, one of those subsets is randomly chosen with a probability of $\frac{1}{2}$, and then the marbles are selected.

If the bag is RB:

$$P(R, B, R) = (1/2)(1/2)(1/2)(1/2) = 1/16$$

If the bag is RGB:

$$P(R, B, R) = (1/2)(1/3)(1/3)(1/3) = 1/54$$

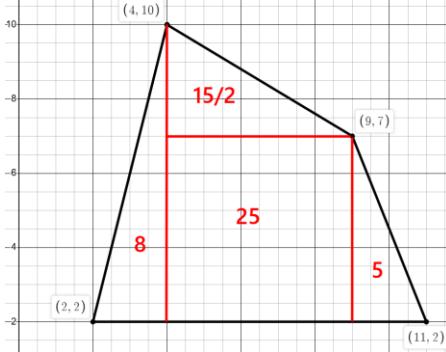
These are the only possibilities.

$$1/16 + 1/54 = 35/432$$

Therefore, probability that it is the RB bag is: $P = (1/16)/(35/432) = 27/35$

“Math is Cool” Championships -- 2025-26
High School
Team Test Solutions

9/ 10th	11/ 12th	Answer	Solution
1	1	84,000 [mm³]	A standard iPhone 14 is shaped like a rectangular prism, with dimensions of 15 centimeters, 7 centimeters, and 8 millimeters. What is the volume of this iPhone 14, in cubic millimeters? $15 \text{ cm} = 150 \text{ mm}$. $7 \text{ cm} = 70 \text{ mm}$ $150 \times 70 \times 8 = 84,000 \text{ mm}^3$
2		6 [perfect squares]	How many perfect squares are divisors of 2025? $2025 = 3^4 \times 5^2$. We can multiply any of 1, 3^2 , 3^4 with 1, 5^2 for a total of $3^2 = 6$ perfect squares.
	2	12 [= n]	What is the largest integer n such that n^2 is a divisor of $24 \cdot 35 \cdot 46 \cdot 57$? $24 \cdot 35 \cdot 46 \cdot 57 = 2^4 \cdot 3^2 \cdot 5 \cdot 7 \cdot 19 \cdot 23$ Therefore, $n = 2^2 \cdot 3 = 12$ is the largest integer that can be squared ($= 2^4 \cdot 3^2$) and still divide the original number.

3	3 91 [= 2X] [= twice the area]	<p>Let X = the area of the quadrilateral on the coordinate plane with the following vertices: A (4,10), B (9,7), C (11,2) and D (2,2)</p> <p>What is the value of 2 times X? We can use the shoelace theorem.</p> $4*7 + 9*2 + 11*2 + 2*10 = 88$ $9*10 + 7*11 + 2*2 + 4*2 = 179$ $\frac{1}{2}(179-88) = \frac{1}{2}*91, \text{ answer is } 91.$ <p>OR, by making a rough sketch of the figure, can split it up into regions to find the area that way.</p> 
4	4 6 [quarters]	<p>Alek has 21 coins, a mixture of dimes and quarters. If the dimes were quarters and the quarters were dimes, Alek would have \$1.35 more than he has now. How many quarters does he currently have?</p> $D + Q = 21$ $25D + 10Q = 135 + (10D + 25Q)$ $15D - 15Q = 135$ $D - Q = 9$ $2D = 30, D = 15, \text{ therefore } Q = 6$
5	70 [%]	<p>An integer from 1 through 40 inclusive is randomly chosen. As a percentage, what is the probability that it is not a prime number?</p> <p>The prime numbers between 1 and 40 are: 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37</p> $(40-12)/40 = 28/40 = 7/10 = 70\%$

