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Inside the book

SYLLABUS AND INFORMATION ABOUT THE TEST

GENERAL INFORMATION

The test is designed to measure the candidate's ability to think systematically, to use the verbal and mathematical skills and to assess his/her aptitude for admission into MBA/MCA programme. The Test emphasizes accuracy. Therefore, the candidate is required to go through the instructions carefully. This is an objective type test and the questions are of multiple choice. Out of the given options, the candidate has to choose the correct answer. If the Candidate gives more than one answer to any question, such answers will be ignored while awarding marks.

PATTERN OF THE TEST

The duration of the test will be 2.5 hours (150 minutes) and consists of 200 questions of one mark each in the following topics.

Section-A: Analytical Ability: 75Q (75 Marks)

1. Data Sufficiency: 20Q (20 Marks)

A question is given followed by data in the form of two statements labeled as i and ii. If the data given in i alone is sufficient to answer the question then choice (1) is the correct answer. If the data given in ii alone is sufficient to answer the question then choice (2) is the correct answer. If both i and ii put together are sufficient to answer the question but neither statement alone is sufficient, then choice (3) is the correct answer. If both i and ii put together are not sufficient to answer the question and additional data is needed, then choice (4) is the correct answer.

2. Problem Solving 55Q (55 Marks)

a) Sequences and Series 25Q (25 Marks)

Analogies of numbers and alphabet, completion of blank spaces following the pattern in a:b::c:d relationship; odd thing out: missing number in a sequence or a series.

b) Data Analysis 10Q (10 Marks)

The data given in a Table, Graph, Bar diagram, Pie Chart, Venn Diagram or a Passage is to be analyzed and the questions pertaining to the data are to be answered.

c) Coding and Decoding Problems 10Q (10 Marks)

A code pattern of English Alphabet is given. A given word or a group of letters are to be coded or decoded based on the given code or codes.

d) Date, Time & Arrangement Problems 10 Q (10 Marks)

Calendar problems, clock problems, blood relationships, arrivals, departures and schedules, seating arrangements, symbol and notation interpretation.

Section -B: Mathematical Ability 75Q (75 Marks)

1. Arithmetical Ability 35Q (35 Marks)

Laws of indices, ratio and proportion; surds; numbers and divisibility, l.c.m. and g.c.d; Rational numbers, Ordering.; Percentages; Profit and loss; Partnership, Pipes and cisterns, time, distance and work problems, areas and volumes, mensuration, modular arithmetic.

2. Algebraical and Geometrical Ability 30Q(30 Marks)

Statements, Truth tables, implication converse and inverse, Tautologies-Sets, Relations and functions, applications - Equation of a line in different forms.

Trigonometry - Trigonometric ratios, Trigonometric ratios of standard angles, (0°, 30°, 45°, 60°, 90°, 180°): Trigonometric identities: sample problems on heights and distances, Polynomials; Remainder theorem and consequences; Linear equations and expressions; Progressions, Binomial Theorem, Matrices, Notion of a limit and derivative; Plane geometry - lines, Triangles, Quadrilaterals, Circles, Coordinate geometry-distance between points.

3. Statistical Ability: 10Q (10 Marks)

Frequency distributions, Mean, Median, Mode, Standard Deviations, Correlation, simple problems on Probability.

Section-C: Communication Ability: 50Q (50 Marks)

Objectives of the section

1. identify vocabulary used in the day-to-day communication.
2. understand the functional use of grammar in day-to-day communication as well as in the business contexts.
3. identify the basic terminology and concepts in computer and business contexts (letters, reports, memoranda, agenda, minutes etc.).
4. understand written text and drawing inferences.

Part 1. Vocabulary 10Q (10M)
Part 2. Business and Computer terminology 10Q (10M)
Part 3. Functional Grammar 15Q (15M)
Part 4. Reading Comprehension (3 Passages) 15Q (15M)

SECTION – A

ANALYTICAL ABILITY

(75 Questions – 75 Marks)

DATA SUFFICIENCY

CONCEPTS

Purpose of Data sufficiency:

Here the examiner's intention is to check the student's capability in decision making. One can agree that the decision making is the sense of checking whether the data is sufficient or not.

Questions need not be solved. The statements have to be judged as to whether they have enough information to solve the question.

Each question is followed by data in the form of two statements labeled I and II. Decide whether the data given in the statements are sufficient to answer the questions.

(a) Mark option-(a), if the Statement-I alone is sufficient to answer question.

(b) Mark option-(b), if the Statement-II alone is sufficient to answer question.

(c) Mark option-(c) if the statements I and II are sufficient to answer the question but neither statement alone is sufficient to answer the question

(d) Mark option-(d) if both the statements together are not sufficient to answer the question and additional data is required.

CONCEPTUAL EXAMPLES

1) What is the three digit number?

I. Three–fifth of that number is less by 90 of that number.

II. One–fourth of that number is 25% of that number.

Explanation: (a) From statement-I,

$$x-\frac{3x}{5}=90\Rightarrow\frac{2x}{5}=90\Rightarrow x=225$$

Thus, statement-I alone is sufficient to answer the given question.

Statement-II is a fact and is not required to answer the given question.

Hence, option-a is correct.

2) What is the colour of the fresh grass ?

I. Blue is Green, Red is Orange and Orange is Yellow.

II. Yellow is White, White is Black, Green is Brown and Brown is Purple.

Explanation: (b) The colour of fresh grass is Green.

Statement-II states 'Green is Brown' and is sufficient to answer the question.

Hence, option-b is the right answer.

3) How is A related to B ?

I. B and C are children of D who is wife of A.

II. E's brother A is married to C's mother.

Explanation: (a) Statement-I alone is sufficient to deduce that A is B's father.

From statement-II we can determine that A is C's father. We again need statement-I to confirm A is B's father.

Hence, option-a is correct.

4) How is 'never' written in the code language?

I. 'never ever come here' is written as '*jo na hi da*'.

II. 'come here and go back' is written as '*ho ma si no di*'.

Explanation: (d) Neither statements provide sufficient information to answer the question.

Hence, option-d is correct.

5) How many children are there between P and Q in a row of children?

I. P is 15^{th} from the left in the row.

II. Q is exactly in the middle and there are 10 children towards his right.

Explanation: (c) From statement-II, Q is in the middle has 10 children to his right. ∴ The position of Q is 11^{th} from the left. Now, considering both statements together, we can conclude that there are 3 positions in between Q(11^{th}) and P(15^{th}).

Hence, option-c is correct.

6) In how many days can A and B working together complete a job ?

I. A alone can complete the job in 10 days.

II. B alone can complete the job in 15 days.

Explanation: (c) (A and B)'s 1 day work = $\frac{1}{10}+\frac{1}{15}=\frac{1}{6}$

∴ A and B together can complete the work in 6 days.

∴ Statements-I and II together are necessary to answer the question.

Hence, option-c is correct.

7) In how many days, A and B working together complete a job?

I. A alone can complete the job in 5 days.

II. B takes 2 days less than A to complete the job.

Explanation: (c) A's 1 day work = $\frac{1}{5}$

B's 1 day work = $\frac{1}{3}$

(A+B)'s 1 day work = $\frac{1}{5}+\frac{1}{3}=\frac{8}{15}$

∴A and B together can complete the work in $\frac{15}{8}$ days.

Hence, both statements are required and option-c is correct.

19) Find the average sales of motorcycles from Jul 2007 to Dec 2007 of a company?
I. Motorcycle sales from Jul 2007 to Sep 2007 is 66282
II. Motorcycle sales from Oct 2007 to Dec 2007 is 72363.
Explanation: (c) From statement I and II, the average sales of motorcycles from Jul to Dec is
$= \frac{66282+72363}{6} = \frac{138645}{6} = 23107.5$
Both statement-I and II are required to answer the question.
Hence, option-c is correct.
20) What is the speed of the car in *Km/hr*?
I. The car traveled 200 *Km* in 4 *hours.*
II. The car crossed 150 electric poles, the distance between a pair of poles is 1 *Km.*
Explanation: (a) $\text{Speed} = \frac{\text{Distance}}{\text{Time}}$
Statement-I provides both distance and time. Hence, it is sufficient to answer the given question.
Since, statement-II does not provide information on time and hence, option-a is correct.
21) What is Hari age?
I. Hari is 3 times younger than Sita.
II. Asha is twice the age of Sita and the sum of their ages is 72.
Explanation: (c) Let the age of Sita = x *years.*
From statement-II, Age of Asha = $2x$ *years*
then $x + 2x = 72$
$\Rightarrow 3x = 72$
$\Rightarrow \quad x = 18$ *years*
From statement-I, Hari is 3 times younger than Sita
i.e. $\frac{18}{3} = 6$ *years.*
Therefore, both the given statements are necessary to answer the question.
Hence, option-c is correct.
22) What is the ratio of the total number of boys to the total number of girls in a school?
I. The ratio of the total number of girls to the total number of boys last year was 4 : 5.
II. There are 3500 students in the school, out of which 60% are girls.
Explanation: (b) From statement-I alone, it is not possible to find the required ratio because the data given is of the previous year.
From statement-II, girls ratio is 60%,
then boys ratio will be 40%.
$\therefore$ The required ratio = Boys : Girls = 40% : 60% = 2 : 3
Hence, option-b is correct.
23) What is the speed of bus?
I. The bus covers a distance of 80 *Km*
II. The time taken is 5 *hours.*
Explanation: (c) $\text{Speed} = \frac{\text{Distance}}{\text{Time}}$
The information related to distance and time is clearly evident from both the statements together.
So, option-c is correct.
24) What is the ratio of the number of freshers to the number of seniors in a college?
I. The ratio of males and females in the college is 8 : 4.
II. There are 1120 female freshers in the college
Explanation: (d) The information given in both the statements is not sufficient to find the required ratio. Hence, option-d is correct.
25) What is Mr. Mohan's present income?
I. Mr. Mohan's income increases by 20% every year.
II. His income will increase by ₹2500 this year.
Explanation: (c) From both statements, 20% = ₹2500.
If 20% = ₹2500, then 100% = ₹12500, which is nothing but his income in the previous year. And, his present income will be ₹15000.
Here, both statements are necessary to answer the given question. Hence, option-c is correct.

EXERCISE

Directions: Each question is followed by data in the form of two statements labeled I and II. Decide whether the data given in the statements are sufficient to answer the questions and mark one of the options:
(a) If the Statement-I alone is sufficient to answer question.
(b) If the Statement-II alone is sufficient to answer question.
(c) If the statements I and II are sufficient to answer the question but neither statement alone is sufficient to answer the question
(d) If both the statements together are not sufficient to answer the question and additional data is required.

1) What is the cost of painting the four walls of a room with no windows or doors at the rate of Rs. 50/m^2?
I. The length, width and height of the room are 6m, 4m and 8m respectively.
II. The base area of the room is 24 m^2.
2) A path runs around the outer edge of a rectangular lawn. What is the cost or travelling it at Rs. 80/m^2 ?
I. The width of the path is 2.5 m
II. The length and breadth of the lawn are 16 m and 13 m respectively.

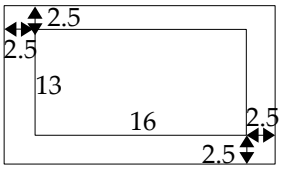
3) What is the area of the rectangle?
I. The area of the rectangle is 2 times its perimeter
II. The ratio of the length and the breadth is 4 : 2.
4) If A : B = 3 : 5, then A : C = ?
I . B : C = 2 : 9 **II.** C : D = 3 : 4
5) What is A's share?
I. The total amount is Rs. 3600
II. The ratio of shares of A and B is 5 : 7
6) What is the ratio between two numbers x and y ?
I. x is 10% of 50 **II.** y is 20% of 80
7) What is the ratio of the total number of girls to the the total number of boys in a school ?
I. There are 5600 students in the school
II. 60% of the students are boys.
8) The ratio of three numbers x, y and z is 1 : 3 : 4. Then what is the value of 'z'.
I. The value of 'z' is equal to the sum of x and y
II. The sum of the three numbers is 32.
9) What is the ratio $x : y : z$?
I. $\frac{x}{y}=2$ and $\frac{z}{y}=\frac{1}{4}$ **II.** $xyz = 32$
10) Find the ratio x and y.
I. x is 4 more than twice of y. **II.** y is 10% of 40.
11) What is the two-digit number ?
I. The difference between the two-digit number and the number formed by interchanging the digits is 18.
II. The difference between the two digits is 2.
12) What is the two-digit number ?
I. The difference between the two-digit number and the number formed by interchanging the digits is 54.
II. Unit's digit is less than the ten's digit by 6.
13) What is the two-digit number?
I. The number is a multiple of 23.
II. The sum of the digits is 11.
14) What is the two-digit number ?
I. The sum of the digits is 12.
II. The ratio of the two digits is 3 : 1
15) What is the sum of the digits of the two-digit number?
I. The ratio between the ten's digit and unit's digit of the number is 2 : 1.
II. The product of the digits is 32.
16) What is the value of $(x - y)$?
I. x is the largest possible five digit number
II. y is the smallest possible four digit number.
17) x and y are integers. Is y an even number ?
I. $(x + y)$ is an odd number. **II.** x is a multiple of 2.
18) Is y larger than 10 ?
I. y is greater than zero **II.** $y^2 - 225 = 0$
19) Is the integer x divisible by 6 ?
I. x is divisible by 2. **II.** x is divisible by 3.
20) How many integers are there of the form $\frac{5x}{11}$.
I. x is an integer and $0 < x < 50$ **II.** x is an odd integer
21) How is 'one' written in the code ?
I. 'one and go' written as '*je ta ma*'
II. 'go back and' is written as '*ta sa je*'
22) Among M, N, O, P and Q each securing different marks in an examination, whose position is last among them.
I. P has secured less marks than only O and Q
II. N has secured more marks than M.
23) In a row of 20 students waiting at a counter on the left end, what is Priya's position from the right end?
I. Ashwini is fifth to the right of Priya
II. Ashwini is 18^{th} from the left end of the row.
24) How many daughters does Jaswanth have ?
I. Mani and Kani are sisters of Thisya
II. Thisya's mother is wife of Jaswanth
25) When is Bindu's birthday this year ?
I. It is between January 13 and 15, January 13 being Wednesday.
II. It is not on Friday.
26) On which day was the bag purchased by Anusha in 1996 ?
I. Certainly before 18^{th} December, 1996 but definitely not before 15^{th} December 1996.
II. Certainly after 16^{th} December, 1996 but not later than 19^{th} December, 1996.
27) Is Manoj taller than Goutham ?
I. Dinesh is of the same height as Manoj and Goutham.
II. Goutham is not shorter than Dinesh.
28) How is P related to Q ?
I. S is the brother of Q.
II. S is P's son.
29) How many brothers does Tarun have ?
I. Tarun's father has three children.
II. Tarun has two sisters.
30) In a certain code language, '297' means 'tie clip button'. Which number denotes 'button' ?
I. In that language '333' means 'peace peace peace'.
II. In that language '175' means 'hole and button'.
31) Who is R's partner in the game of cards involving four players P, Q, R and S?
I. S is sitting opposite to P.
II. Q is sitting facing North.
32) Is S brother of U?
I. Q has two sons of which U is one.
II. S's mother is married to Q.

33) What is Aruna's age ?
I. Aruna, Vimala and Kamala are all of the same age.
II. Total age of Vimala, Kamala and Anitha is 32 and Anitha is as old as Vimala and Kamala together.
34) How is Rajesh related to Jagadesh ?
I. Tapan's wife Nisha is paternal aunt of Jagadesh.
II. Rajesh is the brother of a friend of Nisha.
35) Manoj, Praveen, Anil and Kamal are four friends. Who among them is the heaviest ?
I. Praveen is heavier than Manoj and Kamal but lighter than Anil.
II. Manoj is lighter than Praveen and Anil but heavier than Kamal.
36) Rohith ranks 10^{th} in a class. How many students are there in the class ?
I. His friend got 58^{th} rank which is the last.
II. Rohith's rank last year from the last is 49^{th}.
37) Vinay's and Ajay's salaries are in the proportion of 4 : 3 respectively. What is Vinay's salary ?
I. Ajay's salary is 75% that of Vinay's salary.
II. Ajay's salary is Rs. 4500.
38) How many sons does 'S' have ?
I. P's father has three children.
II. Q is P's brother and son of S.
39) On which day in January, Sukesh left for Japan ?
I. Sukesh has so far spent 10 *years* in Japan.
II. Sukesh friend Anil left for Japan on 15^{th} Feb and joined Sukesh 20 *days* after Sukesh arrival.
40) What is the area of this plot ?
I. The perimeter of the plot is 208 *m*.
II. The length is more than the breadth by 4 *m*.
41) How many children are there in the group?
I. Average age of children is 16 years. The total ages of all the children in the group is 240 years.
II. The sum of ages of all the children in the group and the teacher is 262 years. The teacher's age is six years more than the average age of the children.
42) What is the cost of laying a carpet in a rectangular hall?
I. Cost of the carpet is ₹450 per square meter.
II. Perimeter of the hall is 50 meters.
43) A shopkeeper marked the price of an article and gave a discount of 20%. Find the marked price of the article.
I. The cost price of the article is ₹2500.
II. After giving the discount the shopkeeper gets 28% profit.
44) What is the rate of the simple interest per annum?
I. The sum triples in 20 years at simple interest.
II. The difference between the sum and the simple interest earned after 10 years is ₹1000.
45) What will be the cost of the second necklace?
I. The cost of the first necklace is $\frac{1}{5}$ more than the second and the cost of the third necklace is $\frac{2}{5}$ more than the second. The total cost of all the three necklaces is Rs. 120000.
II. The cost of the first necklace is $\frac{2}{5}$ more than the second. The cost of the third necklace is the least and total cost of all the three necklace is Rs. 120000.
46) A train crosses another train running in the opposite direction in 30 seconds. What is the speed of the train?
I. Both the trains are running at the same speed.
II. The first train is *y cm* long.
47) How many children are there in the class?
I. Number of boys and girls are in the respective ratio of 3 : 4.
II. Number of girls is more than the number of boys by 18.
48) The area of a rectangle is equal to the area of a right angled triangle. What is the length of the rectangle ?
I. The base of the triangle is 40 *cm.*
II. The height of the triangle is 50 *cm.*
49) How many marks did Prakash obtain in Maths ?
I. Prakash secured an average of 55% marks in Maths, Physics and Chemistry together.
II. Prakash secured 10% more than the average in Maths.
50) What is the difference between the two digits in a two-digit number ?
I. The sum of the two digits is 8.
II. $\frac{1}{5}$ of that number is equal to 15 less than $\frac{1}{2}$ of 44
51) What is the capacity of a cylindrical tank ?
I. Radius of the base is half of its height, which is 28 *m*.
II. Area of the base is 616 sq meter.
52) X, Y and Z are integers. Is X an odd numbers ?
I. An odd number is obtained when X is divided by 5.
II. (X+Y) is an odd number.
53) What is the price range of ordinary wall clocks?
I. The price range of ordinary wrist watches of company *x* is ₹400 to ₹600 .
II. The price range of ordinary wall clocks of company x is 50% that of their ordinary watches.
54) What is the average monthly income per family member?
I. Each male member of the family earns Rs. 1000 a month and each female member of the family earn Rs. 800 a month.
II. Ratio of male to females in the family is 2 : 1 .

55) What is Reena's rank in the class?
I. There are 26 students in the class.
II. There are 9 students who scored less than Reena.
56) Find the population of a state 'A' in 2006.
I. Population in state 'A' in 2000 is 6 crore, year by year the rate of increase of population is 10%**.**
II. Population of state 'A' in 2000 is twice that population of state 'B' in the same year .
57) Find the value of $m - n \div 37$?
I. m is the largest possible six-digit numbers and n is the smallest possible six-digit numbers.
II. The difference between m and n is known.
58) What is the present age of the mother?
I. Father's age is eight years more than the Mother's age. Father got married at the age of 28 years.
II. Present age of the father is 30 years. Four years back the ratio of Mother's age to Father's age was 12 : 13.
59) What was the total compound interest on a sum after three years?
I. The interest after one year was Rs 100.
II. The difference between simple and compound interest on a sum of Rs.1000/- at the end of two years was Rs.10.
60) What is the rate of interest (percent per annum) on an amount of ₹ 6000 deposited in a bank?
I. The simple interest for four years is Rs 2400.
II. The difference between the simple interest and compound interest is ₹384.60.
61) What is the number?
I. 25% of the number is $\frac{1}{4}^{th}$ of that number.
II. $\frac{3}{4}^{th}$ of that number is less by 34 of the same number.
62) The age of Ram and Shyam are in the ratio of 7 : 6. What is the age of Shyam?
I. The ages of Ram and Awez are in the ratio of 8 : 5.
II. After 5 years the ratio of Awez and Hanuman's age will be 3 : 2.
63) Is x an odd number?
I. x multiplied by an odd number is equal to an even number.
II. x is a power of 2.
64) What is the salary of x, in a group of u, v, w, x, y and z whose average salary of ₹ 51126 ?
I. Total of the salaries of u and z is ₹89782.
II. Total of the salaries of v and w is ₹ 54,665.
65) What is the profit earned by selling a watch for ₹12675?
I. The marked price of 5 such watches is equal to the selling price of 4 such watches.
II. 25% profit is earned by selling each watch.
66) The ages of Ramesh and Suresh are in the ratio 6 : 5. What is the age of Ramesh?
I. The age of Ramesh and Suresh are in the ratio of 10:7.
II. After 5 years the ratio of Ramesh's and Suresh's ages will be 7 : 6.
67) What is the salary of A, in a group of A, B, C, D and E whose average salary is ₹65970 ?
I. Total of the salaries of B and C is ₹84625.
II. Total of the salaries of D and E is ₹58040.
68) In how many days 14 men complete the work?
I. 18 women complete the same work in 24 *days.*
II. 28 children complete the same work in 56 *days.*

EXPLANATIONS

1)a; From statement-I,
Area of 4 walls of a room = $2(l + b) \times h$ = 160 m^2
Cost of painting = 160 × 50 = Rs. 8000
∴ Statement-I alone is sufficient where as data in Statement-II is redundant and not required.
2)c; Using both statements I and II,



Area of the path = [(16+5) × (13+5) – 16 × 13] = 170 m^2
Required cost = Rs. 80 × 170 m^2 = Rs.13600
3)c; From statements I and II alone we cannot Find the area of the rectangle. Thus, Statement I and II together are necessary to solve the given question.
4)a; Given A : B = 3 : 5,
From Statement-I, we get B : C = 2 : 9
⇒ A : B : C = 6 : 10 : 45 ∴ A : C = 2 : 15
Statement-II, does not help us to get required answer.
5)c; From both Statements,
A's Share = $\left(\frac{5}{5+7} \times 3600\right) = 1500$
∴ Thus, both the statements are sufficient to get the required answer.
6c; From statement-I, we get $x = \frac{10}{100} \times 50 = 5.$
From statement-II, we get $y = \frac{20}{100} \times 80 = 16.$
The required ratio is $x : y = 5 : 16$
∴Both statements are required to answer the question.

7)b; Statement-II: If 60% of the students are boys, 40% are girls. Thus, the required ratio of boys to girls is 40 : 60 or 2 : 3. Thus, Statement-II alone is sufficient to answer the question.

8)b; $x : y : z = 1 : 3 : 4$

From statement-I, we get $z = x + y$.

This can be inferred from the ratio given in the question and hence, this statement is redundant.

From statement-II, we get $z = \frac{4}{8} \times 32 = 16$.

$\therefore$ Statement-II alone is sufficient to get the answer.

9)a; From statement I, we get $y = \frac{x}{2}$ and $z = \frac{y}{4} = \frac{x}{8}$.

Now, $x : y : z = x : \frac{x}{2} : \frac{x}{8}$

$\Rightarrow x : y : z = 8 : 4 : 1$.

Statement II, does not help us to get required answer.

10)c; From statement-I, we get $x = 2y + 4$

From statement-II, we get $y = \frac{10}{100} \times 40 = 4$

$\Rightarrow x : y = 2y + 4 : y \quad = 12 : 4 \quad = 3 : 1$

$\therefore$ Both the statements are necessary to get the answer.

11)d; Let the ten's and unit's digit be 'x' and 'y' respectively.

From statement-I, $(10x + y) - (10y + x) = 18$

$\Rightarrow x - y = 2$

From statement-II, $x - y = 2$.

$\therefore$ Additional data is required to get the ration.

12)d; Let ten's and unit's digit be x and y respectively.

From statement-I, $(10x + y) - (10y + x) = 54$

$\Rightarrow x - y = 6$

From statement-II, $x - y = 6$.

$\therefore$ Both statements together also is not sufficient to get the answer.

13)c; Let the number = $10b + a$.

From statement-I, $10b + a = 23 \times c$; $(c \in N)$

From statement-II, $a + b = 11$, taking $c = 4$,

we get, $10b + (11 - b) = 23 \times 4$

By solving we get $b = 9$ and $a = 2$

$\therefore$ Required number is 92.

