

WMML  
Meet #1  
Dec. 7, 2021

Name \_\_\_\_\_

School \_\_\_\_\_

Arithmetic and Number Theory

1) Let  $p(n)$  be defined as the sum of all prime numbers from 1 to  $n$ , inclusive. Find  $p(20)$ .

1. \_\_\_\_\_

2) Let  $q(n)$  be defined as the sum of all unique prime factors of  $n$ . Find  $q(1776)$ .

2. \_\_\_\_\_

3) Let  $p(n)$  and  $q(n)$  be defined as above. Find  $q(q(q(p(30))))$ .

3. \_\_\_\_\_

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Algebra 1

1) If  $x$  and  $y$  are inversely proportional and  $x = 10$  when  $y = 6$ , what is  $x$  when  $y = 4$ ?

1. \_\_\_\_\_

2) Chad drives to his mother's house, which is 40 miles away, and then drives back. On the way there he drives 40 miles per hour, but on the way back he drives only 20 miles per hour. What is his average speed for the whole trip?

2. \_\_\_\_\_

3) Evaluate the following expression:

3. \_\_\_\_\_

$$\frac{\left(4^{\frac{2}{3}}\right)\left(2^{\frac{1}{6}}\right)\left(3^{\frac{3}{2}}\right)}{\left(2^{-\frac{1}{2}}\right)\left(3^{\frac{1}{2}}\right)}$$

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Geometry

1) The point  $A(2,4)$  is translated 5 units down, reflected across the  $x$ -axis, reflected across the  $y$ -axis, rotated  $90^\circ$  clockwise around the origin, and dilated by a factor of 3 (centered at the origin), in that order. What are the coordinates of the image after all the transformations?

1. \_\_\_\_\_

2) Sides  $AB$ ,  $BC$ ,  $CD$ , and  $DA$  of convex quadrilateral  $ABCD$  have lengths 3, 4, 12, and 13, respectively; and  $\angle CBA$  is a right angle. What is the area of the quadrilateral?

2. \_\_\_\_\_

3) A circle is inscribed in a triangle with sides of lengths 8, 13, and 17. Let the segments of the side of length 8 made by a point of tangency be  $r$  and  $s$ , with  $r < s$ . Find the ratio  $r : s$ .

3. \_\_\_\_\_

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Algebra 2

1) The graphs of the equations  $x + 3y = 6$  and  $kx + 2y = 12$  are perpendicular. What is the value of  $k$ ?

1. \_\_\_\_\_

2) Find all  $x$  such that  $1 + \frac{x + 3}{x - 2} = \frac{3x - 3}{6 - x}$ .

2. \_\_\_\_\_

3) Find all values of  $m$  which will make  $x + 2$  a factor of  $x^3 + 3m^2x^2 + mx + 4$ .

3. \_\_\_\_\_

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Trigonometry and Complex Numbers

1) Find the value of  $\left| \frac{7 - 24i}{4 + 3i} \right|$ .

1. \_\_\_\_\_

2) Triangle  $ABC$  has a right angle at  $C$ . If  $\sin(A) = \frac{2}{3}$ , then find the exact value of  $\sin(B) \cdot \cos(A) \cdot \tan^2(B)$ .

2. \_\_\_\_\_

3) If the 6 solutions to  $x^6 = -64$  are written in the form  $a + bi$ , where  $a$  and  $b$  are real, then find the product of those solutions with  $a > 0$ .

3. \_\_\_\_\_

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Precalculus

1) Find the polar coordinate representation of the center of the circle defined by the equation  $(x - 4)^2 + (y + 4)^2 = 37$ .

1. \_\_\_\_\_

2) The line through  $(3, \frac{8}{3}k)$  and  $(4, k^2 + 2)$  is perpendicular to the line  $3x + y = 2021$ . Find all possible values of  $k$ .

2. \_\_\_\_\_

3) In the expansion of  $(xy - 2y^{-3})^{16}$ , find the coefficient of the term that does not contain  $y$ .

3. \_\_\_\_\_