MATHEMATICS
SHORT ANSWER PROBLEMS

Name : _____ **Index Number** : _____

Country : _____

19th International Mathematics and Science Olympiad

Indonesia

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Instructions:

1. Write your name, country and index number on both the Question Booklet and the Answer Sheet.
2. Write your Arabic Numerical answers or English alphabet answers only in the Answer Sheet.
3. There are 25 questions in this paper.
4. For problems involving more than one answer, marks are only awarded when ALL answers are correct.
5. Each question is worth 1 mark. There is no penalty for a wrong answer.
6. You have 60 minutes to complete this paper.
7. Use black pen or blue pen or pencil to write your answer.

Do not turn over this page until you are told to do so.

SHORT ANSWER PROBLEMS

1. There is a basket which contains apples and pears on Mrs. Putri's kitchen table. One day, all of her grandchildren came to visit and she gave each one of them the same number of fruits without keeping track which kind it is. If Dewi received $\frac{1}{5}$ of all the apples and $\frac{1}{7}$ of all the pears, what is the minimum number of grandchildren can Mrs. Putri have?

2. Anggi is 140 cm tall and she can grab any object 40 cm above her head. She wants to take a book from the top of a cupboard which is 2.8 meters from the floor. She has several chairs with the same height, which can be stacked without overlap. If she uses one chair and stands on it, the distance between the tip of her hand and the book is 65 cm. What is the minimum number of chairs she needs to use to be able to grab the book?

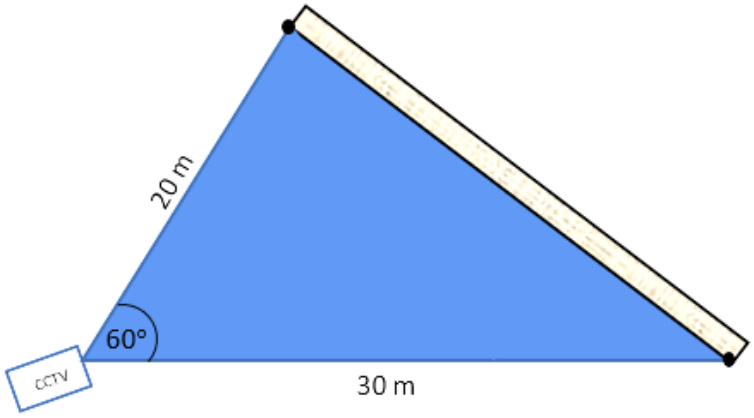
3. Consider the sequence $\frac{1}{1},\frac{1}{2},\frac{2}{1},\frac{1}{3},\frac{2}{2},\frac{3}{1},\frac{1}{4},\frac{2}{3},\frac{3}{2},\frac{4}{1},\ldots,\frac{1}{k},\frac{2}{k-1},\frac{3}{k-2},\ldots,\frac{k-1}{2},\frac{k}{1},\ldots$.
If the 2022nd term of this sequence is in the form a/b, in simplest form, what is the value of $a + b$?

4. In the number pattern below, what is the first number in Row 2023?

Row 1	1					
Row 2	3	2				
Row 3	4	5	6			
Row 4	10	9	8	7		
Row 5	11	12	13	14	15	
Row 6	21	20	19	18	17	16
…	…	…	…	…	…	…
Row 2023	?					

5. An old static CCTV camera, which can only move horizontally, covers the area shown in the figure below. If the distance from the CCTV camera to the ends of the wall are 20 m and 30 m, respectively, what is the total area, in m^2, that is covered by the CCTV camera?

(If the answer is in the form of $a\sqrt{b}$ where b is the smallest non-square number, write the answer in the form $a; b$)



6. Mr. Andi maintains two gardens namely A and B, where the grass grows at a rate of 1 cm every 4 and 5 days, respectively. The initial height of the grass for both gardens is 1 cm. He needs to mow the garden only if the grass reaches 6 cm in height, and that after each mowing session, the height of the grass will be reduced back to 1 cm. On the days that he has to mow only one garden, he earns $15 per session, while on some days where he needs to mow two gardens in one day, he will get $10 for each garden mowed. How much dollars will Mr. Andi get in one year?

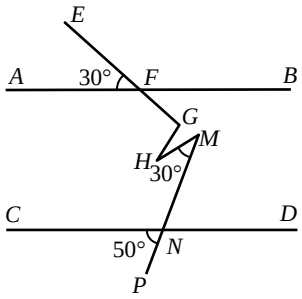
7. A vendor is selling three kinds of drinks namely: milk, juice, and soda. It is known that he has one bucket of soda and the total number of buckets of milk and juice is five. If the volumes of the buckets are 18, 19, 21, 23, 25 and 34 litres respectively and he has twice as much milk as he has juice. What is the volume, in litres, of the bucket containing soda?

8. Let *N*, *C*, *O*, *V*, *I* and *D* represent different digits from 0 – 9. What is the smallest possible value of the expression

$$\overline{NOCOVID} + \overline{COVIDNO} + \overline{VOID}$$

where the first digit of each term cannot be 0?

9. In the figure below, it is given that $\overline{AB} \| \overline{CD}$, $\angle EFA = 30°$, $\angle FGH = 90°$, $\angle HMN = 30°$ and $\angle CNP = 50°$. What is the measure, in degrees, of $\angle GHM$?



10. All students in a class, including Amy, stand in a line. One at a time, they starting counting the numbers consecutively starting from 1, 2, 3, …. The sum of the numbers from all students minus twice of Amy's number is 100. If Amy's number is *A* and the number of all students is *B*, what is the value of *A* + *B*?

