1. Find the greatest odd three-digit number with hundreds digit equal to twice its ones digit and an even tens digit.

2. Find the smallest positive integer greater than 1000 that leaves the same positive integral remainder when divided by 30, 36, and 50.

3. Given $f(x)=3x+14$ and $g(x)=2x^2-15$, find the value(s) of x for which $f(2x-1)=g(x+3)$.

4. An employee received a raise of 2% last year and 3% this year. After these raises, her current salary is $66,445 rounded to the nearest dollar. Rounded to the nearest dollar, find the dollar value of her salary two years ago (before the first of the two raises).

5. When $5x+4y$ is divided by $x+y$, the quotient is 3 with a remainder of 2. Find the remainder when $10x+5y$ is divided by 7.

6. All members of the math team decide to order four extra-large pizzas. If there were three more people on the team, the cost would have been one dollar less per person. If there had been two fewer people, the cost would have been one dollar more per person. Find the price, in dollars, of an extra-large pizza.

7. The number 5760 can be expressed as $4^{(a)}5^{(b)}6^{(c)}$, where a, b and c are rational numbers. Find the value of $(a+b+c)$.

8. $\sqrt{k}+\sqrt{3}=\sqrt{75}$ where k is a positive integer. Find the value of k.

9. If $x+y=7$ and $\frac{1}{x}+\frac{1}{y}=\frac{3}{8}$ with $xy\neq 0$, find the value of $\left(x^2+xy+y^2\right)$. Express your answer as a common or improper fraction reduced to lowest terms.

10. Determine the number of ways there are to arrange three different algebra books and four different geometry books in a line so that geometry books are on both ends.

11. If $\frac{2}{3}$ of k is 42 and $\frac{4}{7}$ of w is 36, find the value of $\frac{5}{6}$ of $(k+w)$.

12. If $\frac{1}{3^{(x)}}\left(\frac{1}{9}\right)^{(x)}+\left(\frac{1}{3}\right)^{(3x-2)}-\left(\frac{1}{27}\right)^{(x-1)}=\frac{k}{m^{(px)}}$ where m is a prime number, find the value of $(k+p)$.

13. If $f(x)=4x-1$ and $g(f(x))=32x^2-16x+6$, find the value of $g(4)$.

14. Given $x^2+y^2=6xy$ and $0<y<x$, find the exact value of $\frac{x+y}{x-y}$.

15. Three integers are in a ratio of $2:3:5$. If the largest integer is 12 less than three times the smallest integer, find the absolute value of the difference between the middle integer and the largest integer.

16. A fraction F has a value such that $\frac{5}{8} < F < \frac{2}{3}$. The denominator of F is an integer that is 7 more than the numerator of F. Find the largest possible denominator of F.

17. If k is selected at random from the set of positive integers less than or equal to 100, find the probability that the graph of $y = x^2 - kx + 5$ has two $x-$intercepts and that these $x-$intercepts are located no more than 10 units apart. Express your answer as a common fraction reduced to lowest terms.

18. The line $y = 2x + 5$ intersects the graph of $y = x^2 + 3x - 1$ at the points P and Q. Find the exact distance between the points P and Q.

19. Kellie rides her bike 3 miles each day to school. The first mile is uphill and she rides at a constant rate of 4 mph. The second mile is downhill, where she coasts at a constant rate that is an integer, is faster than her uphill rate and is less than 60 mph. For the final mile, she rides at a constant rate of 6 mph. If her average speed, in mph, for the entire trip to school is an integer, find the speed, in mph, that she coasts down the hill.

20. Write the base 5 number 20.14_5 as a decimal in base 10.

2014 SAA
Algebra I

Name ANSWERS

School ____________________

(Use full school name – no abbreviations)

______ **Correct X 2 pts. ea. =** [ ]

Note: All answers must be written legibly in simplest form, according to the specifications stated in the Contest Manual. Exact answers are to be given unless otherwise specified in the question. No units of measurement are required.

1. 683

2. 1801

3. $-4, 1$ (Must have both answers in either order.)

4. 63245 ($ or dollars optional)

5. 3

6. 15 ($ or dollars optional)

7. $\frac{11}{2}$ OR $5\frac{1}{2}$ OR 5.5

8. 48

9. $\frac{91}{3}$ (Must be this reduced improper fraction.)

10. 1440 (Arrangements or ways optional.)

11. 105

12. -14

13. 36

14. $\sqrt{2}$ (Must be this exact answer.)

15. 24

16. 20

17. $\frac{3}{50}$ (Must be this reduced common fraction.)

18. $5\sqrt{5}$ (Must be this exact answer.)

19. 12 (mph optional.)

20. 10.36 (Base ten or base 10 designation optional.)

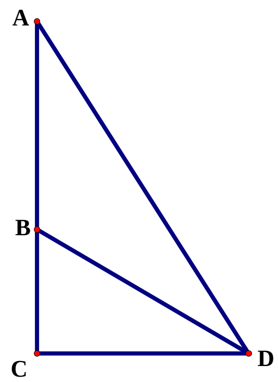
1. I am a regular polygon with k sides. The ratio of one of my exterior angles to one of my interior angles is $1:6$. Find the value of k.

2. Points P and Q are on circle O, and chord $\overline{PQ}$ is drawn. A second circle is drawn with diameter $\overline{OP}$, intersecting chord $\overline{PQ}$ at point S. If $OP=7$ and $PQ=12$, find the length of $\overline{PS}$.

3. The width of a rectangle is decreased by 30% and its length is increased by 35%. When this is done, the area of the rectangle decreases by $k\%$. Find the value of k. Express your answer as the value of k only. Do not use the % symbol.

4. There are two circles that pass through the point $(9,2)$ and are tangent to both the $x-$axis and the $y-$axis. Find the positive difference between their radii.

5. In ΔADC, $\overline{BD}$ bisects $\angle ADC$, and $AD=2(CD)$. Find the ratio of the length of $\overline{BC}$ to $\overline{AC}$. Write your answer in the form $k:w$, where k and w are integers with no common factors.

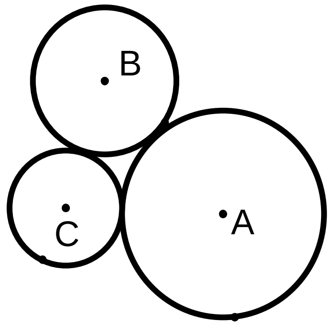


6. A lead control sheath at a nuclear plant is a thick pipe with a hollow core and must be cylindrical with circumference 18 inches. The cross-sectional area of lead must be two-thirds the area of the inner cross-sectional circle (representing the hollow tube which will hold the nuclear rod.). Find the radius, in inches, of the inner cross-sectional circle Express your answer as a decimal rounded to the nearest hundredth.

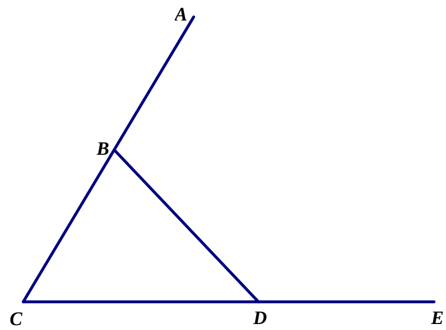
7. Two points are chosen on the circumference of a circle. Find the probability that the chord connecting these two points is longer than the radius of the circle. Express your answer as a common fraction reduced to lowest terms.

8. If the lengths of all three sides of a triangle are integers, determine the **number** of distinct triangles there are that have a perimeter of 20.

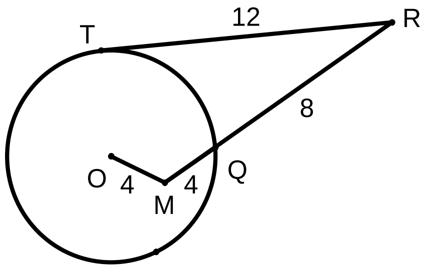
9. Circles A, B, and C are mutually externally tangent to each other as shown but not drawn to scale in the diagram. $AB = 12$, $BC = 6$, and $AC = 6\sqrt{3}$. Find the area of the region inside ΔABC but not interior to the circles. Express your answer as a decimal rounded to the nearest hundredth.