$\therefore$ Both statements I and II together are necessary.

14)d; Let ten's and unit's digits be x and y respectively.

Statement-I: $x + y = 12$

Statement-II: Ratio of the digits = 3 : 1

The number can either be 39 or 93.

The given information is not sufficient to find the two-digit number and hence, option-(d) is the answer.

15)c; Based on statement-I, let ten's and unit's digits be $2x$ and x.

From statement-II, $(2x)(x) = 32$

$\Rightarrow x^2 = 16 \quad \Rightarrow x = 4$.

Combining both statements-I and II, the number is 84.

Thus, statements-I and II together are necessary to answer the question.

16)c; From Statement-I, we get $x = 99999$

From Statement-II, we get $y = 1000$

From statements I and II together, we can find $(x - y)$.

$\therefore$ Correct answer is option-c.

17)c; As x is multiple of 2 (statement-II), x is even.

From statement-I, if x is even, then y has to be odd as $(x + y)$ is an odd number.

Thus, combining both the statements, we can say y is an odd integer and not an even integer.

18)c; From statement-II, we get $y = \pm 15$

From statement-I, we get $y > 0 \quad \Rightarrow y = 15$

Thus, both statements are required.

19)c; Combining both statements, if x is divisible by 2 and 3, then it is also divisible by 6.

$\therefore$ Both the statements are necessary.

20)a; From statement-I, x = 11, 22, 33 or 44 for $\frac{5x}{11}$ to be an integer. Thus, there are four possible integers.

$\therefore$ Statement-I alone is sufficient to answer.

21)c; From both statements, 'go' or 'and' is coded as '*je*' or '*ta*'. Thus, the remaining word in the statement-I, 'ONE', is coded as '*ma*'. Hence, both statements I and II are required to answer the question.

22)c; By combining statements-I and II together M's position is last among them {O, Q} > P > N > M.

23)c; From statement-II, Ashwini is 3rd from the right end. Since, she is 5th to the right of Priya (Statement-I), Priya's position is 7th from the right end.

$\therefore$ Both statements are required to answer the question.

24)d; The data in statement-I and II together are not sufficient to answer. Since, Thisya is a gender neutral name, more information is required.

25)a; From statement-I, we conclude that Bindu's birthday is on January 14, which is Thursday, this year. So, only statement-I is sufficient.

26)c; From statement-I, we conclude that Anusha purchased the bag between 15th and 18th December. From statement-II, it is clear that she purchased bag on 17th or 18th or 19th. By combining both the statements together, we can say that she purchased bag on 17th December.

$\therefore$ Both the statements are necessary.

27)a; From statement-I, we conclude that Manoj, Goutham and Dinesh are of same height. So, Manoj is not taller than Goutham. Thus, only statement-I is sufficient to answer the question.

28)d; From statement-I, we can say that S is brother of Q. From statement-II, P is father of 'S'. By combining both statements-I and II, P can either be father or mother of Q. Hence, we need additional information to determine P's relation to Q.

29)c; From both the statements together, we get that Tarun's father has three children, Tarun and his two sisters. This means Tarun has no brother.

So, both statements are necessary.

30)b; Given '2 9 7' means 'tie clip button'.

From statement-II, '7' refers to 'button' as it is the only common word.

∴ Statement-II alone is sufficient to answer the question.

31)a; In a game of cards, team members sit opposite to each other. Hence, statement-(I) is sufficient to answer the question.

32)c; From statement-I, we conclude that Q has two sons and 'U' is the son of Q. From statement-II, we conclude that Q's wife is S's mother. This means that S and U are the sons of Q. And S is the brother of U.

∴ Both statement I and II are necessary.

33)c; From statement-I,

Aruna (Ar) = Vimala (V) = Kamala (K)

From statement-II, Anita (A)+V+K = 32. And, A = V + K.

$2A = 32 \Rightarrow A = 16.$ $\Rightarrow V + K = 16.$

From statement-I, V = K

So, V = K = 8. Thus, Aruna = 8 *years*.

∴ Both the statements are necessary.

34)d; Both the statements are not sufficient to answer the question.

35)a; From statement-I, Praveen (P) > Manoj (M);

P > Kamal (K) ; Anil (A) > P.

∴ Anil (A) is heaviest among them.

From statement-II, A>M, P>M. M>K.

Statement-II is not enough to assess who is the heaviest. ∴ Statement-I alone is sufficient to answer.

36)c; From statement-I, Rohith's friend got 58^{th} rank which is last. i.e,Total 58 students are there in the class

∴ Statement-I alone is sufficient to answer.

37)b; From statement-I, we can not determine the salary of Vinay.

From statement-II: Let Vinay's and Ajay's salary be $4x$ and $3x$ respectively. $3x = 4500 \Rightarrow x = 1500.$

∴ Vinay's salary = 6000.

∴ Statement-II alone is sufficient.

38)d; From statements-I and II, we can conclude that P and Q are the children of S. But the gender of P and the gender of the third child of S is not known.

So, both the statements together are also not sufficient to answer the question.

39d; Clearly, even from both the given statements, we cannot conclude the exact date of Sukesh's leaving for Japan.

40)c; From statement-II, let the breadth of the plot be 'x' metres. Then, length = $(x + 4)$ metres.

From statement-I, perimeter = 208 metres.

Combining both statements,

Perimeter = $2(l + b)$

$\Rightarrow 208 = 2(x + 4 + x)$ $\Rightarrow x = 50$

∴ length = 54 m, breadth = 50 m.

Area of the plot = $54 \times 50 = 2700\ m^2$.

Hence, both statements I and II are necessary to answer the question.

41)a; $\text{Average} = \dfrac{\text{Total of ages}}{\text{Number of children}}$

From statement-I, Average = 16. Total of ages = 240.

By substituting this information in the above equation, we can find total number of children. So, statement-I alone is sufficient to answer the given question.

The data in statement-II alone is not sufficient to answer the given question. Hence, option-a is correct.

42)d; To find the cost of laying a carpet we need

1. Cost of carpet per square meter
2. Area of the hall.

From statement-I, we have the cost of carpet per square meter. But this statement alone is not sufficient to find area. From statement-II, $2(l+b) = 50$. But, Area = $l \times b$.

Using statement-II, it is not possible to find the value of *area.* Hence, neither of the statements is sufficient to answer the given question. So, option-d is correct.

43)c; Let, marked price = x.

The shopkeeper gave 20% discount.

i.e. he sold it for $\dfrac{80}{100}x$.

SP = CP + Profit (or) CP – Loss

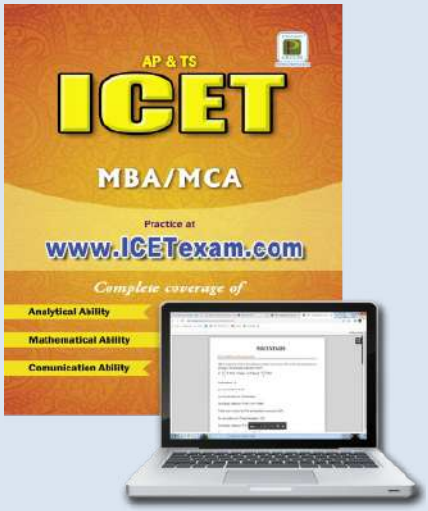
From statement-I, cost price is known. But this statement alone is not sufficient. Still we need information about either profit or loss.

From statement-II, we have, profit = 28%.

Profit or loss is always calculated CP.

Then, $\dfrac{80}{100}x = 2500 + \dfrac{28}{100}(2500)$

From the above equation, we can find the value of x *i.e.* marked price. Hence, both the statements together are required to answer the given question.



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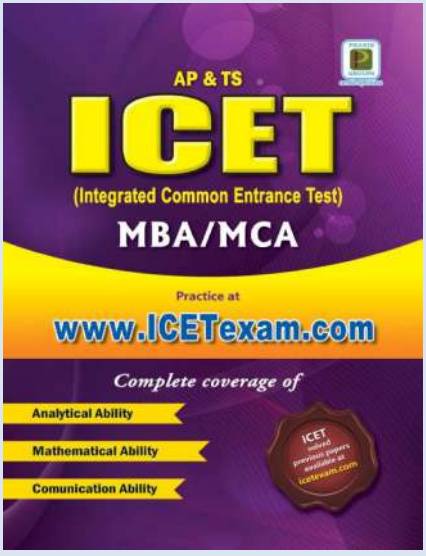

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44)a; Let the sum = P; According to statement-I, the sum triples in 20 years.
i.e. Amount = 3P and Time = 20 years.
Then S.I = Amount - Sum = 3P - P = 2P.

$$S.I=\frac{P\,R\,T}{100}\Rightarrow 2\,P=\frac{20(PR)}{100}$$

From the above equation, R can be determined.
So, statement-I alone provides the sufficient information to answer the given question.

From statement-II, $S.I=\frac{(PR)10}{100}$

Given, $\frac{(PR)10}{100}-P=1000$

Here the value of P is not given. So, it is not possible to find the value of R. Hence, statement-II is not sufficient to answer. So, option-a is correct.

45)a; From statement-I, Ratio of the costs of first, second and third necklaces is 6 : 5 : 7, and hence, the price of second necklace can be calculated.
Hence, option-a is correct.

46)d; The length of the other train is not given in any of the statements. Hence, option-d is correct.

47)c; From Statement-I: Ratio of boys and girls = $3k : 4k$
From Statement-I and II: $4k - 3k = 18 \Rightarrow k = 18$
$\therefore 4k + 3k = 7k = 7\times18 = 126$. Hence, option-3 is correct.

48)d; When we combine both statements-I and II, we can find the area of the triangle, which is also the area of the rectangle. But without knowing the breadth of the rectangle, length of the rectangle cannot be determined. Hence, option-d is correct.

49)d; Using the information in both statements, it is not sufficient to find marks obtained by Prakash in Mathematics. Hence, option-d is correct choice.

50)b; Let, the two digit number be $xy = 10x + y$,
From statement-I, $x + y = 8$

From statement-II, $\frac{1}{5}(10x+y)=\frac{44}{2}-15=7$

$\therefore$ The number $10x + y = 7 \times 5 = 35$ and so, the required difference = 5 – 3 = 2.
Hence, option-b is correct as information in statement-I is irrelevant in determining the difference.

51)a; Capacity of a cylindrical tank = (Area of the base of cylinder) × (Height of cylinder) = $\pi r^2 h$
Since, statement-I provides the information on both r and h, option-a is correct.

52)a; Statement-I alone is sufficient to answer the question. We know that whenever any odd number is divided by any odd number, it gives an odd number. Hence, option-a is correct.

53)d; From statement-I we can conclude the price range of ordinary wrist watches in company 'X' to be Rs. 400 to Rs. 600 but it is not enough to get the price range of ordinary wall clocks.
Since, not all watches are wrist watches, statement-II is also not helpful.
Hence, option-d is correct.

54)c; In statement-I we get income obtained by male and female members of the family. But this statement alone is not sufficient to conclude the question.
In statement-II we get the ratio of male and females in the family as 2 : 1 this alone is also not sufficient on combining both the statements we get

Average = $\frac{2x\times1000+x\times800}{3x}=\frac{2800}{3}$

So, both the statements together are required.
Hence, option-c is correct.

55)c; Statement-I provides the information about the number of students in the class. But that is not sufficient to conclude the question.
Statement-II provides the information about the number of students who scored less than Reena.
This statement alone cannot conclude the question hence, we require both the statements to explain about the rank of Reena in the class.
Hence, option-c is correct.

56)a; Here statement-I alone is sufficient because in 2000 the population is given and also year be year the rate of increase in population is also given.
In statement II just he is giving the ratio of population between two states which is irrelevant to the problem.
Hence, option-a is correct.

57)a; I → m = 999999, n = 100000 = 999999 – 100000 ÷ 37
⇒ 999999 – 2702.70 = 997293.30
II → m - n is known but the value of 'n' is not known. So we cannot find the value of $m - n \div 37$ by this statement, here VBODMAS rule voids, which says that ÷ (divided by) has more priority then – (minus).
Hence, option-a is correct

58)b; From statement-I we can determine the ages of father and mother at the time of marriage only

From statement II, $\Rightarrow\frac{M-4}{F-4}=\frac{12}{13}\Rightarrow13\mathrm{M}-52=12\mathrm{F}-48$

$\Rightarrow13\mathrm{M}=12\times30-48+52=364$
$\therefore$ M = 28Years
Hence, statement-II alone is sufficient and option-b is correct.

59)b; From statement-II,
Principal = 1000, and Time = 2 years.
With this information the rate of interest (R) can be found. Then it will be possible to find the compound interest on the principal after 3 years.
So, statement-II alone is sufficient.
Hence, option-b is correct.

60)a; From statement-I, Rate of interest = $\frac{SI \times 100}{P \times T}$

= $\frac{2400 \times 100}{6000 \times 4}$ = 10% per annum.

In statements-II, time of deposit is not given So we cannot find the solution.
Hence, option-a is correct.

61)b; From statement-II, $x - \frac{3x}{4} = 34 \Rightarrow x = 136$

From statement-I, 25% of any number is one-fourth of the number. It does not give any particular value.
Hence, option-b is correct.

62)d; Enough information is not given in both the statements combined to give the answer.
Hence, option-d is correct.

63)a; From statement-I, If
(x) × odd number = even number ,
then x is definitely an even number. Hence, from statement-I we can say whether x is not an odd number. So, statement-I alone is sufficient to answer the given question.
From statement-II, x is power of 2. Then x can be odd for 2^0 and even for higher powers.
So, statement II alone is not sufficient to answer the question. Hence, option-a is correct.

64)d; From the given data, we can have the values of u, v, w, z. But, y value is not given.
Hence, it is not possible to find the value of x, even from the data given in both the statements.
Hence, option-d is correct.

65)b; From statement-I, marked price and selling price alone cannot be used to calculate profit.
We need cost price also to calculate the profit.
i.e. data in statement-I alone is not sufficient to answer the question.
From statement-II, we have profit%,
So it is possible to find profit.
Profit% = 25% then profit = $\frac{12675 \times 25}{125} = 2535$
i.e. statement-II is also sufficient to answer the question.
Hence, option-b is correct.

66)b; Let the age of Ramesh = $6x$
and that of Suresh = $5x$
From statement-I, it is not possible to find the age of Ramesh.
From statement-II, we have, $6x + 5 : 5x + 5 = 7 : 6$
$36x + 30 = 35x + 35$
$\Rightarrow x = 5$
Ramesh's age is $6x = 6 \times 5 = 30$ years.
So, Statement-II alone is sufficient to answer the given question.
Hence, option-b is correct.

67)c; Total salary of A, B, C, D and E = 5×65970 = 329850
From statement-I, total salary of B and C = 84625
From statement-II, total salary of D and E = 58040
Salary of A = 329850 – (84625 + 58040) = 187185.
Hence, option-c is correct.

68)d; The relation between either men and women or men and children is not given in the question. Therefore, both the statements are not sufficient to answer the given question.
Hence, option-d is correct.

SERIES AND ANALOGY

CONCEPTS

Analogy is comparison between things which have similar features (*i.e.* similarity or correspondence).

Analogy plays a significant role in problem solving such as creativity, memory, perception, emotion, decision making, explanation and communication.

Types of Analogy: Analogy questions are two types. They are, a) Number Analogy,

b) Alphabet Analogy.

Analogy involve critical thinking and involve little bit of secret language. In this type of problems, a rule or a logic will lie behind the given items, based on that the candidate is required to find the similar item/pair.

A simple analogy is as follows.

Word-1: Word-2 : : Word-3 : Word-4

Here ':' reads as *"is to"* and '::' reads *"as"*.

Steps for Analogy problem solving:

Step-1: Observe the first pair of given analogy and then find out the relation between them. Be sure to look all parts of the relationship between them.

Step-2: Once you find the correct relationship between the first analogy pair, apply the same relation to given options. If any of the option pair has the same relation as first pair then that option is the required answer. If more than one option has same relation as the first pair, then find out some other relationship between the first pair and apply it to the options.

a) <u>Number Analogy:</u> In this type of analogy, you are required to find similar pair or single number based hidden relation in then given pair(*s*).

Examples: 1) 2 : 7 :: 5 : ?

a) 15 b) 16 c) 18 d) 20

Explanation:

The relation between 2 and 7 is, 2×3 +1=7.

5 × 3 + 1 = 16 is the answer.

2) 3 : 28 : : ?

a) 2: 9 b) 3: 29 c) 4: 64 d) 5: 125

Explanation: Here only 1st pair is given, we have to find the 2nd analogy pair.

The relation between 1st pair is : $3 \rightarrow 3^3 + 1 = 28$.

From option-*a*, $2 \rightarrow 2^3 + 1 = 9$.

b) <u>Alphabet Analogy:</u> In this method, a group of alphabet pairs or an individual alphabet will be given. You need to find out the similar relationship from the options which correctly matches to the question analogy pair.

Examples: 1) A : E : : T : ?

Explanation: The relation in the first pair is $A + 4 = E$.

In the same way $T + 4 = X$.

2) KP : LO : : BY : ?

Explanation: In first pair K, P are opposite letters.

L is next to K. Opposite of L is O.

In the same way, letter next to B is C. Opposite letter of C is X. Answer is CX.

3) ABC : GHI : : MNO : ?

Explanation: In the first pair, the last letter of the first part is C and the first letter of the 2nd part is G. The relation between C and G is C + 4 = G.

In the same way, in the second pair, last letter of the first part (MNO) is O. So, O + 4 = S.

Hence, answer is 'STU'.

Complex Expressions: Sometimes the hidden relation between the given numbers could be any complex expression. For example, 6 : 19 : : 8 : ?

a) 34 b) 30 c) 38 d) 33

Explanation: The hidden relation in the first pair is $n : \left(\frac{n^2}{2}+1\right)$ So, $8 : \left(\frac{8^2}{2}+1\right) \Rightarrow \frac{64}{2}+1=33$

CONCEPTUAL EXAMPLES

Directions to solve (1-5): In each of the following questions a number series is given with one term missing. Choose the correct is given with one term missing. Choose the correct alternative that will continue the same pattern.

1) 16, 21, 26, 31, ...

a)36 b) 38 c) 40 d) 46

Explanation: (a) Each number is increased by 5.

16_{+5}, 21_{+5} , 26_{+5} , 31_{+5} , **<u>36</u>**

2) 6, 13, 27, 55, ...

a) 113 b) 111 c) 102 d) 104

Explanation: (b) Each number is multiplied by 2 and then added 1 to the result to get the next number.

6 ×2 + 1 = 13; 13 × 2 + 1 = 27;

27 × 2 + 1 = 55; 55 × 2 + 1 = **<u>111</u>**

3) 1, 2, 2, 9, 3, 28, 4, ...

a) 60 2) 62 c) 65 d) 63

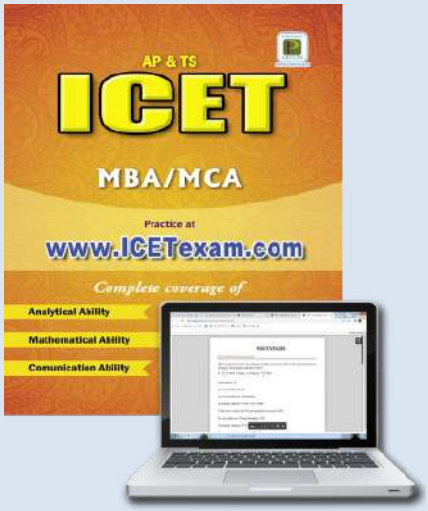
Explanation: (c)

The series goes as n, $n^3 + 1$, n+1, $(n+1)^3$ … (n∈N)

1, $1^3+1 = 2$; 2, $2^3+1 = 9$;

3, $3^3+1 = 28$; 4, $4^3+1 =$ **<u>65</u>**

∴ Required answer is 65.



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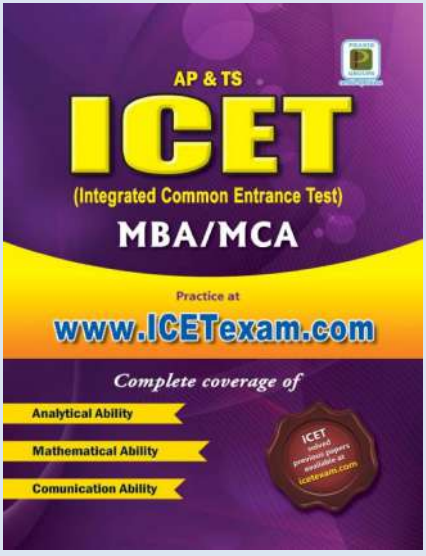

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45)a; The series goes as ×5, ×10, ×15, ×20, …
3×5 = 15; 15×10 = 150; 150×15 = 2250; 2250×20 = **45000**
46)b; Each term of the series is multiplied by consecutive prime number to get the next term.
2×2 = 4; 4×3 = 12; 12×5 = 60; 60×7 = **420**
47)c; Each number is multiplied by 2 first and then added 5.
17×2 + 5 = 34 + 5 = 39; 39×2 + 5 = 78 + 5 = 83
83×2 + 5 = 166 + 5 = 171; 171×2 + 5 = **347**
48)d; Each consecutive number is divided by 3.
567/3 = 189; 189/3 = 63; 63/3 = 21; 21/3 = **7**
49)d; The series goes as n×(n + 1).
1×2 = 2; 2×3 = 6; 3 × 4=12; 4 × 5 = 20;
5 × 6 = 60; 6×7 = 42; 7 × 8 = 56; 8 × 9 = **72**
50)c; The series consists of square of consecutive prime numbers.
2^2=4, 3^2=9, 5^2= 25, 7^2= 49, 11^2= 121, 13^2= 169, 17^2= 289
51)c; Second number is the cube of three more than the first number.
4+3 = 7 → 7^3 = 343
7+3 = 10 → 10^3 = **1000**
52)b; The second number is 1760 less than the first number.
1947 – 1760 = 187
5405 – 1760 = 3645
53)a; The second number is the sum of the first number and its next consecutive prime number.
Next prime number to the 13 is 17. 13 + 17 = 30.
Next prime number to the 41 is 43, ∴ 41 + 43 = **84**.
54)d; This is in the form of $n^3 : n^3 + n$
27 = 3^3 ∴ 27 : 30 ($3^3 : 3^3 + 3$)
125 = 5^3 ∴ 125 : **130** ($5^3 : 5^3 + 5$)
55)d; This is in the form of $n^2 : n^3 + n$
$(6)^2 : (6)^3 + 6$ ⇒ 36 : 222
$(9)^2 : (9)^3 + 9$ ⇒ 81 : **738**
56)a; This is in the form of $n : n^n$
$3 : 3^3$ ⇒ 3 : 27 ; $6 : 6^6$ ⇒ 6 : **46656**
57)b; This is in the form of n : n × 7
136 × 7 = 952 and 38 × 7 = **266**
58)c; This is in the form of n : n × 4 - 3
14 : 14 × 4 – 3 ⇒ 14 : 53
12 : 12 × 4 – 3 ⇒ **12** : 45
59)d; Sum of the digits of the first number is subtracted from that number to get the next number.
8463 + (8 + 4 + 6 + 3) = 8442
9346 – (9 + 3 + 4 + 6) = **9324**
60)a; The second number is square of the sum of the digits in the first number.
$46 : (4+6)^2 :: 72 : (7+2)^2$
∴ The required number is **81**.
61)b; Each unit is split into 3 parts and the place values of the three parts in the consecutive units shift by -8, -3 and -8.
20_{-8} W_{-3} 24_{-8} , 12_{-8} T_{-3} 16_{-8} , **4**$_{-8}$ **Q**$_{-3}$ **8**$_{-8}$, -4 N 0
62)a; Place value of consecutive characters is shifted backward by 4.
i.e, V – 4 = R, R – 4 = N , N – 4 = J, J – 4 = **F**, **F** – 4 = B
63)c; Each unit is split into four characters. Each character is shifted one place value forward in consecutive units.
C_{+1} G_{+1} K_{+1} O_{+1} = DHLP; D_{+1} H_{+1} L_{+1} P_{+1} = EIMO
E_{+1} I_{+1} M_{+1} Q_{+1} = **FJNR**; **F**$_{+1}$ **J**$_{+1}$ **N**$_{+1}$ **R**$_{+1}$ = GKOS
64)d; Every number is multiplied by $\frac{n}{4}$ to get the next number. (*n* is the position of the number in the series).
$4096 \times \frac{1}{4}$, $1024 \times \frac{2}{4} = 512$, $512 \times \frac{3}{4} = 384$,
$384 \times \frac{4}{4} = 384$, $384 \times \frac{5}{4} = 480$.
∴ Required answer is **384**.
65)b; Every number is multiplied by $\frac{n}{2}$ to get the next number (*n* is the position of the number in the series).
9 × 0.5 = 4.5, 4.5 × 1 = 4.5, 4.5 × 1.5 = 6.75,
6.75 × 2 = **13.5**, **13.5** × 2.5 = 33.75
66)a; Every number is multiplied by (n + 3) and then (n+1) is added to get the next number in series.
(*n* is the position of the number in the series).
2 × 4 + 2 = 10 ; 10 × 5 + 3 = 53; 53 × 6 + 4 = **322**;
322 × 7 + 5 = 2259
67)a; Each number is multiplied with prime numbers starting from 2.
∴ 5 × 2 = 10, 10 × 3 = 30, 30 × 5 = 150,
150 × 7 = 1050, 1050 × 11 = **11550**.
68)b; Each number is multiplied with '3' and 4 is subtracted from the result to get the next number.
126 × 3 – 4 = 374; 374 × 3 – 4 = 1118
1118 × 3 – 4 = **3350**; **3350** × 3 – 4 = 10046
69)c; Each unit is split into 3 parts and the place values of the three parts in the consecutive units shift by +1, +1 and -1.
B_{+1} A_{+1} Y_{-1} , C_{+1} B_{+1} X_{-1} , D_{+1} C_{+1} W_{-1} , **E**$_{+1}$ **D**$_{+1}$ **V**$_{-1}$, F E U
70)a; Each unit is split into 3 parts and the place values of the three parts in the consecutive units shift by +1, +1 and +1.
A_{+1} D_{+1} B_{+1} , B_{+1} E_{+1} C_{+1} , C_{+1} F_{+1} D_{+1} , **D**$_{+1}$ **G**$_{+1}$ **E**$_{+1}$, E H F

DATA INTERPRETATION - TABLES

The information related to any event given in the form of graphs, tables, charts etc is termed as data. The methodology of interpreting data to get the information is known as data interpretation.

