GATEFLIX

LOGICAL REASONING

For

CIVIL ENGINEERING
COMPUTER SCIENCE ENGINEERING
ELECTRICAL ENGINEERING
INSTRUMENTATION ENGINEERING
ELECTRONICS & COMMUNICATION ENGINEERING
MECHANICAL ENGINEERING

LOGICAL REASONING

SYLLABUS

Number series, letter series & odd man out, Blood relations, Direction sense, Cubes, Arrangements, Clocks, Calendars, Venn diagrams, Deductions, Data sufficiency

ANALYSIS OF GATE PAPERS

Exam Year	1 Mark Ques.	2 Mark Ques.	Total
2010	1	1	3
2011	2	1	4
2012	0	1	2
2013	0	1	2
2014 Set-1	2	2	6
2014 Set-2	2	2	6
2014 Set-3	2	2	6
2015 Set-1	1	0	1
2015 Set-2	0	1	2
2015 Set-3	1	1	3
2016 Set-1	1	2	5
2016 Set-2	2	2	6
2016 Set-3	1	2	5
2017 Set-1	2	1	4
2017 Set-2	2	1	4
2018 Set-1	-	2	4
2018 Set-2	-	1	2

CONTENT

1   NUMBER SERIES, LETTER SERIES & ODD MAN OUT

Number and Letter Series form an important part of the Reasoning section in various competitive examinations. There are two or three broad categories of questions that appear in various exams from this particular chapter.

A series of numbers/ letters is given with one number/ letter (or two numbers/ letters) missing, represented by a blank or a question mark. The given series of numbers/ letters will be such that each one follows its predecessor in a certain way, i.e., according to a definite pattern. Students are required to find out the way in which the series is formed and hence work out the missing number/numbers or letter/ letters to complete the series. There are a large variety of patterns that are possible and the student requires a proper understanding of various patterns to be able to do well in these types of questions.

NUMBER SERIES

For better understanding, we will classify this into the following broad categories.
1) Difference series
2) Product series
3) Squares /Cubes series
4) Miscellaneous series
5) Combination series

1) DIFFERENCE SERIES

The difference series can be further classified as follows.
a) Number series with a constant difference.
b) Number series with an increasing or decreasing difference.

In the number series with a **Constant difference,** there is always a constant difference between two consecutive numbers. For example, the numbers of the series1, 4, 7, 10, 13... are such that any number is obtained by adding a constant figure of 3 to preceding term of the series

If we have to find the next number in the above series, we need to add a 3 to the last term 13. Thus, 16 is the next term of the series.

Under the series with constant difference, we can have series of odd numbers or series of even numbers also.

In the series with **increasing /decreasing difference,** the difference between consecutive terms keeps increasing (or decreasing as the case may be).For example let us try to find out the next number in the series 2, 3, 5, 8, 12, 17, 23,.....
Here, the difference between the first two terms of the series is 1; the difference between the third and the fourth terms is 3 and so on. That is the difference between any pair of consecutive terms is one more that the difference between the first number of this pair and the number immediately preceding this number. Here, since the difference between 17 and 23 is 6, the next difference should be 7. So the number that comes after 23 should be (23+7) =30

We can also have a number series where the difference is in decreasing order (unlike in the previous example where the difference is increasing). For example, let us find out the next term of the series 10, 15, 19, 22, 24,.....
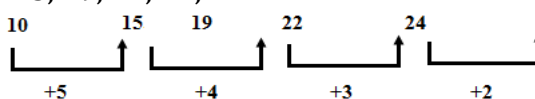

Here the difference between 1st & 2nd, 2nd & 3rd, 3rd & 4th numbers, etc are 5, 4, 3, 2 and so on since the difference between 22 and 24 is 2, the next difference should be 1. So, the number that comes after 24 should be 25.

2) PRODUCT SERIES

A product series is usually a number series where the terms are obtained by a process of multiplication. Here also, there can be different types of series . We will look at these through examples.
Consider the series 2, 4, 8, 16, 32, 64…..
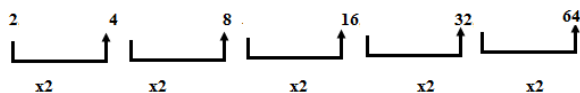
Here, each number in the series is multiplied by 2 to get the next term. So the term that comes after 64 is 128. So, each term is multiplied by a fixed number to get the next term. Similarly we can have a series where we have numbers obtained by dividing the previous term with a constant number. For example, in the series 64, 32, 16, 8…. Each number is obtained by dividing the previous number by 2 (or in other words, by multiplying the previous term by ½). So here, the next term will be 4 (obtained 8 with 2).
Consider the series 4, 20, 80, 240….
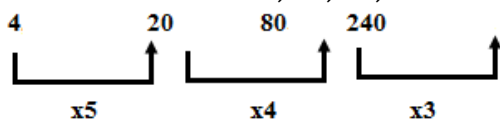
Here, the first term is multiplied by 5 to get the second term, the second term is multiplied by 4 to get the third term; the third term is multiplied by 3 to get the fourth term now, we have to multiply the fourth term by 2 to get the fifth term i.e. 480. So each term is multiplied by a decreasing factor (or it could also be an increasing factor) to get the next term. That is, with whatever number a particular term is multiplied to get the next term, this latest term is multiplied by a number different from the previous multiplying factor to get the next term of the series. All the multiplying factor follow a certain pattern (normally of increasing or decreasing order).
Consider the series 2, 6, 12, 20, 30….
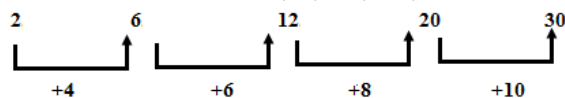
This can be looked at a series of increasing differences. The difference of consecutive pairs of terms are 4 (between 2 and 6), 6 (between 6 and 12), 8 (between 12 and 20), 10 (between 12 and 20), 10 (between 20 and 30) and so on. Hence, the difference between 30 and the next term should be 12 and so the next terms will be 42. But this series can also be looked at as a product series

$$2 \quad 6 \quad 12 \quad 20 \quad 30$$
$$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$
$$1\times2 \quad 2\times3 \quad 3\times4 \quad 4\times5 \quad 5\times6$$

The first term is the product of 1 and 2; the second term is the product of 2 and 3; the third terms is the product of 3 and 4; the fourth term is the product of 4 and 5 and the fifth term is the product of 5 and 6. Hence the next term will be the product of 6 and that is 42.

3) SQUARES /CUBES SERIES

There can be series where all the terms are related to the squares of numbers or cubes of numbers. With squares/ cubes of numbers as the basis, there can be many variations in the patterns of the series. Let us look at various possibilities of series based on squares/ cubes
Each term of the series may be the square of a natural number such as 1, 4, 9, 16….

1   4   9   16
$\downarrow \; \downarrow \; \downarrow \; \downarrow$
$1^2 \;\; 2^2 \; 3^2 \; 4^2$

The numbers are squares of 1, 2, 3, 4… respectively. The number which follows 16 (which is the square of 4) will be 25 (which is the square of 5).
The terms of the series may be the squares of odd numbers (for example, 1, 9, 25, 49….) or even numbers (for example, 4, 16, 36, 64…)
The terms of the series could be such that a number and its square are both given one after the other and such pairs are given in some specific patterns. For example, take the series 2, 4, 3, 9, 4, 16 …
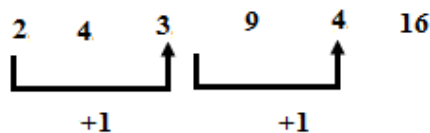
Here, 2 is followed by its square 4; then comes the number 3 (which is one more than 2) followed by its square 9 and so on. Hence the next number in the series is 5 and the one after that is square i.e. 25.

Similarly each term could be the square root of its predecessor, For example, in the series 81, 9, 64, 8, 49, 7, 36, ... 81 is the square root of 9, 64 is the square root of 8, and so on. Therefore the next number which follow in the series should be the square root of 36 ie. 6.

The terms of the series could be the squares of natural numbers increased or reduced by certain number. For example, in the series 3, 8, 15, 24....

We have {Squares of natural numbers-1} as the terms. The first term is $2^2 - 1$; the second term is $3^2 - 1$, the third term is $4^2 - 1$ and so on. Hence, the next term will be $6^2 - 1$ i.e. 35 [Please note that the above series can also be looked at as a series with increasing differences.]

The difference between the 1st & 2nd term, the 2nd & 3rd terms, and on are 5, 7, 9, and so on. Hence the next difference should be 11 giving us the next term as 35. There could also be series with {squares of natural numbers + some constant}.

Like we have seen with squares of numbers. We can have similar series with cubes of numbers. For example take series 1, 8, 27, 64...

1	8	27	64
↓	↓	↓	↓
1^3	2^3	3^3	4^3

Here, all the terms are cubes of natural numbers So, the next terms will be 5^3, i.e. 125.

Consider the series 2, 9, 28, 65....

2	9	28	65
↓	↓	↓	↓
1^3+1	2^3+1	3^3+1	4^3+1

Here, the terms are {Cubes of natural numbers +1}. The first terms is 1^3+1, the second term is 2^3+1, the third term is 3^3+1 and so on. Hence the next term will be 5^3+1 i.e. 126.

4) MISCELLANEOUS SERIES

There are series that do not come under the other patterns and are of general nature but are important and are fairly common. Even here, sometimes there can be specific patterns in some cases.

Take the series 3, 5, 7, 11, 13 ..... This is a series of consecutive **PRIME NUMBERS.** It is an important series and the student should look out for this as one of the patterns. The next term in this series is 17.

There can also be variations using prime numbers. Take the series 9, 25, 49, 121... In this series, the terms are squares of prime numbers. Hence the next term is 13^2 i.e. 169.

Take the series 15, 35, 77.... The first term is 3×5; the second term is 5×7; the third term is 7×11; here the terms are the product of two consecutive product of 11 and 13 i.e. 143.

Take the series 8, 24, 48, 120, 168.... Here the 2nd term is 3 times the first term and the 3rd term is 2 times the 2nd term, but after that it does not follow this pattern any more, if you look at the terms carefully ,you will find that the terms are {one less that squares of prime numbers}. Hence the next term will be $17^2 - 1$ i.e. 288.

Consider the series 1, 4, 9, 1, 6, 2, 5, 3.... At first sight there is nothing we can say about the series. This is actually a series formed by a squares is in two or more digits, each of the digits is written as a separate term of the series. Thus the first terms are 1, 4 and 9 the squares of 1, 2 and 3 respectively .After this we should get 16 (which is the square of 4) since this different terms 1 and 6 in the series. Similarly, the next square 25 is written as two different terms 2 and 5 in the series. So, the next square 36 should be written as two terms 3 and 6. Of these 3 is

already given, so the next terms of the series is 6.

Consider the series 1, 1, 2, 3, 5, 8…

$$1 \quad 1 \quad\quad 2 \quad\quad 3 \quad\quad 5 \quad\quad 8$$
$$\downarrow \quad\quad \downarrow \quad\quad \downarrow \quad\quad \downarrow$$
$$1+1 \quad 1+2 \quad 2+3 \quad 3+5$$

Here, each term starting with the third number, is the sum of the two preceding terms, After the first two terms as given (1 and 1), then onwards, to get any term, we need to add the two terms that come immediately before that position . Hence to get the next term of the series, we should take the two preceding terms 5 and 8 and add them up to get 13. So the next term of the series is 13. The term after this will be 21(=8+13)

COMBINATION SERIES

A number series which has more than one type of (arithmetic) operation performed or more that one series combined together is combination series. The series that are combined can be two series of the same type or could be different type of series as described above. Let us look at some example.

First let us look at those series which are formed by more than one arithmetic operation performed on the terms to get the subsequent terms.

Consider the series: 2, 6, 10, 3, 9, 13, 4, 12,…

Here the first term 2 is multiplied by 3 to get the second term, and 4 is added to get the third term. The next term is 3 (one more than the first term 2) and it is multiplied by 3 to get 9 (which is the next terms) and then 4 is added to get the next term 13. The next term 4 (which is one more than 3) which is multiplied by 2 to get 12. Then 4 is added to this to get the next number 16.

Consider the series: 1, 2, 6, 21, 88….. Here we can observe that 88 is close to 4 time s 21. It is in fact $21 \times 4 + 4$ .So, if we now look at the previous term 21, it is related to the previous term 6 as $6 \times 3 + 3$. Now we

get the general patterns: to get any term, multiply the previous term with k and then add k where k is a natural number with values in increasing order from 1. So, to get the second term, the first term has to be multiplied with 1 and then 1 is added. To get the third term, the second term is multiplied with 2 and then 2 is added and so, on Hence after 88 the next term is $88 \times 5 + 5$ i.e. 445.

Now, let us look at a series that is formed by combining two (or more) series can be of the same type or of different types described above.

Consider the series 8, 12, 9, 13, 10, 14….. Here the 1st, 3rd, 5th… terms which are 8, 9, 10… form one series whereas the 2nd ,4th ,6th etc. terms which are 12,13,14 forms another series. Here both series that are being combined are two simple constant difference series. Therefore the missing number will be the next term of the first series 8, 9, 10 … which is equal to 11.

Consider the series 0, 7, 2, 17, 6, 31, 12, 49, 20…. Here the series consisting of 1st, 3rd, 5th …. terms (i.e., the series consisting of the odd terms) which is 0, 2, 6, 12, 20,… is combined with another series consisting of 2nd 4th 6th …. terms(i.e., the series consisting of the even terms) which is 7, 17, 31, 49…The first series has the differences in increasing order 2, 4, 6, 8, 10 and so on. The second series also has the difference in increasing order 10, 14, 18… Since the last term 20 belongs to the first series a number from the second series will be obtained by adding 22 to 49 that is 71.

Consider the series 1, 1, 2, 4, 3, 9, 4, 16,… Here one series consisting of odd terms, which is 1, 2, 3, 4….is combined with the series of even terms which is 1, 4, 9, 16….. The first series is a series of natural numbers. The second series is the squares of natural numbers. Hence, the next term is 5.

A GENERAL APPROACH TO NUMBER SERIES

The best way of approaching the number series questions is to first observe the difference between terms. If the difference is constant, it is a constant difference series. If the difference is increasing or decreasing by a constant number, then it is series with a constant increasing or decreasing difference, then try out the product series approach .For this first divided the second term with the first term, third with the second, and so on. If the numbers obtained are the same then it is a product series. Alternatively try writing each term of the series as a product of two factors and see if there is any pattern that can be observed, if still there is no inference, but the difference is increasing or decreasing in a rapid manner, then check out the square series. If the increase is very high and it is not a square series, then try out the cube series.

If the difference is alternatively decreasing and increasing (or increasing for some time and alternately decreasing), then it should most probably be a mixed series. Therefore test out the series with alternate numbers. If still the series is not solved, try out the general numbers.

LETTER SERIES

The questions here are similar to the questions in Number Series. Instead of numbers we have letters of the alphabet given here. We have to first identify the patterns that the series of letters follow. Then we have to find the missing letter based on the pattern already identified. In number series we saw different patterns that the numbers in the series can follow-like squares, cubes. In letter series, obviously, patterns like squares, cubes will not be possible. In letter series, in increasing or decreasing difference. The position of the letters in the English alphabet is considered to be the value of the alphabet in questions on letter series. Also when we are counting after we count from A to Z we again start with A, i.e. we

treat the letters as being cyclic in nature like in Number Series. In this type of Letter Series also, we can have a "combination " of series , i.e. two series are combined and given . We need to identify the patterns in the two series to find out the missing letter. Sometimes, there will be some special types of series also Let us look at a few examples to understand question on Letter Series.

Q.1 Find the next letter in the series
D, G, J, M, P, _____
a) Q   b) R
c) S   d) T

Solution   **(c)**
Three letters are added to each letter to get the next letter in the series
i.e.D+3, G+3, J+3, M+3, P+3, $\underline{S}$ and P=16 +3=19 and the 19th letter in the alphabet is S.

