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Art of Problem Solving



**Bangladesh Mathematical Olympiad 2019**

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**1** Find all prime numbers such that the square of the prime number can be written as the sum of cubes of two positive integers.

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**2** Prove that,if $a,b,c$ are positive real numbers,

$$\frac{a}{bc}+\frac{b}{ca}+\frac{c}{ab}\geq\frac{2}{a}+\frac{2}{b}-\frac{2}{c}$$

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**3** Let $\alpha$ and $\omega$ be two circles such that $\omega$ goes through the center of $\alpha.\omega$ intersects $\alpha$ at $A$ and $B$.Let $P$ any point on the circumference $\omega$.The lines $PA$ and $PB$ intersects $\alpha$ again at $E$ and $F$ respectively.Prove that $AB=EF$.

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**4** $A$ is a positive real number.$n$ is positive integer number.Find the set of possible values of the infinite sum $x_0^n+x_1^n+x_2^n+...$ where $x_0,x_1,x_2...$ are all positive real numbers so that the infinite series $x_0+x_1+x_2+...$ has sum $A$.

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**5** Prove that for all positive integers $n$ we can find a permutation of $1,2,...,n$ such that the average of two numbers doesn't appear in-between them.For example $1,3,2,4$works,but $1,4,2,3$ doesn't because $2$ is between $1$ and $3$.

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**6** When a function $f(x)$ is differentiated $n$ times ,the function we get id denoted $f^n(x)$.If $f(x)=\frac{e^x}{x}$.Find the value of

$$\lim_{n\to\infty}\frac{f^{2n}(1)}{(2n)!}$$

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**7** Given three cocentric circles $\omega_1$,$\omega_2$,$\omega_3$ with radius $r_1,r_2,r_3$ such that $r_1+r_3\geq 2r_2$.Constrat a line that intersects $\omega_1$,$\omega_2$,$\omega_3$ at $A,B,C$ respectively such that $AB=BC$.

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**8** The set of natural numbers $\mathbb{N}$ are partitioned into a finite number of subsets.Prove that there exists a subset of $S$ so that for any natural numbers $n$,there are infinitely many multiples of $n$ in $S$.

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**9** Let $ABCD$ is a convex quadrilateral.The internal angle bisectors of $\angle BAC$ and $\angle BDC$ meets at $P.\angle APB=\angle CPD$.Prove that $AB+BD=AC+CD$.

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**10** Given $2020 * 2020$ chessboard, what is the maximum number of warriors you can put on its cells such that no two warriors attack each other.
Warrior is a special chess piece which can move either $3$ steps forward and one step sideward and $2$ step forward and $2$ step sideward in any direction.

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