



EXUN_ELITE_2008.cpp
JUNIOR PROGRAMMING (PRELIMS)
(IX-X)

General Instructions:

The paper has been divided into three Sections (A, B)

Class IX students have to attempt **only Section A**

Class X students have to attempt **Section A + Section B**

Points of each question have been mentioned with it.

Total Points = A(50) + B(50)=100 points

Allowed time - **1 hour**

There is no negative marking in the paper

Please note that there are **11 printed pages**

Enough space has been provided for your solutions. If you are finding it less, it means you are somewhere going wrong.

Important

Please remove the pin only when the announcement has been made and you have finished filling your details to prevent disqualification.

Name of the Participants	Class	Section
1. _____	_____	_____
2. _____	_____	_____

Please open the seal after the announcement has been made!

BEST OF LUCK!

How to go about solving this paper?

- For each question we have given some clues which represent some hidden message.
- These can be broadly divided into three categories:

a) Logical Type (L)

Most questions in this paper fall under this category.

b) Mechanical Type (M)

These are the tedious questions for which you will have to use the rough paper provided with this paper. Don't worry there aren't many of these here.

Example, vbqn tq pvdtjno is decoded as WARM UP QUESTION.
First increase one letter V..W then decrease B..A and so on.

c) Algorithm Type (A)

A true test for good programmers. Preference will be given to those who use their brains in these questions (in case of a tie!)

Example, how to calculate the number of words in a given sentence

Step1.Using a loop, we calculate the number of spaces in the given sentence
Step 2.Number of words=Number of spaces + 1 .

SECTION “A”- 50 points

- Q 1. If Suresh is taller than Ashutosh, Raju is taller than Charu but shorter than Bala. Ashutosh is shorter than Charu and Charu is taller than Suresh, then Who is the tallest? *(L)-1 point*

Bala

- Q 2. X says, “Y is my brother”
Y says, “X is not my brother”
Assuming that none of them are lying, how is this possible? *(L)-1 point*

X is the sister of Y

- Q 3. A baker has only 2 timers that can measure 7 minutes and 11 minutes. How can he set a timer for 15 minutes to bake a cookie? *(L)-2 points*

$$11+(11-7)=15$$

Note the trick that if we can produce a linear expression such as the above then we can say that the time can be measured.

-
- Q 4. One of the words listed below is my secret word.

AIM DUE MOD OAT TIE

With this list in front of you, if I were to tell you any one letter of my secret word, then you would be able to tell me the number of vowels in my secret word.

Which word is my secret word? *(L) - 2points*

TIE

- Q 5. Fermat's last theorem states that the following condition always holds for integers (x, y, z) & $(n > 2)$:

$$x^n + y^n \neq z^n$$

It was one of the most alluring of mathematical statements whose proof eluded mathematicians for many years before it was proved by Andrew Wiles in the 1990s.

A computer scientist claims that he proved somehow that the Fermat theorem is incorrect for the following 3 numbers:

$$\begin{aligned}x &= 2233445566, \\y &= 7788990011, \\z &= 9988776655\end{aligned}$$

He announces these 3 numbers and calls for a press conference where he is going to present the value of N and to show that

$$x^n + y^n = z^n$$

As the press conference starts, a 10-year old boy raises his hand and says that the respectable scientist has made a mistake and the Fermat theorem cannot hold wrong for

those 3 numbers. The scientist checks his computer calculations and finds a bug.

How did the boy figure out that the scientist was wrong? **(L)- 2 points**

$X^n = 6^n$ will always give 6 as last digit
 $y^n = 1^n$ will always give 1 as last digit
 $6^n + 1^n = 7$ as the last digit

$z^n = 5^n$ will always give 5 as last digit

Q 6. Find the next two terms in the series
2, 3, 10, 12, 13, 20, 21 ___ ___ **(L)-2 points**

(Hint: Try it orally)

If you write them in word form, these numbers begin with "t"
Hence 22, 23 are the next terms

Q 7. Fill the eight spaces below with numbers from 1 to 8. No number that comes before or after any other number should be placed in an adjacent space, either horizontally, vertically or diagonally. (Please Turn Over)
(For example 2 should not be next to the number 1 or the number 3) **(M) - 2 points**

