**Answers and Explanations:**

**Permutation and Combination**

Ans 1 : Option c

We know that N objects can be arranged around a circle in (N - 1)!

We can choose any of the 7 people out of given 15 people to sit around the first table in 15C7 ways.

After selecting 7 people for the first table, the number of ways for which they can be seated around is (7-1)! = 6!

The remaining of the 8 people can be made to sit around the second circular table in (8-1)! = 7! ways.

Hence, total number of ways = 15C7 \* 6! \* 7!

Ans 2 : Option d

RAJEEV is a 6 letter word with 3 vowels and 3 consonants.  
  
If all the vowels are to be together, then there will be 4 sets of object i.e. one group of 3 vowels and 3 distinct consonants which needs to be rearranged. Thus, the possible number of arrangements is 4!  
  
Now, the group of 3 vowels contains two Es and one A. These can be arranged in 3! / 2! Ways. 

Hence, the total numbers of arrangement in which the all the vowels appear together are 4! \* 3! / 2!

Ans 3 : Option d

The smallest number in this set is 1000, a 4-digit number and the largest number in the set is 7000, the only 4-digit number to start with 7.

The digit at the thousands’ place of each of the 4 digit numbers except 7000 can take one of any of the three values – 1 or 2 or 5. While, the next three digits (hundreds, tens and units place) can take any of the 5 values – 0 or 1 or 2 or 5 or 7. Hence, there are 3 \* 5 \* 5 \* 5 or 375 numbers from 1000 to 6999.

Including 7000, there will be 376 numbers in all.

Ans 4 : Option c

In any rearrangement of the word RAJEEV, consider only the positions of the letters E, E and A.

These can be as E E A, E A E or A E E. So, logically one-third of all the possible words will have 'A' in between the two 'E's.

Since, the total numbers of rearrangement are 6! / 2!  = 360. Its one-third is 120.

Ans 5 : Option d

For the five letter palindrome word, the first letter from the left can be chosen in 26 ways because there are 26 alphabets. Thereafter, the second letter can also be chosen in 26 ways.

Having chosen the first two letters, the third letter can also be chosen in 26 ways as the fourth letter is the same as the second letter and the fifth letter is the same as the first letter.

Thus, the maximum possible number of five letter palindromes is 26 \* 26 \* 26 = 17576.

Ans 6 : Option c

Any factor of this number should be of the form 2a×3b×5c. For the factor to be a perfect square – a, b, c have to be even. a can take values 0, 2, 4. b can take values 0,2, 4, 6 and c can take values 0,2.

Thus, Total number of perfect squares =3×4×2= 24

Ans 7 : Option a

The four parrots can be arranged in 4! Ways. Now, to arrange no two pigeons together, they have to be arranged in five places between these four parrots. This can be done in 5! Ways.

Thus, total arrangements = 4! \* 5! ways

Ans 8 : Option c

The order of each letter in the dictionary is A, B, L, O, R and U.

Now, with A in the beginning, the remaining letters can be permuted in 5! ways.

Similarly, with B in the beginning, the remaining letters can be permuted in 5! ways.

With L in the beginning, the first word will be LABORU, the second will be LABOUR.

Hence, the rank of the word LABOUR is 5! + 5! + 2= 242.

Ans 9 : Option c

In order to reach (5 , 6) covering the shortest distance at the same time, Naveen has to make 5 horizontal and 6 vertical steps.

The number of ways in which these steps can be taken is given by = 11! / (5! \* 6!) = 462 ways.

Ans 10 : Option c

In all, there are 9 \* 10 \* 10 \* 10 \* 10 = 90000 5-digit positive integers. Out of these 90000 positive integers, the sum of the digits of half of the numbers will add up to an odd number and the remaining half will add up to an even number. Hence, there are 45000 numbers of 5 digits whose digitsum add up to odd number.

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Ans 11 : Option a

The required numbers are from 1 to 99999 and these have to be formed by the digits 0, 6 and 9.

The maximum number of digits that a number can take is 5. So, logically, every digit place can be filled by the digits 0,6 and 9 in three ways.

Thus, total number of ways =3 \* 3 \* 3 \* 3 \* 3 = 243. But in this, 00000 is also a number formed and has to be excluded since it is not the natural number.

So, Total numbers possible = 243 – 1 = 242.

Ans 12 : Option a

The total number of ways in which these 5 parts can be arranged = 5! = 120

The total number of ways in which part-1 and part-3 are always together = 4! \* 2! = 48

Therefore, the total number of arrangements, in which they are not together is = 120 – 48 = 72

Ans 13 : Option c

If there is 1 black shirt, then it can be placed in 6 ways.

If there are 2 black shirts, they can be placed in 5 ways i.e. in positions (1,2), (2,3), (3,4), (4,5)and (5,6).