10. In the given diagram, $\angle ABD = (4x+8)^\circ$, $\angle BDE = (6x)^\circ$ and $\angle ACE = (3x-11)^\circ$. Find the degree measure of $\angle CBD$.



11. In the diagram, not drawn to scale, $\overline{RT}$ is tangent to $\odot O$ at point T and $\overline{RM}$ intersects $\odot O$ at Q. $RT = 12$, $RQ = 8$, and $QM = OM = 4$. Find the radius of $\odot O$.

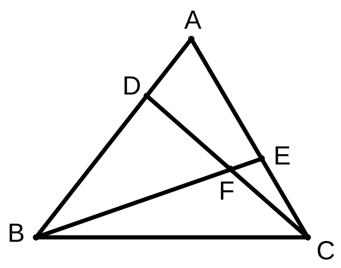


12. Given right triangle ABC with right angle C and midpoints D, E and F located on sides $\overline{AB}$, $\overline{BC}$, and $\overline{AC}$ respectively. If $AE = \sqrt{26}$ and $BF = \sqrt{14}$, find the length of $\overline{DB}$.

13. The lengths of the face diagonals of a rectangular solid are $\sqrt{1234}$, $\sqrt{1302}$ and $\sqrt{1492}$. Find the length of the diagonal of the 3-dimensional solid.

14. A rectangular sheet of paper 40 cm by 70 cm is folded once so that opposing corners are coincident. Find the number of cm in the length of the crease in the paper.

15. In ΔABC, D lies on $\overline{AB}$ so that $\frac{AD}{DB}=\frac{2}{5}$, E lies on $\overline{AC}$ so that $\frac{AE}{EC}=\frac{3}{2}$, and $\overline{DC}$ and $\overline{EB}$ intersect at F, Find $\frac{DF}{FC}+\frac{EF}{FB}$. Express your answer as a common or improper fraction reduced to lowest terms.

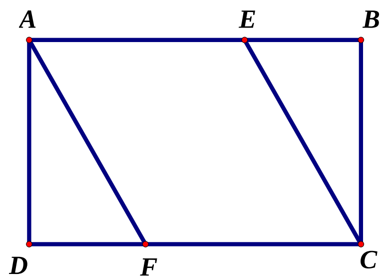


16. On a plane surface, two circles with radii 13 and 22 are 6 units apart. Find the length of a common external tangent segment of the two circles.

17. A triangle is selected at random from the set of triangles with integral degree measure angles and for which the ratio of the degree measures of the angles is $a:b:c$, where a, b and c are consecutive positive integers. Find the probability that the degree measure of the largest angle is an odd number. Express your answer as a common fraction reduced to lowest terms.

18. Given $A(5,6)$, $B(14,16)$ and C is a point on $\overline{AB}$ so that $AC:CB=2:1$. If $D(2,-3)$ and E is a point on the $x-$axis so that $\overline{CE}\parallel\overline{BD}$, find the coordinates of point E. Express your answer as an ordered pair (x,y).

19. $ABCD$ is a rectangle with $AB=20$ and $BC=12$. Points E and F are located such that $AECF$ is rhombus. Find the length EF. Express your answer as a decimal rounded to 4 significant digits.



20. A regular tetrahedron has an edge of length 1. Two of the faces are randomly selected and the centroid of each of these two faces is found. Determine the distance between these two centroids. Express your answer as a common fraction reduced to lowest terms.

2014 SAA
Geometry

Name **ANSWERS**

School ____________________

(Use full school name – no abbreviations)

_______ **Correct X 2 pts. ea. =** [ ]

Note: All answers must be written legibly in simplest form, according to the specifications stated in the Contest Manual. Exact answers are to be given unless otherwise specified in the question. No units of measurement are required.

1. 14

2. 6

3. 5.5 OR $5\frac{1}{2}$ OR $\frac{11}{2}$

4. 12

5. $1:3$ (Must be in this form.)

6. 2.22 (Must be this decimal, inches optional.)

7. $\frac{2}{3}$ (Must be this reduced common fraction.)

8. 8 (Triangles optional.)

9. 2.23 (Must be this decimal.)

10. 80 (Degrees optional.)

11. $2\sqrt{10}$ (Must be this exact answer.)

12. $2\sqrt{2}$ (Must be this exact answer.)

13. $\sqrt{2014}$ (Must be this exact answer.)

14. $\frac{40\sqrt{65}}{7}$ OR $\frac{40}{7}\sqrt{65}$ (Must be this exact answer, cm optional.)

15. $\frac{431}{350}$ (Must be this reduced improper fraction.)

16. 40

17. $\frac{4}{11}$ (Must be this reduced common fraction.)

18. $(3,0)$ (Must be this ordered pair.)

19. 13.99 (Must be this decimal.)

20. $\frac{1}{3}$ (Must be this reduced common fraction.)

1. Find the coordinates of the center of the circle described by the equation $x^2+y^2+6x+8y-5=0$. Express your answer as an ordered pair (x, y).

2. Find the value(s) of x so that the matrix $\begin{bmatrix} 4 & x & 5 \\ 6 & 3 & 1 \\ x & 1 & 2 \end{bmatrix}$ does not have an inverse.

3. A rectangular solid box has two faces each of area 8 and two faces each of area 6. If the lengths of all edges of the box are integers greater than one, find the volume of the box.

4. Solve for x: $\dfrac{\sqrt{x+1}+x}{\sqrt{x+1}-x} = -\dfrac{1}{5}$.

5. Given that f and g are real, non-constant functions such that for all x, y, $f(x+y)=f(x)g(y)+g(x)f(y)$ and $g(x+y)=g(x)g(y)-f(x)f(y)$, find all possible ordered pairs $(f(0), g(0))$. Express your answer(s) as **ordered pair(s)**.

6. Find the area of the figure described by the intersection of the graphs of the inequalities $x+y\le 6$, $y\ge -x$, $x\ge -2$ and $y\ge -3$.

7. Given that a is the solution for x of the equation $\log(x-1)=k$ where k is a non-negative integer, let b be a when its digits are reversed. Find the ratio of a to b. Write your answer in the form $x:y$ where x and y are integers with no common factors.

8. Find the largest integer x for which another integer n exists, given $nx = n + 12x$.

9. For all real x, $f(x+1) + f(x) = 1$. If $f(9) = 18$, find the value of $f(1)$.

10. A two-digit number has the property that all positive integral powers of the number have the same last two digits as the number itself. Find the sum of all such numbers.

11. Find the sum of all values of x for which $9 \cdot 2^{2x+3} - 4^{2x} = 512$.

12. Find the number base b for which $(257_b)(9_b) = 1643_b$.

13. There exist two arithmetic sequences, A and B. Both have the same first and same last term (p and q respectively), where p and q are positive. The sum of A and the sum of B differ by $(p+q)$. Determine how many more terms the sequence with the larger sum has than the sequence with the smaller sum.

14. A man is standing in a given location. At a given signal, he either takes a step left (with probability $\frac{2}{3}$), or a step right (with probability $\frac{1}{3}$). The signal is given four times. Find the probability that he ends up in his original spot. Assume that the length of each step is always the same in either direction and that he always remains facing the same direction. Give your answer as a common fraction reduced to lowest terms.

15. Find all integers n for which $\dfrac{n^3+2n^2+3n+1}{n^2+2n-1}$ will be an integer.

16. Let $x \neq 1$. Solve for y: $(\log_3 x)(\log_x 2x)(\log_{2x} y) = \log_x x^2$.

17. Find the final (i.e. rightmost) three digits in the decimal numeral expansion of 3^{9999}.

18. Given $f(x) = \dfrac{x-3}{x+1}$. Define a sequence of functions by: $f_1 = f$ and $f_n = f(f_{n-1})$ for $n > 1$. Evaluate $f_{2014}(4)$.

