



 Coron Island

# PHILIPPINE INTERNATIONAL MATH AND SCIENCE OLYMPICS NATIONAL ROUND 2022



**PIMSO Math**

## 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 FOUR (4) CATEGORIES namely: ARITHMETIC & NUMBER THEORY, LOGICAL ANALYSIS, 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.

**BEGIN HERE:**

1. What is the highest possible value of integer  $k$  that will make  $9876!$  divisible by  $67^k$ ?
2. If you are to cross out all integers from 1 to 900 which are divisible by 2, 5, or 7, how many numbers will be crossed out?
3. If we divide the product of  $1 \times 2 \times 3 \times 4 \times 5 \times \dots \times 884$  by 887, what will be the remainder?
4. The following numbers are expressed in the binary system:  $101110111000_2$ ,  $011011111110_2$ . Expressed their difference in the decimal system.
5. 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**

Convert your answer in #4 into the base-20 system.

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

7. What is the next number in the series: 3 6 11 33 39 156 163 815  
\_\_\_\_\_

8. Cecilia, Dina, Elena, and Fiona are cousins with different ages. When a new neighbor asked them who is the youngest, they answered:  
Cecilia: I am the eldest.  
Dina: I am not the youngest.  
Elena: I am neither the eldest nor the youngest.  
Fiona: I am the youngest.

Given that one of them is not telling the truth, who is the youngest of the four cousins?

9. Pointing out to a man Robert Fordan said, "He is the son of a woman who is the mother of the husband of my mother." The man is Robert Fordan's \_\_\_\_\_.

10. If the 9<sup>th</sup> day of a month is 4 days earlier than Wednesday, what will be the 20<sup>th</sup> day of the month?

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

12. 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?

13. Simplify  $5^{12} \left[ \left( \frac{1}{125} \right)^{2,023} \times \left( \frac{1}{625} \right)^{2022} \times (5^{2021})^7 \times \left( \frac{1}{25} \right)^{2022} \times (625^{2021})^{1/2} \right]$

14. Simplify  $\left[\frac{(2-1.999\dots)^{101}}{64}\right]^2 \left[\frac{(2+1.999\dots)^{101}}{32}\right]^2$

15. If  $P = \{p, i, m, s, o\}$  and  $C = \{c, i, s, m, o\}$  then  $\mathfrak{R} = \{x \mid x \text{ is a subset of } P\}$  and  $\mathcal{F} = \{y \mid y \text{ is a subset of } C\}$ . 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  $N + M - X$ .

16. Simplify:  $2,023 \left[ \frac{1}{2 \times 1} + \frac{2}{3 \times 4} + \frac{3}{4 \times 9} + \frac{4}{5 \times 16} + \dots + \frac{2,021}{2,022 \times 2,021^2} + \frac{2,022}{2,023 \times 2,022^2} \right]$ .

17. Simplify:  $\frac{64}{98} + \frac{64}{294} + \frac{64}{588} + \frac{64}{980} + \frac{64}{1,470} + \frac{64}{2,058} + \frac{64}{2,744}$ .

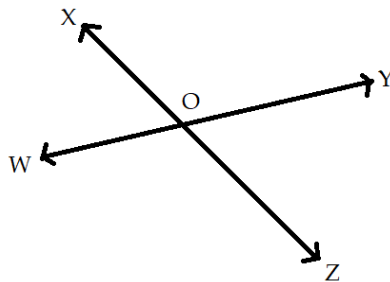
18. Simplify:

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

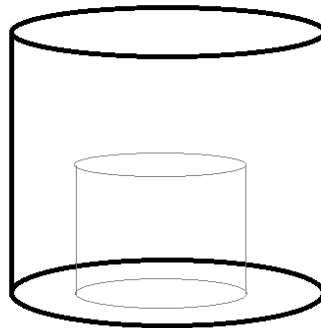
19. Object A and Object B are geometrically similar. If one dimension of A is  $n$ , its corresponding measurement in B is  $3n$ , and B's volume is  $X$  cubic units, what is the volume of A?

20. \_\_\_\_\_ is the point of intersection of the three medians of a triangle.

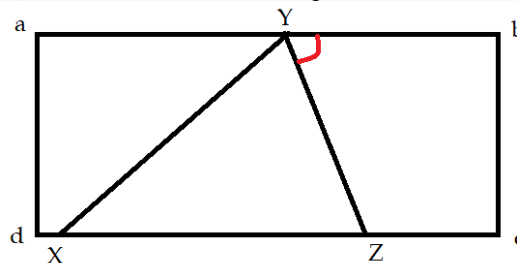
21. Consider the figure below. If  $\angle XOY : \angle YOZ = 5:4$ , what is  $\angle WOZ$  and  $\angle WOX$  respectively?



22. The cylinder below has a height and diameter of 24 feet each. It has a cylindrical hollow inside that is half of its size. Find the volume of the solid cylinder. (Use  $\pi=3.14$ )



23. Given the figure below, triangle XYZ lies on rectangle abcd. If the triangle's angles are  $\angle X=55^\circ$  and  $\angle Y=85^\circ$ , find the measure of the angle indicated in red.



24. Equilateral triangle AGE is inscribed in rectangle MATH such that points G and E also lie on the rectangle. Suppose that the respective distances of G and E from the vertices nearest to them is equal and that the areas of GMA and AET are both 8 sq. units each, what is the area of GHE?

25. How many counting numbers from 1 to 1,000 are not divisible by 2, 3 and 5?

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

27. Ian can only choose to join two international mathematics competitions from a list of five mathematical Olympiads: PIMSO, SIMSO, CISMO, Copernicus and Fermat. How many ways can this be done?

28. 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)?

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

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

-END OF TEST-

Thank you for participating in the PIMSO National Round!