	5	121 [= A + B]	<p>An integer from 1 through 70 inclusive is randomly chosen. The probability that it is not prime can be written as simplified fraction A/B. What is A + B?</p> <p>The prime numbers between 1 and 40 are: 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67</p> <p>$(70-19)/70 = 51/70$.</p> <p>Answer is $51+70 = 121$.</p>
	6	27 [= times, or number of times]	<p>In a list of 100 numbers, we know that there are at least 50 distinct values. How many times must a single number be repeated to ensure that it must be the unique mode?</p> <p>If a number is repeated 26 times, then there can be 2 values repeated 26 times and the other 48 values are repeated 1 once, which doesn't lead to a unique mode. Therefore, a number must be repeated 27 times.</p>
	7	841 [= CBA]	<p>In the following addition problem, each letter represents a different digit from 0 to 9. What is the 3-digit integer CBA?</p> $ \begin{array}{r} & A & B & C \\ & A & B & C \\ + & A & B & C \\ \hline & B & B & B \end{array} $ <p>Can analyze by choosing values of C to see when a contradiction results. For example, $C \neq 0$ because that would result in B also equaling 0. $C \neq 1$ because then B would equal 3 according to the right column, but in the middle column $3 + 3 + 3 = 9$, and B can't equal both 3 and 9.</p> <p>Continuing on this way, the only result that work is if $C = 8$, therefore $B = 4$ and $A = 1$.</p> <p>$CAB = 841$</p>

7

20 [= sum
of values in
shaded
square]

In the following puzzle, which may have more than one solution, fill in the boxes with one number each to make the four equations true. There are two equations reading across the rows, and two equations reading down the columns. What is the sum of the values that go in the shaded square, for all valid solutions?

$$\begin{array}{c}
 \boxed{} \times \boxed{} = 15 \\
 + \quad + \\
 \boxed{} - \boxed{} = 5 \\
 = \quad = \\
 3 \quad 12
 \end{array}$$

Write 4 equations:

$$ab = 15$$

$$a + c = 3$$

$$b + d = 12$$

$$c - d = 5$$

$$\text{Eqn 2} - \text{eqn 4: } a + d = -2$$

$$\text{Substitute: } 15/b + d = -2$$

$$\text{Subtract: } b - 15/b = 14$$

$$b^2 - 15 = 14b$$

$$b^2 - 14b - 15 = 0$$

$$(b - 15)(b + 1) = 0$$

$$b = 15 \text{ or } b = -1$$

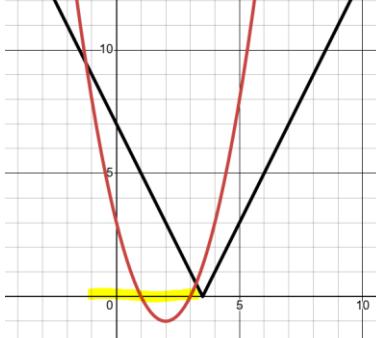
Verify that both solutions work:

$$a = 1, b = 15, c = 2, d = -3$$

$$a = -15, b = -1, c = 18, d = 13$$

$$\text{Sum of } c \text{ values} = 2 + 18 = 20$$

$$\begin{array}{c}
 \boxed{a} \times \boxed{b} = 15 \\
 + \quad + \\
 \boxed{c} - \boxed{d} = 5 \\
 = \quad = \\
 3 \quad 12
 \end{array}$$

8	8	20 [integers]	<p>How many positive three digit integers less than 600 exist where the sum of the tens and ones digit equals the hundreds digit?</p> <p>100s: 101, 110</p> <p>200s: 211, 202, 220</p> <p>300s: 303, 312, 321, 330</p> <p>400s: 404, 413, 422, 431, 440</p> <p>500s: 505, 514, 523, 532, 541, 550</p>
9	9	5 [values of x]	<p>How many integer values of x satisfy the following: $2x - 7 > x^2 - 4x + 3$</p> <p>By making a rough sketch of the graphs, one can discover that the integer values of x where this is true are: $x = -1, 0, 1, 2, 3$. Therefore, there are 5 values.</p> 
10	10	4 [= the 2026th digit]	<p>An infinite sequence of numbers is formed as follows, where the n^{th} number is repeated n times:</p> <p>122333444455555...</p> <p>What is the 2026th digit in this sequence?</p> <p>The numbers 1-9 make up the first $9 * 10 / 2 = 45$ digits, leaving $2026 - 45 = 1981$ digits, which means we're looking for the first digit of the $1982/2 = 991^{\text{st}}$ number, starting at 10. This is the same as the $991+45 = 1036^{\text{th}}$ number starting at 1. We see that the sum of the first 45 numbers is $45 * 46 / 2 = 1035$. Thus, the 1036th number is the first appearance of 46, whose first digit is 4.</p>