Mathematical identities which we use in data interpretation are given below.

To solve the problems on data interpretation, you need to be thorough in 'Percentages', 'Ratios' and 'Averages' chapters.

Percentage: Proportions with the base 100 are known as percentages (%).

For example, $\frac{x}{y}\times 100$ is in percentage form.

e.g.: If the ratio of boys to total number of students in a college is $\frac{1015}{4060}$ This can be written in a percentage form as $\frac{1015}{4060}\times 100 = 25\%$.

To find by how much percent $'x'$ is more or less than y (or over y) when compared to y is given as

$$\text{Required Percentage} = \frac{\text{Value of X} - \text{Value of Y}}{\text{Value of Y}} \times 100$$

Observe that the denominator contains the value with which the comparison is made.

In the above formula, if numerator is positive, then there is percentage growth. If numerator is negative, then there is a decline in the percentage.

Ratio: In the simplest possible form, ratio is a quotient or the numerical quantity obtained by dividing one figure by the other figure of same units.

TABULAR DATA INTERPRETATION

In this type of questions a table with data as well as a set of questions on the same data is given. Analyze the table and answer the given questions.

Example: Study the following table carefully and answer the questions that follow.

Table: Percentage of marks scored by students in SSC

Marks percentage	Girls	Boys
>75	25	12
60-75	15	12
50-59	10	23
35-49	5	2
< 35	3	1

1) Give the total percentage of Girls who wrote SSC examination from that School.

1) 25% 2) 54% 3) 23% 4) 58%

2) Give the percentage of students who scored distinction (> 75).

1) 43% 2) 34.25% 3) 24.85% 4) 40%

3) Give fail percentage of students in SSC examination.

1) 1% 2) 2% 3) 4% 4) 8%

4) Give pass percentage of boys in SSC examination.

1) 90% 2) 88% 3) 98% 4) 99%

5) Give the percentage of students who scored more than 60% in the SSC examination.

1) 25% 2) 59.3% 3) 22.2% 4) 50%

Explanation:

1)2; Total no.of girls appeared for SSC Examination = 25 + 15 + 10 + 5 + 3 = 58.

Total no.of students appeared for SSC examination = 58 + 50 = 108.

$\therefore$ Percentage of girls who wrote SSC Examination = $\frac{58}{108}\times 100 = 53.7 = 54\%$ (approximately)

2)2; No.of students who scored distinction = 25 +12 =37.

$\therefore$ Percentage of students who scored distinction = $\frac{37}{108}\times 100 = 34.25\%$

3)3; Total no.of students failed in SSC examination = 4.

$\therefore$ Fail % = $\frac{4}{108}\times 100 = 3.7 = 4\%$ (approximately)

4)3; No.of boys passed in the examination = 49.

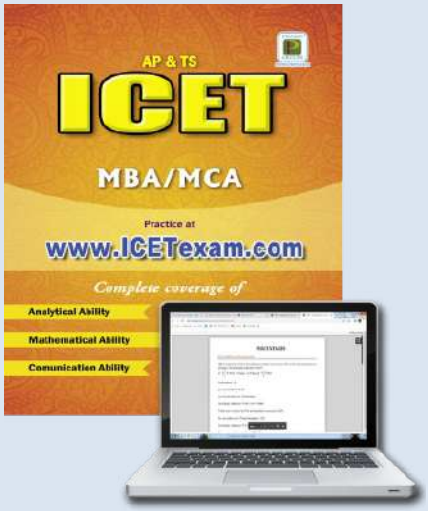
$\therefore$ Boys pass percentage = $\frac{49}{50}\times 100 = 98\%$

5)2; No.of students who scored more than 60% = 64.

$\therefore$ Percentage of students who scored more than 60% = $\frac{64}{108}\times 100 = 59.26\% = 59.3\%$ (approximately)

Example: Production of cars by different companies in the span of 1980-2005 given. Interpret the data to answer the questions given below.

Company	Production of cars in thousands				
	1980-85	1985-90	1990-95	1995-00	2000- 05
Maruthi	12.5	15.0	16.2	18.0	22
Hindustan Motors	10.4	11.1	11.5	11.5	12
Hyundai Motors	12	14.3	16.2	17.8	18.9
Ford	14.4	14.1	13.2	18.1	25.3
General Motors	19.2	13.8	13.5	14.1	15.8



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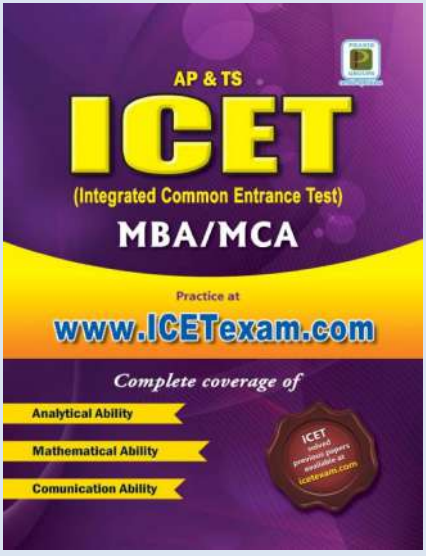

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39)3; From 2000 to 2005, the prices of coconut oil increased highest in 2005. *i.e.* 5892 – 4872 = Rs. 1020.

40)1; Clearly, from the table, 'black grams' decreased twice from 2000 to 2005. *i.e.* in 2001 and 2003.

41)3; Fare from Mumbai to Chennai in Jet Airway=5448.
Fare from Mumbai to Chennai of Air India=3648.
Difference = 5448 – 3648 = Rs.1800.
∴ Fare of Jet airways is more than Air India by
$\frac{1800}{3648}\times 100 = 49.3\,\%$

42)3; Flight charges = (6×4426) + (4×2848) + (5×2789)
= 26556 + 11392 + 13945 = 51893.

43)4; Highest price of flight fare from Mumbai to Kolkata = 6642 (Jet airways)
Lowest price of flight fare from Mumbai to Kolkata
= 2789 (Air Deccan)
∴ The difference price = 3853.
∴ Flight fare of Jet Airways is more than Air Deccan from Mumbai to Kolkata by $\frac{3853}{2789}\times 100 = 138\,\%$.

44)4; Flight fare of Indian Airways from Mumbai to Hyderabad = 2864. Flight fare of Indian Airways from Mumbai to Goa = 4866
∴ The difference of the fare = 4866 – 2864 = 2002.
Flight fare of Indian Airways from Mumbai to Hyderabad is less than the flight fare from Mumbai to Goa by $\frac{2002}{4866}\times 100 = 41\,\%$.

45)3; Clearly, from the table, flight fare of Indigo from Mumbai to Hyderabad and Mumbai to Delhi are equal.

46)3; The fees paid by the man in 1998–99
= 1 Grad + 1 Inter + 1 Class-IX + 1 Class-V
= 12845 + 9152 + 6294 + 5265 = 33556.

47)2; Course fees increased for post graduation in 2000–01 = 17256 – 16000 = 1256.
∴ Increased Percentage = $\frac{1256}{16000}\times 100 = 7.8\,\%$.

48)1; Tuition fee of Inter in 1996–97 = 7650
The tuition fee of Inter in 2001–02 = 11830
∴ Increased tuition fee = 11830–7650 = 4180
∴ Increased Percentage = $\frac{4180}{7650}\times 100$ = 55% (approx).

49)1; Avinash got 1st rank in 1996–97.
∴ He paid post graduate fee in 1997–98.
He got concession of 35% of his fee.
He paid remaining 65% of the post graduation course fee = $\frac{65}{100}\times 12400 = 8060$.

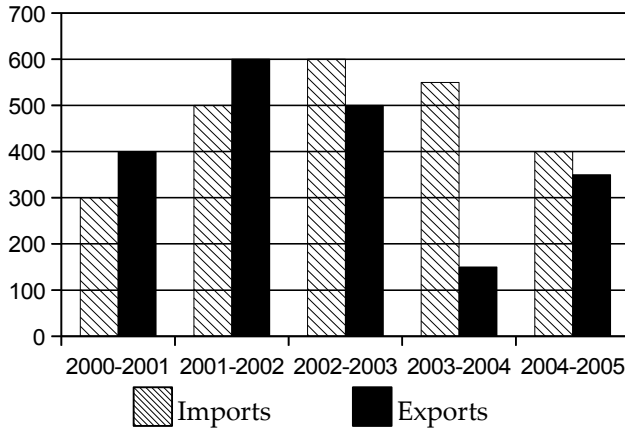
50)1; Fee increased for class VIII-X from 1997–1998 to 2000–2001 = 7200 – 5684 = 1516.
∴ Increased percentage = $\frac{1516}{5684}\times 100 = 27\%$ (approx)

DATA INTERPRETATION – BAR GRAPHS

CONCEPTS

Bar graphs normally comprise X-axis, Y-axis and bars. X and Y-axes represent the data. And bars represent the trend of data with respect X and Y-axes. In this type of questions, data is given in the form of bar graphs. You need to analyze the bars with respect to X and Y-axes to answer the given questions.

Example: Imports and exports of a country from 2000 - 2001 to 2004 -2005.



1) In which of the following year the gap between import and export was maximum.

1) 2001-02 2) 2002-03 3) 2003-04 4) 2004-05

2) In which of the following year the gap between imports and exports was minimum.

1) 2002-2003 2) 2003-2004 3) 2004-2005 4) none

3) Exports in 2001–2002 was approximately how many times that of the year 2003–2004.

1) 2 2) 3 3) 4 4) 5

4) Give the ratio between the number of years in which exports is greater than imports and import is greater than exports.

1) 3 : 2 2) 2 : 3 3) 3 : 1 4) 1 : 3

5. Difference between average of imports and exports is

1) 100 2) 90 3) 80 4) 70

Explanations:

1)3; From the graph, gap between import and export was maximum in 2003-2004.

2)3; From the graph, gap between imports and exports is minimum in 2004-2005 = 400–350 = 50 crore.

3)3; Exports of the year 2001–2002 = 600

Exports of the year 2003–2004 = 150

∴ Exports of 2001–2002 is 4 times greater than that of 2003–2004.

4)2; In 2 years *i.e.* 2000-2001 and 2001-2002 exports are greater than imports.

In 3 years *i.e.* 2002-2003, 2003-2004, 2004-2005 imports are greater than exports.

5)4; Average of imports during 2000-2005 =

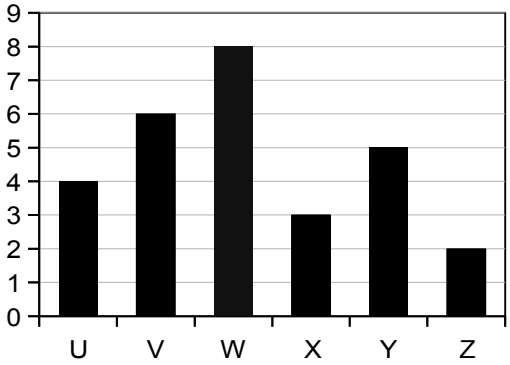
$$\frac{300+500+600+550+400}{5}=\frac{2350}{5}=470$$

Average of exports during 2000-2005 =

$$\frac{400+600+500+150+350}{5}=\frac{2000}{5}=400$$

∴ Difference = 470 – 400 = 70.

Example: Turnover in crores of six companies (U, V, W, X, Y and Z) are given.



1) Which company's turn over is highest?

1) U 2) V 3) W 4) X

2) What is the percentage of turn over of the company-X over the turn over of the company-V?

1) 25% 2) 50% 3) 75% 4) 100%

3) Give the difference of average turnovers of first three companies and last three companies.

1) 3.33 2) 6.66 3) 2.67 4) 1.85

4) Give the percentage contribution of turnover of W in the overall turnover of all the companies.

1) 12% 2) 50% 3) 40% 4) 29%

5) Difference of average percentage contribution of turnovers of companies U, V and X, Y is.

1) 1% 2) 2% 3) 3% 4) 4%

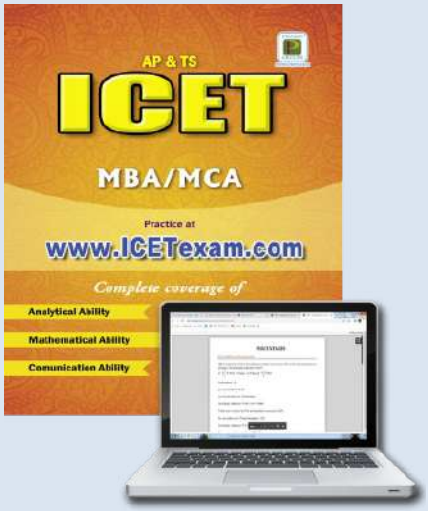
Explanations:

1)3; It is clear from the graph that turn over of company W is highest *i.e.* 8 crores.

2)2; Turnover of company X = 3 crores

Turnover of company V = 6 crores

∴ Percentage of turn over of X over V= $\frac{3}{6}\times 100=50\%$



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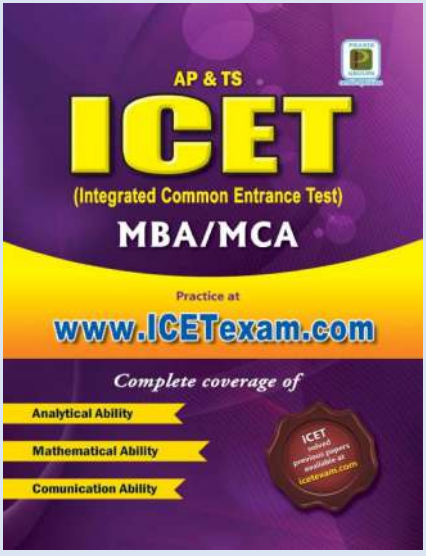

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EXPLANATIONS

1)3; From the graph, we can say, only family C spends more money than it earns.

2)2; From the graph, expenditure of only family C is more than its income. ∴ Ratio becomes 4 : 1

3)2; We can clearly observe that income of D is twice greater than that of the income of E.

4)2; Average income of five families = $\frac{30000}{5}=6000$

Average expenditure of five families = $\frac{21000}{5}=4200$

∴ Difference = 6000 – 4200 = 1800

5)4; Income of the family E = 4000.

Income of the family B = 7000

∴ Percentage of income of E over the income of B = $\frac{4000}{7000}\times 100=57.41\%$.

6)2; From the graph, we can say, maximum percentage of IIT students appeared for the exam in 2000.

7)3; From the graph, we can observe that there is sudden fall in the percentage of students appearing for IIT examination in 1997-1998.

8)3; During 1996-1997 there is only 40% increase rate but during 1999-2000 there 50% increase rate.

9)3; Percentage of students appeared for IIT exam in 1996 = 20; That of in 1999 = 30; ∴ Difference = 10%.

10)2; Percentage of students appearing for IIT exam in 1997 = 60; That of in 1999 = 30.

∴ Ratio = 60 : 30 = 2 : 1.

11)3; Percentage of infant death rate of state 4 = 25%.

Percentage of infant death rate of state 3 = 30%.

Difference = 5%.

Increase in the percentage of infant death rate from state 3 to state 4 = $\frac{5}{25}\times 100=20\%$.

12)1; Percentage of infant death rate of state 3 = 30.

Percentage of infant death rate of state 2 = 15.

13)4; The ratio between percentage of infant death rates of state 1 and state 5 = 35 : 50 = 7 : 10.

14)4; Infant death rate of state 1 = 35%

Infant death rate of state 2 = 15%.

Difference = 20%

∴ Decrease in the percentage of infant ratio of state 2 over state 1 = $\frac{20}{35}\times 100=57\%$

15)2; Average percentage of infant death rate = $\frac{35+15+30+25+50}{5}=\frac{155}{5}=31\%$

16)4; Sale of pep-up was maximum in 1989.

17)1; Average annual sale of Dew-drop = $\frac{10+15+25+15+30+25}{6}=20$ lakhs

Average annual sale of Cool-sip = $\frac{25+7+20+20+25+30}{6}=21.16$ lakhs

Average annual sale of Pep-up = $\frac{30+35+30+25+20+20}{6}=26.66$ lakhs

18)3; Required percentage = $\frac{25-20}{20}\times 100=25\%$

19)3; Required number = 30 – 20 = 1000000

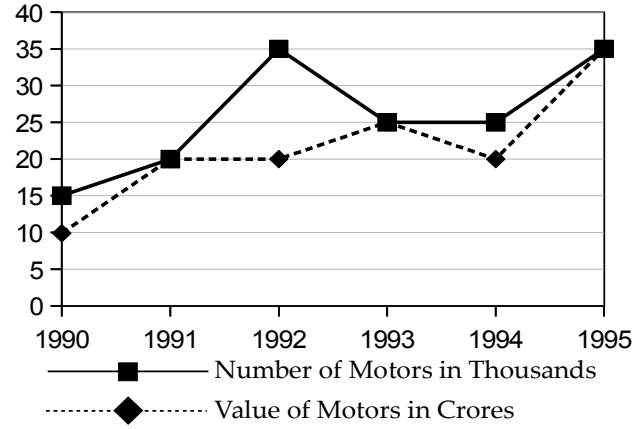
20)3; Required percentage drop = $\frac{35-30}{35}\times 100=14\%$

DATA INTERPRETATION - LINE GRAPHS

CONCEPTS

Line graphs: Line graphs normally comprise X-axis , Y-axis and lines. X-axis and Y-axis represent the data and lines represent the trend of data with respect to X and Y-axis. In this type of questions the data is given in the form of line graphs. You need to analyze the peaks and depth of the line graphs to answer the questions.

Example: Production of motors by a company.



1) What was the value of each motor in 1995?

1) Rs. 50000 2) Rs. 35000 3) Rs. 10000 4) Rs. 15000

2) What was the percentage hike in production of number of motors from 1991 to 1992?

1) 25 2) 50 3) 75 4) 100

3) What was the difference in revenue from the motors sold in 1993 and 1994?

1) 2 crore 2) 5 crore 3) 4 crore 4) 3 crore

4) What was the difference in the value per motor between the years 1990 and 1991?

1) 1282 2) 2228 3) 3333 4) 4456

5) In which of the following years number of motors in thousands graphically coincides with the value of motors (in crores)?

1) 1991 2) 1993 3) 1995 4) All

Explanations:

1)3; Value of each motor in 1995

$$\frac{\text{Total value in 1995}}{\text{Number of motors in 1995}} = \frac{35\times10^7}{35\times10^3} = 10^4 = \text{Rs. } 10000$$

2)3; Percentage hike in the production of motors from 1991 to 1992= $\frac{35-20}{20}\times100$ =75%.

3)2; Difference in revenue from the motors sold in 1993 and 1994 = (25–20) in crores = 5 crores

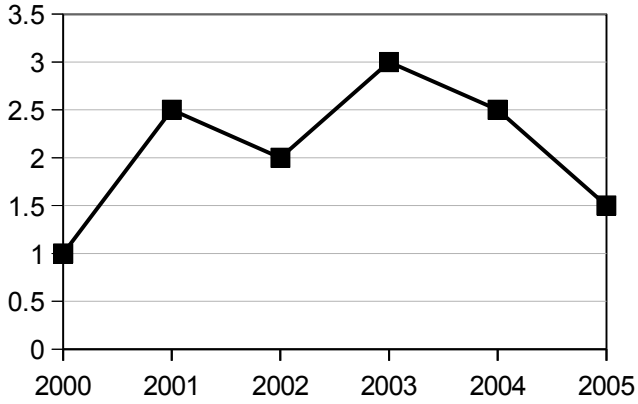
4)3; Value of each motor in 1990 = 6666.66 = Rs.6667

Value of each motor in 1991 = Rs. 10000.

∴ Difference in the value per motor between the years 1990 and 1991 = 10000 - 6667 = Rs. 3333.

5)4; From the graph we can understand that the number of motors (in thousands) graphically coincides with the value of the motors (in crores) in 1991, 1993 and 1995.

Example: Financial report of a company from 2000-2005; On Y axis - Ratio of income to expenditure.



1) If the income in 2003 was Rs. 200000 lakhs then give the expenditure of that year.

1) 150000 2) 33333 3) 66666 4) 800000

2) Find percentage decrease in income from 2001 to 2002.

1) 25 2) 50 3) 75 4) Data inadequate

3) Give the ratio between ratios of income expenditure of 2003 and 2004.

1) 2 : 3 2) 3 : 2 3) 5 : 6 4) 6 : 5

4) In how many years the expenditure shows a positive growth with respect to income.

1) 3 2) 2 3) 5 4) Data Inadequate

5) If the expenditure of company in 2004 is Rs. 10 lakh then give the income of that company in that year.

1) Rs.10 lakhs 2) Rs.25 lakhs 3) Rs.30 lakhs 4) None

Explanations:

1)3; In 2003, $\frac{\text{Income}}{\text{Expenditure}} = 3$

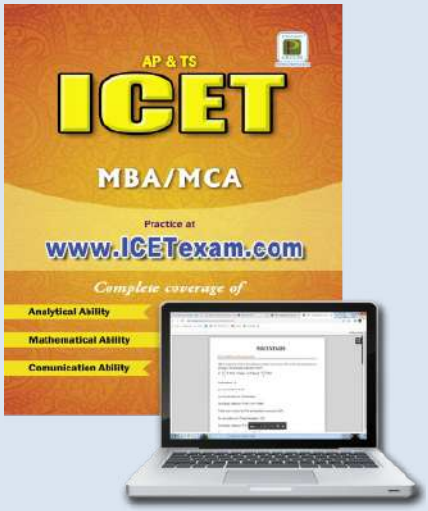
$$\text{Expenditure} = \frac{\text{Income}}{3} = \frac{2}{3}\text{ lakhs} = \frac{200000}{3} = \text{Rs. } 66666$$

2)4; From the graph we cannot depict the absolute values of income and expenditure. Hence, data is inadequate.

3)4; Ratio of income to expenditure in 2003 is 3.

Ratio of income to expenditure in 2004 is 2.5.

∴ Ratio between these ratios = 3 : 2.5 = 6 : 5.



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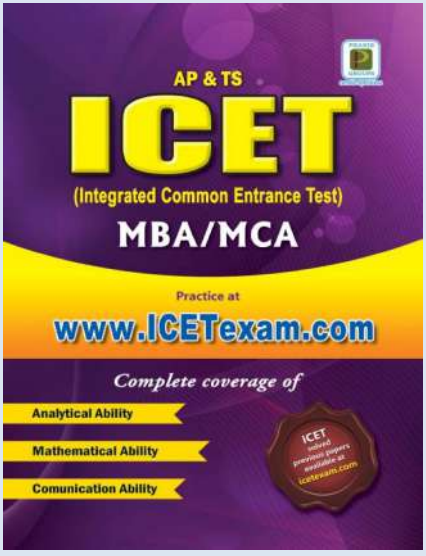

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22)4; Income of company B in 1997 = Rs. 42 lakh.

Income increased by 40% = $\frac{40}{100}\times 42 = 16.8$

Then, income of company B in 1998 = Rs. 58.8 lakh.

Profit of company B in 1998 = 30%.

$\therefore$ Profit of company in B in 1998 $= \frac{\text{Exp.}\times 30}{100} = \frac{3}{10}\text{Exp.}$

$\therefore \text{Income} = \text{Expenditure} + \text{Profit.}$

$58.8 = \text{Exp.} + \frac{3}{10}\text{Exp.} \Rightarrow \frac{13}{10}\text{Exp.}$

Expenditure of company B in 1998 =

$\frac{588}{13} = 45.2 \cong 45$ lakhs.