Q.2 Find the next letter in the series
A, B, D, H, _____
a) L   b) N
c) R   d) P

Solution   **(d)**
Each letter in the given series is multiplied with 2 to get the next letter in the series. $A \times 2 \Rightarrow 1 \times 2 = 2$ And the 2nd letter is B, $B \times 2 \Rightarrow 2 \times 2 = 4$ and the 4th letter is D.
Similarly $H \times 2 \Rightarrow 8 \times 2 = 16$ and the 16th letter is P.

Q.3 What is the next letter in the series?
B, D, G, K, P, _____
a) S   b) V
c) W   d) X

Solution   **(b)**
B+2, D+3, G+4, K+5, P+6,_____
P+6=16+6=22 and the 22nd letter is V

Q.4 I, X, J, W, K, V, L, _____
a) M   b) U
c) S   d) T

Solution   (b)

The given series is an alternate series, I+1, J+1, K+1, L is one series and X-1, W-1, V-1, _____ is the other series .

X-1 =W, W-1 =V and V-1=22 -1 =21 and the 21st letter is U

2 BLOOD RELATIONS

There are two type of questions based on blood relations that are given in different competitive examinations. For the sake of convenience we will refer to the two types of questions as Type I and Type II. (Please note that the questions on blood relationships are not categorized as above in the actual exam papers. It is being done purely from the point of better understanding).

In the exams, the success of a candidate in the questions on blood relations depends upon his knowledge about values blood relations. Some of the relationship given below help in solving the problems.

The easiest and non-confusing way to solve these types of problems would be to draw a family tree diagram and increase the levels in the hierarchy as shown below:

1st	GRANDPARENTS	Grandfather, Grandmother, Granduncle, Grandaunt
2nd	PARENTS & IN-LAWS	Father, Mother, Uncle, Aunt, Father-in-law, Mother in law
3rd	SIBLINGS, SPOUSE & IN-LAWS	Brother, Sister, Cousin, Wife, Husband, Brother in law, Sister in law
4th	CHILDREN & IN-LAWS	Son, Daughter, Niece, Nephew, Son in law, Daughter in law
5th	GRANDCHILDREN	Grandson, Granddaughter

Mother's or Father's son	Brother
Mother's or Father's daughter	Sister
Mother's or Father's brother	Uncle
Mother's or Father's sister	Aunt
Mother's or Father's mother	Grandmother
Mother's or Father's father	Grandfather
Grandmother's brother	Grand uncle
Grandfather's sister	Grand aunt
Grandfather's brother	Grand uncle

Grandmother's sister	Grand aunt
Sister's or Brother's son	Nephew
Sister's or Brother's Daughter	Niece
Uncle or Aunt's son or daughter	Cousin
Son's wife	Daughter in law
Daughter's husband	Son-in-law

Husband's or Wife's sister	Sister- in- law
Husband's or Wife's brother	Brother- in- law
Sister's husband	Brother- in law
Brother's wife	Sister- in law
Children of same parents	Siblings (could be all brothers, all sisters or some brothers and some sisters)
Children	Son, Daughter
Children's Children	Grandson, Granddaughter (Grandchildren)

In addition, remember the word spouse which means either husband or wife.

Grandfather and grandmother will come in the first stage. Mother, father uncle and aunt will come in the second stage: sister brother and cousin will come at the third stage: son daughter, niece and nephew will come in the fourth stage and finally, granddaughters and grandsons will come. The above stage are made from the point of view of an individual.

In type I questions, the relationship between two people is given through a roundabout way of relating them through other people. We have to go through the series of relationship can be given I in the questions. The relationship can be given as a simple statements or as a statement made by a person. In the first example given below, a person is involved in making a statement whereas in the second question, there is no person involved in making a statement.

GATEFLIX

WORKED OUT EXAMPLES

Q.1 A's father's mother-in law only daughter's son is b. How is A related to B?
a) Brother
b) Sister
c) Nephew
d) Cannot be determined

Solution **(d)**

A's father's mother- in –law's only daughter is A's mother. A's mother's son is A's brother. But A can either brother or sister to B.

Q.2 If A's father is B, C is the father of B and D is A's mother, then how is C related to D?
a) Father
b) Grandfather
c) Father- in law
d) Uncle

Solution **(c)**

A's father is B and mother is D. Therefore D is B's wife and C is the father of B. Hence C is D's father-in law.
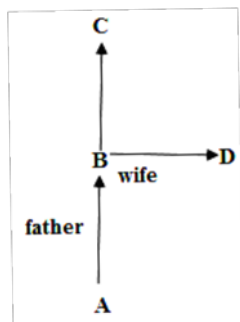
Q.3 A+B means A is the son of B
A-B means A is the daughter of B.
A× Bmeans A is the father of b.
A÷ B means A is the mother of B.
If $M \times N + O - P \div Q$, then how is M related to?
a) Husband
b) Cousin
c) Brother- in law
d) Uncle

Solution **(c)**

$M \times N + O - P \div Q$ Means M is the father of N, N is the son of O, O is the daughter of P & P is the mother of Q. M is the father of N and N is the son of O means m is the husband of O. O is the daughter of P and P is the

mother of Q means O is the sister of Q.
M is the husband of O and O is the sister of Q means M is the brother-in law of Q.
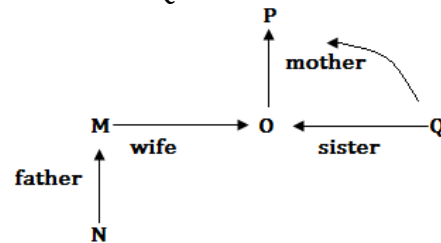
Q.4 A+B means A is the son of B
A-B means A is the daughter of B.
A× B means A is the father of B.
A÷ B means A is the mother of B.
Which of the following means S is the son- in law of P?
a) $P + Q \div R \times S - T$ b) $P \times Q \div R - S + T$
c) $P + Q \times R - S \div T$ d) $P \times Q - R \div S \times T$

Solution **(b)**

$P + Q \div R \times S - T$ Means P is the son of Q. Q is the daughter of R, R is the father of S and S is the daughter of T. Hence S is the nephew of P.

$P \times Q \div R - S + T$ Means P is the father of Q, Q is the mother of R, R is the daughter of S and S is the son of T. Hence S is the son –in law of P.

$P + Q \times R - S \div T$ Means P is the son of Q, Q is the father of R, R is the daughter of S and S is the mother of T. Hence S is the mother of P.

$P \times Q - R \div S \times T$ Means P is the father of Q, Q is the daughter of R, R is the mother of S and S is the father of T. Hence S is the son of P.

Q.5 Pointing to a person, Raju said, "He is the only brother of my father's mother's daughter". How is the person related to Raju?

Solution **(b)**

Raju's father's mother's daughter is Raju's father's sister. Raju's father's sister's only brother is Raju's father. Hence the person is Raju's father.

3 | DIRECTION SENSE

The questions on direction sense typically involve a person moving certain distances in specified directions. Then, the student is asked to find out the distance between the initial and the final points. The easiest way of solving these problem and ensure that the diagram reflects all the information given in the problem.

To solve these of problems, the student should be aware of the directions. The student should also recognize the left and right of person walking in a particular direction. The following diagram shows all the directions and left (L) and right (R) of a person walking in that direction and the student should memories the diagram.
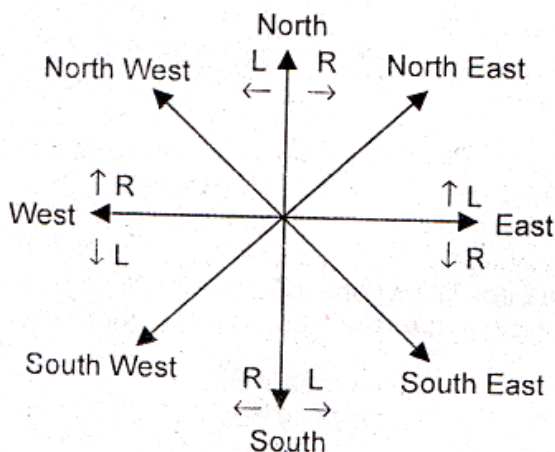
NOTE

The distance from a particular point after travelling a distance of x meters in the horizontal direction and a distance of y meters in the vertical direction is equal to $\sqrt{x^2 + y^2}$ (please note that in common usage, North South direction is referred to as "vertical "direction and the East West direction is referred to as the "horizontal" direction).

WORKED OUT EXAMPLES:

Q.1 A person travels a distance of 7 km towards east from his house, then travels 7 km towards north and then a distance 7 km towards east and finally 7 km towards north. What is the vertical distance traveled by him?

Solution
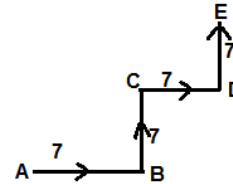
Let A and E be the initial and the final positions.

The vertical distance travelled =BC+ED (7+7) km=14km

Q.2 A person starts from his house and travels 8m towards west then he travels 6 m towards his left then 8m towards west ad then 4m towards south. Finally he turns right and travels 5m. What is the horizontal distance travelled by him?

Solution
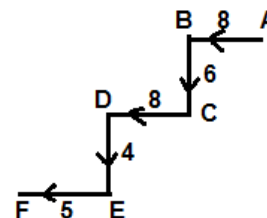
Let A and F be the initial and the final positions.

∴ Horizontal distance traveled =FE+DC+BA=5+8+8=21 m

Q.3 Surya travels 3 m towards east and then turns right and travels 4 m. What is the distance between the initial & the final position of Surya?

Solution
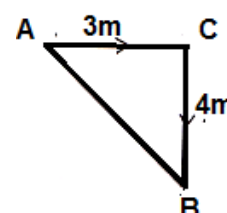
Let A and B the initial and the final positions of Surya.

$$AB = \sqrt{AC^2 + BC^2}$$
$$= \sqrt{3^2 + 4^2} = 5m$$

Q.4 Starting from his house, Sachin walks a distance of 8 m towards north, then he turns left and walks 6m, then walks 3m towards south an finally travels 6m towards west to reach his office. What is the distance between his house and office and also find in which direction is his office situated with respect to his house.

Ans:
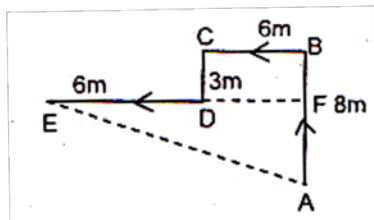
Let A be the Sachin's house and E his office. The distance between A and E

$$= \sqrt{(EF)^2 + (AF)^2}$$
$$= \sqrt{(ED + CB)^2 + (AB - FB)^2}$$
$$= \sqrt{(ED + CB)^2 + (AB - CD)^2}$$
$$= \sqrt{12^2 + 5^2} = 13m$$

Q.5 Starting from her house, Nisha traveled 8m towards west then turned right and travelled 15m. She then traveled 20 m towards east, followed by 20 m to south to reach a hostel .How far is her house from the hostel and in which direction?

Ans:
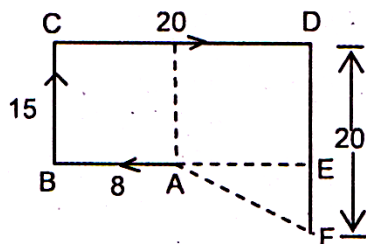
Let A and f be the initial and final positions.
Now

$$AF = \sqrt{AE^2 + EF^2}$$
$$AE = CD - BA = 20 - 8 = 12m$$
$$EF = DF - DE - CB = 20 - 15 = 5m$$
$$\therefore AF = \sqrt{144 + 25} = \sqrt{169} = 13m$$

Her house is towards north- west from the hostel

4 | CUBES

4.1 Introduction

A cube is a solid which has 6 faces, 8 corners and 12 edges.

Following are some of the important types based on which questions have been asked in various aptitude tests.

(i) Number of cuts given to a cube is given, find the maximum number of identical pieces that can be produced.

(ii) Number of pieces a cube is cut into is given, find the least number of cuts required to produce these many pieces.

(iii) Miscellaneous types.

It must be remembered that in order to obtain the maximum number of pieces, the cuts given to a large cube must be divided as equally as possible in three different directions.

Let us discuss each of these types with the help of examples.

(i) Number of cuts = given;
   Maximum number of pieces =?

   (a) Whenever the number of cuts made to a cube is a multiple of 3.

   If 'n' is the number of pieces along each edge, and

   $$n = \left(\frac{\text{Total cuts}}{3}\right) + 1, \text{ then}$$

   Maximum number of identical pieces = n^3

   Number of pieces with 3 faces visible = 8

   Number of pieces with 2 faces visible = 12(n - 2)

   Number of pieces with 1 face visible = $6(n-2)^2$

   Number of pieces with no face visible = $(n-2)^3$

Let us take an example where 30 cuts are made to a large cube to get the maximum number of pieces.

Here, the value of 'n' will be $\frac{30}{3} + 1 = 11$ Then,

- Maximum number of pieces = n^3 = 11^3 = 1331
- Number of 3 - face visible pieces = 8.
- Number of 2 - faces visible pieces = 12(n - 2) - 12(11 - 2) = 108.
- Number of 1- face visible pieces - $6(n 2)^2 = 6(11 - 2)^2 = 486$.
- Number of no face visible pieces = $(n 2)^3 = (11 - 2)^3 = 729$.

(b) Whenever the number of cuts made to the large cube is NOT a multiple of 3.

In such a case, there is no direct formula for finding out the 2 - faces visible, 1 - face visible or no face visible pieces, but the maximum number of pieces produced can be found out. Let us consider that a large cube is given 4 cuts. Now 4 cuts are divided into three directions as 1 cut, 1 cut, 2 cuts. We know that the number of pieces along each edge is one more than the number of cuts along that edge (when all cuts are made in the same direction - parallel to the same pair of faces). We can represent the above as shown below:

$$\begin{array}{ccc} 1 & 1 & 2 \\ +1 & +1 & +1 \\ \hline 2 \times 2 \times 3 \end{array} = 12 \text{ pieces.}$$

Similarly, 11 cuts will give us maximum 100 pieces, as shown below:

$$\begin{array}{ccc} 3 & 4 & 4 \\ +1 & +1 & +1 \\ \hline 4 \times 5 \times 5 \end{array} = 100 \text{ pieces.}$$

(ii) Number of pieces = given,
   Least number of cuts =?

   We use the reverse process. To get the least number of cuts to produce 100

pieces, factorise 100 into 3 factors with least difference between them, and then subtract one from each of them, as shown below:

$$
\begin{array}{rcccc}
100 = & 4 & \times & 5 & \times & 5 \\
& -1 & & -1 & & -1 \\
\hline
& 3 & + & 4 & + & 4 & = 11 \text{ cuts}
\end{array}
$$

(iii) Miscellaneous types:

Apart from the above two types, a cube can be coloured with one, two or more colours, and then is given some number of cuts.

Let us study and practice each of the above types with the questions given in the exercise.

5 ARRANGEMENTS

LINEAR SEQUENCING

Linear sequencing is essentially arranging the items in a sequence (in a single line.) The questions of this type are also referred to as "Seating Arrangement". The word "Seating Arrangement" should not be misconstrued- it should not be treated as questions involving only persons sitting a specified conditions. Essentially, these questions involve arranging subjects (people or things) according to the given conditions. The arrangement is done only on one "axis" and hence, the positions of the subjects assume importance in terms of order like first position second position, etc.

LET US LOOK AT THE EXAMPLES:

Directions for Questions 1 to 5:
Read the data given below carefully and answer the questions.
Seven persons Paul, Queen, Rax, Sam, Tom, Unif and Vali are sitting in a row facing us. Rax and Sam sit next to each other. There must be exactly four persons between Queen and Vali. Sam sits to the immediate right of Queen.