19. Let $d(n)$ represent the largest odd divisor of n, where n is a positive integer. Find the **number** of values of n, $n < 1000$, for which $d(n) = 3$.

20. A polynomial has degree 4 and the $y-$intercept of its graph is -48. The coefficient of its 4^{th} degree term is -2. It has four $x-$intercepts, three of which are 4, -3, and $\dfrac{1}{2}$. Find the fourth $x-$intercept.

2014 SAA
Algebra II

Name ANSWERS

School

(Use full school name – no abbreviations)

______ Correct X 2 pts. ea. = [ ]

Note: All answers must be written legibly in simplest form, according to the specifications stated in the Contest Manual. Exact answers are to be given unless otherwise specified in the question. No units of measurement are required.

1. $(-3,-4)$ (Must be this ordered pair.)

2. $2, 25$ (Must have both answers in either order.)

3. 24

4. $-\frac{3}{4}$ OR $\frac{-3}{4}$ OR -0.75 OR $-.75$

5. $(0,0),(0,1)$ (Must have both ordered pairs in either order.)

6. 48

7. $1:1$ (Must be this ratio in this form.)

8. 13

9. 18

10. 101

11. $\frac{9}{2}$ OR $4\frac{1}{2}$ OR 4.5

12. 15

13. 2

14. $\frac{8}{27}$ (Must be this reduced common fraction.)

15. $-6, -2, 0$ (Must have all 3 answers in any order.)

16. 9

17. 667

18. $\frac{1}{5}$ OR 0.2 OR $.2$

19. 9 ((Values optional.)

20. -4

1. Find the largest real value for x that satisfies $x^{\log_8 x} = \frac{x^3}{64}$.

2. Given ΔABC with $AB = 10$, $AC = 15$, and $BC = 21$. Find the product $(\sin B)(\csc A)$. Express your answer as a common or improper fraction reduced to lowest terms.

3. If $x^5 + 5x^4 + 10x^3 + 10x^2 - 8x + 2 = 14$, find the numerical value of $(x+1)^4$. (Assume $x \neq -1$).

4. Evaluate $\sin^2 15° + \cos^2 75°$. Express your answer as a single reduced rational expression.

5. A sequence is defined recursively as follows: $a_1 = 5$, $a_2 = 9$, $a_n = \frac{2a_{n-1} + a_{n-2}}{3}$. Evaluate $\lim_{n \to \infty} a_n$.

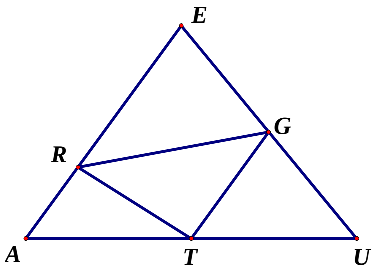
6. If $2^{x^2+2x} = 7$, then the exact value of $(x+1)^2$ is $\log_2 k$ where k is an integer. Find the value of k.

7. A committee of 3 is selected from 2 juniors and 3 seniors. Find the probability that there are more seniors than juniors on the committee. Express your answer as a common fraction reduced to lowest terms.

8. $i=\sqrt{-1}$. The vector from the origin representing $-8+6i\sqrt{3}$ in the complex plane is rotated $150°$ clockwise about the origin. Find the exact complex number the vector now represents. Express your answer in the form $a+bi$ with exact coefficients a and b.

9. Find the largest integer value of x satisfying $\binom{2013}{1000}+\binom{2013}{1001}=\binom{2014}{x}$.

10. ΔAEU is equilateral, ΔRTG has a right angle at T, $RA=1$, $AT=4$, and $UT=2$. Find the exact length of UG. Express your answer as a common or improper fraction reduced to lowest terms.



11. In the expansion of $(x+y)^{12}$ written in decreasing degree for x, the second and third terms are equal when evaluated for $x=a$ and $y=b$, where a and b are positive and $a+b=1$. Find the value of b. Express your answer as a common fraction reduced to lowest terms.

12. Evaluate $\sum_{n=1}^{1000}\frac{1}{n^2+3n+2}$. Express your answer as a common fraction reduced to lowest terms.

13. For all real numbers x, $f(x^2+1)+3f(22-5x)=x^2+2$. Find $f(17)$.

14. Find the exact value of $x^2+2xy+y^2$ if $\frac{x}{3-5i}+\frac{y}{2+7i}=\frac{5+2i}{41+11i}$, where x and y are both real numbers and $i=\sqrt{-1}$.

15. From the set $\{9, 15, 15, 16, 18, 20, 21, 22, 23, 31, 32\}$, one number is selected at random. Find the probability that the number is within one (population) standard deviation from the arithmetic mean of the set. Express your answer as a common fraction reduced to lowest terms.

16. r and s are the roots of $x^2+x+7=0$. Find the exact value of $2r^2+rs+2s^2+7$.

17. Three distinct positive integers form an arithmetic sequence. If the sum of the cubes of the three numbers is divided by the sum of the three numbers, the quotient is 81. If the three numbers are arranged in numerical order, find the second term (the "middle" value) of the sequence.

18. $i=\sqrt{-1}$. A cubic equation with rational coefficients has $1-3i$ as one of its roots, 1 as its leading coefficient, and no quadratic term. Find the constant term.

19. If $\left(\sqrt{20\sqrt{14}+5}-\sqrt{20\sqrt{14}-5}\right)^2=a\sqrt{14}-c\sqrt{d}$, where a, c, and d are positive integers and d is as small as possible, find the exact value of $\sqrt{a+c+d+15}$.

20. Given that $\sin x+\cos x=\frac{6}{5}$ where $0\le x\le\frac{\pi}{6}$, then the exact value of $\sin x$ is $\frac{k+w\sqrt{p}}{q}$ when completely simplified and reduced and where k, w, p, and q are integers. Find the value of $(k+w+p+q)$.

2014 SAA
PreCalculus

Name ANSWERS

School ______________________

(Use full school name – no abbreviations)

______ **Correct X 2 pts. ea. =** [ ]

Note: All answers must be written legibly in simplest form, according to the specifications stated in the Contest Manual. Exact answers are to be given unless otherwise specified in the question. No units of measurement are required.

1. 64

2. $\frac{5}{7}$ (Must be this reduced common fraction.)

3. 13

4. $\frac{2-\sqrt{3}}{2}$ OR $\frac{-\sqrt{3}+2}{2}$

5. 8

6. 14

7. $\frac{7}{10}$ (Must be this reduced common fraction.)

8. $7\sqrt{3}-5i$ (Must be this exact answer.)

9. 1013

10. $\frac{14}{5}$ (Must be this reduced improper fraction.)

11. $\frac{2}{13}$ (Must be this reduced common fraction.)

12. $\frac{250}{501}$ (Must be this reduced common fraction.)

13. $-\frac{9}{8}$ OR $\frac{-9}{8}$ OR -1.125

14. 4

15. $\frac{8}{11}$ (Must be this reduced common fraction.)

16. -12

17. 7

18. 20

19. $12\sqrt{2}$ (Must be this exact answer.)

20. 29

1. Given $a \otimes b = 4(ka+b)$. If $3 \otimes 2 = 14$, find the value of $6 \otimes 3$.

2. Two numbers have a sum of 8 and a product of 10. Find the sum of the reciprocals of these two numbers.

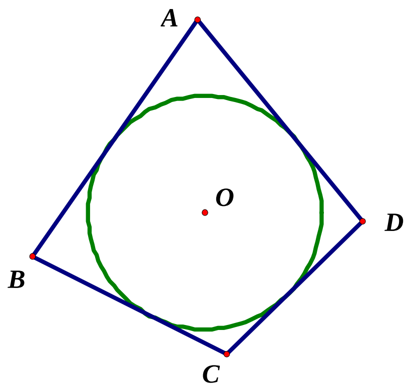
3. Find the value(s) of x for which $7\sqrt{2x+3} = 18\sqrt{2x+3} - 55$.