23)4; Profit Percentage $= \frac{\{\text{Income} - \text{Expenditure}\}}{\text{Expenditure}}$

Given that, expenditure is same for both companies.

$\frac{I_A - E}{E} = \frac{80}{100} \Rightarrow I_A = \frac{80E}{100} + E = \frac{180E}{100}$ ------ (1)

$\frac{I_B - E}{E} = \frac{50}{100} \Rightarrow I_B = \frac{50E}{100} + E = \frac{150E}{100}$ -------(2)

From the given data, $I_A + I_B = 15.75$ millions

i.e $\frac{180E}{100} + \frac{150E}{100} = 15.75 \text{ millions} \Rightarrow \frac{330E}{100} = 15.75 \text{ millions}$

$\Rightarrow$ E = 4.77 millions = 48 lakhs approximately.

24)4; $\frac{I_A - E_A}{E_A} = \frac{20}{100} \Rightarrow I_A = \frac{120E_A}{100}$

$\frac{I_B - E_B}{E_B} = \frac{40}{100} \Rightarrow I_B = \frac{140E_B}{100}$

From the given data, $I_A = I_B$.

i.e. $\frac{120E_A}{100} = \frac{140E_B}{100} \Rightarrow \frac{E_A}{E_B} = \frac{140}{120} \Rightarrow 7:6.$

CODING – DECODING

CONCEPTS

A code is a system of words, letters or signs which is used to represent a message in secret form. The student is expected to identify the rule interpreted and decode the given message.

Approach to solve the questions:

1. You will be given two messages, one is original message and another one is coded message.
2. You have to compare each element of the original message with corresponding element of coded message. Thereafter try to identify the rule in which coded message is formed.
3. Using the identified rule you can easily answer the question asked.

Tips to solve easily:

1) Remember English alphabets from A to Z with their position values *i.e.* A–1, B–2, C–3, ..., Z–26.

2) Remember reverse order of English alphabets. *i.e.* Z to A with their position values *i.e.* Z–1, Y–2, ... , A–26.

3) Remember the corresponding opposite letter of each alphabet with their position values. The following table will give the opposite letter of each alphabet.

1	2	3	4	5	6	7	8	9	10	11	12	13
A Z	B Y	C X	D W	E V	F U	G T	H S	I R	J Q	K P	L O	M N
26	25	24	23	22	21	20	19	18	17	16	15	14

To find out the opposite letter of a particular letter, we can use the below formula.

Sum of the position numbers of a letter and it's opposite letter is always 27.

Position number of a letter + Position number of its opposite letter = 27.

e.g.: The opposite letter of 'H' is 'S'.

Because, H–8, S–19. H+S = 27 ⇒ 8+19=27.

Types of Coding-Decoding:

(I) <u>Letter Coding:</u> In this type of coding, the original alphabets of the given word are replaced by certain other alphabets based on specific rule to form its code. You have to detect the hidden rule and answer the questions accordingly.

Examples: (1) In a certain code language,'COLLEGE' is written as 'GSPPIKI' then how will 'GROUPS' be written in that code?

Explanation: Each letter of the word is moved four steps forward to obtain the code. So, GROUPS will be coded as KVSYTW.

2) 'ZYXW' as coded as 'ABCD' then 'STUV' is coded as.

Explanation: Here each letter is coded with its opposite letter. *i.e.* Z – A, Y – B, X – C, W – D.

Similarly, S – H, T – G, U – F, V – E.

3) *'bcd'* is coded as *'def'* then *'true'* is coded as.

Explanation: Here every letter is moved two steps forward. *i.e. b* (+2) → *d* , *c* (+2) → *e*, *d* (+2) → *f* .

Similarly, *t* → *v*, *r* → *t*, *u* → *w*, *e* → *g*.

So, the answer is *'vtwg'*.

4) *'Hyderabad'* is coded as *'ixedszcze'* then *'chennai'* is coded as?

Explanation:

Here the letters are alternatively increasing and decreasing by 1.

h(+1) → *i* , *y*(-1) → *x* , *d*(+1) → *e* , *e*(-1) → *d*, *r*(+1) → *s*,

a(-1) → *z*, *b*(+1) → *c*, *a*(-1) → *z*, *d*(+1) → *e*.

So, *chennai* will be coded as *dgfmozj*.

(II) <u>Number Coding:</u> In this type of coding, alphabets are assigned to the numbers or numerical code values are assigned to a word or alphabets. You have to compare the given codes to answer the questions.

Example:

1) If READ is coded as 7421 and BOOK is coded as 8335, then how would you encode BOARD?

Explanation: The alphabets are coded as follows.

R	E	A	D		B	O	O	K
7	4	2	1		8	3	3	5

From the above codes, we can say, B is coded as 8, O is coded as 3, A is coded as 2, R is coded as 7, D is coded as 1. Hence, BOARD is coded as 83271.

(III) <u>Substitution:</u> In this type, the names of objects are substituted with different names. We should carefully trace the substitution to answer the questions.

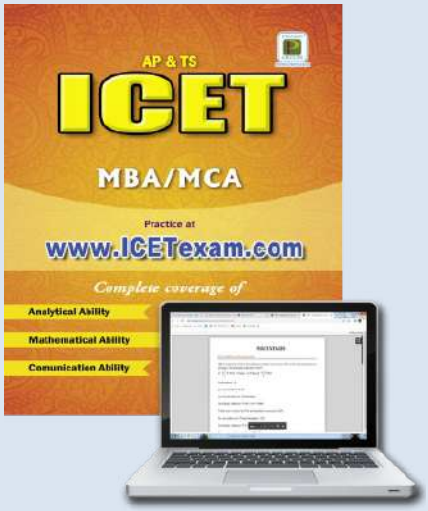
Example:

1) In a certain code language, *'book'* is coded as *'pencil'*, *'pencil'* is coded as *'mirror'*, *'mirror'* is coded as *'board'*. Then what is useful to write on a paper?

Explanation: We use *pencil* to write on a paper but here *pencil* is coded as *mirror.* So, the answer is *mirror.*

2) In a certain language, *'man'* is called as *'woman'*, *'woman'* is called as *'girl'*, *'girl'* is called as *'boy'*, *'boy'* is called as *'worker'*. Then in the same language what does a 6 year old female is called?

Explanation: In general language, 6 years old female is called as *girl*. But in the given coded language *'girl'* is called as *'boy'*. So, the answer is *'boy'*.



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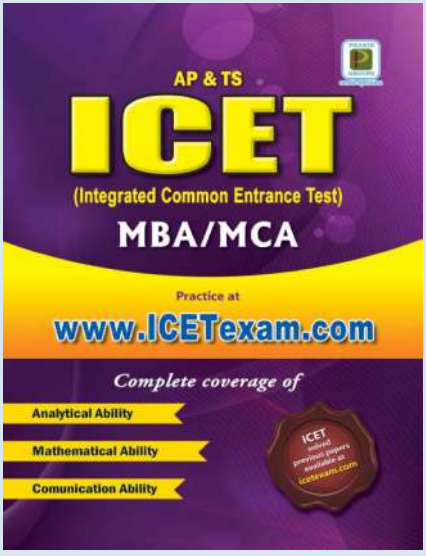

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NOTE Every letter the given word is coded as '-1' with English alphabet for Questions **28 to 37**.

The coding chart is as below:

l: character c: coded character

l	A	B	C	D	E	F	G	H	I	J	K	L	M
c	Z	A	B	C	D	E	F	G	H	I	J	K	L
l	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
c	M	N	O	P	Q	R	S	T	U	V	W	X	Y

28)a; 29)b; 30)b; 31)c; 32)d; 33)d; 34)a; 35)b; 36)c; 37)a;

Coding chart for questions **38 - 47** is as below:

l: character

f: character shifted forward by 2 place values

b: character shifted backward by 2 place values.

l	A	B	C	D	E	F	G	H	I	J	K	L	M
f	C	D	E	F	G	H	I	J	K	L	M	N	O
b	Y	Z	A	B	C	D	E	F	G	H	I	J	K
l	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
f	P	Q	R	S	T	U	V	W	X	Y	Z	A	B
b	L	M	N	O	P	Q	R	S	T	U	V	W	X

38**)d;** n = No. of letters in the word. MADRAS = 6, which is even. ∴ The first $\frac{n}{2}$ = 3 letters should be shifted forward by 2 places. M → O, A → C, D → F.

And last $\frac{n}{2}$ = 3 letters should be shifted backward by 2 places. R → P, A → Y, S → Q.

Hence, the code for MADRAS is OCFPYQ.

39)b; Here n = 6, i.e even.

∴ The code word for KERALA is MGTYJY

40)c; Here n = 5, $\frac{n-1}{2}$ = 2 letters are forwarded by 2 places. E → G, N → P, middle letter 'J' remains same. O → M, Y → W

∴ The code word for Enjoy is GPJMW

41)a; Here, n = 7, $\frac{n-1}{2}$ = 3 letters are forwarded by 2 places. W → Y, E → G, B → D middle letter 'S' is fixed. Last 3 letters are shifted backward by 2 places.

I → G, T → R, E → C.

∴ The required code word for WEBSITE is YGDSGRC

42)a; Here, n=d; even

∴ The code E X A M

↓ ↓ ↓ ↓

G Z Y K

43)d; Here, n=5; odd.

∴ The code M U S I C

↓ ↓ ↓ ↓ ↓

O W S G A

44)c; Here, n=6; even, ∴ The code for the given word is

T E M P L E

↓ ↓ ↓ ↓ ↓ ↓

V G O N J C

45)c; Here, n=8; even, ∴ The code for the given word is

S O F T W A R E

↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓

U Q H V U Y P C

46)a; Here, n=6; even, ∴ The code for the given word is

S C H O O L

↓ ↓ ↓ ↓ ↓ ↓

U E J M M J

47)d; Here, n=5; odd, ∴ The code for the given word is

H O U S E

↓ ↓ ↓ ↓ ↓

J Q U Q C

The coding chart for questions 21-30 is as below:

l: character c: coded character

l	A	B	C	D	E	F	G	H	I	J	K	L	M
c	I	F	G	H	O	J	K	L	U	M	N	P	Q
l	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
c	R	A	S	T	V	W	X	E	Y	Z	B	C	D

48)a; 49)b; 50)c; 51)d; 52)d; 53)b; 54)a; 55)b; 56)c; 57)d;

The code sheet for the questions 58 - 67 is as below

l = character; n = Place Value;

r = Rem(n/26); c = coded character;

l	A	B	C	D	E	F	G	H	I	J	K	L	M
n	1	2	3	4	5	6	7	8	9	10	11	12	13
r	9	14	19	24	3	8	13	18	23	2	7	12	17
c	I	N	S	X	C	H	M	R	W	B	G	L	Q
l	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
n	14	15	16	17	18	19	20	21	22	23	24	25	26
r	22	1	6	11	16	21	26	5	10	15	20	25	4
c	V	A	F	K	P	U	Z	E	J	O	T	Y	D

58)a; 59)b; 60)c; 61)a; 62)b; 63)c; 64)d; 65)a; 66)b; 67)c;

DAY SEQUENCE/ CALENDAR

CONCEPTS

In day sequence, questions will be asked on calendars to find a particular day of the week (or) a particular day of the given date. In order to solve these problems easily, you should have knowledge on calendar *i.e.* leap year, odd days etc.

• **Leap year:** If the last two digits of a given year is perfectly divisible by 4 then that year is a *leap year.*

Example: 2016 is a leap year because last 2 digits *i.e.* 16 is perfectly divisible by 4.

But a century year is not a leap year *i.e.* 100, 200, 300,.... But every 4th century year is a leap year. *i.e.* 400, 800, 1200, 1600, 2000 etc.

A leap year has 366 days.

Examples:

(i) Each of the years 1764, 1028, 1948, 1676, 2004 etc is a leap year.

(ii) Each of the years 400, 800, 1200, 1600, 2000, 2400 etc is a leap year.

(iii) The years 2001, 2002, 2003, 2005, 1900, 2100 are not leap years.

• **Ordinary year:** The year that is not a leap year is called an *ordinary year*. An ordinary year has 365 days.

In order to solve the questions on calendars, we use a concept called *'odd days'*.

• **Odd day:** The number of days more than a complete week are called *odd days* in a given period.

Lets discuss how to count the odd days in a given period.

• **Counting of odd days:**

To find the number of odd days in a given period, we divide the total number of days with 7. The remainder obtained is the total number of *odd days*.

Examples:

1) How many odd days are there in 10 days.

Explanation:
```
7) 10 (1
   7
   3 = Remainder → 3 odd days.
```

2) How many odd days are there in 100 days.

Explanation:
```
7) 100 (14
   98
    2 → odd days
```

3) How many odd days are there in an ordinary year?

Explanation: An ordinary year has 365 days. So,
```
7) 365 (52
   364
    1 → odd day
```

• Hence, in an **ordinary year** there are 52 perfect weeks and **1 odd day**. [365 days = 52 weeks + 1 day]

4) How many odd days are there in a leap year?

Explanation: As we know, a leap year has 366 days. So,
```
7) 366 (52
   364
    2 → odd days
```

• Hence, in a **leap year**, there are 52 perfect week and **2 odd days**. [366 days = 52 weeks + 2 days]

Note: Total number of odd days can be from **0 to 6** only.

• Counting odd days for century years:

1) 100 years = 76 ordinary years + 24 leap years.
= (76×1 + 24×2) odd days = 124 odd days

(Here 1 and 2 indicates number of odd days in *an ordinary year* and *a leap year* respectively)

124 odd days = 17 weeks + 5 days = 5 odd days.

∴ Number of odd days in **100** years = **5**.

2) Number of odd days in **200** years = (5×2) = **3**.

3) Number of odd days in **300** years = (5×3) = **1**.

4) Number of odd days in **400** years = (5×4+1) = **0**.

Similarly, each set of 800, 1200, 1600, 2000 year etc has 0 (zero) odd days as they are multiples of 400.

• Some Important points to remember:

1) In every *normal / ordinary year* the first day (1st January) and the last day (31st December) are always same. For example, if January 1st is *Monday* then December 31st is also *Monday.*

2) In every leap year if the first day (January 1st) is *Sunday*, then last day (December 31st) will be it's next day *i.e. Monday.*

3) In every year, the calendar for the months *April* and *July* are always same.

4) For every 400 years, the day repeats.

For example, if 14-April-1604 is *Saturday*, then 14-April-2004 will also be *Saturday.*

5) The last day of a century cannot be either *Tuesday* or *Thursday* or *Saturday.*

Questions on day sequence / calendar are mainly 5 types.

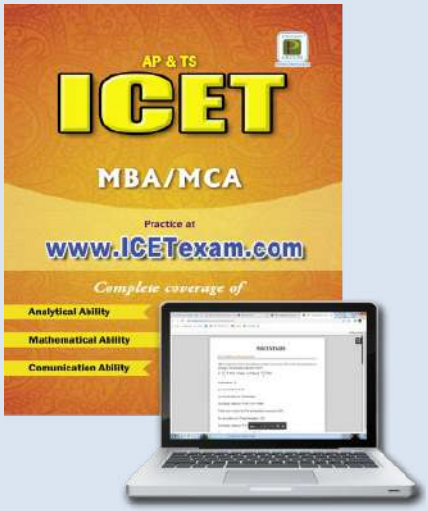
1) Problems based on Total Day–Particular Day.

2) Problems based on Leap Year.

3) Problems based on Particular Date–Day.

4) Problems based on Same Calendar Year.

5) Problems based on Same Day–Date of the Month.



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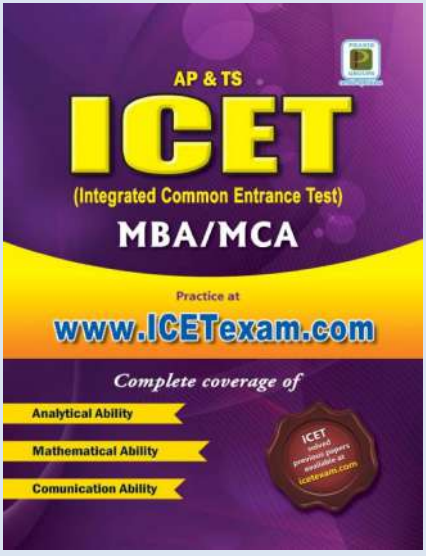

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18)2; Odd day from 2024 to 2030 is

2024, 2025, 2026, 2027, 2028, 2029, 2030

2 1 1 1 2 1

Number of Odd days = 2 + 1 + 1 + 1 + 2 + 1 = 8

Required Day = Given day + $remainder\left(\frac{8}{7}\right)$

= *Tuesday* + 1 = *Wednesday*

∴ The day on 01-Jan 2030 is *Wednesday.*

19)1; Here 600 is a century year. So, It should be divisible by 400 to become a leap year. But it is not divisible by 400. So, 600 is not a leap year. Remaining all are leap years, because 2076 and 2084 are divisible by '4' and 2000 is divisible by 400.

20)4; Given date 08–May–1986. (*Check with Type*-3)

Required day $=\frac{08+2+85+21+0}{7}=remainder\left(\frac{116}{7}\right)=4$ ∴ From day codes table 4 = *Thursday.*

Ask doubt with Question Id: 8002

21)3; Sahithya born 2 years, 2 months 2 days after Alekhya born. *i.e.*, Sahithya born exactly 2 years, 2 months and 2nd day from Alekhay's birthday.

i.e., Sahithya born on: 06 – October – 1994.

Required day $=\frac{06+1+93+22+0}{7}=\frac{122}{7}=3(remainder)$

∴ From day codes table, 3 = Wednes*day.*

Ask doubt with Question Id: 8003

22)1; In order to solve this, we should know the date of first Sunday of January 2014. For this we have to find the day of the 01-January-2014.

i.e. $\frac{01+1+13+3+6}{7}=remainder\left(\frac{24}{7}\right)=3=Wednesday$

01-Jan-2014 is *Wednesday.*

∴ So, first *Sunday* will be on 05-Jan. And *Sundays* fall on 5th, 12th, 19th and 26th of January 2014.

23)3;From the concepts, we know 100 years=5 odd days

Day after 100 years = *Sunday* + 5 = *Friday.*

24)1; Since, 2020 is a leap year, add 28 to get same calendar year *i.e.* 2020 + 28 = 2048.

25)4; 1998 is not a leap year. So, write up to leap year before and after the given year including 1998.

i.e. 1996 1997 1998 1999 2000

Now eliminate leap years. *i.e.* 1997, 1998, 1999.

Add the code (6) (11) (11).

1997	1998	1999
6	11	11
	2009	

The sum corresponding to the given year is the answer.

∴ The year 2009 will have the same calendar year 1998.

26)1; Since, 2016 is a leap year. So, there are 2 odd days.

∴ Required day = *Sunday* + 2 = *Tuesday.*

27)2; No.of odd days from 26-Mar-2013 to 14-Oct-2013=

= 5 + 2 + 3 + 2 + 3 + 3 + 2 + 14 = $remainder\left(\frac{34}{7}\right)=6$.

So, 6 days after *Tuesday* is *Monday*.

28)3; If today is *Monday,* then day after tomorrow will be *Wednesday.* We have to find the day 126 days ago of Wednesday.

∴ Required day = Wednesday – $remainder\left(\frac{126}{7}\right)$

= Wednesday – 0

∴ The required day is *Wednesday* itself.

CLOCKS

CONCEPTS

1) 60 minute space traces an angle of 360^0 for minute hand. $\therefore$ 1 minute space traverses an angle of 6^0.

2) In 1 hour:

Minute hand traverses 60 minute space or 360^0.

Hour hand traverses 5 minute space or 30^0.

3) The minute hand travels 90^0 in 15 minutes.

4) The hands of the clock are in straight line when they coincide (or) when they are opposite to each other.

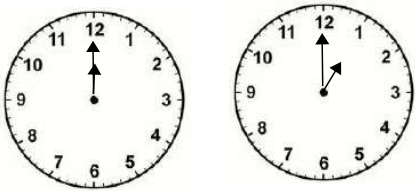
5) The hands of the clock are perpendicular to each other for 22 times in 12 hours and for 44 times in day.

6) The hands of the clock are opposite to each other for 11 times in 12 hours and 22 times in a day.

7) The hands of the clock coincides with each other for 11 times in 12 hours and 22 times per day.

8) The hands of the clock are 44 times in a straight line per day.

9) 55 minute spaces are gained by minute hand in 60 minutes period.



To find how many minute spaces it has actually gained, let us assume a standard point where the both minute hand and hour hand coincides. After 60 minutes, minute hand moves 60 minute spaces and hour hand moves 5 minute spaces. Now there are 55 minute spaces between minute hand and hour hand. So we can say in 60 minutes of time, minute hand leads/gains hours hand by 55 minute spaces.

Angle traversed by the hands of the clock

Hand of clock	Second (S)	Minute (M)	Hour (H)
1 s	6^0	$\left(\frac{1}{10}\right)^0$	$\left(\frac{1}{120}\right)^0$
1 m = 60s	360^0	6^0	$\left(\frac{1}{2}\right)^0$
1 h = 60m = 3600s	21600^0	360^0	30^0
12 h	259200^0	4320^0	360^0

Angle of hands with respect to 12-Marking on clock when hour, minute and seconds are given,

$$\theta_H=\left[30\mathrm{H}+\frac{M}{2}+\frac{\mathrm{S}}{120}\right]^0$$

$$\theta_M=\left[6\mathrm{M}+\frac{\mathrm{S}}{10}\right]^0 \;;\; \theta_S=6\mathrm{S}^0$$

Example: At what time between 2 O'clock and 3 O'clock the hands of the clock be together.

Explanation: At 2 O'clock the minute hand is at 12 and hour hand is at 2. They are 10 minute spaces apart. To be together, minute hand must gain 10 minute spaces over hour hand. 55 minutes are gained in 60 minutes.

10 minutes are gained in x minutes.

i.e. $x=\frac{10\times60}{55}=10\frac{10}{11}$ minutes after 2 O'clock the two hands of a clock will be together.

Alternate Method: Hands of the clock are together. It means the angle between minute hand and hour hand is zero. $\theta=\left|\theta_M-\theta_H\right|=\frac{11}{2}m-30\mathrm{h}\Rightarrow\frac{11}{2}m-(30\times2)=0$

$$\Rightarrow\frac{11}{2}m=60m=\frac{120}{11}=10\frac{10}{11}$$

Example: What is the angular difference between the Hours hand and Seconds hand at 4:25:40.

Explanation:

$$\theta=\left|\theta_S-\theta_H\right|=\left|6\mathrm{S}-\left(30\mathrm{H}+\frac{M}{2}+\frac{S}{120}\right)\right|$$

$$=\left|\frac{119\mathrm{S}}{120}-30\mathrm{H}-\frac{M}{2}\right|$$

$$=\left|\frac{119*40}{120}-30*4-\frac{30}{2}\right|$$

$$=\left(120+15-\frac{119}{3}\right)^0=\left(\frac{286}{3}\right)^0$$

Example: What is the angular difference between the Minute hand and Seconds hand at 4:25:40.

Explanation:

$$\theta=\left|\theta_S-\theta_M\right|=\left|6\mathrm{S}-\left(6\mathrm{M}+\frac{S}{10}\right)\right|$$

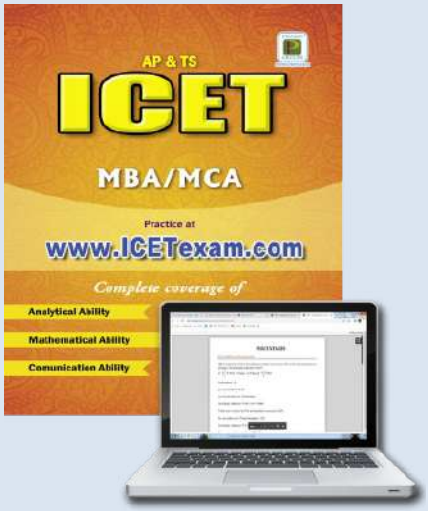
$$=\left|\frac{9\mathrm{S}}{10}-6\mathrm{M}\right|=\left|\frac{9*40}{10}-6*25\right|$$

$$=\left(150-36\right)^0=114^0$$

Example: At what time between 2 O'clock and 3 O'clock the hands of the clock are opposite to each other.

1) $3\left(\frac{6}{11}\right)$ 2) $43\left(\frac{7}{11}\right)$ past 2 O'clock

3) $56\left(\frac{8}{11}\right)$ past 2 O'clock 4) $64\left(\frac{9}{11}\right)$ past 2 O'clock



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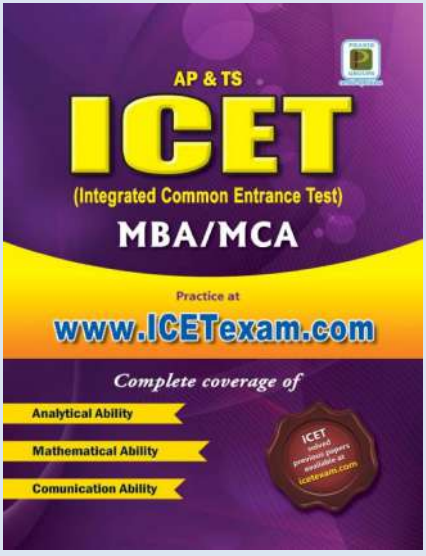

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6)2; At 9 O'clock the minute hand is 45 *min* behind the hour hand. To be straight, it has to gain 15 *min*.
55 minutes are gained in 60 minutes.