Q.1 If Paul and Tom are separated exactly by two persons, then who sits to the immediate left of Vali?
a) Paul   b) Tom
c) Unif   d) Rax

Q.2 If Queen is not sitting at either extremes of the row, then who among the following has as many persons on his left as on his right ?
a) Sam   b) Unif
c) Rax   d) Vali

Q.3 If Queen sits at one extreme, then who is at the other extreme?

a) Paul
b) Tom
c) Vali
d) Cannot determined

Q.4 Tom sits to the right of Queen, and Paul is separated from Tom by exactly three persons. Then, who is sitting to the immediate left of Vali?
a) Sam   b) Unif
c) Tom   d) Rax

Q.5 In how many different ways can the seven persons sit in a row?
a) 3   b) 2
c) 10   d) 12

Solution:
Let us write down the conditions given in short form and then represent them pictorially Also, let us treat the left of the persons sitting as "left" and their right as "right" for interpreting the conditions
Rax and Sam sit next to each other → RS or SR.
There are exactly 4 persons between Queen and Vali
Q __ __ __ __V   or
V __ __ __ Q
Sam sits to the immediate right of Queen → SQ.
Now let us analysis the data /conditions that we are given and then put the three conditions together. Let us number the steps from our left to right as Seat 1 to Seat 7.
Since S is to the right of Q and since R and SA have to be next to each other, R can come only to the immediate right of S. Thus, R, S and Q will be in the order RSQ. Since there are four persons between Q

and V, Q can be placed in seats for R and S. Hence, there are only two seats available for Q .Let us fix the positions of R, S and V in each of these two positions of Q and write them down. The directions Left and Right are as shown below.

←R   L→

Arrangement I:

1234567y

V   RS   Q

ArrangementI II :

1234567

V   RS   Q

These are the only two arrangements possible for the four persons V,R,S and Q .The other three persons Paul ,Tom and Unif can sit in the three vacant seats in any order, as no inforamtion is given about them . Now let us look at each of the questions.

Q.1   Solution (c)
Paul and Tom are separated by exactly two persons.
Arrangement I is the only one possible as in Arrangement II, Paul and Tom cannot have exactly two persons between them . So, we have the arrangement as follows.
T/P, V,U,P/T, R,S,Q
So, Unif must be sitting to the immediate left of Vali.

Q.2   Solution (c)
If Queen is not at the extreme right, then only arrangement II mentioned above is possible . The peson who has as many persons on his left as on his right can only be the person who is sitting in the middle seat i.e. seat 4. In this arrangement Rex is sitting in seat 4.

Q.3   Solution (d)
"Queen sits at one extreme" means that we should look at arrangement I. In this arrangement I. In this arrangement, any one out of the three persons Paul, Tom and Unif can be in seat1, i.e. extreme right

Q.4   Solution (b)
If Tom and Paul are separted by exactly three pesons, then only arrnagement II is possible. So Tom and Paul have to be in seats 3 and 7, Since it is also given that Tom is to the right of Queen ,Tom has to be in seat 3 and Paul, in seat 7. So the arrangement must be follows:
V,U,T,R,S,Q,P
The person sitting to the immediate left of Vali is Unif .

Q.5   Solution (d)
We have two possible arrangements – "Arrangemnt I and Arrangement II" that we have already looked at In each arrangement. The remaining three people can sit in the remaining three seats in 6 ways. Thus, a total of 12 ways of seating the seven persons is possible.

Directions for Questions 6 to 10:

Read the data given below carefully and answer the questions that follow.
Seven boys, Rajan, Shyam, Vardhan , Mithra, Vimal , Raj and Kishan – are sitting in a row Shyam sits to the immediate left of Vardhan and third to the right of Rajan, wheras Mithra, who sits at the extreme left is next ot Kishan.

Q.6   Who is sitting to the immediate right of Shyam?
a) Mithra   b) Kishan
c) Vamal   d) Vardhan

Q.7   If Vardhan and Kishan exchange place with each other without changing the rest of the arrangement that is already done, then who will sit to the immmedaite left of Rajan ?
a) Kishan   b) Raj

c) Vimal   d) Vardhan

Q.8 If only Shyam sits betweeen Raj and Vardhan , who is exactly in the middle of the row?
a) Raj   b) Vardhan
c) Vimal   d) Rajan

Q.9 Which of the following cannot confirm the seating arrangement of all the boys?
a) Raj is to the immediate right of Rajan , wheres Vimal is to the left of Shyam.
b) Mithra and Raj have two persons between them .
c) Raj and Kishan have two persons between them .
d) Rajan and Shyam have two person in betweeen them.

Q.10 After arranging all the boys as per the conditions given in the data, if Rajan now exchange his place with Mithra, and Vardhan exchange his place with Vimal then how many persons will be there between Vimal and Rajan ?
a) Three   b) Two
c) Five   d) One

Solution:
Let us denote Left and Right as shown below:
←L   R→
Now let us represent the data given in pictroial form (We use R for Raj and Rn for Rajan ; Va for Vardhan ; Vi for vimal; S for Shyam ; M for Mithra and K for Kishan.)
Mithra sits at the extreme left –next to Kishan →   MK ___ ___ ___ ___
Shyam sits to the immediate left of Vardhan and third to the right of Rajan → Rn ___ ___ S Va
Putting both the above condition together Va can go only to the extreme right postion. Thus, We have the arrrangement as M K Rn ___ ___ S Va.

Raj and Vimal occupy the two vacant seats between Rajan aand Shyam .

Q.6 **Solution (d)**
From the seating arrangement figure above Vardhan is to the immediate right of Shyam

Q.7 **Solution (d)**
If Kishan and Vardhan exchange places as can be seen from the arrangement, the person to the immediate left of Rajan will be Vardhan

Q.8 **Solution (c)**
If Shyam sits between Raj and Vardhan then the seating arrangement is as follows. Mithra, Kishan, Rajan, Vimal, Raj, Shyam, Vardhan. Then, Vimal will be exactly in the middle of the row.

Q.9 **Solution (d)**
Statement (a) gives the arrangement as Mithra, Kishan , Rajan , Raj, Vimal , Shyam, Vardhan
Statement (b) gives the seating arrangement as Mithra, Kishan, Rajan, Raj, Vimal Shyam , Vardhan
Statement (c) gives the seating arrangement as: Mithra, Kishan, Rajan, Vimal, Raj, Shyam, Vardhan
So only statement (d) cannot makes the seating arrangement unique while others can.

Q.10 **Solution (c)**
The arrangement is M K Rn R/Vi Vi/R S Va
Rajan exchange his place with Mithra and Vimal with Vardhan then we have the following arrangement Rn K M R/Va Va/R S Vi
While we still do not know the exact position of Vardhan (or which place Vimal sits), we can see that there are five persons between Rajan and Vimal

6 CLOCKS

The hour hand and the minute hand of a clock move in relation to each other continuously and at any given point of time, they make an angle between $0°$ and $180°$ with each other.

If the time shown by the clock is known, the angle between the hands can be calculated. Similarly, if the angle between two hands is known, the time shown by the clock can be found out.

When we say angle between the hands, we normally refer to the acute/obtuse angles (upto $180°$) between the two hands and not the reflex angles (> $180°$).

For solving the problems on clocks, the following points will be helpful.

1) Minute hand covers $360°$ in 1 hour, ie. in 60 minutes. Hence **MINUTE HAND COVERS 6° PER MINUTE.**
2) Hour hand covers $360°$ in 12 hours. Hence hour hand covers $30°$ per hour. Hence, **HOUR HAND COVERS 1/2° PER MINUTE**. The following additional points also should be remembered, in a period of 12 hours, the hands make an angle of
   a) $0°$ with each other (ie. they coincide with each other) 11 times.
   b) $180°$ with each other (i.e. they point exactly in opposite directions) 11 times.
   c) $90°$ or any other angle with each other 22 times.

NOTE
We can also solve the problems on clocks using the method of "Relative Velocity".
In 1 minute Hand covers $6°$ and Hour hand covers $1/2°$
Therefore, Relative Velocity
$= 6 - 1/2 = 5\frac{1}{2}°$ per minute. Alternately, in 1 hour hand covers 5 minute divisions.

$\therefore$ Relative Speed = 60-5=55 minutes per hor. However, adopting the approach of actual angles covered is far simplest and does not create any confusion.

POINTS TO NOTE

1) Any angle other than ($0°$ and $180°$) is made 22 times in a period of 12 hours.
2) In a period of 12 hours there are 11 coincidences of the two hands, when the two hands are in a straight line facing opposite directions.
3) The time gap between any two coincidences is 12/11 hours or $65\frac{5}{11}$ minutes
4) If the hands of a clocks (which do not show the correct time) coincide every 'p' minutes. Then, If $p > 65\frac{5}{11}$ then the watch is going slow or losing time.
   If $p < 65\frac{5}{11}$ then the watch is going fast or gaining time.
5) To calculate the angle 'θ' between the hands of a clocks, we use the following formula (where m=minutes and h=hours)
   i) $\theta = \frac{11}{2}m - 30h \left(\text{when } \frac{11}{2}m > 30h \right)$
   ii) $\theta = 30h - \frac{11}{2}m \left(\text{when } 30h > \frac{11}{2}m \right)$

WORKED OUT EXAMPLES

Q.1 What is the angle between the minute hand and the hour hand of a clock at 3 hour 40 minutes?
a) $20°$ b) $70°$
c) $90°$ d) $130°$
Solution (d)
The angle between the hands can be calculated by $\theta = \left| \frac{11}{2}m - 30h \right|$ where

m is minutes and h is hours. Here, m=40 and h=3

$$\therefore \theta = \left|\frac{11}{2} \times 40 - 30 \times 3\right|$$

$$= |220 - 90| = 130°$$

The angle between the two hands is 130°

Q.2 Find the time between 2 and 3 O'clock at which the minute hand and the hour hand
1) Make an angle of *60°* with each other
2) Overlap.
3) Are perpendicular to each other.
4) Are on the same straight line but are facing opposite directions.

Solution

1) In the formula

$$\theta = \left|\frac{11}{2}m - 30h\right|$$

$$\theta = 60° \text{ and } h = 2$$

$$\therefore 60 = \frac{11}{2}m - 30 \times 2$$

$$\frac{11}{2}m = 120$$

$$m = \frac{240}{11} = 21\frac{9}{11} \min \text{ past } 2$$

(or)

$$60 = 30 \times 2 - \frac{11}{2}m$$

$$\therefore \frac{11}{2}m = 0$$

$$m = 0$$

Therefore, the angle between the hour hand and the hour hand and the minute hand is 60° at 2 O'clock and at $21\frac{9}{11}$ minutes past 2 O'clock.

2) When the two hands overlap, the angle between them is 0°

$$\theta = \left|\frac{11}{2}m - 30h\right|$$

$$\therefore \theta = 0° \text{ and } h = 2$$

$$\theta = \frac{11}{2}m - 30 \times 2$$

$$m = \frac{120}{11} = 10\frac{10}{11} \min \text{ past } 2.$$

3) When two hands are perpendicular $\theta = 90°$ and h=2

$$\therefore \theta = \left(\frac{11}{2}m - 30h\right) \text{or} \left(30h - \frac{11}{2}m\right)$$

$$90 = \frac{11}{2}m - 30 \times 2$$

$$\frac{11}{2}m = 150$$

$$m = \frac{300}{11} = 27\frac{3}{11} \text{ minutes past } 2$$

(Or)

$$90 = 30 \times 2 - \frac{11}{2}m$$

$$\frac{11}{2}m = 30$$

As m cannot be negative, this case is not possible. So, the hands are perpendicular to each other only once i.e. at $27\frac{3}{11}$ minutes past 2 O'clock.

4) When two hands are pointing opposite directions and are on a straight line the angle between them would be 180° ie. $\theta = 180°$ and h=2

$$180° = \frac{11}{2}m - 30h$$

$$\frac{11}{2}m = 180 + 60 = 240$$

$$m = \frac{480}{11} = 43\frac{7}{11}$$

So, at $43\frac{7}{11}$ minutes past 2 O'clock the hands will be at 180°

7 CALENDARS

Suppose you are asked to fine the day of the week on 30th June 1974 it would be a tough job to find because you do not know the method. The method of finding the day of the week lies in the number of "odd day"

NOTE

Every 7th day will be the same day count wise, i.e. if today is Monday then 7th day counting from Tuesday onwards will once again be Monday. Odd days are the days remaining after completion of an exact number of weeks. An Odd day is the reminder obtained on dividing the total number of days with seven.
Example: $52 \text{days} \div 7 = 3 \text{odd days}$

LEAP AND NON- LEAP YEAR

A non –leap year has 365 days whereas a leap year has one extra day because of 29 days in the month of February .Every year which is divisible by 4 is called leap year. Leap year consists of 366 days, (52 complete weeks +2 days). The extra two days are the odd days. So, a leap year has two odd days.
A non-leap year consists of 365 days (52 complete weeks +1 day). The extra one day is the odd day.

NOTE

Every century, year which is a multiple of 400, is a leap year. A century year which is not divisible by 400 is a non-leap year
Example:
400,800, 1200, 1600...are leap years
500,700, 900, 1900...are non-leap years

COUNTING THE NUMBER OF ODD DAYS

100 years consist of 24 leap years +76 ordinary years. (100 years when divided by 4 we get 25. But at the 100th year is not a leap year, hence only 24 leap year).

$= 2 \times 24 \text{odd days} + 1 \times 76 \text{odd days}$
$= 124$ days
$= 17$ weeks+5 days

The extra 5 days are the odd days.
So, 100 years contains 5 odd days.
Similarly, for 200 years we have 10 extra days (1week +3day)
∴ 200 years contains 3 odd days.
Similarly 300 years contains 1 odd day and 400 years contains 0 odd days.

COUNTING OF NUMBER OF ODD DAYS, WHEN ONLY ONE DATE IS GIVEN

Here we take January 1st AD as the earlier date and we assume that this day is a Monday. We take is its previous day i.e. Sunday as the reference day. After this the above mentioned method is applied to count the number of odd days and find the day of the week for the week for the given date.

COUNTING NUMBER OF ODD DAYS, WHEN TWO DATES ARE GIVEN

Any month which has 31 days has 3 odd days (∵ $31 \div 7$ leaves 3 as reminder) and any month which has 30 days has 2 odd days ($30 \div 7$ leaves 2 as reminder).
Then, the total numbers of odd days are calculated by adding the odd days for each month. The value so obtained is again divided by 7 to get the final number of odd days. The day of the week of the second date is obtained by adding the off days the day of the week of the earlier date.

Examples:

Q.1 If you were born on 14th April 1992 which was a Sunday then on which day of the week does your birthday fall in 1993?

a) Monday
b) Tuesday
c) Wednesday
d) Cannot be determined

Solution   (a)
14th April 1992 to 14 the April 1993 is a complete year, which has 365 days.
Hence the number of odd days from 14th April 1992 to 14th April 1993 is 1.
Hence 14th April 1993 is one day after Sunday ie. Monday

Q.2 If 1st Jan 1992 is a Tuesday then on which day of the week will 1st Jan 1993 fall?
a) Wednesday   b) Thursday
c) Friday   d) Saturday

Solution   (b)
Since 1992 is a leap year there are 2 odd days. Hence 1st January 1992 is two days after Tuesday i.e. Thursday.

Q.3 If 1st April 2003 was Monday, then which day of the week will 25th December of the same year be?
a) Tuesday   b) Wednesday
c) Thursday   d) Friday

Solution   (b)
The number of days from 1st April to 25th December
(29+31++30+31+31+30+31+30+ 25) Days
=268 days.
$= \dfrac{268}{7} = 38 + 2$ odd days.

Hence 25th December is two days after Monday i.e. Wednesday

Q.4 On which day of the week does 4th June 2001 fall?
a) Monday   b) Tuesday
c) Wednesday   d) Thursday

Solution   (a)
4th June 2001 ⇒ (2000) year+1st January to 4th June 2001

We know that 2000 years have zero odd days. The number of odd days from 1st January to 4th June2001
Month:
Jan+ Feb +Mar +Apr +May +June
Odd day: 3+ 0+ 3 + 2 + 3 + 4
$\Rightarrow \dfrac{15}{7} = 1$ odd day.
Hence 4th June 2001 was a Monday.

Q.5 Which year will have the same calendar as that of 2005?
a) 2006   b) 2007
c) 2008   d) 2011

Solution   (d)
Year:
2005+2006+2007+2008+2009+ 2010
Odd days: 1+ 1+ 1+2++1 +2+1
Total numbers of odd days from 2005 to 2010 are 7=0 odd days.
Hence 2011 will have the same calendar as that of 2005

Q.6 What day of the week was 18th April 1901?
a) Monday   b) Tuesday
c) Wednesday   d) Thursday

Solution   (d)
18th April 1901⇒(1600+300) years +1st January to18th April 1901
1600 years have =0 odd days
300 years have -1 odd day. The number of days from 1st January 1901 to 108 days≅3 odd days
∴ Total number of odd days =3+1=4
Hence 18th April 1901 is Thursday

8 VENN DIAGRAMS

Venn Diagrams are diagrammatic representation of sets, using geometrical figures like circles, triangles rectangles etc. Each geometrical figure represents a group as shown in the examples. The area common to two or more figure represent those elements which are common to two or more groups. There are various models in Venn Diagrams which we will discuss with examples.

