WMML
Meet #4
Feb. 1, 2022

Name _____

School _____

Arithmetic and Number Theory

1) If 4 morbs are worth 3 meebs and 2 meebs are worth 5 marps, how many marps are worth the same as 10 morbs?

1._____

2) The price of a car is originally $10,000. If the price decreased by 25%, then increased by 25%, and finally decreased by 25% again. What is the final price of the car?

2._____

3) Find the units digit of $7^{42} + 42^7$.

3._____

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Algebra 1

1) There are 16 coins in a piggy bank. If the coins are all nickels and dimes and they total $1.05, how many nickels are there?

1._____

2) Find all (x, y) such that $2\sqrt{x} + 4\sqrt{y} = 10$ and $2\sqrt{x} - 3\sqrt{y} = 3$.

2._____

3) Simplify the following expression:

3._____

$$\left(2 + \sqrt{2} + \frac{1}{2+\sqrt{2}} + \frac{1}{\sqrt{2}-2}\right)^2$$

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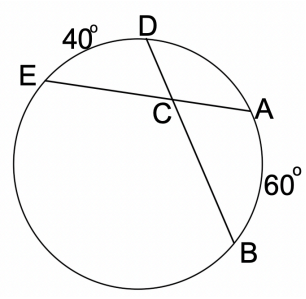
Geometry

1) In the figure, if $\overset{\frown}{AB} = 60^\circ$ and $\overset{\frown}{DE} = 40^\circ$, then what is $\angle ACD$?

1._____

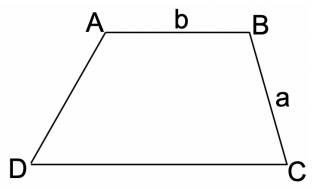


2) A 25-foot ladder is placed against a vertical wall. The foot of the ladder is 7 feet from the base of the wall. If the top of the ladder slips 4 feet, then how far will the foot slide?

2._____

3) In the figure below, segments AB and CD are parallel, the measure of angle B is twice that of angle D, and the measures of segments CB and AB are a and b respectively. Find CD in terms of a and b.

3._____



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Algebra 2

1) How many integers satisfy $|x| + 1 \geq 3$ and $|x - 1| < 3$?

1._____

2) Find the sum

$$\frac{1}{3+2\sqrt{2}} + \frac{1}{2\sqrt{2}+\sqrt{7}} + \frac{1}{\sqrt{7}+\sqrt{6}} + \frac{1}{\sqrt{6}+\sqrt{5}} + \frac{1}{\sqrt{5}+2} + \frac{1}{2+\sqrt{3}}$$

2._____

3) Find $x^6 + \frac{1}{x^6}$ if $x + \frac{1}{x} = 3$.

3._____

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Trigonometry and Complex Numbers

1) Find the value of $\sec(1920^\circ)$.

1._____

2) What is the radius of a circle that is inscribed in a triangle with side lengths 8, 15 and 17?

2._____

3) If $f(z) = \dfrac{z+1}{z-1}$, then find $f^{2022}(2+i)$.

3._____

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Precalculus

1) Find the product of all roots of the polynomial

$$x^3 + x^2 - 17x + 15.$$

1._____

2) Find the equations of all asymptotes for the equation

$$\frac{(x+1)^2}{4} - \frac{(y-2)^2}{9} = 1.$$

2._____

3) Find the cosine of the angle between the vectors $(3 \quad 4 \quad 5)$ and $(-1 \quad 4 \quad 3)$.

3._____

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Team Round

1. If $a\sharp b = a^b + b$, determine the value of $\left(4\sharp 5\right) - \left(5\sharp 4\right)$.

1._____

2. If $f(x) = 5x - 2$, $g(x) = ax + b$, and $f(g(x)) = g(f(x))$, find an expression for b in terms of a.

2._____

3. How many cubes, each 3 inches on an edge, are needed to make a volume equal to that of a rectangular solid whose dimensions are 2 feet by 2 feet by 3 feet?

3._____

4._____

4. Let x be an integer such that $-20 \leq x \leq 20$. If x is chosen at random, determine the probability that it will be a solution to both $|x - 5| \geq 5$ and $x^2 \leq 196$.

5. If $F(x) = 3x^3 - 2x^2 + x - 3$, find $F(1 + i)$.

5._____

6. If $\begin{bmatrix} 2 & 4 \\ 6 & 8 \end{bmatrix} \cdot \begin{bmatrix} a & 1 \\ b & 0 \end{bmatrix} = \begin{bmatrix} 8 & 2 \\ 12 & 6 \end{bmatrix}$, determine a and b.

6._____