“Math is Cool” Championships -- 2025-26

High School

Pressure Round Solutions

9/ 10th	11/ 12th	Answer	Solution
1		4 [palindromes]	<p>How many three-digit palindromes (positive integers that read the same forwards and backwards) are divisible by 22?</p> <p>An integer is divisible by 11 if the sum of the digits in its odd place minus the sum of the digits in its even place is a multiple of 11. An integer is divisible by 2 if its units digit is 0,2,4,6, or 8. Since there are 3 digits, this means that the sum of the hundreds and units digit minus the tens digit is a multiple of 11 AND the units digit is even.</p> <p>242, 484, 616, 858 4 possibilities</p>
	1	85 [= A + B]	<p>Nikko rolls 4 standard 6-sided dice. The probability that the product of the 4 resulting numbers is divisible by 4 can be written as a simplified fraction A/B.</p> <p>What is A + B?</p> <p>We can solve through complimentary counting.</p> <p>Case 1) The product is not divisible by 2. This means all 4 numbers are odd, which has a probability of $(\frac{1}{2})^4 = 1/16$.</p> <p>Case 2) The product is divisible by 2 but not by 4. This means that three numbers are odd, and one is either a 2 or 6.</p> <p>$4 * (\frac{1}{3}) * (\frac{1}{2})^3 = 1/6$</p> <p>$1 - 1/16 - 1/6 = 37/48$, $A + B = 85$</p>

2		20 [days]	<p>Lizette reads 1 page of a book on the first day, 2 on the second, 3 on the third, and so on. How many days will it take her to finish a 195 page book?</p> <p>By the nth day, Lizette will have read $n*(n+1)/2$ pages. We are looking for the smallest n such that $n(n+1)/2 > 195$.</p> <p>$19(20)/2 = 190$, not enough. $20(21)/2 = 210$, so $n = 20$.</p>
	2	16 [days]	<p>Lizette reads 3 pages of a book on the first day, 6 on the second, 9 on the third, and so on. How many days will it take her to finish a 405 page book?</p> <p>By the nth day, Lizette will have read $3*n*(n+1)/2$ pages. We are looking for the smallest n such that $3n(n+1)/2 > 405$, or $n(n + 1) > 270$.</p> <p>$15(16) = 240$, not enough.</p> <p>$16(17) = 272$, so $n = 16$</p>
3	3	1,814,400 [arrangements]	<p>How many different arrangements can be created using all of the letters in "MATHISCOOL"?</p> <p>There are 2 Os, so we need to divide the total number of possibilities by $2!$.</p> <p>$10!/2! = 1814400$</p>
4		-2 [= A + B]	<p>The point (-7,1) is rotated about the origin (0, 0) clockwise by 90 degrees. This point is then reflected over the x-axis, after which it is shifted to the right by 4 units. The final coordinates of this point are (A, B). What is A + B?</p> <p>(-7,1) rotated 90 degrees clockwise about (0, 0) becomes (1, 7). Reflecting over the x-axis moves it to (1, -7). Shifting 4 units to the right becomes (5, -7), which equals (A,B). $A + B = 5 + (-7) = -2$.</p>

	4	0 [= A + B]	<p>The point (-7, 1) is rotated about the point (-2, -1) clockwise by 90 degrees. This point is then reflected over the x-axis, after which it is shifted to the right by 4 units. The final coordinates of this point are (A, B). What is A + B?</p> <p>(-7,1) rotated 90 degrees clockwise about (-2,-1) becomes (0,4). Reflecting over the x-axis moves it to (0, -4). Shifting 4 units to the right becomes (4, -4), which equals (A,B). $A + B = 4 + (-4) = 0$.</p>
5	5	765 [alphas]	<p>On the planet of Mathland, one Beta is worth 5 Alphas, One Chi is worth 17 Deltas, 2 Epsilons are worth 13 Alphas, and 1 Delta is worth three Betas. How many Alphas are 3 Chis worth?</p> <p>$1 B = 5 A$ $1 C = 17 D$ $2 E = 13 A$ $1 D = 3 B$ $3 C = ? A$ $3 C = 51 D$ $51 D = 153 B$ $153 B = 765 A$ Therefore, 3 Chis are worth 765 Alphas</p>