Likewise, if there are 6 black shirts, it can be placed in 1 way.

The total number of ways of placing the shirts is = 1+2+3+4+5+6 = 21

Ans 14 : Option b

There are four cases through which Faulkner can score 30 runs in an over.

Case A: Five 6’s and one 0 = 6! / 5! = 6

Case B: Four 6’s, one 4 and one 2 = 6! / 4! = 30

Case C: Four 6’s and two 3’s = 6! / (4! \* 2!) = 15

Case D: Three 6’s and three 4’s = 6! / (3! \* 3!) = 20

Thus, total number of sequences = 6 + 30 + 15 + 20 = 71.

Ans 15 : Option b

There are 20 men and 20 women in all at the party.

When a man meets a woman, there are two HELLOs.

When a person of same gender meets, there is only 1 handshake.

Number of handshakes = 20C2 (for MAN – MAN) + 20C2 (for WOMAN – WOMAN) = 2 \* 380 = 760

For the number of HELLOs, every man does 19 HELLOs to other woman and they respond in the same way. Thus, total number of HELLOs = 20 \* 19 = 380

Total number of greetings = 760 + 380 = 1140

Ans 16 : Option c

The remainder on the first card can be 0, 1, 2 or 3 i.e 4 possibilities.

The remainder written on the next card when divided by 4 can have only 3 possible values except the one that have been written earlier. Subsequently, for each value on the card, the remainder on the next adjacent card can have again 3 possible values.

The total number of possible sequences is = 4 \* 3 \* 3 \* 3 \* 3 = 4 \* 34

Ans 17 : Option d

There are primarily two cases available. We first count the number of committee in which –

* Mr. Y is a member

Mr. Y agrees to be in committee only if Mrs. Z is a member. Now we are left with (6-1) men and (4-2) ladies as Mrs. X is not willing to join.

We can choose this formation in 2C1 + 5C1 = 7 ways.

* Mr. Y is not the member

If Mr. Y is not a member then we are left with (6+4-1) = 9 people. We can select 3 from 9 in 9C3=84 ways.

Thus, total number of ways = 7 + 84 = 91 ways.

Ans 18 : Option a

In a 6x6 grid of a chessboard, each row and each column contains 3 white and 3 black squares placed alternatively. So, there are a total of 18 black and 18 white squares.

For every black square chosen to put one coin, we cannot choose any white square present in its row or column. Similarly, there are 3 white squares in its row and 3 white squares in its column for every black square. Hence for every black square chosen, we can choose (18−6) = 12 white squares.

Total number of possibilities where a black square and a white square can be chosen so that they do not fall in the same row or in the same column = 18C1 \* 12C1 = 216

Ans 19 : Option b

The four persons who wish to sit facing forward can be seated in 5P4 ways and the three persons who wish to sit facing towards the rear can be seated in 5P3 ways and the remaining 3 can be seated on the remaining 3 seats in 3P3 ways.

Thus, total number of ways = 5P4 \* 5P3 \* 3P3 = 43200

Ans 20 : Option a

Here we need the number of possible combinations of 3 out of 5 grandmasters = 5C3 and the number of possible combinations of 3 out of the 15 professionals and amateurs = 15C3

Thus, the total possible combinations = 5C3 \* 15C3 = 4550

Ans 21 : Option a

We are to choose 11 players including 1 wicket keeper and 4 bowlers or, 1 wicket keeper and 5 bowlers.

Number of ways of selecting 1 wicket keeper, 4 bowlers and 6 other players = 2C1 \* 5C4 \* 9C6 = 840

Number of ways of selecting 1 wicket keeper, 5 bowlers and 5 other players = 2C1 \* 5C5 \* 9C5 = 252

Thus, Total number of ways of selecting the team = 840 + 252 = 1092

Ans 22 : Option d

The candidate has to select six questions in all of which at least two should be from Part A and two should be from Part B. He can select questions in any of the following ways:

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| **Questions from Part A** | **Questions from Part B** | **No. of selections** | **Total** |
| 2 | 4 | 5C2 \* 5C4 | 50 |
| 3 | 3 | 5C3 \* 5C3 | 100 |
| 4 | 2 | 5C4 \* 5C2 | 50 |

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Therefore, the candidate can select the question in 50 + 100 + 50 = 200 ways**.**

Ans 23 : Option b

Let the beds be numbered 1 to 7.

**Case 1:** Suppose Anju is allotted bed number 1. Then, Parvin cannot be allotted bed number 2. So Parvin can be allotted a bed in 5 ways. After allotting a bed to Parvin, the remaining 5 students can be allotted beds in 5! ways. So, in this case the beds can be allotted in 5 \* 5! = 600 ways.

**Case 2:** Anju is allotted bed number 7. Then, Parvin cannot be allotted bed number 6.  
As in Case 1, the beds can be allotted in 600 ways.