15 minutes are gained in $15\times\frac{12}{11}16\left(\frac{4}{11}\right)\text{min}$

Required Time = $16\left(\frac{4}{11}\right)$ min past 9

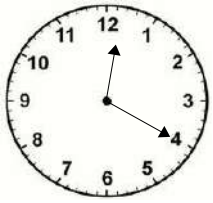
Alternate Method:

$\theta=\frac{11}{2}m-30h\Rightarrow 180=\frac{11}{2}m-(30\times 9)\ \Rightarrow\frac{11}{2}m=270-180$

$\frac{11}{2}m=90\ \Rightarrow m=16\frac{4}{11}$

7)4; At 5:25, the minute hand is at 5. So we have to find the angle made by the hour hand in $25\,min=12\frac{1}{2}^{o}$

8)2; Angle between 12th and 4th position = 120°.



Angle made by the hour hand in 20 minutes = 10°
Required angle = 120°- 10° = 110°.

9)4; At 3 O'clock the minute hand is behind the hour hand by 15 *min.* To go 7 *min* ahead the hour hand, it has to gain (15+7) *min*. *i.e.* 22 *min*.

To gain 22 *min* it has to move $22\times\frac{12}{11}min$

i.e. 24 *min.*

∴ Required Time = 24 *min* past 3.

Alternate Method: $\theta=\frac{11}{2}m-30h$

The minutes hand should be 7 minutes ahead of the hour hand *i.e.* 42°. (1 minute space = 6°).

So, $42=\frac{11}{2}m-(30\times 3)\Rightarrow m=24\ min.$

10)1; $\theta=\frac{11}{2}m-30h\Rightarrow\left(\frac{11}{2}\times 12\right)-(30\times 5)=150-66=84^{0}$

11)3 My watch is gaining 5 minutes for every 60 minutes. It means when the original time is moved 60 minute spaces, my watch has moved 65 minute spaces.
Similarly, when the original time is moved 1 minute, my watch has moved $\frac{13}{12}$ minutes.

1 minute = 360° then $\frac{13}{12}\,minutes=\frac{13}{12}\times 360=390^{o}$.

12)3; Hour hand traces 360^{0} in 12 hours.
∴ Hours from 10 *am* to 2:20 *pm* = 4 hours 20 *min*

$\because\ 4+\frac{20}{60}=4+\frac{1}{3}=\frac{13}{3}\text{hours}$

Now, 12 hours = 360^{0}

$\frac{13}{3}\text{hours}=x$

By cross multiplication,

$12\times x=360\times\frac{13}{3}$

$\therefore\ x=\frac{360\times 13}{12\times 3}=130^{0}$

13)2; Minute hand has to gain 25 minute spaces.
55 minute spaces are gained in 60 *min*.
∴ 25 minute space will be gained in *x min*.

$\therefore\ x=\frac{60\times 25}{55}=\frac{300}{11}=27\frac{3}{11}\,min$ past 5 O'clock.

14)2; $\theta=\frac{11}{2}m-30h=\left(\frac{11}{2}\times 20\right)-30\times 2=50^{0}$

BLOOD RELATIONS

CONCEPTS

Blood relations mean persons connected by some relation like mother–father, daughter–son, sister–brother, aunt–uncle, niece–nephew, sister in law–brother in law etc. Blood relations questions are based on the family tree concept. Questions are asked based on the variety of relationships in the family. To remember easily, we classify them as paternal side relations and maternal side relations.

Paternal side Relations

Father's father	Grandfather
Father's mother	Grandmother
Father's brother	Uncle
Father's sister	Aunt
Father's daughter	Sister
Father's son	Brother
Father's only son (said by a boy)	Himself
Father's only daughter (said by a girl)	Herself
Uncle's wife	Aunt
Aunt's husband	Uncle
Uncle's children	Cousin
Aunt's children	Cousin
Brother's wife	Sister–in–law
Sister's husband	Brother–in–law
Brother's daughter	Niece
Brother's son	Nephew
Son's wife	Daughter–in–law
Daughter's husband	Son–in–law
Grandson or Granddaughter's daughter	Great Granddaughter

Maternal Side Relations:

Mother's father	(Maternal) grandfather
Mother's mother	(Maternal) grandmother
Mother's brother	(Maternal) uncle
Mother's sister	(Maternal) aunt
Children of maternal uncle	Cousin
Wife of maternal uncle	(Maternal) aunt

Tips for Solving Questions on Relationships:

1) Drawing family tree.

2) Properly indicate the nature of relationships between the persons.

3) Understanding the relationship between which two persons is exactly required to be found.

Drawing Family Tree:

If A is male: **A+ ,** 

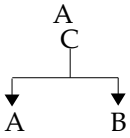
If B is female: **B – ,** 

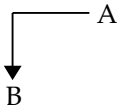
If C's gender is not given in question or irrelevant to solving the question: **C,** 

If A and B are siblings: A ⟷ B

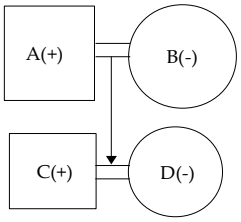
If A and B are married to each other: A = B.

If A is the only child of B: 

If A and B children of C: 

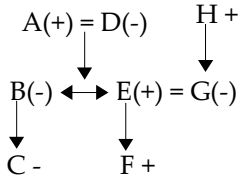
If A is uncle / aunt of B: 

If A and B are parents of either C or D (C and D are a couple):

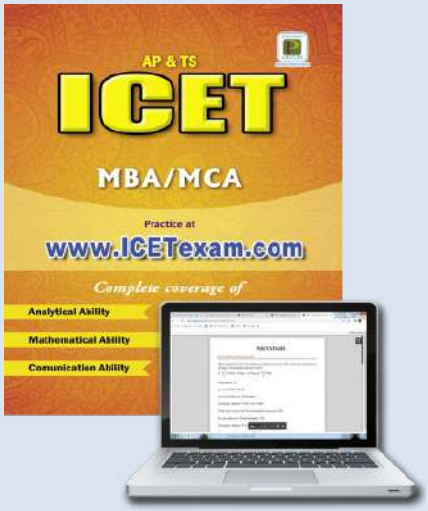


Example: A is the father of B but B is not his son. C is the daughter of B. D is the spouse of A. E is the brother of B. F is the son of E. G is the spouse of E. H is the father of G. Who is the grand daughter of A?

Explanation:



From the above diagram, C is the daughter of B and A is the father of B. So, C is grand daughter of A.



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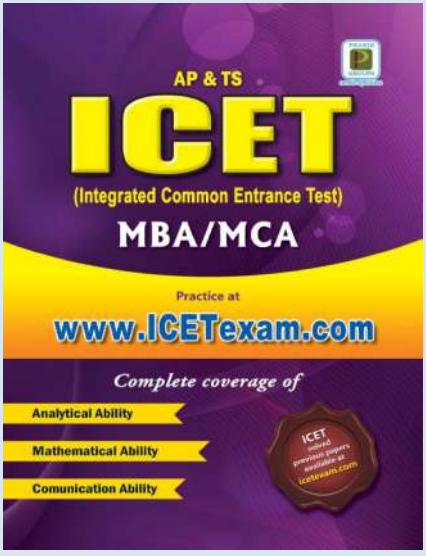

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EXPLANATION

1)4; Kiran is the brother of Praveen. So, Ajay is the father of Kiran. And Sudha is wife of Kiran. So, Sudha is daughter-in-law of Ajay.

2)2;

Lady(-)⟷Brother(+)
↓
Son(+)⟷Sister(-)⟷ Wife(-) = Gourav (+)

Brother of Gourav's wife's sister = brother-in-law Gourav. The son of lady's brother is brother-in-law of Gourav. Therefore, the brother of the lady is the father-in-law of Gourav. So, lady is sister of the Gourav's father-in-law or the lady is aunt-in-law of Gourav.

3)3;

Person (+)⟷ Brother (Arjun's Father) (+)
↓
Arjun(+)
↓
Arjun's daughter (-)

Father of Arjun's daughter's father = Arjun's father.

The person in photograph is brother of Arjun's father. So, the person is uncle of Arjun. (The word *'his'* in the given statement says the *'the person'* is a male).

4)2; A is father of B. B is son of V *i.e.* V is mother of B.

From (i), C is the brother of V. It means A is brother-in-law of C because V is wife of A.

From (ii), in this statement, relation between A and C is not given. So, only statement-(i) is necessary.

5)3;

Mother-in-law(-) = Father-in-law(+)
↓
Brother(+) ⟷ Women(-) = Husband (only son)(+)

My mother-in-law's Husband = My father-in-law.

Only son of my mother–in–law's husband = only son of my father–in–law = Husband.

Brother-in-law of husband = Brother

∴ The man is brother of the woman.

∴ The woman is sister of the man.

6)4; Son of my grandfather's only brother = Vinod's uncle. Son of Vinod's uncle = Vinod's cousin.

7)4; From given data, C is brother of A is true, which is option-3.(Here, gender of B and D is unknown.

8)1; From option-1, (M 3 L) = M is the wife of L and (L 5 Z) = L is the father of Z. Then, M is the mother of Z.

9)3; From the family tree, U is the grandfather of S.

P(+) = U(-)
↓
R(-) ⟷ Q(+) = V(-)
↓ ↓
T(-) S(+)

10)1; From the above family tree, Q is the son of U

11)4; E and D are the cousins of F.

A(-)⟷B(+)⟷C
↓ ↓
F(+) D(-)⟷E(+)

12)4; S is the brother-in-law of T.

Q P
↓ ↓
S(+) ⟷ R(-) = T(+)

13)3; A÷C+D+B means A is daughter of C who is the father of D. D is father of B. *i.e.* A is sister of B's father *i.e.* A is aunt of B.

14)3; P is the brother of Q and Q is the brother of R. So, R may be the brother or sister of P.

15)3; Gita is mother/aunt of the boy.

Uncle(+)
↓
Gita(-) ⟷ Boy's Uncle(+)
↓
Boy(+)

Uncle(+)⟷Uncle(+)
↓ ↓
Gita(-) ⟷ Uncle(+)
↓
Boy(+)

16)3; 3 children (Q, M, O).

P(+)⟷N(+) = L(-)
↓
Q(+)⟷M(+)⟷O(-)

17)4; There are four males.

18)4; L and O are females.

19)4; From given data, wife of P cannot be determined.

20)4; L is the mother of M.

21)4; A÷C+B means A is the daughter of C who is the father of B. *i.e.* A is the sister of B.

22)1; A–C+B means A is wife of C who is the father of B. Then A is the mother of B.

23)4; A×C÷B means A is the brother of C who is the daughter of B. It means, A is son of B.

24)3; A+C÷B means A is the father of C who is the daughter of B. It means B is the mother of C. Then A is husband of B.

25)1; A×C+B means A is the brother of C who is the father of B. Then A is uncle of B

ARRIVALS, DEPARTURES AND SCHEDULES

CONCEPTUAL EXAMPLES

1) The teacher came to the college to give a lecture at 20 *min* past 10 and he came 40 *mins* before the students who were late by 20 *min* to the lecture. At what time was the lecture supposed to start ?

a) 11 : 00 b) 10 : 40 c) 10 : 20 d) 11 : 40

Explanation: (b) Teacher came at 10 : 20

Students came at 10:20 + 0:40 = 11:00

Students are late by 20 *mins* to the lecture.

∴ Lecture time is 10 : 40.

2) A marriage is scheduled at 04:00 AM for which the bridegroom who is away at 200 *km* from the venue has to come. If the bridegroom starts at 02:45 AM in a car which moves a speed of 120 *Kmph*, then the bridegroom is late to the marriage time by how many *min* ?

a)25 *min* b) 30 *min* c)40 *min* d) 15 *min*

Explanation: (a) Total distance = 200 *Km*; speed of bridegroom car = 120 *Kmph* = 2 *Km* per *min*

Starting time = 2 :45 am.

Total journey time = 1 *h* 15 *min*

Distance covered by the car in 1 *h* 15 *min* is 150 *Km.*

Late time = (200 *Km* – 150 *Km*)/(2 *Km*/*min*)

= 50/2 *min* = 25 *min*

3) If t_1 is the time elapsed between 12:00 PM to 5:20 PM; and t_2 is the time elapsed between 11:25 AM to 6 : 15 PM then $t_1 : t_2$ =

a) 3:5 b) 1:2 c) 4:5 d) 2:3

Explanation: (c)

t_1 = 12:00 PM to 5:20 PM = 320 *mins*

t_2 = 11 : 25 AM to 6:15 PM = 400 *mins*

$t_1 : t_2$ = 320 : 400 = 4:5

4) Revanth reached the venue of his office board meeting at 9:15AM. He found that he was 23 *min* earlier than the chairman who came 8 *min* late. The meeting was scheduled at

a) 9:50 AM b) 10:20 AM

c)8:40 AM d)9:30AM

Explanation: (d) Revanth came at 9 :15 AM and 23 *min* earlier than chairman.

→ Chairman came at 9:15 AM + 23 *min* = 9 : 38 AM. Chairman came 8 *min* late to the meeting.

→ The meeting time = 9:30 am.

5) The metro train in Hyderabad leaves the Uppal station at regular intervals of 30 *min*. Reaching the station, Rohith come to know that the train left 8 *min* ago and the next train is at 11 : 35 am. What time did Rohith arrive at the station ?

a) 11:13 AM b) 11:43 AM

c) 11:27 AM d) 12:13 PM

Explanation: (a) The next train is at 11:35 AM. For every 30 *min* there is a train. So before 11:35 AM, the train was at 11:05 AM. He came 8*min*s late

∴ He arrived at 11:13 AM.

6) While going to join a job in Mumbai, Ravi and Rajesh decide to meet at a railway station at the scheduled time. After his arrival at 3:30 PM, Ravi found that he come 42 *min* earlier than rajesh, who came 23 *min* late to the scheduled time. What is the scheduled time of they meet ?

a) 4:23 PM b) 3:49 PM

c) 3:50 PM d) 3:23 PM

Explanation: (b) Ravi came at 3:30 PM, He came 42 *min* earlier than Rajesh. ∴ Rajesh came at 4:12 PM.

Rajesh came 23 *min* late to the scheduled time.

∴ Scheduled time = 3 :49 PM

7) Four trains P, O, Q and R start at 8:15 AM, 9:20 AM , 11:40 AM and 3:12 PM respectively

and reach their respective destinations at 10:45 AM, 12:15 PM, 12:20 PM and 6:45 PM same *day.* The train which travelled for short time is

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

Explanation: (d) The train R travelled for short time.

	start time	Reach time	Duration
P	8:15 AM	10 : 45 AM	2 : 30 h
Q	9:20 AM	12 : 15 PM	2 : 55 h
R	11:40AM	12 : 20 PM	1 : 40 h
S	3:12 PM	6 : 45 PM	3 : 33 h

8) Reaching the venue of meeting at 2:18 PM, Anil is half-an-hour earlier than Sunil who came 26 *min* late. The scheduled time of the meeting is

a) 2:22 PM b) 3:20 PM

c) 3:20 AM d)1:22AM

Explanation: (a) Anil reached at 2 : 18 PM

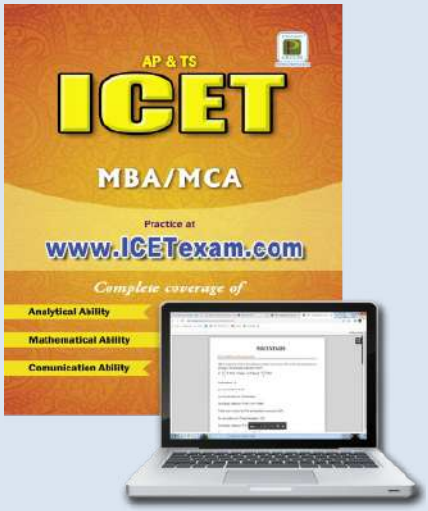
Sunil came at 2 : 48 PM.

Sunil came 26 *min* late i.e, at 2 : 22 PM.

Schedule of meeting = 2 : 22 PM.

9) Two Buses arrived at a station at 12:20 PM and 2:39 PM with a late of 18 *min* and 37 *min* respectively. The time difference (in *min*) between their scheduled arrivals at the station is.

a) 184 b) 120 c) 142 d) 84



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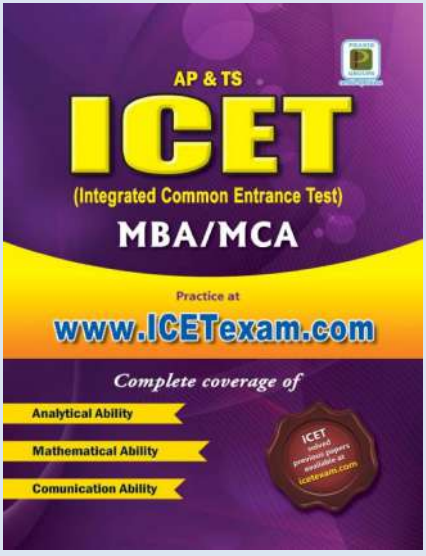

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12)d; Total distance = 250 *Km.*
Speed of the car = 60 *Kmph*
Car starting time = 8:30 AM.
Car moves *1km* per 1*min*. Game time = 11 AM
Total Journey time = 2:30 h.
Distance covered by the car in 2:30 h is 150 Km.
Late time = 250-150 = 100 *Km* = 100 *min*.
13)a; P = 10:30 AM to 3:30 PM = 300 *min*.
Q = 9:00 AM to 5:20 PM – 500 *min*.
P:Q = 300 : 500 = 3 : 5
14)b; Sreevani came to meeting at 8:20 AM.
And she was 30 *min* late than the chairperson.
∴ Chairperson came at 7:50 AM. He came 45 *min*s early.
∴ The meeting schedule time is 8 : 35 AM
15)c; The next train is at 12 : 05 PM. For every 30 *min* there is a train. So, before 12:05 PM, the train was at 11 : 35 AM. Jhansi came 10 *min* late to 11:35 AM.
∴ Jhansi arrived at 11:45 AM.
16)d;Jennifer came at 3:30 PM. She came 35 *min* earlier than Stella. ∴ Stella came at 4:05 pm.
Stella came 20 *min* late to the meeting.
∴ The meeting Scheduled time is 3:45 pm.
17)a;

	Start time	**Reach time**	**Duration**
A	7:30 AM	9:45 AM	2 : 15 h
B	8:15 AM	10 : 40 AM	2 : 25 h
C	10:45 AM	12 : 15 PM	1 : 30 h
D	3:30 PM	7 : 45 PM	4 : 15 h

∴ The dog 'R' barks for short time..
18)b; Praveen reached at 10:30 AM.
Sukhesh came at 10:55 AM.
Sukhesh came 34 *min* late i.e, The scheduled meeting time is 10:21 AM
19)c; A arrived at 9:15 AM and came 30 *min* late,
∴ A's scheduled arrival time = 8:45 AM
B arrived at 11:30 AM and came 40 *min* late.
∴ B's scheduled arrival time = 10:50 AM.
∴ The Difference between their scheduled arrival to the meeting is 2:05 h = 125 *min*
20)d; All three A,B and C visit the Taj Mahal on Tuesday from 11:00 AM to 1:00 PM

SEATING ARRANGEMENT

In this type of questions, information about the seating arrangement of the persons or things is given in the form of a puzzle. You have to arrange the things in proper seating order by understanding the given logical statements and answer the question that follow.

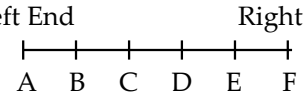
Problems on seating arrangement are mainly two types. They are

1) Linear arrangement

2) Circular arrangement

1) Linear arrangement: In this type, there exists left end and right end of the seating. This arrangement looks like a row or a line.

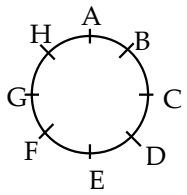
Example:



Here, right side of 'A' are B, C, D, E, F and left side of 'A' is no one.

2) Circular Arrangement: In this type, it is not possible to say what is right end and left end (or) starting or ending points.

Example:



Tips to solve:

1) Read the given information and find an initial clue which is origin of the information.

2) If a statement does not give any clue to arrange, then note it down for further use. Use that information whenever it is required for proper arrangement.

3) Do not assume any condition on your own while solving the problem.

4) Be careful while choosing the correct clue to start.

5) If you see the word like *who* or *which* then consider the second person in place of *who/ which.*

Example: Consider the statement, *'G sits exactly opposite to B* ***who*** *is immediate right of H'*.

In this statement, the word *who* refers to B.

6) If you see the word *and/ is/ but* then consider first person in place of these words.

Example: Consider the statement, *'A is opposite to B and is sitting on the left of C'*.

In this statement, the word *and* refers to A.

CONCEPTUAL EXAMPLES

(I) 5 friends namely A, B, C, D, E are sitting in a row but not in the same order. D is not the neighbor of either A or E. E is not at the center. B sits at one end and third to the right of E (All are facing North).

1) Who sits exactly in the middle of the row?

1) E 2) D 3) B 4) C

2) Who sits at extreme ends?

1) AB 2) EC 3) DC 4) EB

3) What is the position of D with reference to A?

1) 4^{th} right 2) 4^{th} left 3) 3^{rd} left 4) 3^{rd} right

4) In which of the following pairs, first person sits immediate right of second person?

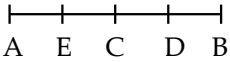
1) AE 2) EC 3) CD 4) BD

5) Who are the neighbors of C?

1) AE 2) ED 3) BD 4) CD

Explanation: In the given information, last point gives us a clue. *i.e. B sits at one end and third to the right of E*.

B cannot be at left end because E should be left of B which is not possible. So, B sits at right end. D is not the neighbor of either A or E. So, D should sit at immediate left of B. C should sit at the center. Finally A sits at left end.



1)d; C sits in the middle of the row.

2)a; A and B sits at extreme ends.

3)a; The position of 'D' with reference to 'A' is 4^{th} right.

4)d; In the given pairs only B sits immediate right of D.

5)b; The neighbor of 'C' are E and D.

(II) Six persons of a family, P, Q, R, S, T, U are sitting around a circular table to have dinner but not in the same order. P sits opposite to Q and immediate right of R. T is not the neighbor either P or U. Q sits second to the right of S and immediate left of U. S sits between T and P.

1) Who sits to the immediate left of Q?

1) T 2) U 3) R 4) S

2) Who are neighbors of U?

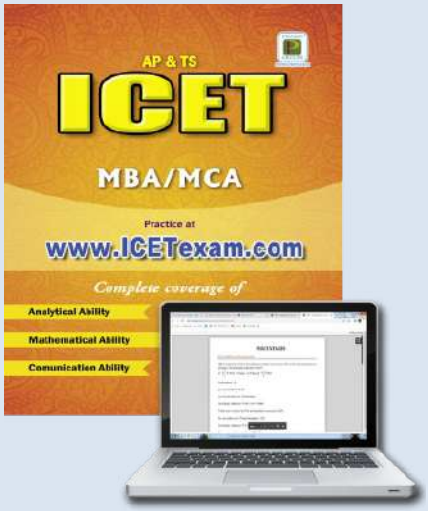
1) SP 2) TS 3) QR 4) PR

3) In which of the following pair, second person sits immediate right of first person?

1) QU 2) RU 3) QT 4) TS

4) In which of the following pairs, first person sits between second and third person?

1) SPR 2) TSQ 3) QUR 4) TSP



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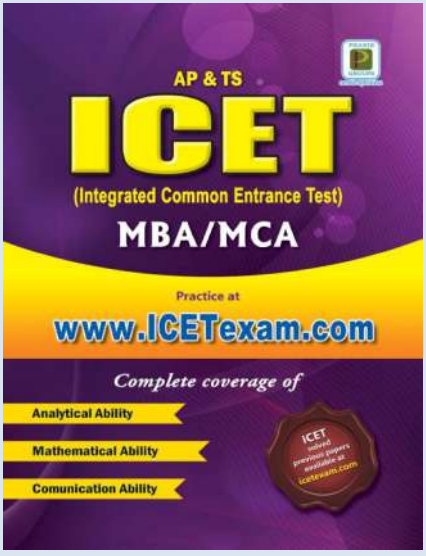

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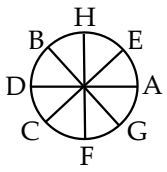
EXPLANATIONS

1)3; D sits exactly opposite to A.

2)2; The neighbors of E are A and H.

3)2; H is neighbour to B and E and also sits in between them.

4) 4; After interchange, H will be third right of C.



5)3; Statement(iii) is not require to arrange properly.

6)2; D stays below of A's plot.