“Math is Cool” Championships -- 2025-26

High School

College Bowl Round #1 Solutions

	Answer	Solution
1	78 [legs]	Eli builds chairs with three legs. If he makes twenty-six chairs, how many legs are there in total? $26 * 3 = 78$
2	14 [= A]	Gracie draws a snowman using three circles stacked on top of each other with radii (pronounced ray-dee-eye) of one, two, and three inches, respectively. The total area of the snowman is A pi square inches. What is A? The sum of the areas of the three circles = $1^2 * \pi + 2^2 * \pi + 3^2 * \pi = 14 \pi$ inches squared
3	72 [= X] [= miles per hour]	Linley drives three hundred ninety-six miles from Spokane to Seattle, first driving three hours at sixty miles per hour, then driving three hours at X miles per hour. What is X? Using the time distance speed formula, $3 * 60 + 3 * X = 396$ $60 + X = 132$, $X = 72$
4	4 [= X] [= rounds]	Nayoun and Phillip are playing a game. After X rounds, Phillip has a win percentage of fifty percent. The next round, Phillip loses and now has a win percentage of forty percent. What is the value of X? If k = # of games Phillip won, then $k/x = 0.5$ & $k/(x+1) = 0.4$ $\Rightarrow x = 2k$, $k/(2k+1) = 0.4$, so $k = 2$ and $x = 4$
5	30 [units squared]	In square units, what is the area of the triangle enclosed by the graphs of the three lines: y equals two, three x plus two y equals sixteen, and y minus x equals eight? Comparing the lines two at a time, their points of intersection are: (-6,2), (4,2), and (0,8). $0.5 * b * h = 10 * 6 / 2 = 30$
6	6 [= A]	On a wall clock, the hour hand is twelve inches long. From nine o'clock AM to nine thirty AM on the same day, the area swept out by hour hand is A times pi inches squared. What is A? The hour hand sweeps out a 15 degree sector in 30 minutes, which has an area of $15/360 * \pi * 12^2 = 6\pi$ inches squared.

7	16 [%]	Zayd rolls two ten-sided dice, which are numbered zero through nine. As a percentage, what is the probability that both dice are showing a prime number? The primes under 10 are: 2, 3, 5, 7, (4 out of 10 cases) $(4/10) * (4/10) = 0.16 = 16\%$
8	31 [is next number]	What number comes next in the sequence that begins as follows: One, three, seven, fifteen, and so on. 1, 3, 7, 15, ... Pattern is +2, +4, +8 $15 + 16 = 31$
9	2 [=reciprocal]	What is the reciprocal of the cosine of sixty degrees? $\cos(60 \text{ degrees}) = 0.5$
10	7 [different values of n]	For how many integer values of n can you make a triangle with side lengths 4, 5, and n? n must be greater than the difference of 4 and 5 but less than the sum of 4 and 5. n can equal 2, 3, 4, 5, 6, 7, and 8. $\Rightarrow 7$ ways.

“Math is Cool” Championships -- 2025-26

High School

College Bowl Round #2 Solutions

	Answer	Solution
1	50 [percent]	When a coin is flipped four times, what is the probability in percent of getting an odd number of heads? 1 head: HTTT THTT TTHT TTHH (4 ways) 3 heads: HHHT HHTH HTHH THHH (4 ways) $(4 + 4)/2^4 = 8/16 = 50\%$
2	306 [days]	How many days are in the last ten months of the year? $365 - 31 - 28 = 306$ (DOESN'T MATTER IF ITS A LEAP YEAR)
3	126 [= sum]	What is the sum of the first six positive multiples of six? $6 + 12 + 18 + 24 + 30 + 36 = 42 * 3 = 126$
4	420 [students]	This year at Pullman High School, twenty percent of students take calculus and forty percent of students take statistics. If there are eight hundred students total, and one hundred of them are taking both calculus and statistics, how many students are taking neither? 20% of 800 = 160 students that are taking calculus. 40% of 800 = 320 students that are taking statistics. # of students taking at least one = $160 + 320 - 100 = 380$. 800 – 380 = 420 students are taking neither.
5	0 [percent]	An ant walks along the edges of a cube, walking the length of one edge every minute, and randomly choosing which adjacent edge to walk along next each time it arrives at a vertex. If the ant starts at vertex A, after exactly five minutes what is the probability in percent that the ant will have returned back to vertex A? For the ant to come back to point A, an even number of minutes must have passed since it must walk to one edge then walk back. 5 is odd, therefore the ant cannot be at point A.
6	20 [= positive difference]	If the operation $a \star b$ is equal to $a^2 + b^2$, what is the positive difference between ten star five and eight star nine? $10 \star 5 = 100 + 25 = 125$ $8 \star 9 = 64 + 81 = 145$ $145 - 125 = 20$.