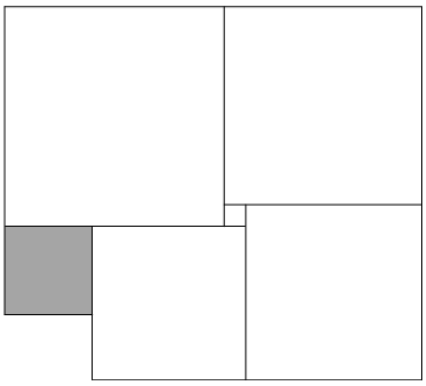
11. Let *n* be the largest positive integer with the following properties:

(*a*) The remainder when 551 and 731 are divided by *n* are the same; which is *R*.

(*b*) The remainder when 1093 are divided by *n* is *R* + 2.

What is the value of *n* divided by *R* – 1?

12. The figure shown below is dissected into six different squares. If the area of the smallest square is 1 cm^2, what is the area, in cm^2, of the shaded square?



13. In a town festival, there is a horse parade event where all of the horses were assigned numbers starting from 1, 2, 3, …. Ria took part in the event and rode the horse which has the largest sum of the digits from all the assigned numbers. If the total number of digits used in numbering the horses is 2022, then what is the number of the horse that Ria rode?

14. What is the maximum number of $1 \times 1 \times 4$ blocks that can fit inside a $6 \times 6 \times 6$ box such that each of the faces of the blocks are parallel to the corresponding faces of the box?

15. What is the largest five-digit positive integer satisfying all of the following properties?

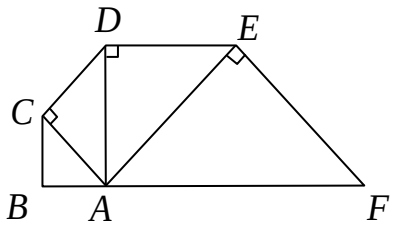
(i) The last two digits is 19.

(ii) It is divisible by 19.

(iii) The sum of all digits is 19.

16. A panel of judges is set to review a movie shown in a cinema which has 50 rows of seats. There are 10 seats in the first row and each subsequent row has one more seat than the previous row. In each row, judges are not allowed to sit next to each other. What is the maximum number of judges that the cinema can accommodate?

17. In the figure below, ΔABC, ΔACD, ΔADE, and ΔAEF are all isosceles right triangles. If the area of pentagon $BCDEF$ is $30\ \text{cm}^2$, what is the length, in cm, of $AB + AD + AF$?



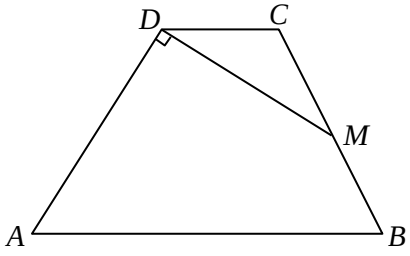
18. How many positive integers n less than 100 are there such that $n!$ is divisible by the sum of the first n positive integers?
Note: $n! = 1 \times 2 \times \ldots \times (n-1) \times n$

19. Suppose $\overline{ABC}, \overline{DEF}$, and $\overline{GHI}$ are three-digit numbers such that

- $\overline{ABC} + \overline{DEF} + \overline{GHI} = 2023$,
- All nine digits are distinct,
- $\overline{ABC} < \overline{DEF} < \overline{GHI}$, and
- $C = 0$.

How many different arrangements satisfy all these conditions?

20. In the figure below, $ABCD$ is a trapezoid having an area 70 cm^2, AD = 10 cm, and M is the midpoint of $\overline{BC}$. What is the distance, in cm, from M to the side $\overline{AD}$?



21. Dewa has a standard 6-sided fair die and a 6-sided unfair die, where each has 6 sides printed with little dots from 1, 2, 3, 4, 5, and 6. For the fair die, each of the outcomes when rolled is equally likely. While for the unfair die, each of the outcomes for a side to appear is proportional to the number of dots on its side. Dewa rolls both dice at the same time independently. If the probability that the sum of the dots on the sides that appear equals 4 is $\frac{m}{n}$ where the greatest common divisor of m and n is 1, then what is the value of $m + n$?

22. A digit game is played where a student writes down each positive integer from 1 to n consecutively which forms a big number. Then, in each turn, the student will remove some digit(s) found in the middle according to this rule:

- If the number of digits in the array is odd, then the student must delete one digit in the middle.
- If the number of digits in the array is even, then the student must delete two digits in the middle.

This process is repeated until the student gets the smallest possible multiple of 9.

For example, Nala writes the numbers from 1 to 15 as follows: 123456789101112131415. In the first turn, she decides to delete 0 and the result is 12345678911112131415. In the second turn, she deletes 1 and 1 and so on, until she gets the smallest multiple of 9, which is 1215, after 9 turns.

If she writes the number from 1 to 2022, what is the minimum possible number of times will she do this process in order to get the smallest possible multiple of 9?

23. Two sides of a regular n-gon, when extended meet at an angle of 42^0. What is the least possible value of n?

24. When looking at the digits after the decimal point in the decimal expansion of $\frac{1}{20^{30}}$, Alex observes that there are k consecutive zeros, followed by a non-zero digit. What is the value of k?

25. A positive integer n has four positive factors, including 1 and n. If $n+1$ is equal to four times the sum of the other two factors, what is the value of n?

- End of Problems -