VENN DIAGRAM TYPE I

In these kind of questions. There are many geometrical figures representing different groups. Let's discuss this type with the help of the following example.
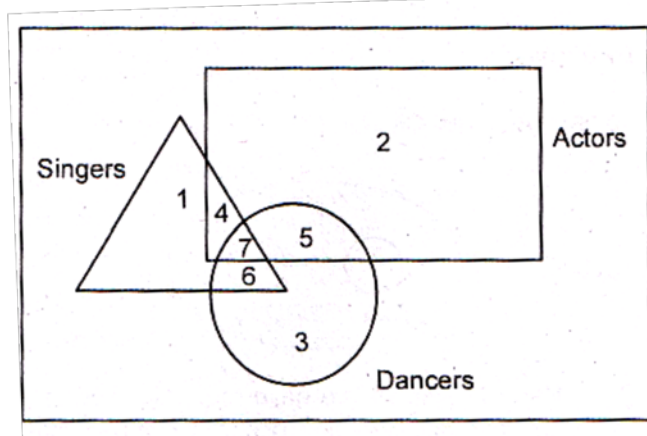
This diagram consists of three groups – Singers, Actors and Dancers represented by a triangle, a rectangle and a circle respectively. There are seven regions represented by numbers from 1 to 7 where each region represents a different group
Region 1→Represents only Singers
Region 2→Represents only Actors
Region 3→Represents only Dancers
Region 4→Represents only Singers & Actors
Region5→Represents only Actors & Dancers
Region6→Represents only Dancers & Singers
Region7→Represents Singers, Actors & dancers.
Hence the various areas as shown represent different groups i.e. region 6

represents those Singers who are only Dancers as region 6 is the intersection of thee triangle and the circle, but not the square. You may be triangle and the circle, but not the square. You may be asked questions like "Which region represents Dancers who are only Singers?" The answer to this question, as explained above will be region 6.

VENN DIAGRAM TYPE II
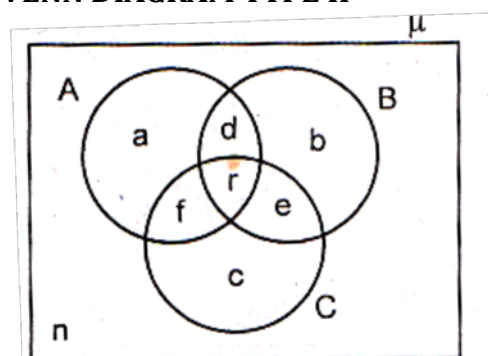
In this type, two three or four different groups could be given with some elements common to two or more groups. Let us observe the diagram given below.
Here A, B and C are three different groups and the various regions can be explained as given below.
Only A=a
Only B=b
Only C=c
A and B only =d
B and C only=e
C and A only = f
All the three (A, B and C) =r
Both A and B =d+r
Both B and C =e+r
Both C and D =f+r
Neither A nor B nor C=n
A, B or C and none =μ Also μ=(A∪B∪C)+n
Here, the rectangle represents the sample space, which consists of three groups A, B and C and also n, which is the number of people belonging to neither A, nor B nor C. Some more formula are as given under.

i) $A' = (b+e+c)+n$ where A'=A complement (not in A)

ii) $B' = (a+f+c)+n$; where B'=B complement (not in B)

iii) $C' = (a+d+b)+n$ where C'=C complement (not in C)

iv) $A-B = A-(A\cap B)$

v) $A\Delta B = (A-B)\cup(B-A)$

vi) Number of people (or things) belonging to at least one out of the three groups
$$= (A\cup B\cup C)$$
$$= (a+b+c)+(d+e+f)+r$$
$$\qquad\uparrow\qquad\quad\uparrow\qquad\uparrow$$
$$\text{Exactly}\qquad\text{Exactly}\quad\text{Exactly}$$
$$\text{one}\qquad\quad\text{two}\qquad\text{three}$$

vii) $A+B+C = (A\cup B\cup C)+(d+e+f)+2r$
$$= (a+b+c)+2(d+e+f)+3r$$

Examples:

In a class of 80 students 30 students like tea, 35 students like milk and 25 students like coffee. It is also known that 15 students like both tea and milk, 17 students like both milk and coffee and 14 students like both tea and coffee 9 students like tea, coffee as well as milk.

Solution
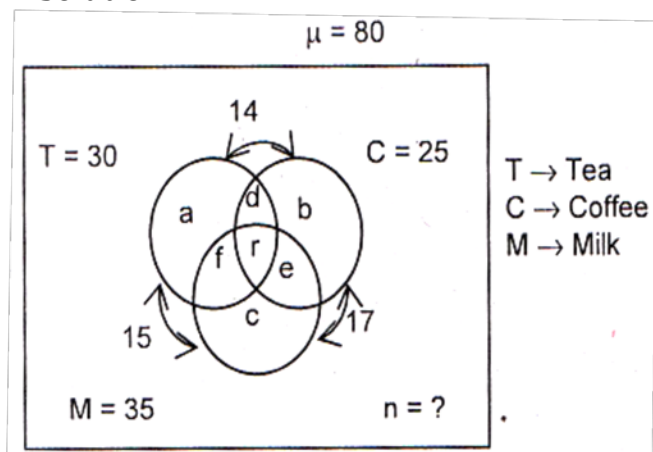
Based on the information given, we get the following diagram

Now r=9 is given
$$\Rightarrow d = 14-9 = 5; f = 15-9 = 6; e = 17-9 = 8$$

Also
$$a = 30-(d+r+f)$$
$$= 30-(5+9+6) = 10$$

$$b = 25-(d+r+e)$$
$$= 25-(5+9+8) = 3$$
$$c = 35-(f+r+e)$$
$$= 35-(6+9+8) = 12$$

Now,
$$T\cup C\cup M = a+b+c+d+e+f+r$$
$$= 10+13+12+5+8+6+9 = 53$$
$$\Rightarrow n = \mu-(T\cup C\cup M) = 80-53 = 27 \quad\text{Hence,}$$

we can now get the following diagram from the above data
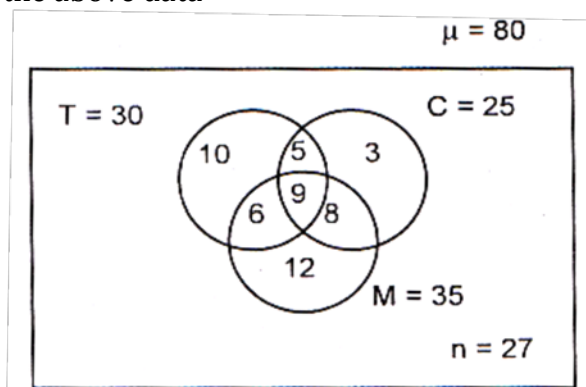
Now, we can answer the questions of the following nature.

Examples

Q.1 What is the total number of students who like neither tea nor coffee nor milk?

Solution
$$n = \mu-(T\cup C\cup M) = 80-53 = 27$$

Q.2 How many students do not like Tea?

Solution
$$T' = b+z+c+n+ = 3+8+12+27 = 50$$
(or)
$$T' = \mu-T = 80-30 = 50$$

Q.3 What is the value of T-C?

Solution
$$(T-C) = a+f$$
(i.e. the regions of A excluding B)
$$= 10+6 = 16$$

Q.4 What is the value of $C\Delta M$?

Solution
$$C\Delta M = (C-M)\cup(M-C) = (b+d)+(d+c)$$
$$= (3+5)+(6+12) = 26$$

Q.5 What is the total number of students who like both tea and coffee but not milk?

Solution

Number of students who like both tea and coffee but not milk = d = 5

VENN DIAGRAM TYPE III

In this type Venn diagrams are used to established relationship between the given groups. In other words two or more groups are given and the Venn diagram, which most correctly establishes a relation between them has to be chosen out of the various Venn diagrams given in the choices. Let us look at some of the examples given below.

Examples:

Examples 1:
Animals, Cat, Dog
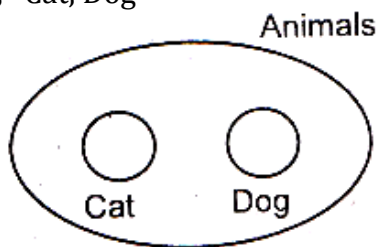
Explanation:
Here, in animals we have many species of which cat and dog are two different kinds of species, having nothing in common. So the above diagram is the most appropriate representation of the given groups.

Examples 2:
Month, week, day
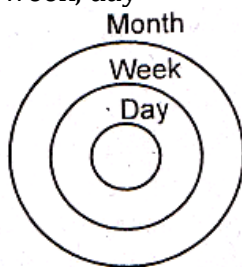
Explanation:
We know that day is a part of the week and week is a part of the month. So the above diagram is the most appropriate representation of the given groups.

Examples 3:
Mars Earth, Jupiter
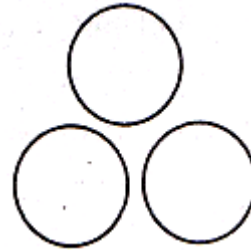
Explanation:
We know that Mars, Earth and Jupiter are there independent entities having nothing in common. So the above diagram is the most appropriate representation of the given groups.

9 DEDUCTIONS

In number of competitive exams there are a few questions on "deductions". Typically here, each question consists of two statements–on the basis of which a deduction has to be made. The answer has to be chosen from the given four (or five) choices and that will be the deduction made.

(If no conclusion can be drawn or the answer is not obtained then the choice which is normally worded as "none of the above" has to be marked).

These questions can be answered by representing the given statements by Venn Diagrams. However, here we will look at arriving at the deduction by using some simple rules.

First let us look at some basic terms used in the rules and understand what they mean. The two statements given in the question are called 'premises' & the answers are conclusion.

Eg. All dogs are cats—(i)

All cats are pigs — (ii)

The premises normally start with the words All, No Some and Some –not

The word "All" has its synonyms as –Every, Any, Each, whereas the word "Some " can also be replaced by Many ,Few, A little, Most of, Much of, More etc.

These words are referred to as qualifiers (also termed as quantifiers).

A premise consists of a subject and a predicate wherein the first term [e.g. "dogs" in statement (i)] is the subject and the second term [e.g. "cat" in statement (i)] the predicate. Similarly, in statement (ii),"cats" is called the subject and "pigs" is the predicate.

The word that occurs in both the premises is known as the 'middle term' ("cat" in the example, give above). The answer or "conclusion" should consists of the other two words ("dog and "pig's in the above example) and the middle term should not appear in the answer.

The premises can be divided into
a) Universal statements and
b) Particular statements.

This classification of the premises into the above categories is dependent on the qualifier used in the premise. For example, the statements where "All" is used are called Universal statements and the statements where "Some" is used are called Particular statements where "Some" is used are called Particular statements. Premises can also be divided into
(i) Positive (affirmative) statements and
(ii) Negative statements)

If there is a negative term like "not" or "no" in the statement it is called a negative premise. Otherwise it is called a positive premise or an affirmative statement. The combination of the two different categories of classification leads to four different premises as given in Table I below.

TABLE I

	Affirmative	Negative
Universal	All A	No E
Particular	Some many l	Some not many 0

The subject and the predicate are either distributed ($\sqrt{}$) or not distributed (x) depending on what kind of a statement it is (particular affirmative etc.)

Table II shows the distribution pattern of the subject and the predicate.

TABLE II

	Subject	Predicate
Universal affirmative	$\sqrt{}$	x
Universal negative	$\sqrt{}$	$\sqrt{}$
Particular affirmative	x	x
Particular negative	x	$\sqrt{}$

Note: $\sqrt{}$ indicate distributed and x indicates undistributed.

RULES FOR DEDUCTIONS

1) Every deduction should contain three and only three distinct terms.
2) The middle term must be distributed at least once in the premises.
3) If one premise is negative, then the conclusion must be negative.
4) If one premise is particular then the conclusion must be particular
5) If both the premises are negative, no conclusion can be drawn
6) If both the premises are particular, no conclusion can be drawn
7) No term can be distributed in the conclusion, if it is not distributed in the premises.

We take example of each type and look at them in details.

Example –I
All dogs are cats -- (i)
All cats are pig - - (ii)

As the first statement is a Universal affirmative statement. The subject (dog) has to be distributed (√) and the predicate (cats) is not distributed(x). As the second statement is also Universal affirmative, the subject cat is distributed (√) and predicate pigs is not distributed (x). The above answer/ logic is arrived at on the basis of Table II.

The middle term ("cat is the middle term as it occurs in both the premises) is distributed once in the premises. Hence it satisfies Rule [2] as "dogs" is distributed in the premise and "pigs" is undistributed in the deduction also, they should appear accordingly. The type of statement that satisfies both of them is Universal affirmative statement i.e. a statement with "All" Hence the answer will be

"All dogs are pigs"

The answer cannot be "All pigs are dogs", because Rule [7] states that no term can be distributed in the conclusion if it is not distributed in the premises. As "pigs" is not

distributed in the premise. It cannot be distributed in the conclusion (because if we take "All pigs are dogs", then the subject "pigs" will be distributed). Hence the conclusion "All pigs will dog" is wrong.

Example II
All cats are dogs -- (i)
All cats are pigs - - (ii)

Statement (i) is Universal affirmative and hence the subject "cats" is distributed and the predicate "dogs "is not distributed as per Table II.
Statement (ii) is also Universal affirmative and hence the subject "cats" is distributed and thee predicate "pigs" is not distributed as per Table II.
Here, the middle term "cats" ("cats" is the middle term as it is occurring in both the premises) is distributed; hence we can draw a conclusion.
The answer should contain the terms "dogs" and "pigs" and both the terms are not distributed Referring to Table II ,we find that this is possible only in Particular affirmative [the conclusion cannot start with qualifier 'All' as the subject in "All" should be distributed]. According to Rule 7 a term cannot be distributed in the conclusion if it is not distributed in the premises. So the answer will be
"Some dogs are pigs" Or "Some pigs are dogs"

Example III
All dogs are cats - - (i)
All pig are cats - -   (ii)

Statements (i) is a Universal affirmative and hence the subject "dogs" is distributed and the predicate "cats" is not distributed. In statement (ii) which is also a Universal affirmative the subject "Pigs" is distributed and the predicate "cats" is not distributed this is arrived at one the basis of Table II.
The middle term "cats" ["cats" is the middle term as it occurs in both the statements] is not distributed in either of the two

statements From Rule [2] which states that the middle term should be distributed at least once in the premises for drawing a conclusion we cannot draw any conclusion in this case.

Example –IV
All cats are dogs. – (i)
Some cats are pigs – (ii)

The first statement is a Universal affirmative premise and hence the subject "cats" is distributed and the predicate "dogs" is not distributed(x). The second statement is Particular affirmative and hence both the subject "cats" and the predicate "pigs" are not distributed (x) as per Table II. As we have a particular premise, the conclusion should also be a particular one as per Rule [4]. The middle term is distributed hence we can draw a conclusion .So the answer will be
"Some dogs are pigs" Or "Some pigs are dogs"

Example –V
All dogs are cats- - (i)
No cats are pigs - - (ii)

As the first premise is a Universal affirmative, the subject (dogs) is distributed and the predicate (cats) is not distributed. In the second premise which is a Universal negative, the first term (cats) and the second term (pigs) are both distributed (as per Table II) As the middle term is distributed at least once in the premises. Rule [2] is satisfied and hence we can draw a conclusion.
From Rule 3] which states that if one of the premises is negative the conclusion should be negative, the conclusion should be negative and as both the terms "dogs" and "pigs" are distributed, the conclusion should be a Universal negative statement. Hence the answer will be
"No dogs are pigs" Or "No pigs are dogs"

Example –VI
All dogs are cats – (i)
Some cats are not pigs (ii)

Since the first statement is a Universal affirmative "dogs" is distributed and "cats" is not distributed. Since the second statement is a Particular negative, "cats" is not distributed and "pigs" is distributed (as per Table II)
In the above given example no conclusion can be drawn , as rule [2] states that the middle term("cats" in the above example as it occurs in both the premises) should be distributed at least once in the premises. This is not satisfied.

