PHILIPPINE INTERNATIONAL MATH AND SCIENCE OLYMPICS

NATIONAL ROUND 2022

PIMSO Math

SECONDARY 1

GENERAL INSTRUCTIONS

1. You have 90 minutes to finish the test.
2. You may write your solutions on the TEST BOOKLET.
3. Write your answers on the ANSWER SHEET.
4. After the test, you must SUBMIT to the proctor both the TEST BOOKLET and the ANSWER SHEET.
5. This test covers FIVE (5) CATEGORIES namely: NUMBER THEORY, LOGICAL ANALYSIS, ALGEBRA, GEOMETRY, and COMBINATORICS.
6. There is a total of thirty (30) questions in this test. Each correctly answered question will be marked five (5) points. No point shall be deducted for incorrect answer.
7. You are NOT ALLOWED to use any calculating device during the test proper.
8. Any form of cheating is a ground for DISQUALIFICATION.

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BEGIN HERE:

1. Consider all the numbers from 1 to 1200. How many of these numbers are NOT divisible by either 2, 5, or 7?

2. Consider the base-20 system using the first 20 letters of the Alphabet below.

A	B	C	D	E	F	G	H	I	J
0	1	2	3	4	5	6	7	8	9

K	L	M	N	O	P	Q	R	S	T
10	11	12	13	14	15	16	17	18	19

How will you write 3000_{10} using this base-20 system?

3. Using the base-20 system in #2, what is **RAF** minus **LBC** in binary system?

4. Convert your answer in #3 into the base-3 system.

5. What is the sum of this series up to its 2020^{th} term?

$$\frac{1}{9}+\frac{1}{18}+\frac{1}{30}+\frac{1}{45}+\cdots$$

6. If we divide the product of $1\times 2\times 3\times 4\times 5\times\cdots\times 770$ by 773, what will be the remainder?

7. In the 2022 PIMSO Math National examination, a student attempted 23 questions and got 45 points. If for every correct answer 3 points were awarded and for every wrong answer 1 point was deducted, then how many answers were wrong?

8. At the end of a meeting, seven students shake hands with each other once. How many handshakes will be there altogether?

9. Robert is at 10^{th} position from the top. In the class of 50 students, there are 26 students between Migs and Robert. How many students are there in between Migs and the last student in the class?

10. My mother is three times older than my sister. My father is 30 years older than me. I was 5 years old when my sister was born. If the present age of my sister is 15 years, then the difference between my mother's and father's age is ____.

11. 11, 202, 3443, 9779 and 88,888 are examples of palindromic numbers. How many two-digit, three-digit and four-digit palindromic numbers less than 2022 are there?

12. Complete the series: 13, 25, 1, 37, –11, ___.

13. Simplify: $2{,}023\left[\frac{1}{2\times1}+\frac{2}{3\times4}+\frac{3}{4\times9}+\frac{4}{5\times16}+\cdots+\frac{2{,}021}{2022\times2{,}021^2}+\frac{2{,}022}{2023\times2{,}022^2}\right]$.

14. If $P = \{p, i, m, s, o\}$ and $C = \{c, i, s, m, o\}$ then $\mathfrak{R} = \{x \mid x \; is \; a \; subset \; of \; P\}$ and $\mathcal{F} = \{y \mid y \; is \; a \; subset \; of \; C\}$. Let N be the number of subsets in $\mathfrak{R}$ and M be the number of subsets in $\mathcal{F}$. Let X be the number of common elements of $\mathfrak{R}$ and $\mathcal{F}$. Find N + M – X.

15. Simplify $\left[\frac{(2-1.999\ldots)^{10}}{64}\right]^2 \left[\frac{(2+1.999\ldots)^{10}}{32}\right]^2$

16. Simplify:
$1{,}111 + 2{,}212 + 3{,}313 + 4{,}414 + 5{,}515 + 6{,}616 + 7{,}717 + 8{,}318 + 9{,}419 + 10{,}520 + 11{,}621 + 12{,}722 + 13{,}823 + 14{,}924$

17. If r and s are roots of the quadratic equation $x^2 - x - 1 = 0$, find r + s.

18. What is the sum of the roots of $ax^2 - 2022x - 2023 = 0$ if a = 2?

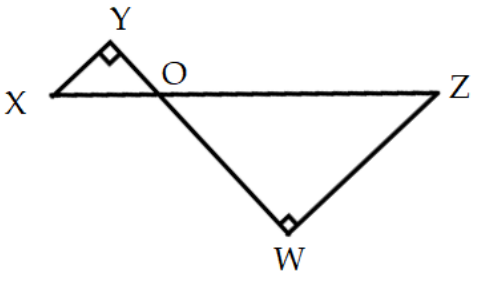
19. _____ is the point of intersection of the angle bisectors of a triangle.

20. A rectangle lies on 2 intersecting identical circles such that the points of intersection of the 2 circles are also intersected by the rectangle. The radii of the circles are 37 mm each while the width of the rectangle is 70 mm. What is the distance between the centers of the 2 circles?

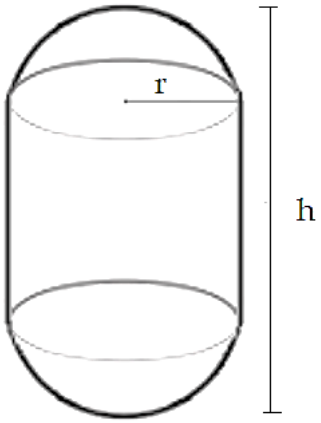
21. Three circles are tangent to the same side of line M in such a way that all of the three are also tangent to one another. If the diameters of the bigger circles are 16 and 4 units, what is the radius of the smallest circle?

22. The lengths of the sides of triangle ABC are 10, 15, x. What are the possible values of x if x is the shortest side of the triangle?

23. Given the figure below (not to scale), find the length of WZ if XY=5, YW=99, and XZ=101.



24. Find the volume of the capsule below if r=2 inches and h=10 inches. (Leave π as it is or express your answer using π.)



25. How many counting numbers from 1 to 1,000 are divisible by 2, 3 and 5?

26. How many integers from 1 to 2,022 are not divisible by 2, 3 and 5?

27. How many ways can you make change for Php100 (one hundred pesos), using Php10, Php20 and Php50 bills (10-peso, 20-peso and 50-peso bills)?

28. Mindanao, the second-largest island in the Philippines, is divided into six administrative regions: the Zamboanga Peninsula, Northern Mindanao, the Caraga region, the Davao region, Soccsksargen, and the autonomous region of Bangsamoro. How many students, each of whom comes from one of the six administrative regions, should participate in the CISMO-Mathematics National Round to guarantee that there are at least 100 students who come from the same region?

29. There are 5 CISMO students in a classroom. It was agreed that all of the students' cellphones will be put to silent mode and placed on the teacher's table before the start of the class. When the class is over, everyone picks up a cellphone at random. What are the chances that nobody gets his/her own cellphone?

30. In how many ways can we arrange the letters of ROBERTFORDAN?

-END OF TEST-

Thank you for participating in the PIMSO National Round!