4. Given ΔABC and ΔDEF such that $AC = 8$, $AB = 12$, $BC = 12$, $\angle D \cong \angle B$, $\angle F \cong \angle E$ and $\overline{EF} \cong \overline{BC}$. Find the exact area of ΔDEF.

5. A chord is drawn in a circle with area 50π at a distance of $3\sqrt{2}$ from the center of the circle. Find the exact length of this chord.

6. A line is drawn parallel to the line $4x+3y=-12$ so that the triangle formed by this parallel line, the $x-$axis and the $y-$axis has an area of 24. Find the x-intercept(s) of all parallel lines that will form such a triangle. Express your answer as the x-intercept and not the coordinates of the x-intercept on a graph.

7. Quadrilateral $ABCD$ is circumscribed about circle O. If $AB = 52$, $BC = 40$ and $AD = 48$, find the length CD.



8. If k is a non-negative value less than 20 and x is a non-negative value less than k, find the maximum value of the expression $|x-k|-|40-x|+|k-x|-|k+25|+|x+k-50|$.

9. Points D, E and F are located on sides $\overline{AB}$, $\overline{BC}$ and $\overline{AC}$, respectively, of equilateral ΔABC. If $AD = BE = CF = 4$ and the perimeter of ΔABC is $6\left(2+\sqrt{3}\right)$, find the exact area of ΔDEF.

10. The equation of the circle that contains the points $(2,1)$, $(0,5)$ and $(-1,2)$ can be written in the form $x^2 + y^2 + Ax + By + C = 0$. Determine the value of the sum $(A+B+C)$.

11. In ΔABC, $\angle A$ is a right angle, $AC = 3$ and $AB = 4$. Point D is located on $\overline{BC}$ so that $BD = 2$. The length of $\overline{AD}$ can be written in reduced simplified form as $\frac{a\sqrt{b}}{c}$. Find the value of $(a+b-c)$.

12. $\sqrt{4\sqrt{5}+9} = a + b\sqrt{c}$, where $\sqrt{c}$ is in simplified form, find the sum $(a+b+c)$.

13. A circle is inscribed in quadrilateral $MATH$, where $MA = AT = 12$, $TH = HM = 9$, $\overline{MA} \perp \overline{HM}$ and $\overline{AT} \perp \overline{TH}$. Find the radius of this circle. Express your answer as a common or improper fraction reduced to lowest terms.

14. If $0 < 2^n < k < 20$ where n and k are integers, determine the **number** of ordered pairs (n,k) for which the expression $2^n + k$ represents a prime integer.

15. The diagonals of square $GEOM$ intersect at point P. If $ME = x^2 - 16$ and $GP = 3x$, find the exact perimeter of $GEOM$.

16. Simplify the expression $\left(\dfrac{x^{-2} + x^{-1}y^{-1} - 2y^{-2}}{x^{-2} - y^{-2}}\right)^{-1}$. Express your final answer as a single rational expression with only positive exponents.

17. If x and y are integers such that $-8 \le x \le 8$ and $-10 \le y \le 10$, find the **number** of ordered pairs (x, y) for which $x^2 + xy + 20 = 69 - xy - y^2$.

18. In ΔABC, X is on $\overline{BC}$ such that $BX : XC = 3:1$, Y is on $\overline{AC}$ such that $AY : YC = 2:1$ and Z is on $\overline{AB}$ such that $\overline{AX}$, $\overline{BY}$, and $\overline{CZ}$ are concurrent at W. If the area of ΔABC is 190, find the area of ΔBCZ.

19. A triangular region is formed by the lines $x = a$, $y = -2$ and $y = -5x + 28$. Find the value(s) of a for which the area of the triangular region is 10.

20. $P(x)$ and $Q(x)$ are polynomial functions such that when $P(x)$ is divided by $Q(x)$, the quotient is $x + 4$ and there is a remainder of $x - 6$. When $P(x)$ is divided by $Q(x) + 3$, the quotient is $x + 2$ and there is no remainder. Find the value of $P(-1)$.

2014 SAA

School **ANSWERS**

Fr/So 8 Person Team

(Use full school name – no abbreviations)

______ **Correct X 5 pts. ea. =** [ ]

Note: All answers must be written legibly in simplest form, according to the specifications stated in the Contest Manual. Exact answers are to be given unless otherwise specified in the question. No units of measurement are required.

1. 24
2. $\frac{4}{5}$ OR 0.8 OR $.8$
3. 11
4. $72\sqrt{2}$ (Must be this exact answer.)
5. $8\sqrt{2}$ (Must be this exact answer.)
6. $6, -6$ (Must have both answers, either order, no coordinates.)
7. 36
8. -15
9. $7\sqrt{3}-6$ OR $-6+7\sqrt{3}$
10. -3
11. 6
12. 8
13. $\frac{36}{7}$ (Must be this reduced improper fraction.)
14. 21
15. $96\sqrt{2}$ (Must be this exact answer.)
16. $\frac{y+x}{y+2x}$ (Must be this single rational expression with positive exponents or exact equivalent.)
17. 24 ("Ordered pairs" optional.)
18. 114
19. $4, 8$ (Must have both values in either order.)
20. 8

1. Find the quotient of base two numbers $\frac{1110101_2}{1101_2}$. Express your answer as a base two number.

2. Evaluate $\log 4^5 + \log 5^{10}$.

3. David has a bag containing six fair coins and four double-headed coins. He takes a coin at random from the bag and tosses it in the air. Given the outcome of the toss was heads, find the probability that David picked a double-headed coin. Express your answer as a common fraction reduced to lowest terms.

4. Find the exact point(s) of intersection of $\frac{x^2}{18} + \frac{y^2}{12} = 1$ and $\frac{x^2}{7} - \frac{y^2}{21} = 1$ which is/are in the first quadrant. Express your answer(s) as ordered pair(s).

5. Determine the sum of all the natural numbers from 1 to 100 inclusive that are divisible by two but not divisible by three.

6. Find the exact **sum** of all x, $0 \le x < 2\pi$, such that $2\cos(2x) - 1 = 0$.

7. Simplify $(1-i)^4 \left(1 - i\sqrt{3}\right)^5$. Express your answer in the form $a + bi$ where a and b represent exact real numbers.

8. Both x and y are integers. Find the **number** of solutions (x, y) that exist for the equation $(x-6)(x-8)=2^y$.

9. Given that $\lim_{x\to 2}\frac{4x^2-16x+16}{3x^3-9x^2+12}=\frac{k}{w}$ where k and w are relatively prime positive integers, find the value of the sum $(k+w)$.

10. If $x, 2x+2, 3x+3, \ldots$ is a geometric sequence, find the numeric value of the fourth term. Express your answer as an exact decimal.

11. Find the smallest positive integer $n > 3000$, such that ${}_nC_{2014}$ is divisible by ${}_nC_{2013}$, but not equal to it. (Note: ${}_nC_r$ indicates the number of combinations of n items, taken r at a time.)

12. The polar graphs $r = 2\sin\theta$ and $r = 1+\sin\theta$ are drawn. Find the rectangular coordinates of the point(s) the graphs have in common. Express your answer as an ordered pair(s) (x, y).

13. Find the **number** of perfect squares that are between 7^4 and 4^7.

14. On the planet Python, there are three species:
Grails, who always tell the truth
Grahams, who always lie
Gilliams, who never speak first, and who, when they do speak, follow a lie by the previous speaker with the truth, and follow the truth by the previous speaker with a lie.
Three Pythonians (A, B, and C) make the following statements in the given order:
A: B is a Grail
B: A is a Gilliam
C: We are all Grails
Find the **number** of these three Pythonians who are Grails.

15. Find the exact eccentricity of the graph of $9x^2 + 4y^2 - 18x + 6y - 11 = 0$. Express your answer as a single rational expression.