7)2; G stays in first floor, so he will not stay in second and third floor.

Floor-3	A	B	C
Floor-2	D	F	E
Floor-1	I	G	H

8)3; F stays in the 2nd floor and his neighbor are D, E.

9)4; E, D and F stay in the same floor.

10)4; Statement-(vii) is not necessary to solve this problem.

11)2; R sits at the right end of the bench.

X T S U Q W V P R

12)4; W is immediate left of V.

13)1; Except TS all are arranged in alternate positions.

14)1; After interchanging, there will be no person at the second right of second person from right end.

15)1; After interchanging, U is in the middle of bench.

X S T Q U V W R P

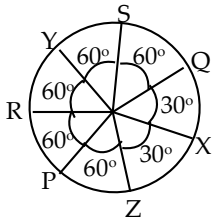
16)2; Z sits at 30 left from X.

17)4; No one sits exactly opposite to X.

18)4; Z and Y are at 180^0 distance to each other.

19)1; 3rd right of Z is S.

20)2; Total number of persons between R and Y from R's right side = 5.



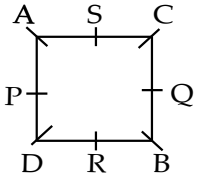
21)4; R is the wife of D.

22)3; A is the husband of P.

23)1; R sits exactly opposite to S.

24)3; The angle between R & Q is 90^0.

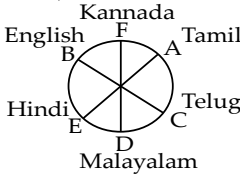
25)2; D–P is an odd pair.



26)3; F studies Kannada.

27)1; The neighbors of C, who study Telugu are A & D.

28)2; D studies Malayalam, the opp person to 'D' is F.



29)4; Except DB, all pairs are opposite to each other.

30)1; After interchanging positions in anti–clockwise, 'A' gets Malayalam.

31)2; 32)4; 33)1; 34)3;

The whole information can be drawn as follows:

Name	Choice	Date of birth
Jayant	Chocolates	February
Kamal	Ice Cream	January or May
Namita	Pastries	March
Asha	Dry fruits	January or May
Tanmay	Bengali sweets	April

35)4; 36)1; 37)1; 38)2;

The final arrangement will be as follows.

C	B	A	D	F	E
1	2	3	4	5	6

39) 3 40) 1 41) 2 42) 4 43) 4

Day	Subject	Person
Monday	Mathematics	Vishnu
Tuesday	History	Indhu
Wednesday	Chemistry	Harsha
Thursday	English	Smitha
Friday	Geography	Gopal
Saturday	Physics	Vimala

44) 1 45) 4 46) 4 47) 3 48) d

	A	B	C	D	E	F
History	C	C	C	O	-	-
Physics	-	-	-	-	C	O
Mathematics	-	-	O	-	O	C
English	O	-	-	C	-	-
Chemistry	-	O	-	-	-	-

49) 3 50) 3 51) 1 52) 4 53)3

The given information may be analyzed as under

	Dramatc	Comp Sci	Physics	History	Math
Madhu	*	*	*	-	-
Shobha	*	*	-	*	-
Anjali	-	*	*	-	*
Poonam	*	-	*	*	*
Nisha	-	-	*	-	*

NUMBER SYSTEM

CONCEPTS

In Hindu–Arabic system we use ten symbols 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 called digits to represent any number. This is the decimal system where we use the digits 0 to 9. Here 0 is called *insignificant digit* where as 1, ... , 9 are called *significant digits*.

• Classification of Numbers:

Natural Numbers: The numbers 1, 2, 3, 4, 5, 6, ... which we use in counting are known as *natural numbers.* The set of all *natural numbers* can be represented by N = {1, 2, 3, 4, 5, ...}

Whole Numbers: If we include 0 among the natural numbers then the numbers 0, 1, 2, 3, 4, 5, ... are called *whole numbers.* Hence, every natural number is a whole number. The set of *whole numbers* is represented by W.

Integers: All counting numbers and their negatives including zero are known as *integers*.

The set of integers can be represented by *Z* or I.

Z = {. . . . . – 4, – 3, – 2, – 1, 0, 1, 2, 3, 4, ...}

Every *natural number* is an *integer* but every *integer* is not *natural number.*

Positive Integers: The set I + = {1, 2, 3, 4, ...} is the set of all positive integers. Positive integers and Natural numbers are synonyms.

Negative Integers: The set I – = {. . . , –3, –2, –1} is the set of all negative integers.

0 (zero) is neither positive nor negative.

Non Negative Integers: The set {0, 1, 2, 3, . . . } is the set of all non negative integers.

Rational Numbers: The numbers of the form $\frac{p}{q}$, where *p* and *q* are integers, *p* is not divisible by *q* and $q \neq 0$, are known as *rational numbers.*

(or) Any number that can be written in fraction form is a *rational number.* This includes *integers, terminating decimals*, and *repeating decimals* as well as *fractions.*

e.g.: $\frac{3}{7}, \frac{5}{2}, -\frac{5}{9}, \frac{1}{2}, -\frac{3}{5}$ etc

The set of rational numbers is denoted by *Q.*

Irrational Numbers: Any real number that cannot be written in fraction form is an *irrational number.* Numbers which are both *non-terminating as well as non-repeating decimals* are called irrational numbers.

e.g.: Absolute value of $\frac{10}{3}, \frac{22}{7}, \sqrt{2}, \sqrt{3}, \sqrt{10} \ldots$

Note: A *terminating decimal* will have a finite number of digits after the decimal point.

e.g.: $\frac{3}{4} = 0.75, \frac{5}{4} = 1.25, \frac{25}{16} = 1.5625.$

Repeating Decimals: A decimal number that has digits that repeat forever.

e.g.: $\frac{1}{3} = 0.333\ldots.(\text{here, 3 repeats forever.})$

Non–Repeating Decimal: A decimal that neither *terminates* nor *repeats***.**

e.g.: $\sqrt{2} = 1.4142135623\ldots.$

Real Numbers: The rational and irrational numbers together are called *real numbers.*

e.g.: $\frac{13}{21}, \frac{2}{5}, \frac{-3}{7}, \frac{+4}{2}$ etc are real numbers.

The set of real numbers is denoted by *R.*

Even Numbers: Any integer that can be divided exactly by 2**.**

e.g.: 2, 6, 0, -8, -10, ... are even numbers.

Odd Numbers: An integer that cannot be divided exactly by 2 is an Odd number.

e.g.: 1, 3, -5, -7, ... are odd numbers.

Prime Numbers: A Prime Number can be divided evenly only by 1, or itself. And it must be a whole number greater than 1.

e.g.: Numbers 2, 3, 5, 7, 11, 13, 17, ... are prime.

All primes which are greater than 3 are of the form (6*n*+1) or (6*n*–1).

Note:

• 1 is not a prime number.

• 2 is the least and only even prime number.

• 3 is the least odd prime number.

• Prime numbers up to 100 are 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83,89,97.

There are 25 prime numbers up to 100.

Composite Number: Natural numbers greater than 1 which are not prime, are known as *composite numbers.* The number 1 is neither *prime* nor *composite.*

Co-prime Numbers: Two numbers are co-prime to each other if they have '*no common factor except* 1'.

e.g.: 3 and 5 are co primes.

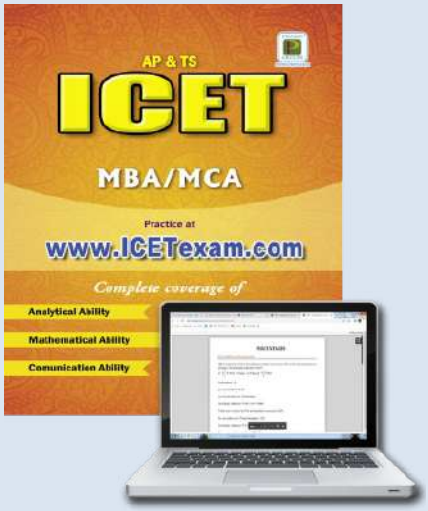
Note:

Natural Numbers = 1 + Prime + Composite Numbers.

Whole Numbers = 0 (Zero) + Natural Numbers.

Integers = Negative Integers + 0 + Positive Integers.

Real Numbers = Rational + Irrational Numbers.



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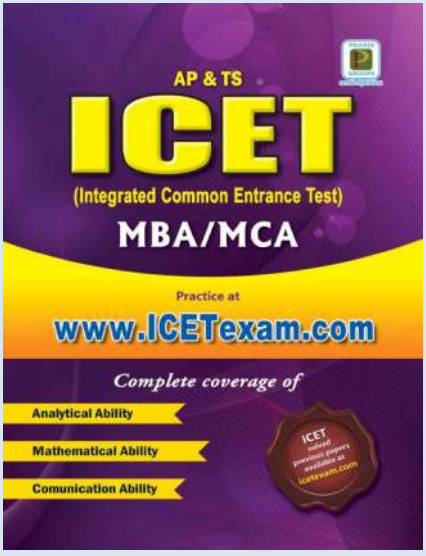

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7)4; LCM of 4, 6, 8, 10, 12 = 120.
120 can be written as 2×2×2×3×5
To make it a perfect square, you have to multiply by 2×3×5. If you can see in the factors that 2×2×2×3×5 = 120 can not make a perfect square until we multiply it by 2 to make 2×2×2×2 and by 3 to make 3×3 and by 5 to make 5×5. Now all the numbers are squares.
i.e. $4^2 \times 3^2 \times 5^2 = (4\times3\times5)^2 = 60^2 = 3600$.

8)2; Let x be the number of students so that each contributed x paise.
Contribution of the students = 49 – 13 = ₹36 = 3600 paise. $\Rightarrow x^2 = 3600 \Rightarrow x = 60$.
$\therefore$ Number of students in the class is 60.

9)1; Let the number be x & y , it is required to find $x\times y$
$x^2 + y^2 = 80$ and $(x-y)^2 = 36$
Now $(x-y)^2 = (x^2+y^2) - 2xy$
$2xy = (x^2+y^2) - (x-y)^2 = 80 - 36 = 44$ then $xy = 22$.

10)2; Required number = HCF (148–4),(246–6),(623–11)
= HCF of 144, 240 and 612 = 12.

11)3; Since (36 – 25) = (48 – 37) = (64 – 53) = 11
$\therefore$ Required smallest number = (LCM of 36, 48, 64)–11
= 576 – 11 = 565.

12)2; $\sqrt{3\sqrt{3\sqrt{3\sqrt{3\sqrt{3}}}}} \Rightarrow \sqrt{3\sqrt{3\sqrt{3\sqrt{3.3^{\frac{1}{2}}}}}}$
$\Rightarrow \sqrt{3\sqrt{3\sqrt{3\sqrt{3^{\frac{3}{2}}}}}} \Rightarrow \sqrt{3\sqrt{3\sqrt{3.3^{\frac{3}{2}\times\frac{1}{2}}}}} \Rightarrow \sqrt{3\sqrt{3\sqrt{3.3^{\frac{3}{4}}}}}$
$\Rightarrow \sqrt{3\sqrt{3\sqrt{3^{\frac{7}{4}}}}} \Rightarrow \sqrt{3\sqrt{3.3^{\frac{7}{8}}}} \Rightarrow \sqrt{3\sqrt{3^{\frac{15}{8}}}} \Rightarrow \sqrt{3.3^{\frac{15}{16}}}$
$\Rightarrow \sqrt{3^{\frac{31}{16}}} \Rightarrow 3^{\frac{31}{32}}$

13)2; Product of numbers = HCF × LCM
$32 \times K = 16 \times 160 \Rightarrow K = 80$.

14)4; 5 meters 44 *cm* = 544 *cm*;
3 meters 74 *cm* = 374 *cm*
The side of the square slab = HCF of 544, 374 = 34.

15)4; Divide 8492 by 72, the remainder is 68.
$\therefore$ Least number to be added = 72 – 68 = 4.

Ask doubt with Question Id: 1681

16)2; $\frac{\text{HCF}\times\text{LCM}}{\text{Given number}} = \frac{65\times1950}{195} = 650$

17)3; The capacity of the largest possible box =
HCF (378, 434, 582) = 2.

18)4; GCM × LCM = Product of the two numbers
$\text{GCM} = \frac{211428}{3356} = 63$

19)4; 5046 = 6 × 29 × 29.
Hence 5046 must be multiplied or divided by 6 to make it a perfect square. If you multiply by 6 it becomes $(6\times29)^2$ which is a perfect square (or) if you divide by 6 it becomes $(29)^2$ which is also a perfect square.

20)2;

2	10, 12, 14
	5, 6, 7

$\therefore$ LCM = 2 × 5 × 6 × 7 = 420 *sec* = 7 minutes
i.e. They ring together again at 11 hours 7 *min*.

21)2; Let the 4 consecutive numbers divisible by 5 are x, x+5, x+10, x+15.
$\therefore\ x + (x+5) + (x+10) + (x+15) = 130 \Rightarrow x = 25$
Largest number = (x+15) = 25 + 15 = 40.

22)4; ₹ 1 + ₹ 2 + ₹ 3 + ... + ₹ n = 36
$\frac{n(n+1)}{2} = 36 \Rightarrow n^2+n = 72 \Rightarrow n^2+n-72 = 0$
$n^2+9n-8n-72 = 0 \Rightarrow (n+9)(n-8) = 0$
$n = -9 (\text{or}) n = 8$
Days cannot be negative, hence n = 8**.**

RATIO – PROPORTION

CONCEPTS

Ratio: A ratio is the relation between two quantities which is expressed by a fraction.

• The ratio of the number *'a'* to the number *'b'* is written as $\frac{a}{b}$ (or) $a : b$ or a to b

e.g.: The ratio of 5 hours to 3 hours can be written as $\frac{5}{3}(\text{or})5:3.$

• The ratio is always a comparison between the quantities of same kind or of same units.

For example, you cannot form the ratio between 5 hours and 3 days. Because the two numbers are expressed in different units. Hence, convert 3 days to hours.

i.e. 3 days = 72 hours. Thus the proper form of this ratio is $\frac{5}{72}$ (or) $5:72.$

• Two quantities which are being compared ($a : b$) are called its terms. The first term (a) is called *antecedent* and second term (b) is called *consequent.*

• The ratio of two quantities is always an abstract number (without any units).

• If the terms of a ratio are multiplied or divided by the same quantity the value of the ratio remains unaltered.

e.g.: The ratio $a : b$ is same as Ma : Mb.

Proportion: Equality of two ratios is called proportion.

Consider the two ratios, $a : b$ and $c : d$, then proportion is written as, $a : b :: c : d$ (or) $a : b = c : d$ (or) $\frac{a}{b}=\frac{c}{d}$

Here a, b, c, d are called *Terms.* a, d are called *Extremes* (end terms) and b, c are called *Means* (middle terms).

e.g.: Since the ratio $4:20(\text{or})\frac{4}{20}$ is equal to the ratio $1:5(\text{or})\frac{1}{5}$ we may write the proportion as

4 : 20 :: 1 : 5 or 4 : 20 = 1 : 5 or $\frac{4}{20}=\frac{1}{5}$

• In a proportion, product of *means* (middle terms) is equal to product of *extremes* (end terms).

i.e. $ad=bc$ or $\frac{a}{b}=\frac{c}{d}.$

Key Notes: If a and b are two quantities, then

1) Duplicate ratio of $a:b=a^2:b^2$

2) Sub-duplicate ratio of $a:b=\sqrt{a}:\sqrt{b}$

3) Triplicate ratio of $a:b=a^3:b^3$

4) Sub-triplicate ratio $a:b=\sqrt[3]{a}:\sqrt[3]{b}$

5) Inverse or reciprocal ratio of $a:b=\frac{1}{a}:\frac{1}{b}$

6) The third proportional of two numbers a and b is defined to be that number c such that $a : b = b : c$. So, if you want to find a number c such that 12 : 18 = 18 : c. That number, c is $\frac{18^2}{12}=27$

7) If $a : b = x : y$ and $b : c = p : q$, then

a) $a:c=\frac{x\times p}{y\times q}$

b) $a : b : c = px : py : qy$

8) Compound Ratio of $(a : b),(c : d),(e : f)$ is $\frac{a}{b}\times\frac{c}{d}\times\frac{e}{f}$

9) The ratio in which two kinds of substances must be mixed together one at Rs. x per kg and another at Rs. y per kg, so that the mixture may cost Rs. n per kg. The ratio is $\frac{n-y}{x-n}$.

10) Let the incomes of two persons be in the ratio of a : b and their expenditure be in the ratio of x : y and if the savings of each person is Rs. n then income of each is ₹$\frac{an(y-x)}{ay-bx}$ and ₹$\frac{bn(y-x)}{ay-bx}$ respectively.

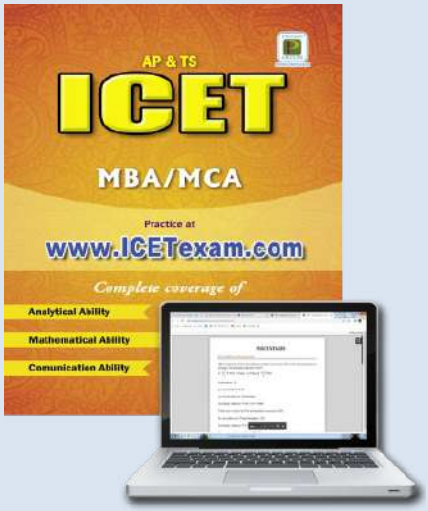
11) In a mixture the ratio of milk and water is a : b. In this mixture another n liters of water is added, then the ratio of milk and water in the resulting mixture became a : m. Then, the quantity of milk in the original mixture $=\frac{an}{m-b}$ and the quantity of water in the original mixture $=\frac{bn}{m-b}$

12) In a mixture of n liters, the ratio of milk and water is x : y. If another m liters of water is added to the mixture, the ratio of milk and water in the resulting mixture = $xn:(yn+mx+my)$

13) If four numbers a, b, c and d are given then

a) $\frac{ad-bc}{(b+c)-(a+d)}$ should be added to each of these numbers so that the resulting numbers may be proportional.

b) $\frac{ad-bc}{(a+d)-(b+c)}$ should be subtracted from each of these numbers so that the resulting numbers may be proportional.



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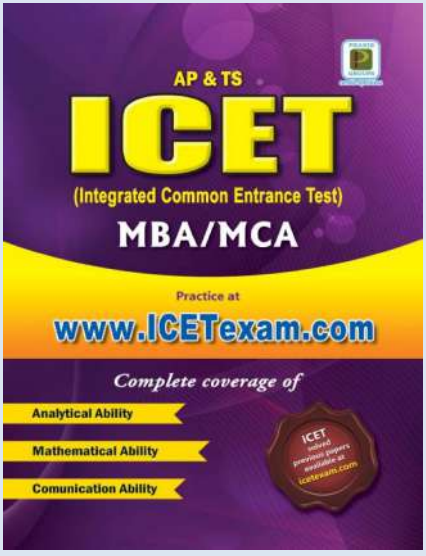

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19)1; The value of 15 one rupee coins, 23 two rupee coins and 16 five rupee coins = 15×1 + 23×2 + 16×5.

= 15 + 46 + 80 = Rs. 141.

But the total value of all the coins is given as Rs.1128.

So, 1128÷141 = 8.

i.e. Number of 5 rupee coins = 8 × 16 = 128.

20)2; Let the numbers = $4x$, $5x$ and $6x$

Given, $(4x)^3 + (5x)^3 + (6x)^3 = 3240$

$64x^3 + 125x^3 + 216x^3 = 3240$

$$405x^3 = 3240 \Rightarrow x^3 = \frac{3240}{405} \Rightarrow x^3 = 8 \Rightarrow x = 2$$

The numbers = $4x$, $5x$, $6x$ = 4×2, 5×2, 6×2 = 8, 10, 12.

21)4; Let, previous salaries of Vinod and Vivek = $4x$, $7x$.

Ratio of increased salaries of Vinod and Vivek = 2 : 3.

i.e. $\frac{4x+4000}{7x+5000} = \frac{2}{3} \Rightarrow 12x + 12000 = 14x + 10000$

$\Rightarrow 2x = 2000 \Rightarrow x = 1000$.

Then previous salaries of Vinod, Vivek = Rs.4000, Rs.7000.

22)3; P : Q = 6 : 7 and Q : R = 5 : 6

Make Q part equal in both ratios. then P:Q:R = 30:35: 42

$$\therefore \text{Share of R in Rs.2140} = \frac{42}{30+35+42} \times 2140 = ₹\,840$$

23)1; Let initially the seats of EEE, ECE and CSE are $11x$, $12x$, $13x$.

$\therefore$ Seats of ECE after increasing = 276

i.e. 115% of $12x = 276 \Rightarrow \frac{115}{100} \times 12x = 276 \Rightarrow x = 20$

Initially seats of EEE = $11x$ = 11×20 = 220.

Seats of EEE are increased by 10% = 110% of 220.

$$= \frac{110}{100} \times 220 = 242$$

Initially seats of CSE = $13x$ =13×20 = 260.

Seats of CSE after increasing 20% = 120% of 260

$$= \frac{120}{100} \times 260 = 312$$

Total seats of all the three branches available after increasing = 242 + 276 + 312 = 830.

24)3; $\frac{5}{9} = 0.55$; $\frac{13}{17} = 0.76$; $\frac{3}{7} = 0.42$; $\frac{21}{25} = 0.84$; $\frac{1}{5} = 0.2$

$\therefore$ 21 : 25 is greatest.

Alternate Method: $5 \times 13 \Rightarrow 85 : 117$ (9 × 17)

Since 117 > 85, the ratio 13 : 17 is greater than 5 : 9.

Now compare 13 : 17 with 3 : 7.

$13 \times 3 \Rightarrow 91 : 51$ (17 × 7)

Since 91 > 51, the ratio 13 : 17 is greater than 3 : 7

Similarly, compare 13 : 17 with 21 : 25.

$13 \times 21 \Rightarrow 325 : 357$ (17 × 25)

Since, 357 > 325, the ratio 21 : 25 is greater than 13 : 17.

Now compare 21 : 25 with 1 : 5.

$21 \times 1 \Rightarrow 105 : 25$ (25 × 5)

Since, 105 > 25, the ratio 21 : 25 is greater than 1 : 5.

25)2; Here the time period of investment is not same. *Hence the ratio = (investment × time).*

(12000×12 months):(15000×9months):(18000×10 months)

= 144 : 135 : 180 ⇒ 16 : 15 : 20

The share of A in the profit = $\frac{16}{51} \times 20400 = ₹\,6400$

The share of B in the profit = $\frac{15}{51} \times 20400 = ₹\,6000$

The share of C in the profit = $\frac{20}{51} \times 20400 = ₹\,8000$

26)3; Let the share values of SBI, Andhra Bank, ICICI Bank be $7x$, $4x$ and $3x$.

$\therefore$ Share value of (6 SBI + 7 Andhra Bank + 12 ICICI) = (6×7x) + (7×4x) + (12×3x) = 5300 ⇒ 42x + 28x + 36x = 5300

$$106x = 5300 \Rightarrow x = \frac{5300}{106} = 50$$

Share values of SBI, Andhra Bank, ICICI = $7x$, $4x$, $3x$

⇒ 7×50, 4×50, 3×50 = Rs. 350, Rs. 200, Rs. 150

27)4; Let, prices of the car after increase and before increase = $26x$, $23x$.

Hike in the price ⇒ $26x - 23x$ = 24150

$$3x = 24150 \Rightarrow x = \frac{24150}{3} = 8050$$

Increased price of car = $26x$ = 26×8050 = Rs.209300.

28)1; Ratio of 3 persons = $\frac{1}{2} : \frac{1}{3} : \frac{1}{4}$

LCM of 2, 3, 4 = 12 (LCM is taken to remove the denominators in the numbers)

$$\therefore \left(\frac{1}{2} \times 12\right) : \left(\frac{1}{3} \times 12\right) : \left(\frac{1}{4} \times 12\right) = 6 : 4 : 3$$

Money that 3rd person will get = $\frac{3}{13} \times 10400 = ₹\,2400$

29)2; Let the boys and girls are $5x$: $6x$.

If 11 boys are added to the hall, ratio will get reversed.

i.e. $\frac{5x+11}{6x} = \frac{6}{5} \Rightarrow (25x + 55) = 36x \Rightarrow 11x = 55 \Rightarrow x = 5$

$\therefore$ Number of girls = $6x$ = 6×5 = 30.

30)1; Let the two numbers be 25, x.

Sum = x+25; Difference = x – 25.

Sum : Differences = 6 : 1. *i.e.* $x + 25 : x - 25 = 6 : 1$

⇒ x+25 = 6x-150 ⇒ 5x = 175 ⇒ x = 35

PERCENTAGES

CONCEPTS

A percentage is a way of expressing a number as a fraction of 100. The word 'per cent' or 'percentage' means for every one hundred. In other words, it gives rate of a parameter per hundred. It is denoted by the symbol %.

e.g.: 30% means 30 out of one hundred or $\frac{30}{100}$.