Example –VII
All cats are dogs - - (i)
Some cats are not pigs -- (ii)

The first statement is a universal affirmative and hence "cats" is distributed and "dogs" is not distributed The second statement is a Particular negative and hence "cats" is not distributed and "pigs" is distributed (as per Table II)
Here, the middle term (cats) is distributed and hence we can draw a conclusion.
The conclusion should be particular negative as Rule [3] states that if a premise is negative. Also Rule [4] state that if a premise is Particular, the conclusion should also be Particular. Hence the conclusion should be a particular negative.
In particular negative, we know that the subject is not distributed and the predicate is distributed.
The terms "dogs" and "pigs" should come in the conclusion. Also since "dogs" is not distributed in the premise, it cannot be distributed in the conclusion, as per Rule [7]
As per the above reasoning only "pigs" can be the predicate in the conclusion and hence "dogs" will be the subject
Thus the answer will be "Some dogs are not pigs"

Example –VIII
No dogs are cats - - (i)
No cats are pigs -- (ii)
We cannot draw any conclusion, as Rule [5] states that if both premises are negative, we cannot draw any conclusion.

Example –IX
No dogs are cats
Some cats are not pigs.

As both the premises are negative hence as per Rule [5] we cannot draw any conclusion (Please note that the first premise is a Universal negative and hence the subject (dogs) is distributed and the predicate (cats) is also distributed as per Table II.
The second statement is a Particular negative and hence the subject (cats) is not distributed and the predicate (pigs) is distributed a per Table II)

Example –X
Some cats are not pigs -- (i)
Some cats are dogs - - (ii)

As the first premise is a Particular negative the subject (cats) is not distributed and the predicate (pigs) is distributed. In the second premise both the subject and the predicate (cats and dogs respectively) are not distributed since the premise is a particular affirmative (as per Table II).
No conclusion can be drawn as both the premises are particular as per Rule [6]

Example –XI
Some cats are not dogs – (i)
Some cats are not pigs - - (ii)

We cannot get an answer from the two premises as Rule [5] states that from two negative premises, no conclusion can be drawn. Also Rule [6] states that from two particular premises no conclusion can be drawn.

10 DATA SUFFICIENCY

Question on Data Sufficiency may consist of two statements or three statements. The questions asked on Data Sufficiency are either based on Mathematical or Reasoning. A firm grasp over the basis of all topics being covered under Quantitative Ability and Reasoning is the prerequisite for doing well in Data Sufficiency.

Data Sufficiency, as the name suggests, tests the ability of the student to identify whether the data given are sufficient to answer a question or not.

Hence, in the question given on Data Sufficiency, the student must stop at the stage of determining the sufficiency of the data and he/she is not expected to solve the problem completely. For that reason most of the question given on data sufficiency will be such that the student is not required to do any calculation but can answer the question by observation. However, in some cases, it is difficult to say whether the data are sufficient or not unless complete calculations are done.

In Data Sufficiency questions, typically, there will be a question followed by some data. The data are given in the form of two statements (statement 1 and 2 or A and B) or three statements. (Statements 1, 2 and 3 or statements A,B and C).

The student has to decide the answer choice for the question depending on whether the data given in the statements are sufficient to answer the questions or not. Direction is provided to the students as to how to arrive at the answer choice. While, as mentioned above, though there can be three statements, giving data, it is question with two statements that are very common.

Before we understand the solving part of questions on data sufficiency, let us look at the direction given on the Data Sufficiency.

Each question is followed by two statements giving certain data. You have to decide whether the information provided in the statements is sufficient for answering the question.

Choose A:
If the question can be answered by using one of the statements alone, but cannot not be answered by using the other statement alone.

Choose B:
If the question can be answered by using either statement alone.

Choose C:
If the question can be answered by using both statements together, but cannot be answered by using either statement alone.

Choose D:
If the question cannot be answered even by using both the statements together.

For solving any Data Sufficiency with two statements, one has to follow four steps in sequential order.
The steps involves are as follows.

Step1:
Look at the sufficiency of the statement 1 alone.

Step2:
Look at the sufficiency of statement 2 alone.

Step3:
If anyone or either of the statements sufficient, then stop.
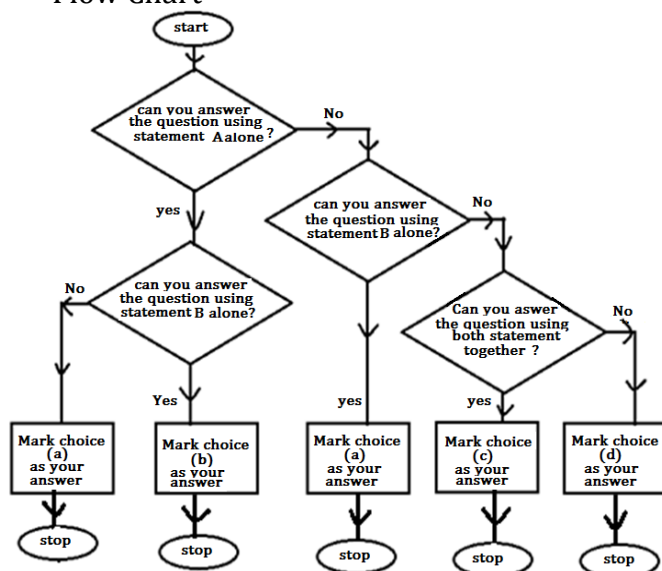
Step4:
If each of the statement is independently insufficient, then combine them.

Step5:
See whether the combination of the statements is sufficient or not.

The following flow chart explains pictorially this set of directions and shows how one can go about deciding the answer choice for any question.

Flow Chart

Examples

Q.1 what is the age of mother?
1. Two years ago, the father's age was six times the son's age.
2. After 18 years, the ratio of the ages of son, mother and father will be 5:9:10.

Solution:
From statement 1, let the present age of the father and the son be f and s respectively. Then we have
(f-2)= 6(s-2)→ (1)
Using statement2, after 18 years father's age is twice son's age.
(f+18)=2(s+18) →(2)
Each statement is independently not sufficient.
Combining both the statements, father's age and son's age can be obtained by simplifying (1) and (2). Using the ratio of their ages, the mother's age also can be obtained.
Choice (A)

Q.2 what is the two digit number xy?
1. The sum of the units digit and the tens digit of xy is 15.
2. Difference between the digits of xy is 1.

Solution:
Given two digit number is xy.
From statement 1, we have x+y=15 from which we cannot find x, y uniquely.
∴Statement 1 is not sufficient to answer.
From statement 2, we have x-y = 1 or y-x = 1.
This alone is not sufficient to answer.
Combining both the statements, we have
x+ y=15 ------(1)
x- y =1 ---- (2)
or y-x=1 -----(3)
From (1) and (2), we have x=8 & y =7.
From (1) and (3), we have x=7 and y=8
Both the statements together also are not sufficient
Choice (D)

Q.3 what is the measure of angle C in triangle ABC?
1. Angle A, B and C is in the ratio 2:1:3.
2. $\angle A+\angle B=130°$

Solution:
Statement 1 alone is sufficient to answer as we know the ratio of the angle.
From statement 2, as $\angle A+\angle B=130°$ and as sum of the angles of any triangle is 180^0, we have
$\Rightarrow \angle C =180-130=50^0$
∴ Statement 2 alone is sufficient to answer the question.
Choice (B)

GATE QUESTIONS

Q.1 Hari (H), Gita (G), Han (I) and Saira (S) are siblings 0(i.e. brothers and sisters). All were born on 1st January. The age difference between any two l successive siblings (that is born one after another) is less than 3 years. Given the following facts:

1. Hari's age + Gita's age > Irfan's age + Saira's age.
2. The age difference between Gita and Saira is 1 year. However, Gita is not the oldest and Saira is not the youngest.
3. There are no twins.

In what order were they born (oldest first)?
a) HSIG   b) SGHI
c) IGSH   d) IHSG
[EC, IN, EE-GATE-2010]

Q.2 Given the sequence of terms, AD CG FK JP, the next term is
a) OV   b) OW
c) PV   d) PW
[CE-GATE-2012]

Q.3 Abhishek is elder to Savan, Savan is younger to Anshul. The correct relations is
a) Abhishek is elder to Anshul
b) Anshul is elder to Abhishek
c) Abhishek and Anshul are of same age
d) No conclusion can be drawn
[CE-GATE-2013]

Q.4 Find the odd one in the following group:
ALRVX, EPVZB, ITZDF, OYEIK
a) ALRVX   b) EPVZB
c) ITZDF   d) OYEIK
[CE-GATE-2014(1)]

Q.5 Anuj, Bhola, Chandan, Dilip, Eswar and Faisal live on different floors in a six-storeyed building (the ground floor is numbered 1, the floor above it 2, and soon). Anuj lives on an even-numbered floor. Bhola does not live on an odd numbered floor. Chandan does not live on any of the floors below Faisal's floor. Dilip does not live on floor number 2. Eswar does not live on a floor immediately above or immediately below Bhola. Faisal lives three floors above Dilip. Which of the following floor-person combinations is correct?

	Anuj	Bhola	Chandan	Dilip	Eswar	Faisal
A	6	2	5	1	3	4
B	2	6	5	1	3	4
C	4	2	6	3	1	5
D	2	4	6	1	3	4

[CE-GATE-2014(1)]

Q.6 In a group of four children, Som is younger to Riaz. Shiv is elder to Ansu. Ansu is youngest in the group. Which of the following statements is/are required to find the eldest child in the group?

Statements :
1. Shiv is younger to Riaz.
2. Shiv is elder to Som.

a) Statement l by itself determines the eldest child.
b) Statement 2 by itself determines the eldest child.
c) Statement 1 &2 are both required to determine the eldest child.
d) Statement 1 & 2 are not sufficient to determine the eldest child.
[CE-GATE-2014(2)]

Q.7 X is 1 km northeast of Y. Y is 1 km southeast of Z. W is 1 km west of Z. P is 1 km south of W. Q is 1 km east of P. What is the distance between X and Q in km?
a) 1   b) $\sqrt{2}$
c) $\sqrt{3}$ d) 2
[CE-GATE-2014(2)]

Q.8 At what time between 6 a.m. and 7 a.m will the minute hand and hour hand of a clock make an angle closest to 60°?
a) 6: 22 a. m.   b) 6:27 a.m.
c) 6: 38 a.m.   d) 6:45 a.m.
[CS-GATE-2014(2)]

Q.9 When a point inside of a tetrahedron (a solid with four triangular surfaces) is connected by straight lines to its corners, how many (new) internal planes are created with these lines?
[GATE-2014]

Q.10 At what time between 6 a.m. and 7 a.m will the minute hand and hour hand of a clock make an angle closest to 60°?
a) 6: 22 a. m.   b) 6:27 a.m.
c) 6: 38 a.m.   d) 6:45 a.m.
[GATE-2014]

Q.11 Which number does not belong in the series below?
2, 5, 10, 17, 26, 37, 50, 64
a) 17   b)37
c) 64   d) 26
[GATE-2014]

Q.12 Read the statements: All women are entrepreneurs. Some women are doctors. Which of the following conclusions can be logically inferred from the above statements?
a) All women are doctors
b) All doctors are entrepreneurs
c) All entrepreneurs are women
d) Some entrepreneurs are doctors
[ME-GATE-2014]

Q.13 What is the next number in the series?
12   35   81   173   357 __
[ME-GATE-2014(1)]

Q.14 Fill in the missing number in the series.
2   3   6   15   _?_ 157.5   630
[ME-GATE-2014(2)]

Q.15 The next term in the series 81, 54, 36, 24, ... is_____
[ME-GATE-2014(3)]

Q.16 In which of the following options will the expression P < M be definitely true?
a) M<R>P>S   b)M>S< P < F
c)Q<M<F=P   d)P=A<R<M
[ME-GATE-2014(3)]

Q.17 Find the odd one from the following group:
WEKO   IQWA   FNTX   NVBD
a) WEKO   b) IQWA
c) FNTX   d) NVBD
[ME-GATE-2014(1)]

Q.18 For submitting tax returns, all resident males with annual income below Rs 10 lakh should fill up Form P and all resident females with income below Rs 8 lakh should fill up Form 0. All people with incomes above As 10 lakh should fill up Form R, except non residents with income above 15 lakhs, who should fill up Form S. All others should   fill Form T. An example of a person who should fill Form T is
a) a resident male with annual income Rs. 9 lakh
b) a resident female with annual income Rs. 9 lakh
c) a non-resident male with annual income Rs. 16 lakh
d) a non-resident female with annual income Rs.16 lakh
[ME-GATE-2014]

Q.19 Find the odd one in the following group QWZB, BHKM, WCGJ, MSVX,
a) QWZB   b) BHKM
c) WCGJ   d) MSVX
[ME-GATE-2014]

Q.20 Lights of four colors (red, blue, green, yellow) are hung on a ladder. On every step of the ladder there are two lights. If one of the lights is red,

the other light on that step will always be blue. If one of the lights on a step is green, the other light on that step will always be yellow. Which of the following statements is not necessarily correct?

a) The number of red lights is equal to the number of blue lights
b) The number of green lights is equal to the number of yellow lights
c) The sum of the red and green lights is equal to the sum of the yellow and blue lights
d) The sum of the red and blue lights is equal to the sum of the green and yellow lights

[ME-GATE-2014(2)]

Q.21 Find the next term in the sequence: 7G, 11K, 13M, _____.
a) 15O   b) 17Q
c) 15P   d) 17P

[ME-GATE-2014(3)]

Q.22 The multi-level hierarchical pie chart shows the population of animals in a reserve forest. The correct conclusions from this information are:
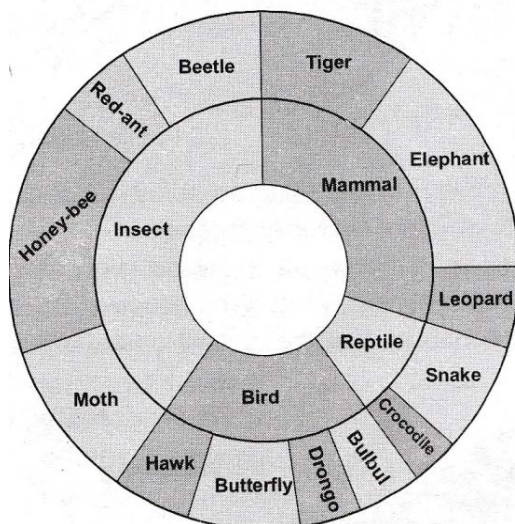
i) Butterflies are birds
ii) There are more tigers in this forest than red ants
iii) All reptiles in this forest are either snakes or crocodiles

iv) Elephants are the largest mammals in this forest
a) (i) and (ii) only
b) (i),(ii), (iii) and (iv)
c) (i). (Hi) & (iv) only
d) (i),(ii) and (iii) only

[ME-GATE-2014(3)]

Q.23 Find the next term in the sequence: 13M, 17O, 19S, ____.
a) 21W   b) 21V
c) 23 W   d) 23 V

[ME-GATE-2014(4)]

Q.24 If `KCLFTSB' stands for 'best of luck' and `SHSWDG' stands for 'good wishes', which of the following indicates 'ace the exam'?
a) MCHTX   b) MXHTC
c) XMHCT   d) XMHTC

[ME-GATE-2014(4)]

Q.25 If ROAD is written as URDG, then SWAN should be written as:
a)VXDQ   b) VZDQ
c) VZDP   d) UXDQ

[CE-GATE-2015(1)]

Q.26 The head of a newly formed government desires to appoint five of the six selected members P, Q, R, S, T and U to portfolios of Home, Power, Defense, Telecom and Finance. U does not want any portfolio if S gets one of the five. R wants either Home or Finance or no portfolio. Q says that if S gets either Power or Telecom, then she must get the other one. T insists on a portfolio if P gets one.
Which is the valid distribution of portfolio?
a) P-Home, Q-Power, R-Defense, S-Telecom, T-Finance
b) R-Home, S-Power, P-Defense, Q-Telecom, T-Finance
c) P-Home, Q-Power, T-Defense, S-Telecom, U-Finance
d) Q-Home, U-Power, T-Defense, R-Telecom, P-Finance

[CE-GATE-2015(1)]

Q.27 Most experts feel that in spite of possessing all the technical skills required to be a batsman of the highest order., he is unlikely to be so due to lack of requisite temperament. He was guilty of throwing away his wicket several times after working hard to lay a strong foundation. His critics pointed out that until he addressed to this problem, success at the highest level will continue to elude him.