16. **(Multiple Choice)** For your answer write the **capital letter** which corresponds to the correct choice.

The parametric equations of a particle's motion in the plane are $x = \cos(2t)$ and $y = \cos(t)$ for $t \in [0, 2\pi]$. The set of points that make up this particle's path is.

(A) A segment. (B) A circular arc. (C) Part of an ellipse
(D) Part of a parabola. (E) Part of a hyperbola. (F) None of the above.

17. Let f be a function such that for all valid real x, $f(x) + 2f\left(\frac{x+2012}{x-1}\right) = 2016 - x$. Find $f(2014)$.

18. The point $P(8,12,z)$ lies on the plane that contains the lines $\frac{1-x}{2} = y - 4 = z$ and $\frac{2-x}{3} = \frac{y-1}{4} = 2 - z$. Find the value of z.

19. Let $[a]$ denote the greatest integer less than or equal to a. Evaluate $\left[\frac{3^{31} + 2^{31}}{3^{29} + 2^{29}}\right]$.

20. Box A contains 4 red marbles and 2 green marbles. Box B contains 1 red marble and 3 green marbles. Box C has 3 red marbles and 4 green marbles. One marble is randomly chosen from each of Box A and Box B. These two marbles are put into Box C. Then one marble is randomly chosen from Box C. Find the probability that this marble is red. Express your answer as a common fraction reduced to lowest terms.

2014 SAA

School ANSWERS

Jr/Sr 8 Person Team

(Use full school name – no abbreviations)

______ Correct X **5** pts. ea. = ☐

Note: **All answers must be written legibly in simplest form, according to the specifications stated in the Contest Manual. Exact answers are to be given unless otherwise specified in the question. No units of measurement are required.**

1. 1001 OR 1001_2

2. 10

3. $\frac{4}{7}$ (Must be this reduced common fraction.)

4. $(3, \sqrt{6})$ (Must be this ordered pair only with exact entries.)

5. 1734

6. 4π (Must be this exact answer.)

7. $-64-64\sqrt{3}i$ OR $-64-64i\sqrt{3}$ (Must be this complex number in this form with exact entries.)

8. 2

9. 13

10. -13.5 (Must be this exact decimal.)

11. 6041

12. $(0,0), (0,2)$ (Must have both ordered pairs in either order.)

13. 78 (Perfect squares optional.)

14. 0 OR zero

15. $\frac{\sqrt{5}}{3}$ (Must be this exact rational expression.)

16. D (Must be this capital letter. Reference also to "part of parabola" ok.)

17. 1342

18. -15

19. 8

20. $\frac{47}{108}$ (Must be this reduced common fraction.)

Round answers to four significant digits and write in either standard or scientific notation unless otherwise specified in the question. Except where noted, angles are in radians. No units of measurement are required.

1. Let x represent real numbers $2 \le x \le 20$. Find the largest value of x such that $\cos x + \dfrac{1}{\ln x} = -0.6$.

2. Find the real number period of the function $y = 1000\cos(9x) + 1500\sin(8x) + 8000\cos\left(\dfrac{4}{5}x\right)$. Express your answer as a decimal rounded to the nearest thousandth.

3. Find the sum $\dfrac{1}{1 \bullet 2} + \dfrac{1}{2 \bullet 3} + \dfrac{1}{3 \bullet 4} + \ldots + \dfrac{1}{2013 \bullet 2014}$. Express your answer as a common fraction reduced to lowest terms.

4. A corporate jet originally cost $17,550,000. The jet's value depreciates at the rate of 5% per year. Find the value of this jet at the end of 10 years. Express your answer rounded to the nearest whole dollar.

5. Find the value of $2014!$. Express your answer in scientific notation rounded to four significant digits.

6. Find the 2014th digit to the right of the decimal point in the decimal representation of $\dfrac{1}{17}$.

7. The measures of the interior angles in a quadrilateral are $(5x+16)°$, $(4x-9)°$, $(6x+2)°$, and $(4x+5)°$. Find the degree measure of the largest exterior angle of the quadrilateral. Express your answer as an improper fraction reduced to lowest terms.

8. Let $x_n = \sqrt[x_{n-1}]{\left(x_{n-1}\right)^4 + 2}$ for $n > 0$ and $x_0 = 1$. Find x_{2014}.

9. Find the value of x such that $2\left(1 + x^3 + x^6 + x^9 + \cdots\right) = 1 + x^2 + x^4 + x^6 + \cdots$.

10. A circle contains the points $(-5,-2)$, $(0,3)$, and $(4,2)$. The equation of this circle can be written in the form $0 = x^2 + y^2 + Ax + By + C$. Find the ordered triple (A,B,C) with exact decimal entries.

11. A cubic polynomial of the form $p(x) = x^3 + bx^2 + cx + d$ has zeros 20.14, 10.24, and -3.14 Find the sum $(b + c + d)$. Express your answer as a decimal rounded to the nearest hundredth.

12. It is known that Wanda will have a hot fudge sundae while watching a baseball game 90% of the time. It is known that Paul will have a hot fudge sundae while watching a baseball game 80% of the time. It is known that Richard will have a hot fudge sundae while watching a baseball game 80% of the time. Find the probability that **at least two** of the three will have a hot fudge sundae if each of them watches a baseball game today. Express your answer as an **exact decimal**. **Do not use 4 significant digits. Do not use scientific notation.**

13. City code requires window signs to be made completely out of card stock, to be rectangular, and to have 48 square inches of print space surrounded by margins 1.5 inches on the left and right sides and 1 inch on the top and bottom. Find the dimensions of the card stock so that a minimum amount of stock is used. Express your answer as an ordered pair (x, y) with decimal entries rounded to the nearest tenth of an inch and where x represents the length along the bottom of the rectangular sign.

14. Let vector $\vec{v} = \langle a,b \rangle = ai + bj$. $\vec{v}_1 = \langle 3,4 \rangle$ and $\vec{v}_2 = \langle -5,12 \rangle$. Find the degree measure of the angle between $\vec{w}_1 = \vec{v}_1 + \vec{v}_2$ and $\vec{w}_2 = \vec{v}_2 - \vec{v}_1$. Express your answer as a decimal rounded to the nearest hundredth of a degree.

15. From the top of a 100-foot vertical tower a student observes a truck moving directly across the level road and towards the tower. He takes a measure of $21°$ for the angle of depression and then precisely 3 seconds later, another measure of $45°$ angle of depression. Find the speed of the truck in miles per hour.

16. The total surface area of a right circular cone is 13π. The altitude (height) of this cone is 5. Find the lateral surface area of this cone.

17. $A = \{1, 3, 11, 8, x\}$ where A consists of five **distinct** positive integers. Let k be the total population standard deviation (σ_X) of A. Let w be the median of A. Find the **number** of distinct values of x such that $|k - w| < 1$. Express your answer as an integer.

18. Find the value of $\dfrac{6^{-3} + \sqrt[5]{1+\sqrt{5}}}{2 - \dfrac{1}{\sqrt[6]{2}}}$.

19. Find the value of x such that $\log_2 1 + \log_4 3 = \log_5 x$.

20. At the Deluxe Dining Restaurant, it has been determined that 7% of all people who make reservations at the Restaurant will not show. Rounded to the nearest whole person, find the maximum number of people who can make reservations at the Restaurant and still have the proprietor be at least 84% sure that no more than 1 person who made a reservation will fail to show.

2014 SAA

Calculator Team

School ANSWERS

(Use full school name – no abbreviations)

______ Correct X 5 pts. ea. = [ ]

Note: All answers must be written legibly. Round answers to four significant digits and write in either standard or scientific notation unless otherwise specified in the question. Except where noted, angles are in radians. No units of measurement are required.

1. 15.99 OR 1.599×10 OR 1.599×10^1

2. 31.416 (Must be this decimal.)

3. $\frac{2013}{2014}$ (Must be this reduced common fraction.)

4. 10507833 (Must be this whole number, $ optional, comma delineation ok.)