7	19 [pos integers]	How many positive integers less than one thousand are divisible by both three and seventeen? $3 \times 17 = 51$ $51 \times 1, 2, \dots, 19 < 1000$
8	3	What is \log_{10} base ten of fifty plus \log_{10} base ten of twenty? $\log_{10} 50 + \log_{10} 20 = \log_{10} 50 \cdot 20 = \log_{10} 1000 = 3$
9	91 [total legs]	Vijay has twelve chickens, three roosters, fourteen pigs, and one three-legged dog on his farm. How many legs are there on his farm, including his own? Total number = $12 \times 2 + 3 \times 2 + 14 \times 4 + 1 \times 3 + 1 \times 2 = 91$
10	27 [= 25 th term]	In a geometric sequence, the seventh term is eight and the thirteenth term is twelve. What is the twenty-fifth term in this sequence? Every 6 terms, the common ratio is $12/8 = 3/2$. 19^{th} term = $12 \times 3/2 = 18$. 25^{th} term = $18 \times 3/2 = 27$

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High School

College Bowl Round #3 Solutions

	Answer	Solution
1	3 [= x]	If four raised to the x plus four raised to the x plus four raised to the x equals one hundred ninety-two, what is the value of x ? $4^x + 4^x + 4^x = 192$ $3(4^x) = 192$ $4^x = 64$, $x = 3$
2	11 [= x]	If the mean of the following data set is equal to five, what is the value of x ? Two, three, four, four, five, six, x $(2+3+4+4+5+6+x)/7 = 5$ $x = 11$
3	4 [= A]	A square with side length four units has one inscribed circle and one circumscribed circle. The positive difference in the area of the two circles is A pi square units. What is A ? The smaller circle has a radius of 2, and therefore an area of $2^2 \pi = 4\pi$. The larger circle has a radius of $2\sqrt{2}$ and therefore has an area of 8π . $8\pi - 4\pi = 4\pi$
4	12 [positive divisors]	How many positive factors does one hundred twenty-six have? $126 = 2 * 3^2 * 7$, therefore has $(1+1)(2+1)(1+1) = 12$ positive divisors.
5	113 [= f(f(1)) [= f of f of 1]]	Let f of x equal x squared plus three x plus five. What is the value of f of f of f of one? (proctor - make sure to read very carefully) $f(1) = 1^2 + 3*1 + 5 = 9$ $f(9) = 9^2 + 3*9 + 5 = 113$
6	13 [= y coor]	One endpoint of a line segment is three comma negative three, and the midpoint is seven comma five. What is the y coordinate of the other endpoint of the line segment? Endpoint (3, -3) Midpoint (7, 5) The y-coordinate went up 8, so it will go up another 8. $5 + 8 = 13$
7	86 [%]	Iowa borders six states: Wisconsin, Minnesota, South Dakota, Nebraska, Missouri, and Illinois. If one of the fifty US States is randomly selected, what is the probability in percent that it is not Iowa or any of Iowa's bordering states? There are 7 states that cannot be picked (The 6 that border Iowa + Iowa) Therefore, the probability = $(50-7)/50 = 43/50 = 86\%$

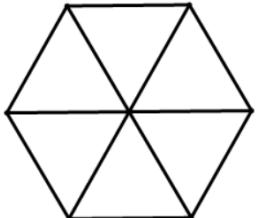
8	9 [palindromes]	A palindrome is an integer that reads the same forwards and backwards, such as one hundred thirty-one. How many palindromes are there between ten and one hundred? 11, 22, 33, 44, 55, 66, 77, 88, 99
9	27 [small dogs]	There are sixty-five dogs, either large or small, competing in a dog show. There are eleven fewer small dogs than large dogs. How many small dogs are there? $S + L = 65$ $S = L - 11$ $S - L = -11$ $2S = 54, S = 27$
10	20 [= max function value]	What is the maximum value of the following function? f of x equals negative x-squared plus eight x plus four $F(x) = -x^2 + 8x + 4 = -(x-4)^2 + 20$ Therefore, F(x) is maximized when x = 4 and is equal to 20.