Which of the statement (s) below is/are logically valid and can be inferred from the above passage?
i) He was already a successful batsman at the highest level
ii) He has to improve his temperament in order to become a great batsman
iii) He failed to make many of his good starts count
iv) Improving his technical skills will guarantee success

a) (iii) and (iv)   b) (ii) and (iii)
c) (i), (ii) and (iii)   d) (ii) only

[CE-GATE-2015(1)]

Q.28 Alexander turned his attention towards India, since he had conquered Persia. Which one of the statements below is logically valid and can be inferred from the above sentence?
a) Alexander would not have turned his attention towards India had he not conquered Persia.
b) Alexander was not ready to rest on his laurels, and wanted to march to India
c) Alexander was completely in control of his army and could command it to move towards India.
d) Since Alexander's kingdom extended to Indian borders after the conquest of Persia, he was keen to move further.

[CE-GATE-2015(1)]

Q.29 Mr. Vivek walks 6 meters North-East, then turns and walks 6 meters South- East, both at 60 degrees to East. He further moves 2 meters South and 4 meters West. What is the straight distance in meters between the point he started from and the point he finally reached?
a) $2\sqrt{2}$ b) 2
c) $\sqrt{2}$ d) $1/\sqrt{2}$

[CE-GATE-2015(2)]

Q.30 There are 16 teachers who can teach Thermodynamics (TD), 11 who can teach Electrical Sciences (ES), and 5 who can teach both TD & Engineering Mechanics (EM). There are a total of 40 teachers, 6 cannot teach any of the three subjects, i.e. EM, ES or TD. 6 can teach only ES. 4 can teach all three subjects, i.e. EM, ES and TD. 4 can teach ES and TD. How many can teach both ES and EM but not TD?
a) 1   b) 2
c) 3   d) 4

[CE-GATE-2015(2)]

Q.31 The given question is followed by two statements: select the most appropriate option that solves the question:

Capacity of a solution tank A is 70% of the capacity of tank B. How many gallons of solution are in tank A and tank B?
Statements:
I. Tank A is 80% full and tank B is 40% full
II. Tank A if full contains 14,000 gallons of solution
a) Statement I alone is sufficient
b) Statement II alone is sufficient
c) Either statement I or II alone is sufficient
d) Both the statements I and II together are sufficient

[CE-GATE-2015(2)]

Q.32 Based on the given statements, select the most appropriate option to solve the given question. If two floors in a certain building are 9 feet apart, how many steps are there in a set of stairs that extends from the first floor to the second floor of the building?
Statements:
(I) Each step is ¾ foot high.
(II) Each step is 1 foot wide.
a) Statement I alone is sufficient, but statement II alone is not sufficient.
b) Statement II alone is sufficient, but statement I alone is not sufficient.
c) Both statements together are sufficient, but neither statement alone is sufficient.
d) Statement I and II together are not sufficient.
[CS-GATE-2015(1)]

Q.33 Based on the given statements, select the most appropriate option to solve the given question
What will be the total weight of 10 poles each of same weight?
Statements
(I) One fourth of the weight of a pole is 15kg.
(II) The total weight of these poles is 160 kg more than the total weight of two poles
a) Statement I alone is not sufficient
b) Statement II alone is not sufficient
c) Either I or II alone is sufficient
d) Both statements I and II together are not sufficient.
[CS-GATE-2015(2)]

Q.34 Tanya is older than Eric.
Cliff is older than Tanya
Eric is older than Cliff.
If the first two statements are true, then the third statement is:
a) True

b) False
c) Uncertain
d) Data insufficient
[ME-GATE-2015(3)]

Q.35 Given below are two statements followed by two conclusions. Assuming these statements to be true, decide which one logically follows.
Statement:
i. All film stars are playback singers.
ii. All film directors are film stars.
Conclusions:
i. All film directors are playback singers.
ii. Some film stars are film directors.
a) Only conclusion I follows
b) Only conclusion II follows
c) Neither conclusion I nor II follows
d) Both conclusions I and II follow
[ME-GATE-2015(1)]

Q.36 Given below are two statements Followed by two conclusions. Assuming these statements to be true, decide which one logically follows:
Statements:
I. No manager is a leader.
II. All leaders are executive.
Conclusions:
I. No manager is a executive.
II. All executive is a manager.
a) Only conclusion I follows.
b) Only conclusion II follows.
c) Neither conclusion I nor II follows.
d) Both conclusion I and II follow.
[ME-GATE-2015(3)]

Q.37 If `relftaga' means carefree, `otaga' means careful and `fertaga' means careless, which of the following could mean 'aftercare'?
a)zentaga   b) tagafer
c) tagazen   d) relffer
[CE-GATE-2016(1)]

Q.38 Indian currency notes show the denomination indicated in at least seventeen languages. If this is not an indication of the nation's diversity, nothing else is. Which of the following can be logically inferred from the above sentences?
a) India is a country of exactly seventeen languages.
b) Linguistic pluralism is the only indicator of a nation's diversity.
c) Indian currency notes have sufficient space for all the, Indian languages.
d) Linguistic pluralism is strong evidence of India's diversity
[CE-GATE-2016(1)]

Q.39 Consider the following statements relating to the level of poker play of four players **P, Q, R** and **S**.
I. **P** always beats **Q**
II. **R** always beats **S**
III. **S** loses to **P** only sometimes
IV. **R** always loses to **Q**
Which of the following can be logically inferred from the above statements?
(i) P is likely to beat all the three other players
(ii) S is the absolute worst player in the set
a) (i) only
b) (ii) only
c) (i) and (ii)
d) neither (i) nor (ii)
[CE-GATE-2016(1)]

Q.40 Today, we consider Ashoka as a great ruler because of the copious evidence he left behind in the form of stone carved edicts. Historians tend to correlate greatness of a king at his time with the availability of evidence today.
Which of the following can be logically inferred from the above sentences?

a) Emperors who do not leave significant sculpted evidence are completely forgotten.
b) Ashoka produced stone carved edicts to ensure that later historians will respect him.
c) Statues of kings are a reminder of their greatness.
d) A king's greatness, as we know him today, is interpreted by historians
[CE-GATE-2016(2)]

Q.41 Fact 1: Humans are mammals.
Fact 2: Some humans are engineers.
Fact 3: Engineers build houses.
If the above statements are facts, which of the following can be logically inferred?
I. All mammals build houses.
II. Engineers are mammals.
III. Some humans are not engineers.
a)II only.
b) III only.
c) I, II and III.
d) I only.
[CE-GATE-2016(2)]

Q.42 If 'relftaga' means carefree, 'otaga' means careful and 'fertaga' means careless, which of the following could mean 'aftercare'?
a) zentaga
b) tagafer
c) tagazen
d) relffer
[CS-GATE-2016(1)]

Q.43 Pick the odd one from the following options.
a) CADBE
b) JHKIL
c) XVYWZ
d) ONPMQ
[CS-GATE-2016(2)]

Q.44 All hill-stations have a lake. Ooty has two lakes.
Which of the statement(s) below is/are logically valid and can be inferred from the above sentences?
(i) Ooty is not a hill-station
(ii) No hill-station can have more than one lake.
a) (i) Only
b) (ii) Only
c) both (i) and (ii)d) neither (i) nor (ii)
[CS-GATE-2016(2)]

Q.45 Among 150 facility members in an institute 55 are connected with each other through Facebook® and 85 are connected through WhatsApp® 30 faculty members do not have Facebook® or WhatsApp® accounts. The number of facility members connected only through Facebook® account is ____.

[GATE-2016]

Q.46 Pick the odd one out in the following:
13,23,33,43,53
a)23   b)33
c) 43   d) 53

[GATE-2016]

Q.47 Michael lives 10 km away from where I live. Ahmed lives 5 km away and Susan lives 7 km away from where I live. Arun is farther away than Ahmed but closer than Susan from where I live. From the information provided here, what is one possible distance (in km) at which I live from Arun's place?
a) 3.00   b) 4.99
c) 6.02   d) 7.01

[ME-GATE-2016(1)]

Q.48 Leela is older than her cousin Pavithra. Pavithra's brother Shiva is older than Leela. When Pavithra and Shiva are visiting Leela, all three like to play chess. Pavithra wins more often than Leela does.
Which one of the following statements must be TRUE based on the above?
a) When Shiva plays chess with Leela & Pavithra, he often loses.
b) Leela is the oldest of the three
c) Shiva is a better chess player than Pavithra
d) Pavithra is the youngest of the three

[ME-GATE-2016(1)]

Q.49 Find the missing sequence in the letter series. B, FH, LNP, _

a) SUWY   b) TUVW
c) TVXZ   d) TWXZ

[ME-GATE-2016(2)]

Q.50 Two and a quarter hours back, when seen in a mirror, the reflection of a wall clock without number markings seemed to show 1:30. What is the actual current time shown by the clock?
a) 8 : 15   b) 11 : 15
c) 12: 15   d) 12 : 45

[ME-GATE-2016(3)]

Q.51 M and N start from the same location. M travels 10 km East and then 10 km North-East. N travels 5 km South and then 4 km South-East. What is the shortest distance (in km) between M and N at the end of their level.
a) 18.60   b) 22.50
c) 20.61   d) 25.00

[ME-GATE-2016(3)]

Q.52 Rahul, Murali, Srinivas and Arul are seated around a square table. Rahul is sitting to the left of Murali. Srinivas is sitting to the right of Arul. Which of the following pairs are seated opposite each other?
a) Rahul and Murali
b) Srinivas and Arul
c) Srinivas and Murali
d) Srinivas and Rahul

[CS-EE-GATE-2017(1)]

Q.53 Arun, Gulab, Neel and Shweta must choose one shirt each from a pile of four shirts coloured red, pink, blue and white respectively. Arun dislikes the colour red and Shweta dislikes the colour white. Gulab and Neel like all the colours. In how many different ways can they choose the shirts so that no one has a shirt with a colour he or she dislikes?
a) 21   b) 18
c) 16   d) 14

[CS-EE-GATE-2017(1)]

Q.54 Six people are seated around a circular table. There are at least two men and two women. There are at least three right-handed persons. Every woman has a left-handed person to her immediate right. None of the women are right-handed. The number of women at the table is
a) 2
b) 3
c) 4
d) Cannot be determined

[CS-EE-GATE-2017(1)]

Q.55 There are five buildings called V, W. X, Y and Z in a row (not necessarily in that order). V is to the West of W. Z is to the East of X and the West of V. W is to the West of Y. Which is the building in the middle?
a) V
b) W
c) X
d) Y

[CS-EE-GATE-2017(2)]

Q.56 Consider the following sentences: All benches are beds. No bed is a bulb. Some bulbs are lamps. Which of the following can be inferred?
(i) Some beds are lamps.
(ii) Some lamps are beds.
a) Only (i)
b) Only (ii)
c) Both (i) and (ii)
d) Neither (i) nor (ii)

[CE-GATE-2017(1)]

Q.57 Students applying for hostel rooms are allotted rooms in order of seniority. Students already staying in a room will move if they get a room in their preferred list. Preferences of lower ranked applicants are ignored during allocation. Given the data below, which room will Ajit stay in?

Names	Student Seniority	Current room	Room preference list
Amar	1	P	R, S, Q
Akbar	2	None	R, S
Anthony	3	Q	P
Ajit	4	S	Q, P, R

a) P
b) Q
c) R
d) S

[CE-GATE-2017(1)]

Q.58 The points in the graph below represent the halts of a lift for durations of 1 minute, over a period of 1 hour.
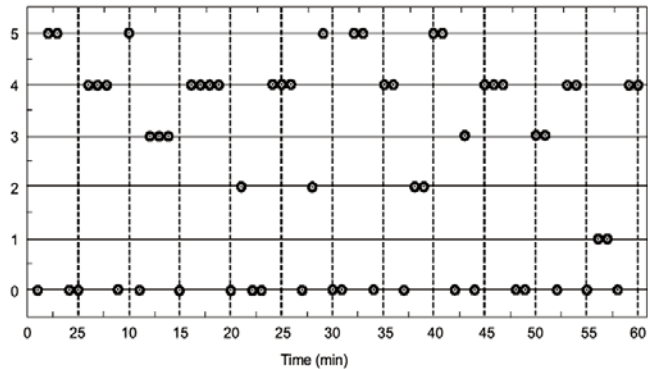
Which of the following statements are correct?
i) The elevator never moves directly from any non-ground floor to another non-ground floor over the one hour period.
ii) The elevator stays on the fourth floor for the longest duration over the one hour period.
a) Only (i)
b) Only (ii)
c) Both (i) and (ii)
d) Neither (i) nor (ii)

[CE-IN-GATE-2017(2)]

Q.59 P, Q, R, S, T and U are seated around a circular table. R is seated two places to the right of Q, P is seated three places to the left R. S is seated opposite U. If P and U now switch seats, which of the following must necessarily be true?
a) P is immediately to the right of R
b) T is immediately to the left of P
c) T is immediately to the left of P or P is immediately to the right of Q
d) U is immediately to the right of R or P is immediately to the left of T

[CE-IN-GATE-2017(2)]

Q.60 Some tables are shelves. Some shelves are chairs. All chairs are benches. Which of the following conclusions can be deduced from the preceding sentences?
(i) At least one bench is a table
(ii) At least one shelf is a bench
(iii) At least one chair is a table
(iv) All benches are chairs
a) only (i)   b) only (ii)
c) only (ii) and (iii)   d) only (iv)
[EC-GATE-2017(1)]

Q.61 S, T, U, V, W, X, Yand Z are seated around a circular table. T's neighbours are Yand V. Z is seated third to the left of T and second to the right of S. U's neighbours are S and Y; and T and Ware not seated opposite each other. Who is third to the left of V?
a) X   b) W
c) U   d) T
[EC-GATE-2017(1)]

Q.62 A rule states that in order to drink beer, one must be over 18 years old. In a bar there are 4 people. P is 16 years old, Q is 25 years old, R is drinking milkshake and S is drinking a beer. What must be checked to ensure that the rule is being followed?
a) Only P's drink
b) Only P's drink and S's age
c) Only S's age
d) Only P's drink. Q's drink and S's age
[EC-GATE-2017(2)]

Q.63 Fatima starts from point P, goes North for 3 km and then East for 4 km to reach point Q. She then turns to face point P and goes 15 km in that direction. She then goes North for 6 km. How far is she from point P and in which direction should she go to reach point P?
a) 8 km, East   b)12 km, North

c) 6 km, East   d)10 km, North
[EC-GATE-2017(2)]

Q.64 500 students are taking one or more courses out of Chemistry, Physics and Mathematics. Registration records indicate course enrolment as follows:
Chemistry (329), Physics (186), Mathematics (295), Chemistry and Physics (83), Chemistry and Mathematics (217) and Physics and Mathematics (63). How many students are taking all 3 subjects?
a) 37   b) 43
c) 47   d) 53
[EC-GATE-2017(2)]

Q.65 Each of P, Q, R, S, W, X, Y and Z has been married at most once. X and Y are married and have two children P and Q. Z is the grandfather of the daughter S of P. Further, Z and Ware married and are parents of R. Which one of the following must necessarily be FALSE?
a) X is the mother-in-law of R
b) P and Rare not married to each other
c) P is a son of X and Y
d) Q cannot be married to R
[EC-GATE-2017(2)]

Q.66 P looks at Q while Q looks at R, P is married, R is not. The number of pairs of people in which a married person is looking at an unmarried person is
a) 0
b) 1
c) 2
d) cannot be determined
[ME-GATE-2017(2)]

Q.67 All people in a certain island are either 'Knights' or 'Knaves' and each person knows every other person's identity. Knights NEVER lie, and knaves ALWAYS lie. P says 'Both

of us are knight'. Q says 'None of us are knaves' Which one of the following can be logically inferred from the above?
a) Both P and Q are knights
b) P is a knight; Q is a knave
c) Both P and Q are knaves
d) The identities of P, Q cannot be determined
[ME-GATE-2017(2)]

Q.68 There are 4 women P, Q, R, S and 5 men V, W, X, Y, Z in a group. We are required to form pairs each consisting of one woman and one man. P is not to be paired with Z, and Y must necessarily be paired with someone. In how many ways can 4 such pairs be formed?
a) 74   b) 76
c) 78   d) 80
[ME-GATE-2017(2)]

Q.69 In a certain code. AMCF is written as EQGJ and NKUF is written as ROYJ. How will DHLP be written in that code?
a) RSTN   b) TLPH
c) HLPT   d) XSVR
[EE-GATE-2018]

Q.70 P, Q, R and S crossed a lake in a boat that can hold a maximum of two persons, with only one set of oars. The following additional facts are available.
(i) The boat held two persons on each of the three forward trips across the lake and one person on each of the two trips.
(ii) P is unable to row when someone else is in the boat.
(iii) Q is unable to row with anyone else except R.
(iv) Each person rowed for at least one trip.
(v) Only one person can row during a trip.
Who rowed twice?

a) P   b) Q   c) R   d) S
[EE-GATE-2018]

Q.71 What is the missing number in the following sequence?
2, 12, 60, 240, 720, 1440,... 0
a) 2880   b) 1440
c) 720   d) 0
[CS-GATE-2018]

Q.72 Each of the letters arranged as below represents a unique integer from 1 to 9. The letters are positioned in the figure such that $(A×B×C)$, $(B×G×E)$ and $(D×E×F)$ are equal. Which integer among the following choices cannot be represented by the letters A, B, C, D, E, F or G?