5. 5.726×10^{5781} (Must be this answer in scientific notation.)

6. 6

7. $\frac{2207}{19}$ (Must be this reduced improper fraction.)

8. 4.006 OR 4.006×10^0

9. -0.6180 OR $-.6180$ OR -6.180×10^{-1} (Trailing zero necessary.)

10. $(-1.4, 5.4, -25.2)$ (Must be this ordered triple with decimal entries.)

11. 731.17 (Must be this decimal.)

12. 0.928 OR $.928$ (Must be this decimal.)

13. $(11.5, 7.7)$ (Must be this ordered pair with these decimal entries, inches optional.)

14. 37.87 (Must be this decimal, degrees optional.)

15. 36.48 OR 3.648×10 OR 3.648×10^1 (MPH optional.)

16. 30.43 OR 3.043×10 OR 3.043×10^1

17. 8 (Must be this integer.)

18. 1.145 OR 1.145×10^0

19. 3.580 OR 3.580×10^0 (Trailing zero necessary.)

20. 10 (People or persons optional.)

1. $A=\{72, 324, 330, 423, 486, 792, 4590, 15330, 23618\}$. Find **the number** of elements from set A that are integral multiples of 18.

2. Let k be a positive integer such that $2k$, $k-3$, and $k+7$ are the lengths of the sides of an isosceles triangle. Find the value of k.

3. Let k be the x-intercept of the line $2x+3y=12$. Let $w=5p-4q$ where (p,q) is the point of intersection of the lines $3x+7y=17$ and $5x-2y=1$. Find the sum $(k+w)$.

4. Let k be the sum of all the zeros of the function $f(x)=x^2-6x-72$. Let w be **the number** of integers that satisfy $\frac{x}{3}\le\frac{2x+1}{4}<3-\frac{x}{2}$. Find the sum $(k+w)$.

5. Suppose $f(n+1)=f(n)+f(n-1)$ for $n=1,2,3,\cdots$. If $f(6)=2$ and $f(4)=8$, find the value of the sum $(f(3)+f(5))$.

6. Find the sum of all distinct integer values of x such that $|2x-5|+9\le 218$.

7. Let k be the numerical area of a triangle with vertices $(1,2)$, $(3,7)$, and $(2013,2014)$. Both bases of an isosceles trapezoid have lengths that are positive even integers. The numerical area of this trapezoid is 210.8 and the altitude has length 12.4. Let w be the longest possible length of one of the bases of this trapezoid. Find the value $(k+w)$.

8. The supplement of an angle is $25°$ more than twice the measure of the angle. The supplement of the complement of the angle can be written as $k+\frac{w}{p}$ where k, w, and p are positive integers and $\frac{w}{p}$ is a reduced common fraction. Find the sum $(k+w+p)$.

9. A circle with radius k is inscribed in a triangle with sides of lengths 18, 80, and 82. The length of the median to the longest side is w. Find the sum $(k+w)$.

10. Let k be the degree measure of the smaller angle between the hour and minute hands of an ordinary analog clock that display the time $2:35$. If c and d are two real numbers and $c\oplus d=cd+6c+7d+35$, find w such that $c\oplus w=c$ for all values of c. Find the sum $(k+w)$. Write your answer as an exact decimal.

1. $A = \begin{Bmatrix} 72, 324, 330, 423, 486, \\ 792, 4590, 15330, 23618 \end{Bmatrix}$.

Find **<u>the number</u>** of elements from set *A* that are integral multiples of 18.

2. Let k be a positive integer such that $2k$, $k-3$, and $k+7$ are the lengths of the sides of an isosceles triangle. Find the value of k.

3. Let k be the x-intercept of the line $2x+3y=12$.

Let $w=5p-4q$ where (p,q) is the point of intersection of the lines $3x+7y=17$ and $5x-2y=1$.

Find the sum $(k+w)$.

4. Let k be the sum of all the zeros of the function $f(x) = x^2 - 6x - 72.$

Let w be **the number** of integers that satisfy

$$\frac{x}{3} \le \frac{2x+1}{4} < 3 - \frac{x}{2}.$$

Find the sum $(k + w)$.

5. Suppose

$$f(n+1) = f(n) + f(n-1)$$

for $n = 1, 2, 3, \cdots$.

If $f(6) = 2$ and $f(4) = 8$, find the value of the sum $\left(f(3) + f(5) \right)$.

6. Find the sum of all distinct integer values of x such that $|2x-5|+9 \leq 218$.

7. Let k be the numerical area of a triangle with vertices $(1,2)$, $(3,7)$, and $(2013,2014)$. Both bases of an isosceles trapezoid have lengths that are positive even integers. The numerical area of this trapezoid is 210.8 and the altitude has length 12.4. Let w be the longest possible length of one of the bases of this trapezoid.
Find the value $(k+w)$.

8. The supplement of an angle is 25° more than twice the measure of the angle. The supplement of the complement of the angle can be written as $k+\dfrac{w}{p}$ where k, w, and p are positive integers and $\dfrac{w}{p}$ is a reduced common fraction. Find the sum $(k+w+p)$.

9. A circle with radius k is inscribed in a triangle with sides of lengths 18, 80, and 82. The length of the median to the longest side is w. Find the sum $(k+w)$.

10. Let k be the degree measure of the smaller angle between the hour and minute hands of an ordinary analog clock that display the time $2:35$. If c and d are two real numbers and $c \oplus d = cd + 6c + 7d + 35$, find w such that $c \oplus w = c$ for all values of c. Find the sum $\left(k + w\right)$. Write your answer as an exact decimal.

2014 SAA

School ANSWERS

Fr/So 2 Person Team

(Use full school name – no abbreviations)

Total Score (see below*) =

NOTE: Questions 1-5 only are *NO CALCULATOR*

Note: All answers must be written legibly in simplest form, according to the specifications stated in the Contest Manual. Exact answers are to be given unless otherwise specified in the question. No units of measurement are required.

	Answer	Score (to be filled in by proctor)
1.	5	
2.	7	
3.	3	
4.	10	
5.	–20	
6.	525	
7.	3050	
8.	146	
9.	49	
10.	127.5 (Must be this decimal.)	

TOTAL SCORE: ______ **(*enter in box above)**

Extra Questions:

11. ______

12. ______

13. ______

14. ______

15. ______

*** Scoring rules:**

Correct in 1st minute – 6 points

Correct in 2nd minute – 4 points

Correct in 3rd minute – 3 points

PLUS: 2 point bonus for being first In round with correct answer

1. Let k be the exact value of $\cos 2\theta$ if $90° \le \theta \le 180°$ and $\cos\theta = -\frac{3}{4}$. Let w be the sum of the reciprocals of the roots of $4x^3 + 7x^2 - x + 13 = 0$. Find the exact sum $(k+w)$. Express your answer as a common or improper fraction reduced to lowest terms.

2. Find the exact length of the segment joining the centers of the conics represented by $4x^2 + 9y^2 - 32x + 90y + 253 = 0$ and $x^2 - 4y^2 + 2x - 8y - 7 = 0$.

3. There are 10 distinct points equally spaced on the circumference of a circle. If 3 of the points are chosen at random, find the probability that the three points will be the vertices of a right triangle. Express your answer as a common fraction reduced to lowest terms.

4. Let k and w represent positive integers. Find the sum of all possible values of k and w for which $x^2 + kx + 50$ and $y^2 + wy - 50$ can be factored over the set of integers.

5. The Sun ICTMA had 5 planets. Starting at a particular point in time, all five planets arrive in peak position. The innermost two planets orbit ICTMA in precisely 6 years and 8 years. At the same time, the outer three planets will orbit ICTMA in precisely 12, 40, and 84 years. The next time all 5 planets arrive in peak position together, the innermost two planets will have been in peak position together k times. Find the value of k.

6. Find the value of $\sum_{9}^{12}\left(\frac{k}{k+4}\right) + \sum_{5}^{8}\left(\frac{k+4}{k+8}\right)$. Express your answer as an improper fraction reduced to lowest terms.

