Part I: SHORT ANSWER

You only write your final answer. The maximum points for each number are 5 points.

1. The fraction

$$\frac{1}{\frac{1}{\frac{1}{\frac{1}{1+2}+2}+2}+2+\frac{1}{2+\frac{1}{2+\frac{1}{2+1}}}}$$

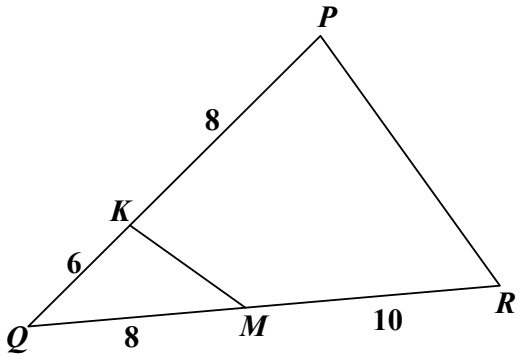
can be written in the from $\frac{a}{b}$ where a and b are relatively prime positive integers. Find $2a+b$.

Answer_____

2. In how many ways can 3 different numbers be selected from the set {2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030} such that the sum of the 3 numbers is an odd number?

Answer_____

3. In the triangle PQR, $QK = 6$, $KP = 8$, $QM = 8$, $MR = 10$, and the area of the triangle QMK is 24 cm^2. What is the area (in cm^2) of quadrilateral $KPRM$?

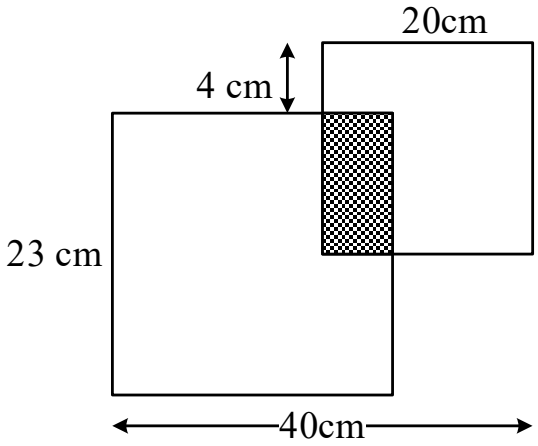


Answer_____

4. Sisi lists all pair of numbers (x, y) such that $x > y$ and both do not end in zero. The product of x and y is a power of 10 (such as $10, 100, 1000, \ldots$). She then computes $x - y$. Which numbers can be the unit digit of $x - y$?

Answer_____

5. Two squares of length 23 cm and 20 cm overlapped each other. Find the area of the overlapping region in cm^2.



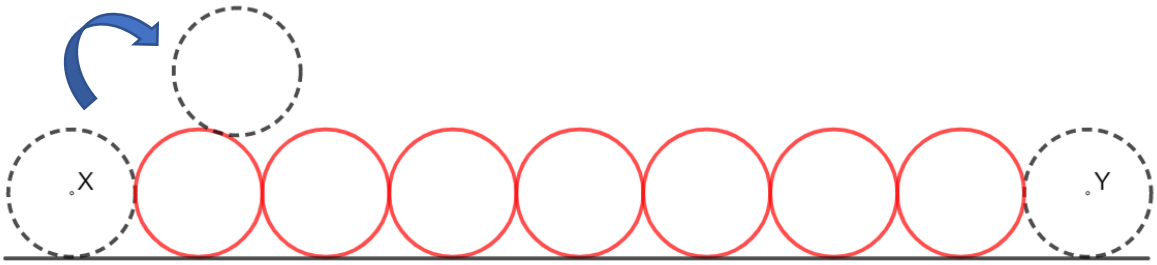
Answer_____

Part II: ESSAY

Write your answers completely with step–by–step. The maximum points for each number are 15 points.

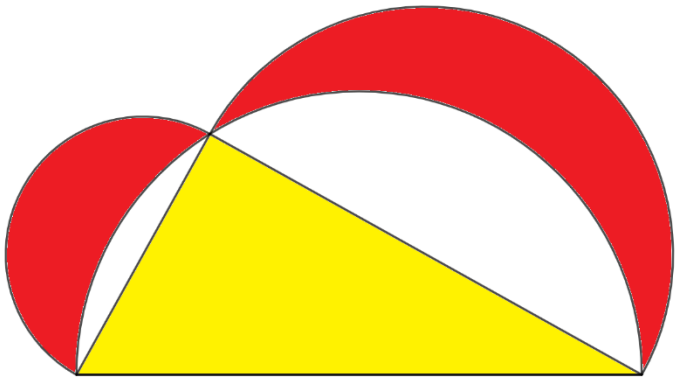
6. How many non–congruent isosceles triangles but not equilateral triangle with each side has integer length less than 2023?

7. A circle rolls, without slipping, across the top of the other seven identical circles to get from position X to position Y. Find the number of revolutions it must make.



8. We say that a positive integer is $p - special$, where p is a positive integer, if the sum of the digits of the number plus p times the product of the digits of the number equals the original number.
   For example, 29 is $1 - special$, since $(2 + 9) + 1 \times (2 \times 9) = 29$. What is the largest integer p such that a 3–digit number can be $p - special$?

9. A *lune* is a crescent shape formed by two intersecting circular arcs; The diagram below shows a triangle and two lunes whose boundaries are formed by three semicircles.



Consider the sum of the areas of two lunes and the area of the triangle. Which is larger?

10. Two diagonals are drawn in each of unit square of an 100×101 square, and as a result the big square divided into 40400 triangles. Every triangle is painted either black or white so that each black triangle shares a common side with at least one white triangle. What is the minimum possible number of the white triangles?

ANSWER

No.	ANSWER
1	82
2	28
3	102
4	1, 3, 7, 9
5	48
6	3,064,341
7	3
8	108
9	Equal
10	10,200