A		D
B	G	E
C		F

a)4   b)5   c)6   d)9
[CE-GATE-2018(1)]

Q.73 A faulty wall clock is known to gain 15 minutes every 24 hours. It is synchronized to the correct time at 9AM on 11th July. What will be the correct time to the nearest minute when the clock shows 2PM on 15th July of the same year?
a) 12:45PM   b) 12:58PM
c) 1:00PM   d) 2:00PM
[CE-GATE-2018(2)]

Q.74 Find the missing group of letters in the following series:
BC, FGH, LMNO, _____
a) UVWXY   b) TUVWX
c) STUVW   d) RSTUV
[ME-GATE-2018(1)]

Q.75 Forty students watched films A, B and C over a week. Each student

watched either only one film or all three. Thirteen students watched film A, sixteen students watched film B and nineteen students watched film C. How many students watched all three films?

a) 0   b) 2   c) 4   d) 8

[ME-GATE-2018(1)]

Q.76 Consider the following three statements:

(i) Some roses are red

(ii) All red flowers fade quickly.

(iii) Some roses fade quickly

Which of the following statements can be logically inferred from the above statements?

a) If (i) is true and (ii) is false, then (iii) is false.

b) If (i) is true and (ii) is false, then (iii) is true.

c) If (i) and (ii) are true, then (iii) is true.

d) If (i) and (ii) are false, then (iii) is false.

[ME-GATE-2018(2)]

Q.77 In a detailed study of annual crow births in India, it was found that there was relatively no growth during the period 2002 to 2004 and a sudden spike from 2004 to 2005. In another unrelated study, it was found that the revenue from cracker sales in India which remained fairly flat from 2002 to 2004, saw a sudden spike in 2005 before declining again in 2006. The solid line in the graph below refers to annual sale of crackers and the dashed line refers to the annual crow births in India. Choose the most appropriate inference from the above data
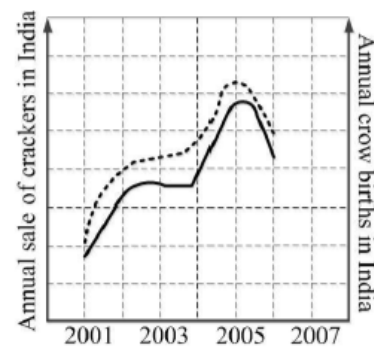
a) There is a strong correlation between crow birth and cracker sales.

b) Cracker usage increases crow birth rate.

c) If cracker sale declines, crow birth will decline.

d) Increased birth rate of crows will cause an increase in the sale of crackers

[IN-GATE-2018]

Q.78 To pass a test, a candidate needs to answer at least 2 out of 3 questions correctly. A total of 6,30,000 candidates appeared for the test. Question A was correctly answered by 3,30,000 candidates. Question B was answered correctly by 2,50,000 candidates, Question C was answered correctly by 2,60,000 candidates. Both questions A and B were answered correctly by 1,00,000 candidates. Both questions B and C were answered correctly by 90,000 candidates. Both questions A and C were answered correctly by 80,000 candidates. If the number of students answering all questions correctly is the same as the number answering none, how many candidates failed to clear the test?

a) 30,000   b) 2,70,000

c) 3,90,000   d) 4,20,000

[IN-GATE-2018]

Q.79 If the number 715■423 is divisible by 3 (■ denotes the missing digit in the thousandths place), then the smallest whole number in the place of ■ is_____.

a) 0 b) 2
c) 5 d) 6
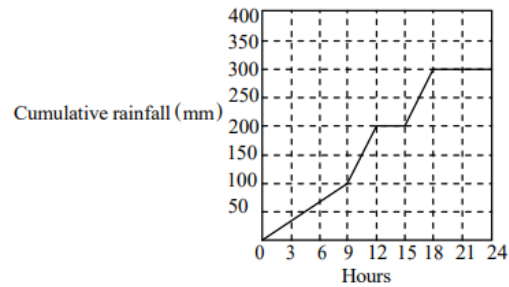
[EC-GATE-2018(2)]

Q.80 The annual average rainfall in a tropical city is 1000mm. On a particular rainy day (24-hour period), the cumulative rainfall experienced by the city is shown in the graph. Over the 24- hour period, 50% of the rainfall falling on a rooftop, which had an obstruction free area of 50m² , was harvested into a tank. What is the total volume of water collected in the tank in liters?

a) 25,000 b) 18,750
c) 7,500 d) 3,125

[CE-GATE-2018(2)]

Q.81 Each of the letters in the figure below represents a unique integer from 1 to 9. The letters are positioned in the figure such that each of (A+B+C), (C+D+E), (E+F+G) and (G+H+K) is equal to 13. Which integer does E represent?
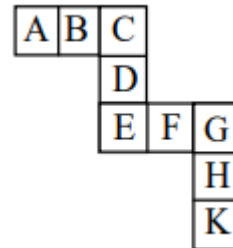
a) 1   b) 4   c) 6   d) 7

[CE-GATE-2018(2)]

ANSWER KEY:

1	2	3	4	5	6	7	8	9	10	11	12	13	14
b)	a)	d)	d)	b)	a)	c)	a)	6	a)	c)	*	*	*
15	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**
*	d)	d)	b)	c)	d)	b)	d)	c)	b)	b)	b)	b)	a)
29	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**
a)	a)	d)	d)	c)	b)	d)	c)	c)	d)	a)	d)	b)	c)
43	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**
d)	d)	a)	b)	c)	d)	c)	d)	c)	d)	d)	a)	a)	d)
57	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
b)	d)	c)	b)	a)	b)	a)	d)	b)	b)	d)	c)	c)	b)
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**			
b)	b)	b)	b)	c)	c)	a)	d)	b)	c)	b)			

EXPLANATIONS

Q.1 **(b)**
Suppose:

Hari's age : H, Gita's age G,
Saira's age : S, Irfan's age : I

- H+G>I+S
- Using Statement (2) both G - S = 1 or S- G = 1; G can't be oldest and S can't be youngest.
- There are no twins thus using statement (2) either GS or SG possible.

(A) HSIG: not possible as there is I between S and G which is not possible using statement (3)

(B) SGHI: SG order is possible, S> G> H>I and G+ H> S + I (possible) because if {S= G + 1; and G = H+1 and H = I +2 then G + (I + 2) > (G + 1) +I}

(C) IGSH: according to this I > G and S > H thus adding these both inequalities we get I+ S> G + H which is opposite of statement (2) thus not possible.

(D) IHSG: according to this I > H and S > G thus adding both inequalities I + S > H + G which is opposite of statement (2) thus not possible.

Q.2 **(a)**
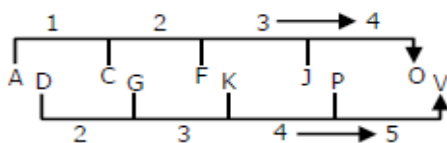
Q.3 **(d)**

Q.4 **(d)**
ALRVX—only one vowel
EPVZB—only one vowel
ITZDF—only one vowel
OYEIK—three vowels

Q.5 **(b)**
a) Anuj: Even numbered floor (2,4,6)
b) Bhola: Even numbered floor (2,4,6)

c) Chandan lives on the floor above that of Faisal.
d) Dilip: not on 2nd floor.
e) Eswar: does not live immediately above or immediately below Bhola

From the options its clear, that only option b) satisfies condition (e).
So, correct Ans is b).

Q.6 **(a)**
Riaz >Som ....(i)
Shiv>Ansu ....(ii)
Ansu is youngest in the group
∴ From equation (i) and (ii)
∴ Riaz >Som >Shiv>Ansu
∴ Statement I itself determines the eldest child which
Statement 2 is incorrect as Ansu is youngest in the group is not satisfied by statement 2
Hence option (a)is correct

Q.7 **(c)**
From the fig: $zx = \sqrt{2}$.
[Pythagoras theorem] zQ = 1 Given
$\Rightarrow$ Considering ZQX, which is right angle, is
$\Rightarrow Qx^2 = ZQ^2 + Zx^2$
$= \sqrt{1+2}$
$= \sqrt{3}$
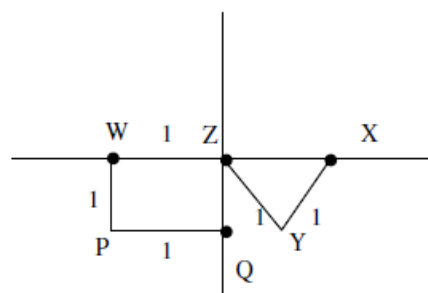
Q.8 **(a)**
Angle by minute's hand
60 min→ 360°
$1\text{min} \rightarrow \dfrac{360}{60} = 6°$
8min → 48°

Angle→48° with number '6'
Angle by hours hand
60 min= 30°

$22\,\text{min} \rightarrow \dfrac{30}{60} \times 22 = 11$

Total Angle=48+11=59°.

Q.9 **(6)**

Q.10 **(a)**

Any angle and corresponding time can be driven by

$$\left[5x - \left(\dfrac{D^0}{6}\right)\right] \times \dfrac{12}{11}$$

Between 6 and 7 pm angle have to be 60° Put x = 6 and D = 60°

$$\left[5 \times 6 - \left(\dfrac{60°}{6}\right)\right] \times \dfrac{12}{11} = 20 \times \dfrac{12}{11} = 21 \times \dfrac{9}{11}$$

So at $4:21\dfrac{9}{11}$ angle between minutes and hour hand will be 60°

In given question angle have to close to 60° nearest option is 6:22

Q.11 **(c)**

2, 5, 10, 17, 26, 37, 50, 64

$2 + 1^2 + 1, \quad 5 = 2^2 + 1, \quad 10 = 3^2 + 1,$

$17 = 4^2 + 1, \quad 26 = 5^2 + 1, \quad 37 = 6^2 + 1$

$50 = 7^2 + 1 \quad 64 = 8^2$

So 64 is the incorrect term.

Q.12 **(*)**

Q.13 **(*)**

Q.14 **(*)**

2, 3,, 6, 15, ____, 157.5, 630

$2 \times 1.5 = 3$

$3 \times 2 = 6$

$6 \times 2.5 = 15$

$15 \times 3 = 45$

$45 \times 3.5 = 157.5$

$157.5 \times 4 = 630$

Hence the answer is 45.

45 is missing term of the series.

Q.15 **(*)**

81, 54, 36, 24, ____

Alternate terms are perfect squares $9^2, 6^2, 4^2$ and in between terms are products $9 \times 6, 6 \times 4m$ ____ and so on missing terms is

$4^2 = 16$

Q.16 **(d)**

$P = A < R < M$

P is surely less than M only in option (d) else in any other option it cannot be conveyed surely.

Q.17 **(d)**

Difference between 1st and 4th, 22nd and 3rd letters in each series respectively is same excepted NVBD.

Q.18 **(b)**

A resident female with annual income Rs.9Lakh should satisfy eligibility for filling form T. So answer is option B is answer. Option A,C,D corresponds to filling form P,S,D respectively.

Q.19 **(c)**

Adding 6, 3 and 2 to the consecutive letters give the only (c) does not follow.

Q.20 **(d)**

Sum of the read and green lights as equal to sum of yellow and blue lights are red and blue will be numbered same and green and yellow will be numbered same.

So, R + H = Y + B

Q.21 **(b)**

7G, 11 K, 13 M, ____

Next term will be Q which is 17 letter on English alphabet.

Among option only (b) (i.ee. 17Q) is correct.

Q.22 **(d)**

On seeing the given figure in question i, ii and iii can be concluded.

Q.23 (c)
13 M, 17 Q, 19 S
Among options only W is correct as w is 23rd letter in English language.

Q.24 (b)

```
BEST   OF      LUCK
B_ST   -F      L-CK
GOOD           WISHES
G-D            W-SH-S
ACE    THE     EXAM
-C-    TH -    X-M
```

So answer is MXHTC (vowel is missing).

Q.25 (b)
R+3=U, O+3=R, A+3=D, D+3=G;
S+3=V, W+3=Z, A+3=D, N+3=Q

Q.26 (b)
Since U does not want any portfolio, c) and d) are ruled out. R wants Home, or Finance or No portfolio, a) is not valid. Hence option b) is correct

Q.27 (b)

Q.28 (a)

Q.29 (a)

Q.30 (a)
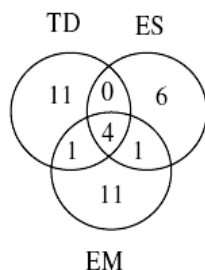
Q.31 (d)
Statement I can be used to solve the question if capacity of both tanks is already known Statement-II can be used if it is known what quantity of each tank is full/empty. Therefore, by using both statements
Let capacity of tank B is x

$$\frac{70}{100} \times 1400$$

$\Rightarrow$ x = 20000 gallons

Solution in tank A = $\frac{80}{100} \times 14000$

=11200 gallons

Solution in tank B = $\frac{40}{100} \times 20000$

= 8000 gallons

$\therefore$ Total solution =11200 + 8000
=19200 gallons

Q.32 (d)

Q.33 (c)
Let weight of each pole be x

I. Given, $\frac{x}{4} = 15kg$

$\Rightarrow$ x = 60 kg
All poles are of same weight
$\therefore$Weight of 10 poles = 10x = 10 × 60
= 600 kg
II. Given, 10x = 2x + 160
$\Rightarrow$ 8x =160 kg $\Rightarrow$x = 20 kg
$\therefore$Weight of 10 poles = 10x = 10×20 = 200 kg

Q.34 (b)
$T > E, C > T \Rightarrow C > T > E$
So, Eric is actually younger than Cliff so third statement is false.

Q.35 (d)
Clearly both the conclusion follows.

Q.36 (c)
Neither conclusion follows.

Q.37 (c)

Q.38 (d)

Q.39 (a)

Q.40 (d)

Q.41 (b)

Q.42 (c)

Q.43 (d)

Q.44 (d)

Q.45 (a)

$$f(x,y) = (2x)^n \times \left(\frac{y}{n}\right)^m = 2^{n-m} \times P$$

Q.46 (b)

BEST   OF   LUCK
B-ST   -F   L-CK
GOOD   WISHES
G—D   W-SH-S
ACE   THE   EXAM
-C-   TH   -X-M
So answer is MXHTC (vowel is missing).