7. Find the value of $\left(\frac{x^2 - x + xy - y}{x^2 + 6x - 7}\right) \times \left(\frac{x^2 + 2xy + y^2}{4x + 4y}\right)^{-1}$ when $x = 2014$ and $y = 1999$. Express your answer as a common or improper fraction reduced to lowest terms.

8. Let $k = \left(1 + \frac{1}{1}\right)\left(1 + \frac{1}{2}\right)\left(1 + \frac{1}{3}\right)\cdots\left(1 + \frac{1}{n}\right)\cdots\left(1 + \frac{1}{2014}\right)$. Let w be the numerical coefficient of the term containing x^5 in the expansion of $(2x + y)^{20}$. Find the sum $(k+w)$.

9. For all real values of x, $f(2x+1) = x^2 - 4x - 12$. Find the sum of the roots of $f(x)$.

10. In ΔABC, $\angle CAB = 28°$, $AC = 10$, and $BC = 7$. Find the sum of all possible length(s) of AB. Express your answer as a decimal rounded to four significant digits.

1. Let k be the exact value of $\cos 2\theta$ if $90° \le \theta \le 180°$ and $\cos\theta = -\frac{3}{4}$. Let w be the sum of the reciprocals of the roots of $4x^3 + 7x^2 - x + 13 = 0$. Find the exact sum $(k + w)$. Express your answer as a common or improper fraction reduced to lowest terms.

2. Find the exact length of the segment joining the centers of the conics represented by

$$4x^2 + 9y^2 - 32x + 90y + 253 = 0$$

and

$$x^2 - 4y^2 + 2x - 8y - 7 = 0.$$

3. There are 10 distinct points equally spaced on the circumference of a circle. If 3 of the points are chosen at random, find the probability that the three points will be the vertices of a right triangle. Express your answer as a common fraction reduced to lowest terms.

4. Let k and w represent positive integers. Find the sum of all possible values of k and w for which $x^2 + kx + 50$ and $y^2 + wy - 50$ can be factored over the set of integers.

5. The Sun ICTMA had 5 planets. Starting at a particular point in time, all five planets arrive in peak position. The innermost two planets orbit ICTMA in precisely 6 years and 8 years. At the same time, the outer three planets will orbit ICTMA in precisely 12, 40, and 84 years. The next time all 5 planets arrive in peak position together, the innermost two planets will have been in peak position together k times. Find the value of k.

6. Find the value of

$$\sum_{9}^{12}\left(\frac{k}{k+4}\right)+\sum_{5}^{8}\left(\frac{k+4}{k+8}\right).$$

Express your answer as an improper fraction reduced to lowest terms.

7. Find the value of

$$\left(\frac{x^2 - x + xy - y}{x^2 + 6x - 7}\right) \times \left(\frac{x^2 + 2xy + y^2}{4x + 4y}\right)^{-1}$$

when $x = 2014$ and $y = 1999$. Express your answer as a common or improper fraction reduced to lowest terms.

8. Let

$$k = \left(1+\frac{1}{1}\right)\left(1+\frac{1}{2}\right)\left(1+\frac{1}{3}\right)\cdots\left(1+\frac{1}{n}\right)\cdots\left(1+\frac{1}{2014}\right).$$

Let w be the numerical coefficient of the term containing x^5 in the expansion of $(2x+y)^{20}$. Find the sum $(k+w)$.

9. For all real values of x, $f\left(2x+1\right)=x^2-4x-12$. Find the sum of the roots of $f\left(x\right)$.

10. In ΔABC, $\angle CAB = 28°$, $AC = 10$, and $BC = 7$. Find the sum of all possible length(s) of AB. Express your answer as a decimal rounded to four significant digits.

2014 SAA

School ANSWERS

Jr/Sr 2 Person Team

(Use full school name – no abbreviations)

Total Score (see below*) = ☐

NOTE: Questions 1-5 only are *NO CALCULATOR*

Note: All answers must be written legibly in simplest form, according to the specifications stated in the Contest Manual. Exact answers are to be given unless otherwise specified in the question. No units of measurement are required.

Answer		**Score** (to be filled in by proctor)
1.	$\frac{21}{104}$ (Must be this reduced common fraction.)	________
2.	$\sqrt{41}$ (Must be this exact answer.)	________
3.	$\frac{1}{3}$ (Must be this reduced common fraction.)	________
4.	170	________
5.	35	________
6.	$\frac{15779}{2730}$ (Must be this reduced improper fraction.)	________
7.	$\frac{4}{2021}$ (Must be this reduced common fraction.)	________
8.	498143	________
9.	10	________
10.	17.66 (Must be this decimal.)	________

TOTAL SCORE: ________
(*enter in box above)

Extra Questions:

11. ________

12. ________

13. ________

14. ________

15. ________

*** Scoring rules:**

Correct in 1st minute – 6 points

Correct in 2nd minute – 4 points

Correct in 3rd minute – 3 points

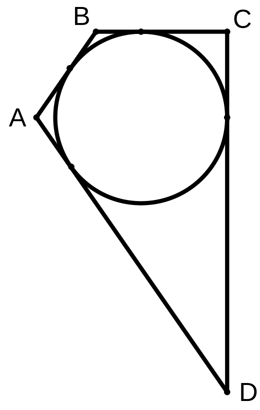
PLUS: 2 point bonus for being first In round with correct answer

1. Find the value of $(-1)^1 + (-1)^2 + (-1)^3 + \cdots + (-1)^{2014}$.

2. A parallelogram is drawn on a piece of graph paper with vertices at $(ANS, 2)$, $(4, 0)$ and $(7, 3)$. The fourth vertex is at (k, w) where $0 < k < 7$. Find the sum $(k + w)$.

3. Find the area in square units of a rhombus if its diagonals measure ANS units and 5 units.

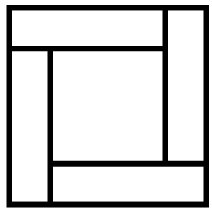
4. Each of the sides of the quadrilateral $ABCD$ is tangent to the circle as shown in the figure (not necessarily drawn to scale.). $AB = 10$, $BC = 15$, and $AD = ANS$. Find CD.



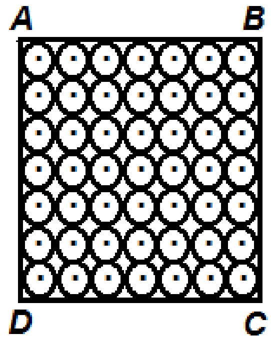
1. There are two whole numbers such that the square of the first number plus the second number equals 31 and the square of the second number minus the first number equals 31. Find the smaller of the two numbers.

2. “Ages are funny”, said Amanda. “As Alex gets older I seem to get younger.” Abby smiled at her. “That’s ridiculous,” she told Amanda. “That can’t be.” “Well, look”, Amanda replied. “Four years ago I was *ANS* times his age then, but in two years I’ll be only twice as old as he will be then.” It did sound a bit odd. Find Amanda’s present age in years.

3. A large square is divided into a small square surrounded by four congruent rectangles as shown in the figure. The perimeter of each of the congruent rectangles is ANS. Find the area of the larger square.



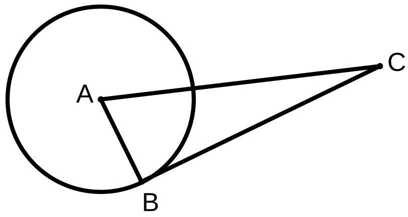
4. The area of the square *ABCD* is *ANS* sq. units. Seven rows of seven circles with the same diameter are inside the square as shown. Find the area of the part of the region that is inside the square but not inside a circle. Express your answer as a decimal rounded to the nearest hundredth.



1. 28 handshakes were exchanged at the conclusion of a meeting. Assume that each participant was equally polite toward all the other participants and shook hands with everyone else exactly once. Find the number of people that were present.