The arrangement of the space is

$$\begin{array}{cccc}
 * & \underline{3} & \underline{6} & * \\
 \underline{7} & \underline{1} & \underline{8} & \underline{2} \\
 * & \underline{4} & \underline{5} & *
 \end{array}$$

Many solutions possible

Q 8. Spot similarities between them (more than one): **(M+L) - 3 points**

Eleven plus two

Twelve plus one

Sum=13

Anagrams of each other

Q 9. How many trailing 0's does **200!** Have? $N! = \text{Factorial } N = N * N-1 * N-2 * \dots * 2 * 1$ **(4 points)**

$$\underline{[200/5]+[200/25]+[200/125]+[200/625]+.....=49} \text{ (where [] represents g.i.f)}$$

Q 10. We have a natural number which has the following properties:

- (1) Each of the 10 digits (0 to 9) appears exactly once in the number.
- (2) For each pair of digits whose sum is 9, the number of other digits positioned strictly between the pair is equal to the smaller digit of the pair.
- (3) The sum of each pair of digits positioned at the same distance from opposite ends of the number is a prime number.
- (4) The difference between any 2 adjacent digits is greater than 1.
- (5) The number is a multiple of the number of digits in the number.

What number am I talking about? This number is unique; there is only one answer to this question. **(A)- 4 points**

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Q 11. **Roman Numerals**

Write an algorithm that reads in a roman numeral and converts the number to normal decimal. The roman characters are :

M = 1000, D = 500, C = 100, L = 50, X = 10, V = 5, I = 1

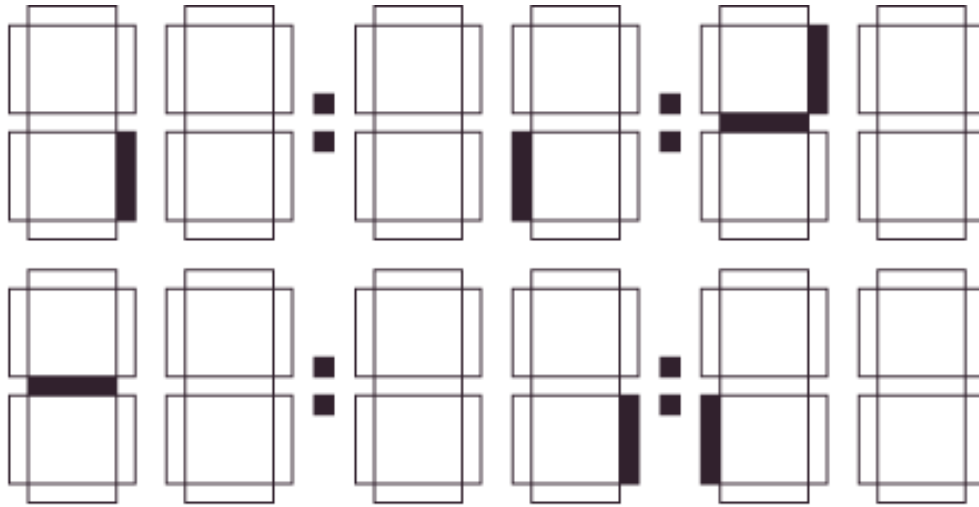
Example values : V (5), IV (4), VIII (8), MM (2000), MCM (1900), MCMXCIV (1994).

(A)- 4 points

I will upload the solutions of Algorithm based questions later!

(These are lengthy to type ☺☹)

Q 12.



An event took exactly 131 seconds. The first picture of a 24-hour digital clock shows the time when the event began, the second one when it ended. However, there was a strange breakdown, and some parts of the display are not visible; the nature of the breakdown was different for the two times. What are the two times? **(L)- 4 points**

Hint: The answer is unique. Prerequisite: Familiarity with the digital clock

Source: International Puzzle Championship, 2006

Start Time :

19:58:49

End Time : 20:01:00

No other solution possible

Q 13. Find the number of integral solutions to the following equation.

$$\frac{1}{x} + \frac{1}{y} = \frac{1}{12}$$

(If you are unsure that you have missed some, give the numbers that you have calculated) **(M+L)= 6 points**

13 solutions

The equation may be written as $(x - 12)(y - 12) = 144$. Now any

decomposition of the RHS into two factors results in a solution of the equation. For example $144 = 8 \cdot 18$, thus $x-12 = 8$ and $y-12 = 18$ gives $x=20$ and $y=30$. In all, there are 13 ways to decompose 144 into product of factors.