Q.47 (c)
Following line with respective distance can be drawn
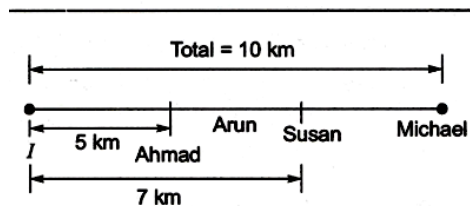
Arun can reside anywhere between Ahmed and Susan i.e. between 5km and 7 km from I. Hence ans (c) 6.02
$5 < 6.02 < 7$

Q.48 (d)
L > P (Leela is older thean Pavithra)
S > L (Shiv is older than Leela)
So Pavithra is youngest

Q.49 (c)
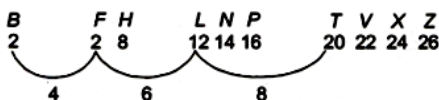
So the required alphabets have to start with 20 is T and thereafter common difference in term will be 2 each hence answer is TVXZ

Q.50 (d)
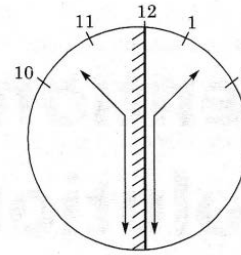
Mirror image of 1:30 is 10:30
10:30 was the time two and quarter hour back so time now will be 12:45

Q.51 (c)
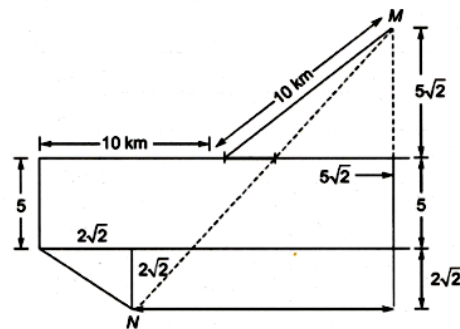
See the adjoining figure for solution
$$MM' = 5\sqrt{2} + 5 + 2\sqrt{2} = 5 + 7\sqrt{2}$$
$$NM' = 10 + 5\sqrt{2} - 2\sqrt{2} = 10 + 3\sqrt{2}$$
$$MN = \sqrt{(MM')^2 + (NM')^2}$$
$$= \sqrt{(5 + 7\sqrt{2}) + (10 + 3\sqrt{2})^2} \approx 20.61$$

Q.52 (d)
Following seating arrangement can be drawn
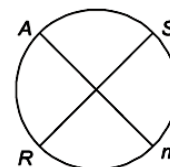
Therefore correct option is (d).

Q.53 (d)
As there are 4 people A,G,N,S and four colours so without any restriction total ways have to be $4 \times 4 = 16$.
Now, Arun→dislikes Red and Shweta dislikes white so 16-2 = 14 ways.

Therefore correct answer should be option (d).
Alternate solution:
Only one option is less than 16.
Therefore correct answer should be option (d).

Q.54 (a)
Out of six people. 3 place definitely occupied by right handed people as at last 2 women are there so these two will sit adjacently. Now as only on seat is left it will be occupied by a left handed man because on right side of this seat is sitting an right handed man.
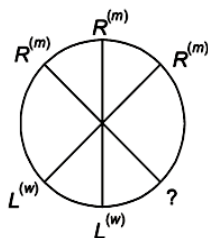
? have to be a left handed man.

Here, $R^{(m)}$ indicates right handed man and $L^{(w)}$ indicates left handed women.
Therefore answer should be only 2 women.

Q.55 (a)

Q.56 (d)
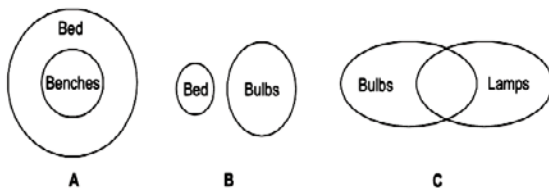
Since there in no direct relation given between lamps and beds. So, neither will be correct.

Q.57 (b)
$$
\left.\begin{array}{l}
\text{Amar} \to \text{R} \\
\text{Akbar} \to \text{S} \\
\text{Antony} \to \text{P} \\
\text{Ajit} \to \text{Q}
\end{array}\right] \text{As per their preference given.}
$$

Q.58 (d)
(i) is incorrect as it has move directly.
(ii) is incorrect as it stayed for Maximum duration on ground floor.

Q.59 (c)
Following two possibilities can be drawn
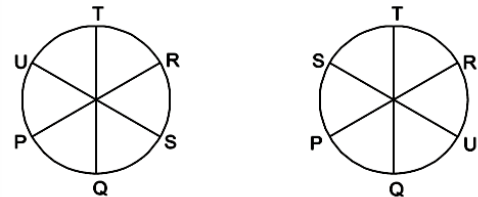
Given in question P & U interchange then new diagram can be drawn.
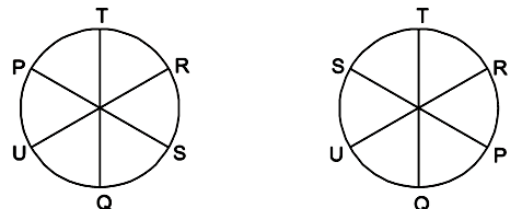
Now verify (c) only follows.

Q.60 (b)
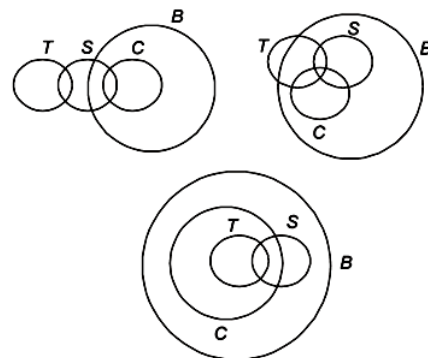
Only conclusion (ii) follows.

Q.61 (a)
Following circular seating arrangement can be drawn
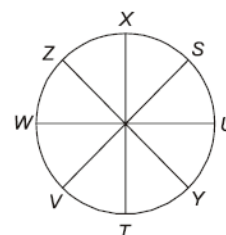
Only one such arrangement can be drawn.
The person on third to the left of V is X.

Q.62 (b)

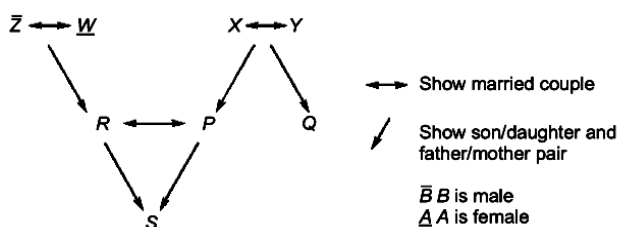For rules to be followed, we need to check P's drink and S's age.

Q.63 (a)
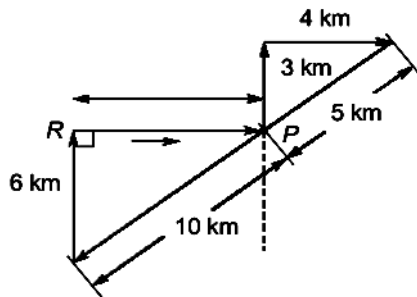
Q.64 (d)

$$n(C) = 329$$
$$n(P) = 186$$
$$n(M) = 295$$
$$n(C \cap P) = 83$$
$$n(C \cap M) = 217$$
$$n(P \cap M) = 63$$
$$n(P \cup C \cup M) = n(C) + n(P) + n(M) - n(C \cap P)$$
$$-n(C \cap M) - n(P \cap M) + n(P \cap C \cap M)$$
$$500 = 329 + 186 + 295 - 83 - 217 - 63$$
$$+n(P \cap C \cap M)$$
$$\Rightarrow n(P \cap C \cap M) = 500 - 447 = 53$$

Q.65 (b)

→← Show married couple

/ Show son/daughter and father/mother pair

$\bar{B}$ B is male
$\underline{A}$ A is female

From here,
P and R are married couple. So option (b) is necessarily false.

Q.66 (b)

P → Married
R → Unmarried
Q → Status Not given
P → Looks @Q
Q → Looks @ R
Now two possibility arise,
1. Let Q be married
pmarried → Qmarried
Qmarried → Runmarried
only one pair in which married person is looking @ unmarried.
2. Let Q be unmarried
Pmarried → Qunmarried
Qunmarried → Runmarried
Then also only one pair exists.
So, only one pair exists in which married person is looking @ unmarried.
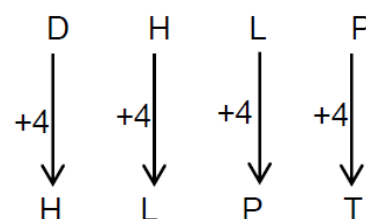
Q.67 (d)

Q.68 (c)

Q.69 (c)

The code for the given words is as follows:
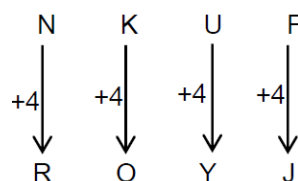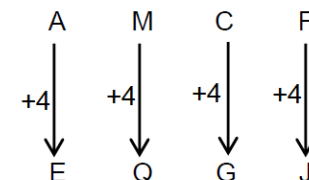
So the code for the given word will be:

Q.70 (c)

On the first trip Q and R will travel, with Q rowing the boat. R will return alone and take P along with him. R will row the boat this time as P cannot row when come one is with him. P alone will come back and take S along with him. S will row the boat this time. Only R rowed the boat twice. Choice (C)

Q.71 (b)

$$2 \xrightarrow[2\times6]{} 12 \xrightarrow[12\times5]{} 60 \xrightarrow[60\times4]{} 240$$

$$\xrightarrow[240\times3]{} 720 \xrightarrow[720\times2]{} 1440 \xrightarrow[1440\times1]{} 1440$$

$$\xrightarrow[1440\times0]{} 0$$

Q.72 (b)

Consider,
A = 1; B = 9; C = 8
                    G = 2
D = 6; E = 4; F = 3.
Then $A \times B \times C = 1 \times 9 \times 8 = 72$
$B \times G \times E = 9 \times 2 \times 4 = 72$
$D \times E \times F = 6 \times 4 \times 3 = 72$
∴ E = 4; D = 6; B = 9

The integer 5 cannot be represented by the letters A, B, C,D, E,F,G.

Q.73 (b)

Clock is gaining 15 min. in every 24 hours.

$\Rightarrow$ Gaining per hour = $\dfrac{15}{24}$ minutes

No. of hours from 11th July 9 am to 15th July 2 pm =101

Total time gain=101x $\dfrac{15}{24}$ =63 min.(approx.)

∴ correct time=2 pm -63 min =12.58 pm

Q.74 (b)

$$BC \xrightarrow{3} FGH \xrightarrow{4} LMNO \xrightarrow{5} TUVWX$$

Q.75 (c)

Given, Total no. of students who watched films A, B and C over a week = n(s)= 40.

Also given that, each student watched either only one film or all three. i.e.

$n(A \cap B \cap \overline{C}) = n(B \cap C \cap \overline{A})$

$= n(C \cap A \cap \overline{B}) = 0$

Where[$\overline{A}, \overline{B}, \overline{C}$ are complimentary events of A,B,C respectively]
Given n(A)=13,n(B)=16,n(C)=19
Assume that no. of students who watch all three films =n(A $\cap B \cap C$)

Given,n(A $\cap \overline{B} \cap \overline{C}$) = 13 − x
n(B $\cap \overline{C} \cap \overline{A}$) = 16 − x
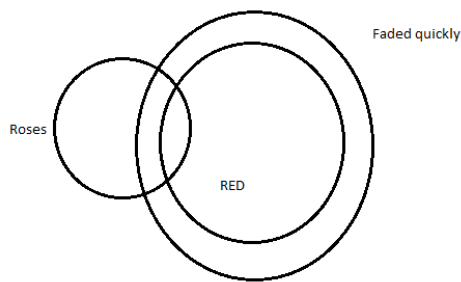n(C $\cap \overline{B} \cap \overline{A}$) = 19 − x
n(S)=13-x+16-x+19-x+x
40=48-2x
x=4

No. of students who watched all the three films =4
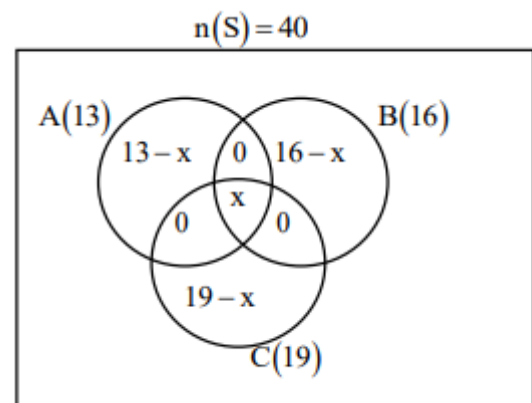
Q.76 (c)

Q.77 (a)

From the above graph there is strong correlation between crow birth and cracker sales. Thus from above option, option (A) is the correct answer.

Q.78 (d)

(i) Total number of candidates appeared = 6,30,000

(ii) Question A was correctly answered by 3,30,000 candidates.

(iii) Question B was answered correctly by 2,50,000 candidates

(iv) Question C was answered correctly by 2,60,000 candidates.

(v) Both questions A and B were answered correctly by 1,00,000 candidates.

(vi) Both questions B and C were answered correctly by 90,000 candidates.

(vii) Both questions A and C were answered correctly by 80,000 candidates.
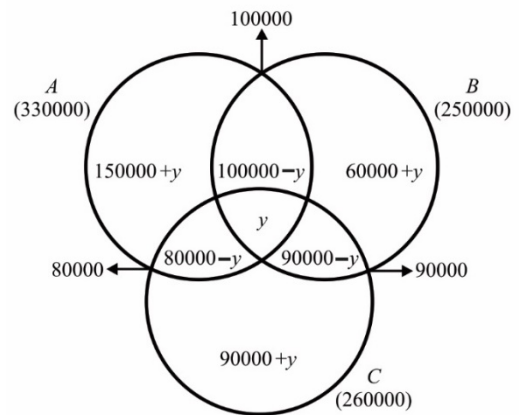
y = Total number of candidate attempted all questions correctly

Also, $630000 = 2y + 150000 + 100000 + 80000 + 60000 + 90000 + 90000$

$630000 - 570000 = 2y$

So, $y = 30000$

The students failed to clear the test
$= 150000 + 60000 + 90000 + 4y = 300000 + 4 \times 30000 = 420000$

Q.79 (b)

Divisibility rule: For a given number, if sum of digits is divisible by 3, then the number will be divisible by 3.

Number is 715 ■ 423

Here we check whether the sum of number is divisible by 3 or not.

$7 + 1 + 5 + x + 4 + 2 + 3 = 22 + x$

Here we see that the value of x satisfied in above equation is 2. Hence, the correct option is (b).

Q.80 (c)

Cumulative rain fall = 300mm = 0.3m

50% of rain fall=0.3/2= 0.15m

Total volume of water collected in tank = 50x 0.15= 7.5m³ =7500 litre

Q.81 (b)

According to the question

$A + B + C = C + D + E = E + F + G = G + H + K = 13$

Adding all $\Rightarrow A + B + 2C + D + 2E + F + 2G + H + K = 52$.........(1)

&

$A + B + C + D + E + F + G + H + K = 45$..(2)

(sum of no's from 1 to 9)

$(1) - (2) \Rightarrow C + E + G = 7$........(3)

and also $C + D + E = 13$.........(4)

$(4) - (3) \Rightarrow D - G = 6$

$$\begin{array}{r} C+D+E=13 \\ - \quad E+F+G=13 \\ \hline (C-F)+(D-G)=0 \end{array}$$

$\Rightarrow (C-F) = (D-G)$

$\Rightarrow (F-C) = 6(\because D-G = 6)$

Possible differences for getting '6' are

$9 - 3 = 6$

$7 - 1 = 6$

$8 - 2 = 6$

But suitable differences for (D-G) & (F-C) are 8-2 & 7-1

$\therefore$ Structure of numbers satisfying given conditions is

$\Rightarrow E = 4$