2. The arithmetic mean of nine numbers is $(ANS)^2$. If two numbers, k and w, are added to the list, the mean of the eleven number list becomes 66. Find the mean of k and w.

3. The radius of Circle A is 40cm. Tangent segment $\overline{BC}$ is ANS cm long. Find the length of segment $\overline{AC}$ in centimeters.



4. The dimensions of a box that is a rectangular solid are 51, ANS, and 119. Find the exact length of the diagonal of the box.

1. Claire, who is four years older than her sister Amy, is now three times as old as Amy was two years ago. Find the number of years old Amy is now.

2. For real numbers x and y, define $x \otimes y = (x+y)(x-y)$. Find the value of $3 \otimes (4 \otimes ANS)$.

3. A regular hexagon with a perimeter of $\left(-\frac{1}{3}ANS\right)$ is inscribed in a circle. Find the exact distance from the center of the circle to one side of the hexagon.

4. Let $k = (ANS)^2$. Two telephone poles are perpendicular to level ground, are 100 feet apart, as measured on the ground, and have heights of k feet and 48 feet. There is a line from the top of each pole to the bottom of the other pole. Find the height above the ground, in feet, for the point where the two lines intersect. Express your answer as an exact decimal.

1. Find the 2014th digit to the right of the decimal point in the decimal representation of $\frac{1}{7}$.

2. One marble is drawn at random from a bag containing ANS orange, 18 blue, and 13 green marbles. Find the probability the marble chosen was orange. Express your answer as a common fraction reduced to lowest terms.

3. ANS will be in the form of a common fraction. k is the numerator of that fraction. The diagonals of an isosceles trapezoid each measure 17 units, the altitude measures k units and the upper base measures 9 units. Find the perimeter of the trapezoid.

4. Two of the angles of a convex quadrilateral have respective degree measures of $143°$ and $ANS°$. One of the two remaining angles of the quadrilateral has a measure that is 5 more than twice the degree measure of the other remaining angle of the quadrilateral. Find the degree measure of the larger of these two remaining angles.

2014 SAA FR/SO RELAY COMPETITION PROCTOR ANSWER SHEET

ROUND 1

1. 0
2. 8
3. 20 (Units optional.)
4. 25

ROUND 2

1. 5
2. 14 (Years old optional.)
3. 49
4. 10.52 (Must be this decimal.)

ROUND 3

1. 8
2. 75
3. 85 (cm optional.)
4. $17\sqrt{83}$ (Must be this exact answer.)

EXTRA ROUND 4

1. 5 (Years optional.)
2. -72
3. $2\sqrt{3}$ (Must be this exact answer.)
4. 9.6 (Must be this decimal, feet optional.)

EXTRA ROUND 5

1. 8
2. $\frac{8}{39}$ (Must be this reduced common fraction.)
3. 50
4. 113 (Degrees optional.)

1. Find the value of x if $\log_4 19 + \log_4 17 + \log_4 10 = \log_4 x + \log_4 2$.

2. The 76^{th} term of an arithmetic progression is ANS. If the first term of the progression is 340, find the common difference between the terms of the progression.

3. Let $k = ANS$. Find the number of distinct positive integral factors for the number $(144k)$.

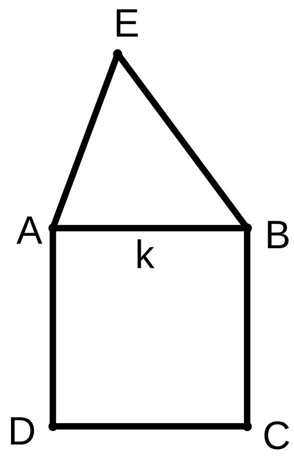
4. In equilateral ΔABC the radius of the circumscribed circle is ANS. Find, in simplest radical form, the area of ΔABC.

1. The graph of $f(x)=\dfrac{(2x-1)(x+3)}{2x^2-11x+5}$ has a vertical asymptote at $x=k$. Find the value of k.

2. The population of Mathville was 501 on May 1, 2013. If the population grows at $(ANS)\%$ per year, find the population of Mathville on May 1, 2015. Report your answer rounded to the nearest integer.

3. Let k represent the sum of the digits in ANS. Solve $\sqrt{k+\sqrt{k+\sqrt{k+\cdots}}} = x-2$ for x. Report your answer rounded to the nearest integer.

4. Let $ANS = k$. In the diagram, not necessarily drawn to scale, quadrilateral $ADCB$ is a square with $AB = k$ inches. In $\Delta\, EAB$, $\angle EAB = 70°$ and $\angle EBA = 60°$. Find the area of polygon $ADCBE$ in square inches. Report your answer as a decimal rounded to the nearest tenth of a square inch.



1. Sharp Eye Shooter of the Miami Freeze is a 75% free throw shooter. Find the probability that Sharp Eye will make at least one of his two free throws after he was fouled. Report your answer as a reduced common fraction.

2. $ANS = \frac{a}{b}$. Find the value of $1+\left(\frac{a}{b}\right)+\left(\frac{a}{b}\right)^2+\left(\frac{a}{b}\right)^3$. Report your answer as a decimal rounded to the nearest tenth.

3. Let $k = 10(ANS)$. Find the area, in square centimeters, of the circumscribed circle of a regular nonagon whose side is k centimeters. Report your answer rounded to the nearest integer.

4. Let k represent the sum of the digits in ANS. Solve for x and report your answer as a decimal rounded to the nearest tenth: $\begin{cases} 2e^x - 3e^y = 5 \\ 5e^x + 2e^y = k \end{cases}$.

1. Find the product of the roots of $(x+5)(x-3)=(2x+5)(3x-4)$.

2. Find x where $\log_3\left(2x+(ANS)\right)=3$.

3. Let $k = ANS$. Solve this system of equations for *x*: $\begin{cases} 2^{2x} - 4\left(2^{y}\right) = 25 \\ 2\left(2^{2x}\right) + 2^{y} = k \end{cases}$. Report your answer as a decimal rounded to the nearest hundredth.

4. Let $k = 100(ANS)$. The area of an isosceles trapezoid with base angles of $60°$ and a shorter base of 6 inches is $k\sqrt{3}$ square inches. Find the length, in inches, of the longer base. Report your answer as a decimal rounded to the nearest hundredth.

1. Find the minimum value of $f(x)$ for the function $f(x) = x^2 + 4x - 6$.

2. Let $k = |ANS|$. Find the number of distinct 5-person committees that can be formed from a group of 6 men and k women if 2 men and 3 women must be selected.

3. Let k be the sum of the digits in ANS. In a raffle there are 3 tickets, each worth $50, 6 tickets each worth $25 and k tickets worth $10. If all the tickets are sold and each ticket sold wins one of these prizes, find the probability a ticket drawn at random is one of the 6 tickets that are each worth $25. Report your answer as a reduced common fraction.

4. Let $k = ANS$. Find, in terms of π , the period of the function
$f(x) = -3\tan\left(2\left(kx - \frac{\pi}{4}\right)\right)$.

2014 SAA JR/SR RELAY COMPETITION PROCTOR ANSWER SHEET

ROUND 1

1. 1615
2. 17
3. 30
4. $675\sqrt{3}$ (Must be this exact answer.)

ROUND 2

1. 5
2. 552 (People optional.)
3. 6
4. 55.1 (Must be this decimal, square inches optional.)

ROUND 3

1. $\frac{15}{16}$ (Must be this reduced common fraction.)
2. 3.6 (Must be this exact decimal.)
3. 8701 (Must be this integer, sq cm optional.)
4. 1.1 (Must be this exact decimal.)

EXTRA ROUND 4

1. -1
2. 14
3. 1.58 (Must be this decimal.)
4. 25.85 (Must be this decimal, inches optional.)

EXTRA ROUND 5

1. -10
2. 1800 (Committees optional.)
3. $\frac{1}{3}$ (Must be this common fraction.)
4. $\frac{3\pi}{2}$ OR 1.5π (Must be exact answer.)