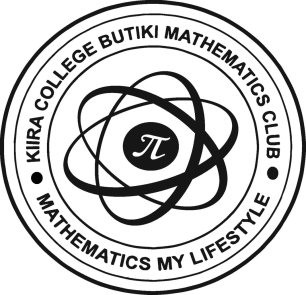
***KIIRA COLLEGE BUTIKI MATHEMATICS CLUB  
  
MATHLETICS CONTEST 2019  
  
INTERMEDIATE MATHLETES CATEGORY SUGGESTED SOLUTIONS***

***Section A:***

***Qn.1.*** We are to find which becomes . From , we note that ; hence .

***Qn.2.*** We are given that slope , is a half of the y-intercept i.e. . From general equation of a straight line, ; substituting in for we have that . Setting ; . Since is when , then the required point is .

***Qn.3.*** Let be . Note that the expression reduces to which turns into . Hence , the whole expression reduces to .

***Qn.4.*** From 10 to 19, there is 1 such number, from 20 to 29, there are 2 such numbers, from 30 to 39, there are 3 of them, from 40 to 49, there are 4 such numbers, from 50 to 59, there are 5; etc. The pattern proceeds in that order, giving us numbers.

***Qn.5.*** ; the lowest possible value of is ; note that it is divisible by 3. Factoring, we get ; but this does not work out as ; multiplying by 3 on both sides gives which works. Hence, is 9 .

***Qn.6.*** for all . Set . Substitute in the original equation to get:

from which we get as the function holds for all . Note that this gives . Then substitute for in the original equation to get to get us , for all . Our expression then becomes . Let it be ; so that which is . Note that what is in the brackets is equal to ; so obtain . Therefore, it is equal to .

***Qn.7.*** Note that , and , . Notice also, that a person who was 43 years old in 1849 must have been born in 1806, and must’ve been 164 years in 1970. This is unlikely. A person was 44 years old in 1936, must’ve been born in 1892, and thus must have been 78 years in 1970; which is valid. So she was born in 1892 .

***Qn.8.*** Rectangle M is a special rectangle with all sides equal; hence, it is a square. Its perimeter must be where is the side length; giving us .

***Qn.9.*** Since and , then the only situation fulfilling this is because but , such that .

***Qn.10.*** Assume the questions were numbered 1, 2, 3, 4, and 5. There are exactly 10 distinct groups of 3 distinct numbers from the set . This is from which are:   
(1, 2, 3); (1, 2, 4); (1, 2, 5); (1, 3, 4);   
(1, 3, 5); (1, 4, 5); (2, 3, 4); (2, 3, 5);  
(2, 4, 5) and (3, 4, 5). Hence the largest number of students in Mr. Asher’s class is 10 .

***Section B:  
Qn.11.*** Each circle drawn has a radius that is half of the radius of the circle drawn before it. The radii of are thus in a sequence as shown below; assuming is the radius of the first circle:  
etc. the sum of the areas will therefore be: to give . We then condense what is in the brackets as follows: Let . Then . Notice that what is in the brackets is also equal to ; such that . The sum . But from the statement of the problem, , so the sum .

***Qn.12   
a).*** Remove fractions by multiplying throughout by to get . Rearrange to have . The left hand side looks like the expansion of ; so add 25 on both sides to obtain . 30 can be factored as . Each of these gives us a pair hence they are 8 .  
***b).*** We want .

***Qn.13.*** If the winner had votes; the second person then had votes, the third had votes and the fourth had votes. Note that . So, the winner got 1575 votes, the second person got 1464 votes, the third got 1456 votes while the fourth got 1413 votes.

|  |  |  |
| --- | --- | --- |
| a  7  6  5  1  7  6 | b | c |
| d |  |  |
| e |  |  |

|  |  |  |
| --- | --- | --- |
| a  7  6  5  1  7  6  3  6 | b | c |
| d |  |  |
| e |  |  |

***Qn.14.*** Clearly; ***a*** across is 765; ***d*** across is 176. At this point, the square is as shown aside. Then for ***a*** down, trying numbers in range 710 to 719, we find that 713 is the valid solution. For ***b*** down, the possible greatest value is 679 whose square root is 26.058… . Hence, the required value is . The square, at this point is as shown aside. Let the empty box be . Since ***e*** is , then . So the square is:

|  |  |  |
| --- | --- | --- |
| a  7  6  5  1  7  6  3  6  9 | b | c |
| d |  |  |
| e |  |  |

***Qn.15.*** Let the house number be ***R***. Note that Ashley got to know the numbers after knowing the value of ***R***. Hence, the value of is unique. Note also, that ***R*** cannot be 2,3,4,5,6,7 or 8 because these can be last digits of many products of two distinct digits; something Ashley couldn’t have figured out so easily; but ***R*** can be 1 or 9; because 1 is the last digit of the product only while 9 is the last digit of the product only. Surprisingly, in both cases, the required sum is of the numbers is 10 .

***Bonus:*** Given that . Find the unique integer such that .