Q 14. How many 4 digit square numbers exist such that after increasing each digit by 1 we get another square number? Also give the numbers, if any. **(M+L) 3+3 = 6 points**

Only 1 number exists...Let it be a^2 and after increasing each digit by it becomes b^2

Then,

$$b^2 - a^2 = 1111$$

$$(b - a)(b + a) = 1111$$

$$(b - a)(b + a) = 11 * 101$$

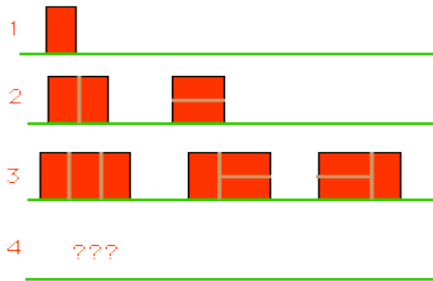
$$(b - a) = 11 \quad (b + a) = 101$$

$$b = 56 \text{ and } a = 45$$

$$a^2 = 2025$$

2025 is the required 4 digit number

Q 15.



If we want to build a brick wall out of the usual size of brick which has a length twice as long as its height, and if our wall is to be **two units tall**, we can make our wall in a number of patterns, depending on how long we want it:

There's just one wall pattern which is 1 unit wide - made by putting the brick on its end.

There are 2 patterns for a wall of length 2: two side-ways bricks lay on top of each other and two bricks long-ways up put next to each other.

There are three patterns for walls of length 3.

How many patterns can you find for a wall of length 4?

How many different patterns are there for a wall of length 5?

Write an algorithm for it if you are able to figure out some pattern. **(A) - 8 points**

It's the Fibonacci pattern

SECTION "B"- 50 points

Q 16. There are 3 colleagues who want to know what their average salary is, but they do not want to disclose to each other their individual salary. How do they go about doing it? In the process of doing it the worst is that each could learn about the salaries of the other two. Is this method fail-proof? Think about it! Would you be willing to adopt your methodology with your colleagues and find the average salary? *(L) - 8 points*

Let the 3 salaries be s_1, s_2, s_3 .

Let A choose a number N . A adds his salary to N and gives the sum $N+s_1$ to B. B adds s_2 to it and gives the sum $N+s_1+s_2$ to C. Now C adds his salary and gives the sum $s_1+s_2+s_3+N$ to A. A subtracts N from it and gets $(s_1+s_2+s_3)$ and thereby the average

Q 17. (a) You blindfolded and let into a room. The room has an infinitely many coins scattered around on the floor. Your friend tells you that that 20 of these coins are tails and the rest are heads. He also says that if you can divide the coins into 2 piles where the number of tails is the same in both piles, then you win all of the coins. You are allowed to move the coins and to flip them over, but you can never tell what state a coin is currently in (the blindfold prevents you from seeing, and you cannot tell by feeling it). How do you go about partitioning the coins so that you can win all of them? *(L) - 4 points*

a) let me make a pile of 20 coins. it can have any no. of tails, say x . when i flip all of them, i get $20-x$ tails. the other pile also has $20-x$ tails

Q 17.(b) A Buddhist monk got an errand from his teacher: to meditate for exactly 45 minutes. He has no watch; instead he is given two incense sticks, and he is told that each of those sticks would completely burn in 1 hour. The sticks are not identical, and they burn with variant yet unknown rates (they are hand-made). So he has these two incense and some matches: can he arrange for exactly 45 minutes of meditation? *(L) -4 points*

b) Burn one of the sticks from both sides and the other from one side; wait for the first to burn out. As soon as it burns out, light the other end of the second stick and wait for it to burn out as well.

Q 18. Just 'add'/'remove'/'replace' just **ONE** character so that the program prints 20 times 'A'

```

int a = 20, n =
0;
for (n=0 ; n<a

```

Note that `cout` is just a function which displays the following code (in this case 'A') on the screen and "for" is the loop statement. Rewrite the code with highlighting the suitable changes. *(L) - 4 points* (Answer shall be written on the next page)

Many solutions

```
-- n           ==>  - -a
n<a           ==>  -n<a
```

Q 19. Sajal has a square orchard in which there are special places to plant trees one metre apart in either direction. These designated positions form an $N \times N$ grid of points, which are labelled from (1,1) on the bottom left corner to (N,N) on the top right corner.