Key Notes:

• To convert a percent into a fraction, divide by 100.

e.g.: $20\% = \frac{20}{100} = \frac{1}{5}$

• To convert a fraction into a percent, multiply by 100.

e.g.: $\frac{3}{4} = \frac{3}{4} \times 100 = 75\%$

• To write a decimal as a percent we move the decimal point two places to the right and put the % sign.

e.g.: $0.35 = \frac{35}{100} = 35\%$

• Conversely to write a percent as a decimal, we drop the % sign and insert or move the decimal point two places to the left.

e.g.: 43% = 0.43; 12% = 0.12.

Calculating a Percentage:

$$Percentage = \left(\frac{Value}{Total}\right) \times 100.$$

For example, if you obtained 18 marks out of 25 marks, what was your percentage of marks?

Explanation: Total marks = 25. Marks obtained = 18.

$\therefore$ Percentage of marks obtained = $\frac{18}{25} \times 100 = 72\%$.

Calculating Percentage Increase or Decrease:

• **% Increase :**

New value = (1+ Increase %) × (Original Value)

• **% Decrease :**

New value = (1−Decrease %) × (Original Value)

e.g.: What is the discounted cost of a Rs. 80 book offered at 30% discount?

Explanation:

New Amount = $\left(1 - \frac{30}{100}\right) \times 80 = 0.70 \times 80 = 56$

• Calculating Percent Change:

Percentage change refers to the relative percent change of an increase or decrease in the original amount.

$$Percent = \frac{Change}{Original\ Value} \times 100$$

e.g.: What is the discount percentage of a Rs. 80 book sold for Rs. 64?

Explanation: Change = 80–64 = 16. Original Value = 80.

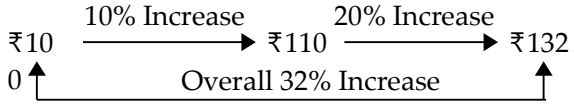
Discount Percentage = $\frac{16}{80} \times 100 = \frac{1}{5} \times 100 = 20\%$

Calculating Successive Percentages:

• If a number is successively increased by x% and y% then a single equivalent increase in that number will be $\left(x + y + \frac{xy}{100}\right)\%$.

e.g.: The price of an article is successively increased by 10% and 20%. What is the overall percent increase in the price of the article.

Explanation:



(or) By using formula:

$$= \left(x + y + \frac{xy}{100}\right)\% = \left(10 + 20 + \frac{(10)(20)}{100}\right)\% = 30 + 2 = 32\%.$$

• If there's an increase and a decrease, in that case, the decrease will be considered a negative value.

e.g.: If there is an increase of 20% and then a decrease of 10% on the price of a commodity, the successive percentage will be

$$20 + (-10) + \frac{20 \times (-10)}{100} = 20 - 10 - 2 = 8\% \text{ increase}.$$

• In case of discounts, the value of discount percentages will be considered negative.

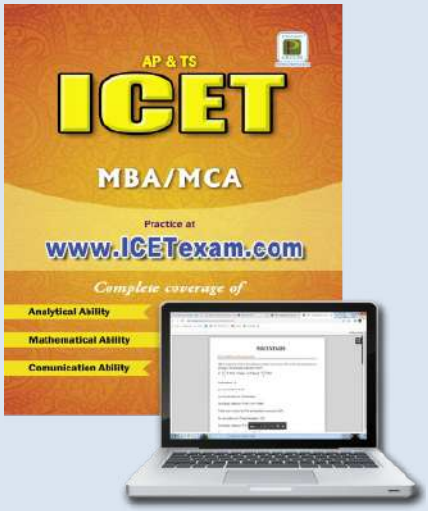
e.g.: If a shop keeper give 20% and 10% discounts on a festival day, the final discount given by shopkeeper is

$$(-20) + (-10) + \frac{(-20)(-10)}{100} = -100 + 25 = 75\%\ discount$$

• If there are three discounts as x%, y% and z% then first find the total discount of x% and y% and using it find the total discount with z%.

• If the price of commodity increases by x%, the percentage should a family reduce its consumption so as not to increase the expenditure on the commodity = $\frac{x}{100 + x} \times 100$.

• If the price of commodity decreases by x %, the percentage should a family increase its consumption so as not to decrease the expenditure on the commodity = $\frac{x}{100 - x} \times 100$.



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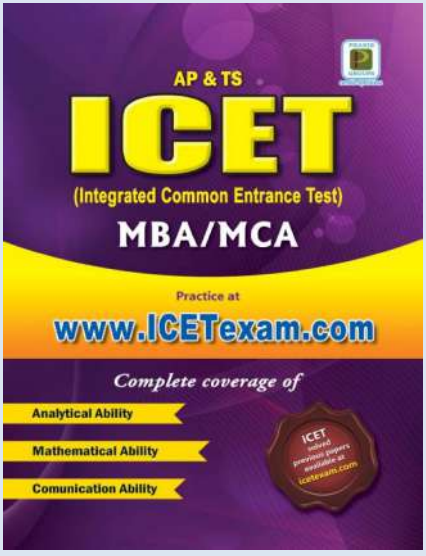

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(iii)4; Set A → common difference = 1

Set B → common difference = 100

$\therefore \frac{1}{100}\times 100 = 1\%.$

16)2; Total hours = 24; Percentage = $\frac{6}{24}\times 100 \Rightarrow 25\%$

17)1; Let, price = ₹100

$20\%\text{ increase} = 100 + \frac{20}{100}\times(100) = 120$

$20\%\text{ decrease} = 120 - \frac{20}{100}\times(120) = 96$

$\therefore$ Loss = 100 – 96 = 4%

18)3; Height on 18th birthday = 159 *cm*. Growth = 6%

Let, previous year height = x.

$\therefore$ During the year he grown 6% =

$x + \frac{6}{100}(x) = 159 \;=\; x\times\frac{106}{100} = 159 \Rightarrow x = 150\,cm$

19)(i)3; Failed by 20 marks.

i.e. Pass marks =100+20 =120

120 marks = 40% then total marks = $120\times\frac{100}{40} = 300$

(ii)2; Passing marks = 80 *i.e.* 80 = 40%

then 100 = x % $\Rightarrow x = \frac{100\times 40}{80} = 50\%$.

(iii)2; 40% of 400 = 160 = Passing marks.

$\therefore$ Marks he need = 160 – 100 = 60.

20)2; 40% solution means it contains 40% acid.

$\therefore$ 40% of 16 = $16\times\left(\frac{40}{100}\right)$ = 6.4 liters.

21)2; $\frac{\left(\frac{48}{7}\right)}{\left(\frac{7}{48}\right)}\times 100 = \frac{48\times 48}{7\times 7}\times 100 = 4700\%.$

22)3; 12.5% of 400 = $\frac{12.5}{100}\times 400 = 50$

5% of 80 = $\frac{5}{100}\times 80 = 4$ $\therefore$ Total = 50 + 4 = 54

23)2; 40% of number is 100.

90% of number is x.

$\therefore x \times 40\% = 100 \times 90\%$

$x = 100\times\left(\frac{90}{40}\right) = 225.$

24)2; Decreased at 10% per annum for 2 years.

i.e. $\frac{100}{100-10} = \frac{100}{90}$ for 2 years

$\therefore\; 810\times\left(\frac{100}{90}\right)\times\left(\frac{100}{90}\right) = 1000$

25)2; Let number of students be x.

Number of students below 9 years of age = 20% of x.

Number of students of 9 years of age = 96.

No. of students above 9 years of age = $\frac{2}{3}(96) = 64.$

Total number of students = $\frac{20}{100}x + 96 + 64 = x$

$\frac{x}{5} + 160 = x \;\Rightarrow\; \frac{4x}{5} = 160 \;\Rightarrow\; x = 200.$

PROFIT AND LOSS

CONCEPTS

Cost Price (CP) is the price at which an article is bought.

Selling Price (SP) is the price at which an article is sold.

Marked Price (MP) or List Price is the price marked on the article. For example, a vendor buys 1kg of mangoes for Rs. 50. He labeled the price as Rs. 80. But sold for Rs. 70. Here CP = Rs. 50, MP = Rs. 80, SP = Rs. 70.

The expenses incurred on transportation, maintenance, packaging, advertisement etc. are considered as *overhead*. These *overheads* and the *profit* when added to the *cost price* determine the *selling price*.

Profit or Gain: Profit is made when the selling price is greater than the cost price.

Profit = SP – CP ; **Profit % = $\frac{\text{Profit}}{\text{Cost Price}} \times 100$**

Considering the same example given above,

Profit = 70–50 = Rs. 20. Profit % = $\frac{20}{50} \times 100 = 40\%$

Loss: Loss is made when the cost price is greater than the selling price.

Loss = CP – SP ; **Loss % = $\frac{\text{Loss}}{\text{Cost Price}} \times 100$**

• Profit or Loss is calculated on cost price only.

Discount is always calculated on the marked price.

Discount = MP–SP; **Discount%= $\frac{\text{Discount}}{\text{MP}} \times 100$**

Consider the same example given above,

Discount = 80–70 =10; Discount% = $\frac{10}{80} \times 100 = 12.5\%$

• To calculate Gain, Loss, Selling Price and Cost Price directly use the formula,

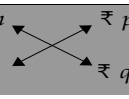
$$\text{SP} = \frac{(100 \pm \text{Gain or Loss}) \times \text{CP}}{100}$$

Use + sign for profit and – sign for loss.

Example: Cost Price of an article is Rs. 70. At what price it should be sold in order to gain 20%?

$\text{SP} = \frac{(100+20)\times 70}{100} = \frac{120 \times 70}{100} = 12 \times 7 = 84$

• If a man purchased m articles for Rs. p and sold n articles for Rs. q. Then how much profit or loss does he make?



Profit or Loss % = $\frac{mq - np}{np} \times 100$

Example: A merchant purchased 7 watches for Rs. 500 and sold 5 watches for Rs. 400. What is loss or gain percent?

Explanation:

$\frac{7\times 400 - 5\times 500}{5\times 500} \times 100 = \frac{2800-2500}{2500} \times 100 = \frac{300}{25} = 12$

• By selling an article for Rs. P, a merchant would gain or loss x%. The price at which he sell it to gain or loss y % is $\text{SP} = \text{P}\left(\frac{100 \pm y}{100 \pm x}\right)$. (+ sign for gain; − sign for loss)

Example: By selling a furniture for Rs. 180 a merchant will loss 10%. At what price must he sell to gain 20%.

Explanation: $\text{SP} = 180 \times \left(\frac{100+20}{100-10}\right) = 240$

• When a man buys two things on equal price each and in those things one is sold at a profit of x% and another is sold at a loss of x%, then there will be no loss or no gain percent.

Example: A merchant purchased a watch and a bag for Rs. 100 each. But he sold the watch at a profit of 20% and bag at a loss of 20%. What is his loss or gain percentage?

Explanation:

	CP		SP
Watch -	Rs. 100	+ 20% Profit =	Rs. 120
Bag -	Rs. 100	– 20% Loss =	Rs. 80
	Rs. 200		Rs. 200

Cost price = Selling Price. Hence, no gain or no loss.

• By selling two articles at the same price a merchant incurs x% loss on the first article and x% gain on the second article. In such a case there is always a loss.

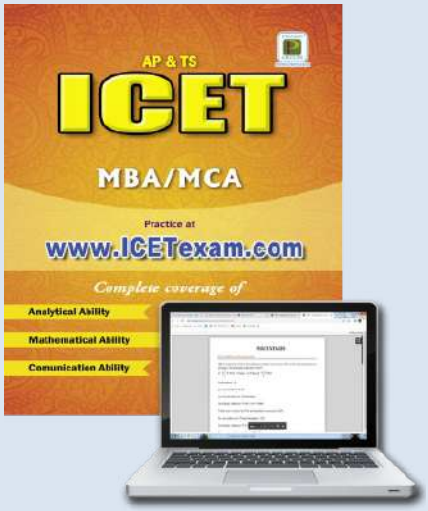
$\text{Loss} = \frac{2 \times \text{SP}}{\left(\frac{100}{x}\right)^2 - 1}$

Example: By selling a watch and a bag at Rs. 100 each a merchant incurred a loss of 20% on watch and gain of 20% on bag. What is his loss or gain percentage?

Explanation:

	SP	CP
Watch	Rs. 100 (20% Loss on CP) =	Rs. 125
Bag	Rs. 100 (20% Profit on CP) =	Rs. 83.33
	Rs. 200	Rs. 208.33

Here, CP > SP. Hence, Loss = $\frac{8.33}{208.33} \times 100 = 3.9\%$



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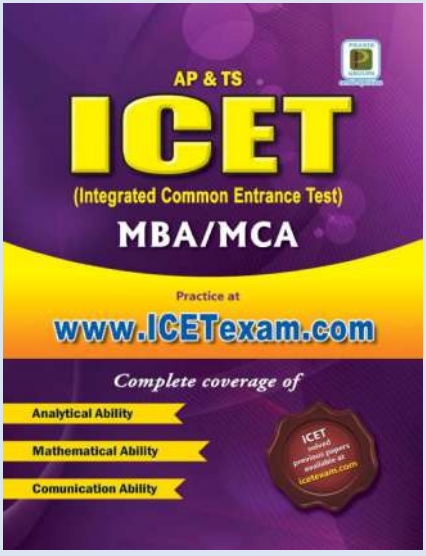

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12)4; Let, he bought the mobile phone at Rs. x.

Then $x-\frac{1}{6}x=7500$ (By losing $\frac{1}{6}^{th}$ on buying cost)

$\therefore \frac{5}{6}x=7500\Rightarrow x=9000$

13)2; For Rs. 30000, the man loses 25%.

$x-\frac{25}{100}x=30000 \Rightarrow x = 40000.$

Now, the man wants gain of 25%.

$\therefore 40000\times\left(\frac{125}{100}\right)=50000$

Alternate Method: Using Formula.

$\text{SP}=30000\left[\frac{100+25}{100-25}\right]$

$\Rightarrow 30000\left[\frac{5}{3}\right]=50000$

14)4; Let the price of the article is Rs. x.

A sold to B at 8% Profit = $x+\frac{8}{100}x=\frac{108}{100}x$

B sold to C at 12% Profit = $\frac{108}{100}\times\frac{112}{100}x$

Ratio of the selling prices = $\frac{108}{100}x:\frac{108}{100}\times\frac{112}{100}x$

$= 1:\frac{28}{25}=25:28.$

15)4; Difference between selling prices = Rs. 3

In the above explanation, ratio of selling prices = 25:28.

The difference of these two (25 and 28) is also 3.

So, one of the selling prices can be either Rs. 25 or Rs. 28.

Option-4 is correct choice.

16)2; Checking from options.

Calculating profit percentages.

Option-(1): Profit percentage = $\left(\frac{5}{50}\right)\times 100=10\%$

Option-(2): Profit percentage = $\left(\frac{3}{20}\right)\times 100=15\%$

Option-(3): Profit percentage = $\left(\frac{6}{60}\right)\times 100=10\%$

Option-(4): Profit percentage = $\left(\frac{5}{40}\right)\times 100=12.5\%$

$\therefore$ Option-(2) is best, as percentage is highest.

17)2; Let, SP = x and CP = y;

$\therefore 6\times x=8\times y\Rightarrow\frac{x}{y}=\frac{4}{3}$

Gain% = $\frac{x-y}{y}\times 100=\left(\frac{4}{3}-1\right)\times 100=\frac{100}{3}=33.33$

Alternate Method: Using formula.

Let cost of 8 articles is Rs. 1.

8 ₹ 1

6 ₹ 1

Profit= $\frac{8-6}{6}\times 100=\frac{1}{3}\times 100=33.33\%.$

18) 2; He sells 0.9 mt pipe at rate of 1 mt pipe.

$\therefore$ SP of 0.9 mt = CP of 1 mt

Let, CP of 1 mt = Rs. 100

$\therefore$ If SP of 0.9 mt = Rs. 100,

then SP of 1 mt = $\frac{1\times 100}{0.9}=111.11$

$\therefore$ Profit = $\frac{111.11-100}{100}\times 100=11.11\%$

Alternate Method: Using direct formula.

100 meters Rs. 10

90 meters Rs. 10

$\frac{100\times 100-100\times 90}{100\times 90}\times 100 = \frac{100}{9} = 11.11\%$

19)1; Let, SP = 100 ; Then, loss = 20

$\therefore$ CP = (100 + 20) = 120

$\therefore$ Loss % = $\frac{20}{120}\times 100\%=16.66\%$

INTERESTS AND DISCOUNTS

CONCEPTS

• The money borrowed or lent out for a certain period is called the *principal* or the *sum*.

• *Interest* is the money paid for the use of borrowed money *i.e.* extra money paid for using others money is called *interest.*

• Sum of *interest* and *principal* is called *amount.*

Amount = Principal + Interest

• **Simple Interest:** For a certain period, if the interest on a certain sum borrowed is reckoned uniformly, then it is called *simple interest.* Denoted by $S.I=\frac{P\times R\times T}{100}$.

Amount = Principal + Simple Interest.

P = Principal; S.I = Simple Interest

T = Time (in years) R = Rate percent per annum

• Time must be expressed in the same units used for time in the Rate.

e.g.: IfRs. 1000 is borrowed for 3 years at 10% simple interest, what is the total amount after 3 years?

Explanation:

Year	Principal	Interest (10%)	Amount
1st	1000	100	1100
2nd	1100	100	1200
3rd	1200	100	**1300**

(or) $S.I=\frac{PRT}{100}=\frac{1000\times10\times3}{100}=300$

Amount = Principal + Interest = 1000 + 300 = 1300

e.g.: IfRs. 1500 is invested at 15% simple annual interest, how much interest is earned after 9 months?

Explanation: Here time is in terms of months but interest is in terms of years. So, Time must be expressed in the same units used for time in the Rate.

i.e. 9 months = $\frac{9}{12}$ years.

Now, $S.I=\frac{1500\times15\times9}{12\times100}=168.75$.

• **Key Notes on Simple Interest**

2) A sum of money becomes n times of itself in T years at simple interest, then the rate of interest is,

$\text{Rate}=\frac{100(n-1)}{T}\%$

3) If a sum of money at simple interest becomes n times of itself in T years then in how many years it will become m times of itself.

$\text{Required time}=\frac{(m-1)\times T}{(n-1)}$ *years*

4) If simple interest on a sum of money is $\frac{1}{x}th$ of the principal and the time T is equal to the rate percent R then $\text{Rate}=\text{Time}\sqrt{100\frac{1}{x}}$.

5) A certain sum is at simple interest at a certain rate for T years. If it had been put at R_1% higher rate, then it would fetchRs. x more.

Then the $\text{Principal}=\frac{x\times100}{T\times R_1}$.

6) Let the rate of interest for first t_1 years is r_1% per annum. r_2% per annum for next t_2 years and r_3% for the period beyond that. Suppose all together the simple interest for t_3 years is 'SI'

Then, $\text{Principal}=\frac{100\times SI}{t_1r_1+t_2r_2+(t_3-t_1-t_2)r_3}$.

7) The simple interest on a certain sum of money at r_1% per annum for t_1 years=Rs. m. The interest on the same sum for t_2 years at r_2% per annum =Rs. n. Then the $\text{sum}=\frac{(m-n)\times100}{r_1t_1-r_2t_2}$.

• **Compound Interest:** If interest as it becomes due and is not paid to the lender but is added on to the principal, then the money is said to be lent at compound interest.

And the total sum owed after a given time is called the amount at compound interest for that time.

$CI=P\left[\left(1+\frac{R}{100}\right)^T-1\right]$; $\text{Amount}=P\left(1+\frac{R}{C\times100}\right)^{T\times C}$

Where T = Number of years and

C = Number of times compounded annually.

e.g.: IfRs. 1000 is borrowed for 3 years at 10% per annum CI, then what is the total amount after 3 years?

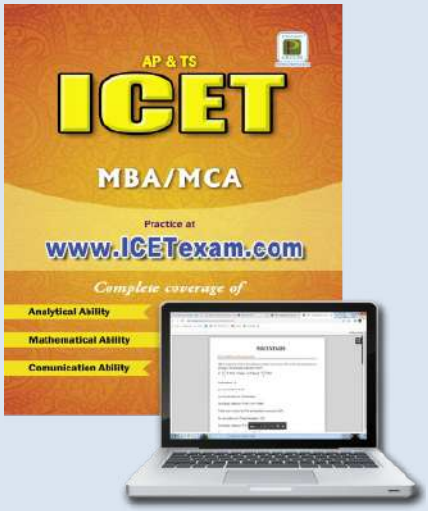
Explanation:

Year	Principal	Interest (10%)	Amount
1st	1000	100	1100
2nd	1100	110	1210
3rd	1210	121	**1331**

(or) Amount = $A=P\left(1+\frac{r}{CX100}\right)^{nXC}$

$\Rightarrow1000\left(1+\frac{10}{1\times100}\right)^{3\times1}=Rs.1331$

Here interest is calculated per annum (*i.e.* once in a year), Hence $C=1$.



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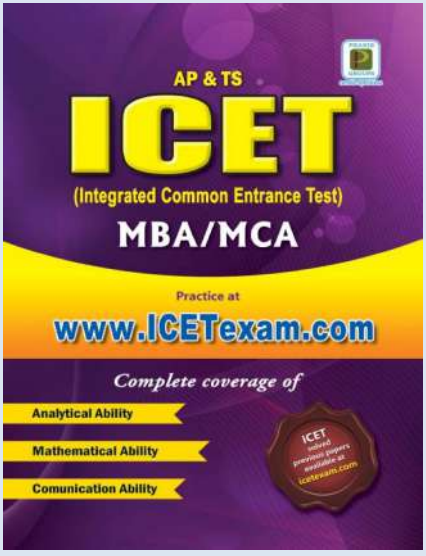

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11)2; In Compound Interest, Amount = $P\left[1+\frac{R}{100}\right]^T$

$\Rightarrow 6800=6400\left[1+\frac{R}{100}\right]^1 \Rightarrow 1+\frac{R}{100}=\frac{17}{16}$

$\Rightarrow \frac{R}{100}=\frac{1}{16} \Rightarrow R=6\frac{1}{4}\%$.

12)3; Here P =8000, R = $\frac{5}{2}\%$, n = 3, A = ?

Using the formula, $A=P\left(1+\frac{R}{100}\right)^n$,

we get, $A=8000\left(1+\frac{5}{2\times 100}\right)^3$

$A=8000\left(\frac{205}{200}\right)^3=\frac{8000\times 205\times 205\times 205}{200\times 200\times 200}\approx \text{Rs. } 8615$

13)3 Since the difference of interest in the two cases is100. For 2 years, x = 100 and R = 5%.

$\therefore$ Sum = $x\times\left(\frac{100}{R}\right)^2=100\times\left(\frac{100}{5}\right)^2$ =40000.

14)4; Simple Interest on 10000 for 2 years at 8% p.a = 11600 and Compound Interest = 11664.
Difference = 64.

15)3; Simple Interest on 3000 for 2 years at 10% p.a = 3600 and Compound Interest = 3630.
Difference = 30.

16)2; P =Rs. 8000, R = 6%, T = 4 years

$\therefore$ C.I = $8000\left(\left(1+\frac{6}{100}\right)^4-1\right)=2099.8$

17)2; If population of a city or town is increasing at a certain rate, then

Population after a fixed time =

$\text{Present population}\times\left(1+\frac{\text{Rate of increase}}{100}\right)^{\text{time}}$

$12000=\text{Population of the village 4 years ago}\times\left(1+\frac{10}{100}\right)^4$

$\therefore$ Population of the village 4 years ago =

$=\frac{12000}{\left(\frac{14641}{10000}\right)}=8196\,(aprx)$

18)3; Suppose the rate percent *p.a* = x%
C.I for $(n+1)^{th}$ year = C.I for n^{th} year + S.I for 1 year on the C.I for n^{th} year

$\therefore$ 15600 = 12000 + x% of 12000

$\Rightarrow 3600=\frac{x}{100}\times 12000 \Rightarrow x = 30\%$

Hence, the rate of interest is 30%.

19)4; Here, P =Rs. 12400, R = 10% *p.a* = 5% half yearly.
i.e. Time = 1 year = 2 half years $\Rightarrow n = 2$.

$\Rightarrow A=12,400\left(1+\frac{5}{100}\right)^2$

$\Rightarrow A=\frac{124}{4}\times 21\times 21=\text{Rs. } 13671$

20)2; $A=P\left(1+\frac{r_1}{100}\right)\left(1+\frac{r_2}{100}\right)\left(1+\frac{r_3}{100}\right)$

$=10000\left(1+\frac{10}{100}\right)\left(1+\frac{15}{100}\right)\left(1+\frac{20}{100}\right)$

$=10000\times\frac{11}{10}\times\frac{115}{100}\times\frac{6}{5}=15180$

21) $P.W=\frac{T.D\times 100}{r\times t}=\text{Rs. }\frac{300\times 100}{\frac{2}{3}\times 9}=\text{Rs. } 5000$

Amount of the bill =Rs. 5000 +Rs. 300 =Rs. 5300

22) Sum due =Rs. 1920 $T.D$ =Rs. 120
Present Worth = 1920 - 120 = 1800
Bankers Discount on Rs. 1800 = 128

$\therefore$ Bankers Discount on Rs. 192 = $1920\times\frac{120}{1800}=Rs.\,128$

Bankers Gain = $B.D$ - $T.D$ = 128 - 120 =Rs. 8

23) P.W =Rs. 729 -Rs. 9 =Rs. 720; T.D =Rs. 9; Rate = 5%

Time $\Rightarrow\frac{T.D\times 100}{P.W\times Rate}=\frac{9\times 100}{720\times 5}=\frac{1}{4}$ years = 3 months.