**Case 3:** Anju is allotted one of the beds numbered 2, 3, 4, 5 or 6. Parvin cannot be allotted the beds on the right hand side and left hand side of Anju’s bed. For example, if Anju is allotted bed number 2, beds numbered 1 or 3 cannot be allotted to Parvin. Therefore, Parvin can be allotted a bed in 4 ways in all these cases. After allotting a bed to Parvin, the other 5 can be allotted a bed in 5! ways.

Therefore, in each of these cases, the beds can be allotted 4 \* 5! = 480 ways.

The beds can be allotted in: 2 \* 600 + 5 \* 480 = 1200 + 2400 = 3600 ways

Ans 24 : Option b

Total no. of seats = 1 grandfather + 5 sons and daughters + 8 grandchildren = 14.

The grandchildren can occupy the 4 seats on either side of the table in 4! = 24 ways.

The grandfather can occupy a seat in (5-1) = 4 ways (4 gaps between 5 sons and daughter).

And, the remaining seats can be occupied in 5! = 120 ways (5 seat for sons and daughter).

Hence total number of required ways = 8! × 480

Ans 25 : Option b

7 do not occur in 1000. So we have to count the number of times it appears between 1 and 999. Any number between 1 and 999 can be expressed in the form of xyz where x, y and z lies between 0 and 9.   
  
**Case A:** The numbers in which 7 occurs only once. This means that 7 is one of the digits and the remaining two digits will be any of the other 9 digits except 7. Thus, 1 \* 9 \* 9 = 81 such numbers.  However, 7 could appear as the first or the second or the third digit. Therefore, there will be 3 \* 81 = 243 numbers in which 7 will appear only once.

**Case B:**  The numbers in which 7 will appear twice. In these numbers, one of the digits is not 7 and it can be any of the 9 digits except 7. There will be 9 such numbers. However, this digit which is not 7 can appear in the first or second or the third place. So there are 3 \* 9 = 27 such numbers. In each of these 27 numbers, the digit 7 is written twice. Therefore, 7 is written 54 times.

**Case C:** The number in which 7 appears thrice is  777. 7 is written thrice in it.

Therefore, the total number of times the digit 7 is written between 1 and 999 is = 243 + 54 + 3 = 300

Ans 26 : Option b

Let the number of mangoes, apples and bananas purchased be A, B and C respectively.

Thus, 20A + 5B + C = 1000 and A + B + C = 100

Solving the above two equations by eliminating C, we get –

19A + 4B = 900 or B = (900 – 19A) / 4

B = 225 – (19/4) A

Now, since B is the number of apples and 0 < B < 99. So, putting these limiting values of B in the above equation will provide the value of A as 27 < A < 47. Since, A has to be the multiple of 4, so possible values of A is 28, 32, 36, 40 and 44.

Now, for A = 28 and 32; A + B > 100 ; so these values of A can be rejected.

For all other values of A, we get the desired solution:

A = 36, B = 54, C = 10

A = 40, B = 35, C = 25

A = 44, B = 16, C = 40

Thus, three possible solutions are there.

Ans 27 : Option c

Ten speakers can address the meeting in 10! Ways. Out of which, PM, MP and MLA will be arranged among themselves in 3! = 6 ways. This means that in each of the given set of speakers’ arrangement, there will be some order among PM, MP and MLA. This order will be equally divided among these 6 possible arrangements.

Thus, the required number in which the said protocol will be observed will be 10! / 6.

Ans 28 : Option a

To make a rectangle, we need two horizontal lines and two vertical lines. In 8 \* 8 chessboard, we have 9 horizontal lines and 9 vertical lines. Therefore, the number of rectangles = 9C2 \* 9C2 = 1296.

Ans 29 : Option b

For calculating the number of squares, we need to count with the side having least number of smallest squares i.e. 6. Since, each square will have equal number of squares on each of its sides, thus the total number of squares will be = 6 \* 8 + 5 \* 7 + 4 \* 6 + 3 \* 5 + 2 \* 4 + 1 \* 3 = 48 + 35 + 24 + 15 + 8 + 3 = 133.

Ans 30 : Option d

There are two cases to look into.

Case A:

If n is even, then the number of boys should be equal to number of girls, let each be 'a'.

N = 2a

Then the number of arrangements = 2 \* a! \* a!

If one more students is added, then number of arrangements = a! \* (a+1)!

But this is 200% more than the earlier one i.e.  3(2×a!×a!)=a!×(a+1)!

=> a + 1=6 and a = 5

**Thus N = 10**

Case B:

But if n is odd, then total number of arrangements = a! \* (a+1)!

And N = 2a +1

When one student is included, number of arrangements = 2 \* (a+1)! \* (a+1)!

By applying and solving with the given condition, 2(a+1) = 3, which is not possible.

Thus, N = 10.