The orchard currently has M trees scattered around the grid. Sajal now realizes that he needs to provide a horizontal road K metres wide from left to right across the field. The road has to be aligned with the grid points. In other words, the lower and upper boundaries of the road should both lie along a row of tree planting positions. Any tree that lies on the road will have to be cut, including trees that are on the upper and lower boundary of the road.

Sajal is free to choose the position of this road. Your task is to help him find the minimum number of trees that need to be cut to lay the road.

For instance, suppose that the orchard has 10 rows and columns with 12 trees

at the positions marked below, and the road that is to be built is 3 metres wide. In the figure, each '.' represents a grid point where a tree can be placed and the T's represent the actual positions of the trees. (Please turn over)

```

. . . . . T . .
. T . . . . . .
T . . . T . . . .
. T . . . . . .
. . . T . . . . .
. . . . . T . . . .
. . . . . T . . .
T . . . . . T . .
. . . . . . . T
. . T . . . . .

```

In this case, the best choice is to lay the road between row 4 and row 7 on the grid. This will require cutting 4 trees. Any other choice will sacrifice more trees - for instance, if the road were laid between row 2 and row 5, he would have to cut down 5 trees. **Write an algorithm to calculate minimum number of trees to build a “K” metre wide road in the $N \times N$ grid. (A) - 10 points**

Algorithm(later)

Q 20. The director of Hind Circus has decided to add a new performance called the monkey

dance to his show. The monkey dance is danced simultaneously by N monkeys. There are N circles drawn on the ground. There are N arrows drawn between the circles in such a way that for each circle, exactly one arrow begins at that circle and exactly one arrow ends at that circle. No arrow can both begin and end at the same circle. When the show begins, each monkey sits on a different circle. At each whistle of the ringmaster, all the monkeys simultaneously jump from one circle to the next, following the arrow leading out of the current circle. This is one step of the dance. The dance ends when all the monkeys have simultaneously returned to the circles where they initially started. The director wishes the dance to last as many steps as possible. This can be achieved by drawing the arrows intelligently. For each of the three values of N given below, what is the maximum number of steps that the monkey dance can be made to last by drawing arrows appropriately? (A) - 3+7+10 = 20 points

Source-ZIO 2005

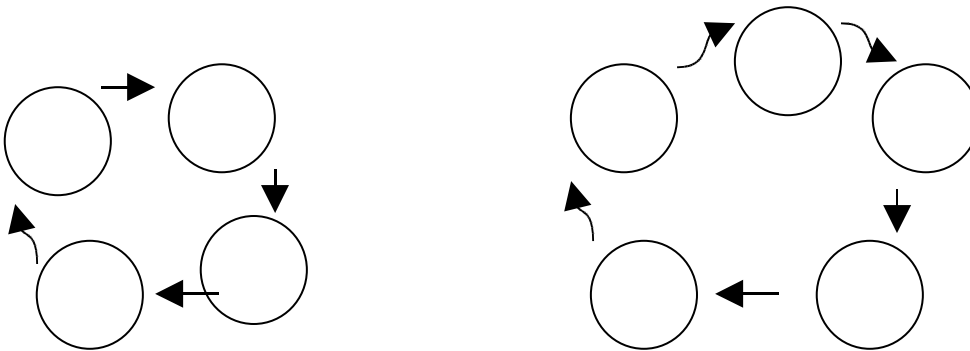
(a) 9 (b) 12 (c) 15

(a) LCM (5,4)=20

(b) LCM (3,4,5)=60

(c) LCM (3,5,7)=105

Explanation for a)



Divide the group of 9 circles into 2 parts so that the LCM of the parts is maximum so that at maximum number of beats they attain their original orientation

I think I have explained it pretty well!

Note: Special treats to those who solve this question completely!

THANKFULLY , NOBODY SOLVED IT!

Please reply to sajaljain4+exun@gmail.com if you have some problem with the solutions given. I hope you enjoyed the event!(Think that the paper was out of 30 and not 100)

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No solutions for the feedback as nobody answered it!