“Math is Cool” Championships -- 2025-26

High School

College Bowl Round #4 Solutions

	Answer	Solution
1	150 [degrees]	An angle measuring five pi over six radians is equal to how many degrees? $5\pi/6 \text{ rad} = 150 \text{ degrees}$
2	115	What is three raised to the fifth power minus two raised to the seventh power? $3^5 - 2^7 = 243 - 128 = 115$
3	10 [pints]	How many pints are there in 5 quarts? There are two pints in a quart, therefore in 5 quarts there are 10 quarts.
4	16 [ways]	There are five juniors and four seniors running for two class officer positions, which are non-distinguishable. If the elected pair must be two people of the same class, how many possible pairs of elected officers can there be? Case 1: Both seniors, $4 * 3 / 2 = 6$ ways Case 2: Both juniors, $5 * 4 / 2 = 10$ ways $10 + 6 = 16$ total ways
5	4896 [cents]	Catarina's dinner bill is forty dollars and eighty cents. If she leaves a twenty percent tip, what is the total cost in cents? $4080 * 1.2 = 4896$
6	17 [percent]	When two fair six sided dice are rolled, what is the probability that the sum of the two numbers rolled equals seven, rounded to the nearest percent? There are $6 * 6 = 36$ total possible cases. Out of them, there are 6 ways to roll a 7: (1,6), (2,5), (3,4), (4,3), (5,2), (6,1). $6/36 = 16.666\%$, which rounds to 17 percent.
7	150 [meters]	Two cars begin driving directly towards one another from a distance of six hundred meters apart. Each car moves at a speed of sixty meters per second. At the same time, a fly starts flying back and forth between the two cars at a speed of thirty meters per second. In How many meters will the fly have traveled by the time the two cars meet? The cars will take $600 / (60 + 60) = 5$ seconds to collide. The fly will therefore be flying for 5 seconds. $5 \text{ seconds} * 30 \text{ meters / second} = 150 \text{ meters}$
8	2 [= x]	For what value of x is $x^2 - 4x + 240$ minimized? $x^2 - 4x + 240$, which is minimized when $x = -(-4)/(2*1) = 2$.

9	2 [= quadrant]	If a is a positive integer and b is a negative integer, what quadrant number is the point b comma a in? $(b, a) = (\text{negative}, \text{positive}) = \text{Quadrant 2}$
10	7 [sq units]	Shivali draws a regular hexagon and an equilateral triangle. Both polygons have equal side lengths. If the hexagon has an area of forty-two square units, what is the area of the triangle in square units? 

The hexagon has an area that is 6 times the area of the triangle. $42/6 = 7$.

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High School

College Bowl Round #5 Solutions

	Answer	Solution
1	2 [x-intercepts]	How many x-intercepts does the following equation have? Y equals x squared minus twelve x plus eleven. $x^2 - 12x + 11 \rightarrow$ the discriminant = $112^2 - 4*1*11 > 0$, $2^2 - 4*1*11 > 0$. Therefore, this equation has 2 x-intercepts.
2	3 [baseballs]	A baseball weighs two hundred grams, and a tennis ball weighs one hundred fifty grams. If there are a combined total of seven balls, and their total weight equals one point two kilograms, how many baseballs are there? We can write this as a system of equations: $x + y = 7$ $200x + 150y = 1200$. Solving, we get $(x,y) = (3,4)$.
3	148 [jellybeans]	Theo has between one hundred and two hundred jellybeans. He divides them among his thirty-seven friends (not including himself), and finds that everyone gets the same number of jellybeans. If Theo has an even number of jellybeans, how many jellybeans does he have? Abdul's number of jellybeans is a multiple of 37 and 2 \rightarrow a multiple of 74. 74*2 is the only multiple between 100 and 200, which equals 148.
4	10 [= f(2)]	If f of quantity x minus one equals x squared plus one, what is the value of f of two? $F(x - 1) = x^2 + 1$ $F(2) = f(3 - 1) = 3^2 + 1 = 10$
5	115 [°]	What is the smallest positive angle in degrees that is coterminal with a negative two hundred forty-five degree angle? $360 - 245 = 115$
6	37 [= A + B]	One integer from fifty-one to eighty, inclusive, is selected. The probability that the integer is prime is a reduced fraction A over B. What is A + B? The primes between 51 and 80 are: 53, 59, 61, 67, 71, 73, and 79. 7/30 is already a reduced fraction, so the answer is $7 + 30 = 37$.

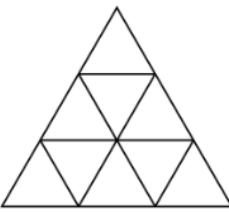
7	157 [marbles]	In a bag, there are fifty-seven white marbles, forty-three black marbles, thirteen blue marbles, and ninety-nine gray marbles. What is the minimum number of marbles that must be randomly selected to guarantee having least three different colors of marbles? You have to consider the case where you get the unluckiest. This is when you draw 99 gray marbles, then 57 white marbles, and then one black or blue marble. $99 + 57 + 1 = 157$.
8	24 [ways]	Five friends are sitting around a circular table. If seatings that are simply rotations of each other count as the same arrangement, in how many unique ways can they be seated? There are 120 total ways to arrange the five friends in a line. But since rotating the circle doesn't create a new arrangement, each unique circular seating has 5 identical rotations, which means that the total number will be $120/5 = 24$.
9	344 [inches]	A square piece of paper is folded in half horizontally to form a rectangle. The rectangle has a perimeter of two hundred fifty-eight inches. In inches, what is the perimeter of the original square? Let x = the side of the square The sides of the rectangle will be $x, x, x/2, x/2$. Perimeter of the rectangle = $3x = 258$, therefore $x = 86$.
10	1,000,000 [mm] [one million]	How many millimeters are in a kilometer? Milli = 10^{-3} Kilo = 10^3 $10^3/10^{-3} = 10^6 = 1000000$

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High School

College Bowl Round #6 Solutions

	Answer	Solution
1	12 [minutes]	Rafferty eats pizza at a rate of one point five slices per minute. If there are two whole pizzas, each with nine slices, how many minutes will it take Rafferty to finish eating both pizzas? $18/1.5 = 12$
2	-6 [= x]	In the following set of numbers, given that the mode is one greater than the mean, what is the value of x? Two, three, three, three, four, five, x Mode = 3, therefore mean = 2 $(2+3+3+3+4+5+x) = 2 * 7 = 14$, $x = -6$
3	4 [= a]	The point a comma a is equidistant from the points one comma five and seven comma three on the coordinate plane. What is the value of a? The line $y = -1/3 * x + 16/3$ passes through both points. Plugging in $y = x$, we get that $y = x = 4$.
4	12321 (twelve thousand three hundred twenty-one) [= palindrome]	What is the value of the palindrome that is closest in value to the integer twelve thousand three hundred forty-five? 12321 is the only palindrome between 12300 and 12399, which are both farther away in value to 12345 than 12321 is.
5	49 [cards]	In a standard fifty-two card deck, how many cards must be drawn without replacement to guarantee that all the cards of a single suit have been drawn? There are 13 cards of each suit. You can draw 12 of each, after which the next card guarantees that you will draw the 13 th card of a single suit. $12*4+1 = 49$

6	9 [triangles]	An equilateral triangle of side length six units can be divided into how many equilateral triangles of side length two units? 
7	60 [%]	Maria has a set of ten index cards labeled with the digits zero through nine. If one card is randomly selected, what is the probability in percent that it is at most five? 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 Six of the numbers are "at most 5", $6/10 = 60\%$
8	16	How many positive even multiples of three are less than 100? This is the same as asking how many multiples of 6 are there less than 100. $100/6 = 16.\text{XX}$, so there are 16.
9	105 [ways]	Out of seven different paint colors, how many ways can three colors be chosen, where one color will be the background and the other two will be mixed to create the color for the foreground? One color is distinct, so there are 7 ways to choose it. From the 6 that are left, you have to pick two (order doesn't matter), so there are $6C2 = 15$ ways. $7 * 15 = 105$.
10	360 [5 \$ bills]	A cash machine contains three times as many five-dollar bills as ten-dollar bills. If it contains three thousand dollars worth of five and ten dollar bills, how many five dollar bills are there? $F = 3T$ $5F + 10T = 3000$ $5(3T) + 10T = 3000$ $25T = 3000$, $T = 120$, $F = 360$