24) T.D = (Sum Due) – (Present Worth)
=1500 – 1250 =250

Rate = 5; Time $=\frac{\text{T.D}\times 100}{\text{P.W}\times\text{Rate}}=\frac{250\times 100}{1250\times 5}=4$ months.

25) If bankers gain is Rs. 1, then $B.D$ is Rs. 41
T.D = B.D - Bankers Gain = Rs. 41 -Rs. 1 =Rs. 40
Now Rs. 1 is the interest on Rs. 40 $\Rightarrow$ Rate is 2.5%

26) $PW=\frac{A}{\left(1+\frac{R}{100}\right)^n}\Rightarrow\frac{4630.25\times 20\times 20\times 20}{21\times 21\times 21}=\text{Rs. } 4000$

27) $B.D$ =Rs. 24; Rate = 4%; Time = 0.5 *yeas*

$S.D=\frac{B.D\times 100}{R\times T}=\frac{24\times 100}{4\times 0.5}=1200$

28)

$\text{P.W}=\frac{\text{S.D}\times 100}{100+\text{T}\times\text{R}}\Rightarrow\frac{14250\times 100}{100+5\times 10}\Rightarrow\frac{14250\times 100}{150}=\text{Rs.}9500$

29) S.I on Rs. 3200 = $T.D$ on Rs. 3248
$\therefore$Rs. 3200 is the $P.W$ of Rs. 3248
$\Rightarrow$Rs. 48 is the S.I on Rs. 3200 at 12%

Time = $\frac{100\times 48}{3200\times 12}\,year=\frac{1}{8}\,years=1.5\,months$

PARTNERSHIPS

CONCEPTS

When two or more than two persons agree to invest money to run a business jointly, this association or deal is called partnership and those who invest money are called partners. The total investment is called the capital.

Kind of partners: There are two kinds of partners.

• **Working or Active Partner:** When a partner devotes his time for the business in addition to invest his money, he is called a working partner. With mutual agreement, the active partners get some fixed percentage of profit
as working allowance.

• **Sleeping or Non Active Partner:**

A partner who simply invests money, but does not attend to the business is called a sleeping partner.

Kinds of Partnership:

• **Simple Partnership:**

If the capitals of several partners are invested for the same period. It is called a simple partnership.

• **Compound or Complex Partnership:**

If the capitals of the partners are invested for different intervals of time, this partnership is called compound or complex partnership.

Ratio of Divisions of Gains:

I. When investments of all the partners are for the same time, the gain or loss is distributed among the partners in the ratio of their investments. Suppose A and B invest Rs.x and Rs.y respectively for a year in a business, then at the end of the year:

(A's share of profit) : (B's share of profit) = x : y.

II. When investments are for different time periods, then equivalent capitals are calculated for a unit of time by taking (capital x number of units of time). Now gain or loss is divided in the ratio of these capitals.

A invests Rs. x for 'p' months and B invests Rs. y for 'q' months then,

(A's share of profit) : (B's share of profit) = xp : yq

• The share of profit to partner is dependent on
(i) investment
(ii) working hours of partners

Share α (working hours of partner)

$$\text{Share} \alpha \frac{1}{\text{Investment}}$$

CONCEPTUAL EXAMPLES

1) X and Y starts a business with the investment of Share Rs. 8000 and Rs. 5000 respectively. Y is an active partner and therefore he gets 10% of the profit separately for supervision of the trade. If total profit of the business is Rs. 3240, what will be the profit of Y.

1) 324 2) 1215 3) 1445 4) 1944

Explanation: Separate Profit of 'Y' for supervision of the business is 10% *i.e.* Rs. 324/-.

Remaining profit =Rs. 2916

$$Y\text{'s share} = \frac{5000}{13000} \times 2916 = 1121$$

$\Rightarrow Y$'s share in the profit
= 324 + 1121
= Rs. 1445

2) Aruna, Amulya and Alekhya started a business in partnership. Aruna invested $\frac{1}{4}^{\text{th}}$ of the total capital and Amulya invested amount equal to the investment of Aruna and Alekhya. If Annual profit of the business is Rs. 1280. What will be the profit of Amulya?

1) 320 2) 480 3) 560 d) 640

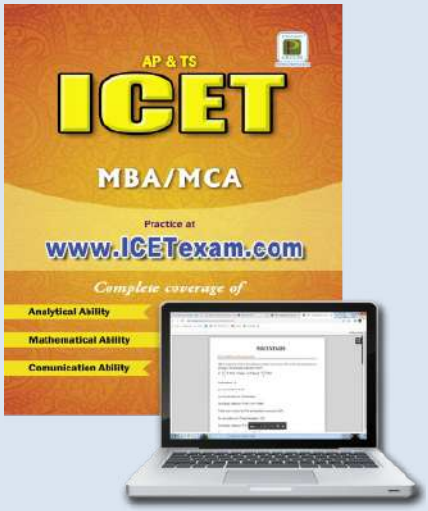
Explanation: Aruna's investment = $\frac{1}{4}^{th}$ *of total capital*

$$\Rightarrow \text{Profit of Aruna} = \frac{1}{4} \times 1280 = \text{Rs.}320$$

Amulya's capital = Aruna's capital + Alekhya's capital
$\Rightarrow$ Amulya's profit = Aruna's profit + Alekhya's profit
Profit of Aruna + Amulya + Alekhya = Rs. 1280
2(Aruna+ Alekhya) = 1280
$\Rightarrow$ Aruna+ Amulya = 640
i.e. Amulya's profit = Rs. 640.

Alternate Method:

Investment of Aruna = 25%
Amulya = Aruna + Alekhya
Amulya – Aruna – Alekhya = 0 % … (1)
Amulya + Aruna + Alekhya = 100% … (2)
Solving (1) and (2),
Amulya = 50 %
i.e. 50% of 1280 = Rs. 640



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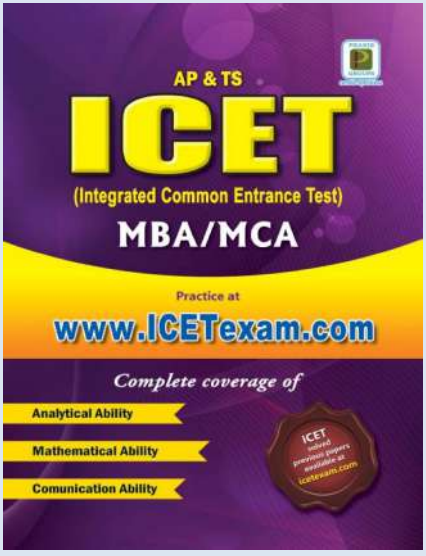

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EXPLANATIONS

1)2; Let the amount invested by Ramesh = Rs. x. Then,
$20000\times6 : 12x = 6000 : 3000$
$120000 = 24x \Rightarrow x = 5000$

2)1; Ratio of shares = 27000 : 81000 : 72000 = 3 : 9 : 8
If Ram's share is Rs. 9, total profit = Rs. 20
If Ram's share is Rs. 36000.
Then total profit = $\left(\frac{20}{9}\times36000\right)=\text{Rs. }80000$

3)4; Let B invested Rs. x for y months.
Then A's investment = Rs. $3x$ for $2y$ months.
Ratio of investments of A and $B = 6xy : xy \Rightarrow 6 : 1$
Given, B's share = Rs. 4000 then A's share = Rs. 24000
Hence, total profit = Rs. 28000

4)2; Ratio of their shares = 6000×12 : 4000×6 = 3 : 1
Madhu's shares = $\left(\frac{1}{4}\times5200\right)=\text{Rs. }1300$

5)4; Let C's share = x.
Then, B's share = $\frac{x}{2}$ and A's share = $\frac{x}{4}$
$A:B:C=\frac{x}{4}:\frac{x}{2}:x=1:2:4$
Hence, C's share = $\left(\frac{4}{7}\times700\right)=\text{Rs. }400$

6)4; A : B : C = 2000 × 12 : 3000 × 24 : 4000 × 24 = 1 : 3 : 4
A's share = $\left(3200\times\frac{1}{8}\right)=\text{Rs. }400$

7)2; Let, total profit be 100.
After donating 20% = Rs. 20 to charity,
Rohit's share = $\text{Rs.}\left(80\times\frac{3}{10}\right)=\text{Rs. }24$
∴ If Rohit's share = 24, then total profit = 100
Then, if Rohit's share = 490, then
Total profit = $\frac{490}{24}\times100=\text{Rs. }2041$

8)3; Let, A's investment is 'x'.
∴ B's investment = x + 10000
C's investment = x + 15000
∴ So, $x + (x+10000) + (x+15000) = 100000$
$3x = 75000 \Rightarrow x = 25000$
∴ A : B : C = 25000 : 35000 : 40000 = 5 : 7: 8
Now, A's share in profit of Rs. 50000
= $\frac{5}{20}\times50000=\text{RS. }12500$

9)1; A worked for 12 months; B worked for 8 months.
Capital spent is same.
∴ Ratio of profits of A : B = 12 : 8 ⇒ 3 : 2
A's share = $\frac{3}{5}\times36000=\text{Rs. }21600$

10)2; Let, initial investment of Ajay = $5x$ and Bala = $3x$.
The investment of Chandra = $5x$.
∴ Ratio of their profits = $(5x \times 12) : (3x \times 12) : (5x \times 4)$
$= 5 \times 12 : 3 \times 12 : 5 \times 4 = 15 : 9 : 5$

11)1; A : B = (9×3) : (2×9) = 27 : 18 = 3 : 2
∴ A's share = $\frac{3}{5}\times150=90$

12)1; Share of A : B = 5 : 7
$5x+7x = 6000 \Rightarrow 12x = 6000 \Rightarrow x = 500$.
A should pay $5x = 5 \times500 = 2500$.

13)2; Sachin invested 25000 for 24 months
Nilesh invested 40000 for 18 months
Sachin : Nilesh = (25000×24) : (40000×18) = 5 : 6
Sachin's share = $\frac{5}{11}\times50000=22727$

14)3; Ganesh : Sai : Krishna =
5000×10 : 10000×5 : 5000×10 = 1 : 1 : 1
Krishna's share = $\frac{1}{3}\times9000=\text{Rs. }3000$

15)4; Profit = 40000
∴ A's share = 50% of 40000 = 20000
Remaining profit = Rs. 20000
Now $B : C = 4 : 6$
∴ C's share = $\frac{6}{10}\times20000=12000$

TIME, SPEED AND DISTANCE

CONCEPTS

1) If a man walks a distance 6 km in each hour, we say that his speed is 6 km per hour. Thus, the speed of a body is the rate at which it is moving.

$$\textbf{Speed} = \frac{\textbf{Distance}}{\textbf{Time}}$$

$$x\ km/hr = x \times \frac{5}{18}\ meters/sec$$

$$x\ meters/sec = x \times \frac{18}{5}\ km/hr$$

2) If the speed of a body is changed in the ratio $m : n$ then the ratio of the time taken will change in the ratio $n : m$.

3) Average Speed: When certain distance is covered by a body in parts at different speeds, then the average speed = $\frac{\text{Total distance covered by a body}}{\text{Total time taken}}$.

Note: (Average Speed) ≠ (Average of different speeds)

i.e. Average Speed ≠ $\frac{\text{Sum of the Speeds}}{\text{Number of different Speeds}}$

There are two different cases when an average speed is required.

Case I: When time remains constant and speed varies: If a man travels at the rate of 'x' *kmph* for 't' hours and again at the rate of 'y' *kmph* for another 't' hours, then for the whole journey, the average speed of man is

$$\text{Average Speed} = \frac{\text{Total Distance}}{\text{Total time taken}}$$

$$= \frac{xt + yt}{t + t} = \frac{x + y}{2}\ kmph$$

Case-II: When the distance covered remains same and the speeds vary: When a man covers a certain distance at speed of 'x' *kmph* and another equal distance at the rate of 'y' *kmph*. Then for the whole journey,

$$\text{Average speed} = \frac{2xy}{x + y}\ kmph$$

4) Relative Speed:

• When two bodies are moving in the opposite direction at a speed of V1 and V2 respectively, then the relative speed is $Vr = V1 + V2$.

• When two bodies are moving in the same direction at speed V1 and V2 respectively, then the relative speed is $Vr = |V1 - V2|$.

Key Notes to Solve Problems:

1) A man covers a certain distance at *'x' km/hr* by car and the same distance at *'y' km/hr* by bicycle. If the time taken by him for the whole journey is by *'t'* hours, then total distance covered by him = $\frac{2(t)(x)(y)}{x + y}\ km$.

2) A boy walks from his house at 'x' *km/hr* and reaches the school *'t_1'* minutes late. If he walks at 'y' *km/hr* he reaches *'t_2'* minutes earlier. Then, distance between the school and house = $\frac{xy}{(x - y)}\left(\frac{t_1 + t_2}{60}\right) km$.

3) If a man walks at x/y of his usual speed he takes *'t'* hours more to cover certain distance. Then the time taken to cover the same distance when he walks with his usual speed is $\frac{xt}{y - x}$ hours.

4) If two persons *A* and *B* start at the same time in opposite directions from the points and after passing each other they complete the journeys in 'x' and 'y' hours respectively, then

A's speed : B's speed = $\sqrt{y} : \sqrt{x}$

5) If the speed is $\frac{a}{b}$ of the original speed, then the change in time taken to cover the same distance = $\left(\frac{b}{a} - 1\right) \times$ Original Time.

BOATS - STREAMS

• If the boat moves against the stream, then it is called 'Upstream'.

• If the boat moves along with the stream, then it is called 'Downstream'.

• If the speed of the boat is *x kmph* and speed of the stream is *y kmph*, then

Speed of the boat against the stream or upstream = (x–y) *kmph*.

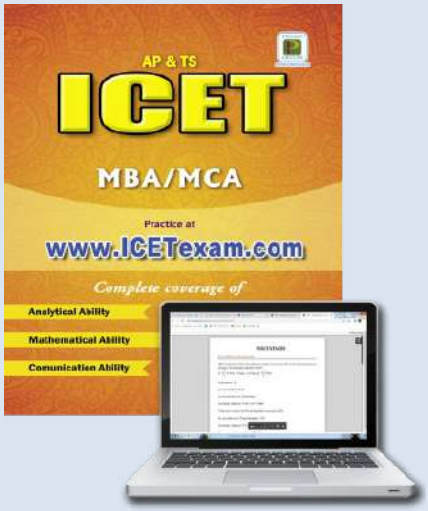
Speed of the boat along with the stream or downstream = (x+y) *kmph*.

• If the speed of the downstream is *'a' kmph* and speed upstream is *'b' kmph*, then

$$\text{Speed of the boat in still water} = \frac{(a + b)}{2}\ kmph$$

$$\text{Rate of the stream are current} = \frac{(a - b)}{2}\ kmph$$

• Speed of boat or swimmer means the speed of the boat or swimmer *in still water*.



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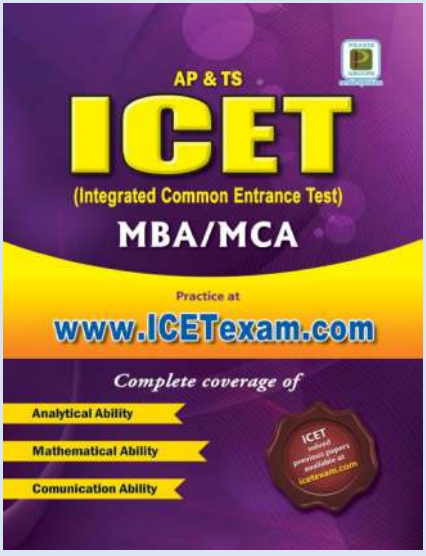

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40)2; (I) Relative Speed = $60+6=66\,kmph=66\times\frac{5}{18}$

Relative speed = 60 + 6 = 66 *kmph* = $66\times\frac{5}{18}=\frac{55}{3}\,mps$

Required time = $\frac{110}{55}\times3=6\,sec$

(II) Relative speed = 66–6 = 54 *kmph*= $54\times\frac{5}{18}=15\,mps$

Required time = $\frac{110}{15}\Rightarrow7\frac{1}{3}\,sec$

41)1; Total hours = 8; First half *i.e.* 4 *hours* @ 24 *kmph*
∴ Distance traveled in first half = 4×24 = 96 *km*
Second half *i.e.* 4 *hours* @ 32 *kmph*
∴ Distance traveled in second half = 4×32 = 128 *km*
∴ Total distance = 96 + 128 = 224 *km*

42)2; Velocity of boat = U, Velocity of stream = V
∴ In upstream, U – V = 50 ———————— (1)
In downstream, U + V = 30 ----———— (2)
Solving (1) and (2), U = 40 , V = 10

43)2; A runs 20% faster than B *i.e.* if B runs 100 *m* then A runs 120 *m.* In other way, if A runs 6 *m* then B runs 5 *m.*
∴ If the length of race is 6 m, then A can give B a start of 1 *m* so that they finish the race in dead heat.
∴ From the question, for the start of 6 *m* the length of race = 6 × 6 = 36 *m.*

44)2; Let, total distance traveled by foot = *x*
∴ Distance traveled on bicycle = 31 – *x*
So, $\frac{x}{3}+\frac{31-x}{5}=9\ \therefore x=21$
∴ Total distance traveled by foot = 21 *km*

45)3; Let, usual speed = *s* and usual time =*t*, distance =*d*
∴ New speed = $\frac{3}{4}s$ and New time = $\frac{4}{3}t$
∴ $\frac{4}{3}t-t=2.5\ \Rightarrow t=7.5$ hours

46)3; Let 2x be the total distance travelled;
First half i.e. x Km @ 24 kmph
∴ Time required for first half = x/24 h
Second half i.e. x Km @ 32 kmph
∴ Time required for second half = x/32 h
∴ Total time = 8 = x/24 +x/32
=> x= 768/7 Km
Total distance = 2x = 219.43 Km = 219 Km (rounded)

TIME AND WORK

CONCEPTS

1) If a person completes a piece of work in *'n'* days, then work done by that person in one day $= \frac{1}{n}^{th}$ part of the work.

2) If a person completes $\frac{1}{n}^{th}$ part of the work in one day, then the person will take *'n'* days to complete the work.

3) The total work to be done is usually considered as one unit.

4) If M_1 persons can do W_1 work in D_1 days and M_2 persons can do W_2 work in D_2 days then

$$M_1 D_1 W_2 = M_2 D_2 W_1.$$

5) If M_1 persons can do W_1 work in D_1 days working T_1 hours per day and M_2 persons can do W_2 work in D_2 days working T_2 hours per day then

$$M_1 D_1 T_1 W_2 = M_2 D_2 T_2 W_1.$$

6) If A can do a piece of work in *'x'* days and *B* can do it in *'y'* days then A and *B* working together will do the same work in $\frac{xy}{(x+y)}$ days.

7) If A, *B* and *C* can do a piece of work in *x*, *y* and *z* days respectively then all of them working together can finish the work in $\frac{xyz}{(xy+yz+zx)}$ days.

8) If A is thrice as good a workman as *B* then,

Ratio of work done by A and *B* = 3 : 1.

Ratio of time taken by A and *B* to finish a work =1 : 3.

9) If A is *'k'* times efficient than *B* and is therefore able to finish a work in *'n'* days less than *B*, then

a) A and *B* working together can finish the work in $\frac{kn}{k^2-1}$ days.

b) A working alone can finish the work in $\frac{n}{k-1}$ *days.*

c) *B* working alone can finish the work in $\frac{kn}{k-1}$ *days.*

10) If A, working alone takes a days more than A and B working together. B alone takes *b* days more than A and B working together. Then the number of days taken by A and B working together to finish the job is $\sqrt{ab}$.

CONCEPTUAL EXAMPLES

1) A is twice as good a workman as *B* and takes 10 days less to do a piece of work than *B* takes. Find the time in which *B* alone can complete the work.

1) 22 days 2) 25 days 3) 23 days 4) 20 days

Explanation: Let *B* alone takes *'x'* days to complete the work. A is twice as good workman as *B.*

It means A takes $\frac{x}{2}$ days to complete the work.

From the given information we can write $x - \frac{x}{2} = 10$

$$\Rightarrow \frac{2x-x}{2} = 10 \Rightarrow \frac{x}{2} = 10 \Rightarrow x = 20.$$

Alternate Method: Using Formula.

Here, $k = 2$ and $n = 10$

$\therefore$ Time taken by *B* working alone to complete the work= $\frac{kn}{k-1}$ days $\Rightarrow \frac{2\times 10}{2-1} = 20$ days.

2) 25 men can reap a field in 20 days. When should 15 men leave the work, if the whole field is to be reaped in 37½ days after they leave the work.

1) 5 days 2) 4 days 3) 3 days 4) 4½ days

Explanation: 25 men can reap the field in 20 days. ⇒ 1 man can reap that field in 25×20 ***i.e.*** 500 days.

Let 15 men leave the work after *x* days so that remaining 10 men can complete the work in 37½ days. It means 25 men have worked for *x* days and 10 men have worked for 37½ days.

$$\therefore 25x + 10 \times 37\frac{1}{2} = 500 \Rightarrow 25x = 500 - 375 = 125 (\text{or}) x = 5$$

$\therefore$ 15 men must leave the work after 5 days.

3) A man is paid Rs. 30 for each day he works, and forfeits Rs. 5 for each day he is idle. At the end of 60 days he gets Rs. 50. Then, he was idle for _____ days.

1) 20 2) 25 3) 30 4) 50

Explanation: Suppose, the man was idle for *x* days.

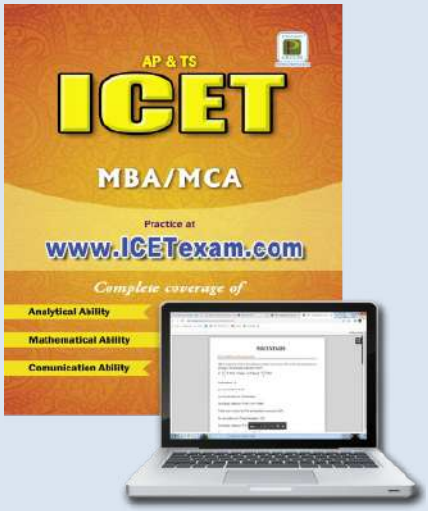
$\therefore 30(60 - x) - 5x = 50 \Rightarrow x = 50$

4) 12 men or 15 women can do a work in 20 days. In how many days 7 men and 5 women would complete the work?

1) 21.8 2) 22.8 3) 25.3 4) 29

Explanation: ***or*** refers either only men are working or only women are working.

and refers to both men and women working simutaneously.



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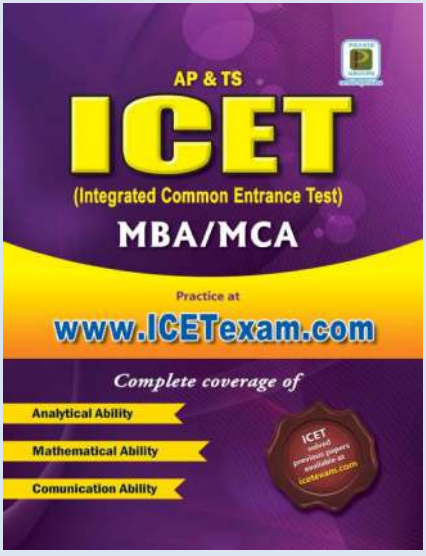

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5)2; (A+B)'s 1 day work= $\frac{1}{8}$;

A's 1 day work = $\frac{1}{10}$

B's 1 day work= $\frac{1}{8}-\frac{1}{10}=\frac{1}{40}$

Money should be divided in the ratio $\frac{1}{10}:\frac{1}{40}=4:1$

Then B gets = $\left(\frac{1}{5}\times 320\right)=\text{Rs. } 64$.

Alternate Method:

A working for 10 days earns Rs. 320 *i.e.* Rs. 32 per day.

If A worked for 8 days, he earns Rs. 256.

Then B's share = 320–256 = 64

6)4; Obviously (5m + 3b) = 5(1m + 1b) = 0 m = 2 b

∴ Ratio of the work done by a man and a boy = 2 : 0.

It means, boy is not doing any work.

7)1; Using Chain Rule, $\frac{1400}{x}=\frac{15}{12}\times\frac{6}{9}\Rightarrow x=1680$

Alternate Method: $M_1 D_1 W_2 = M_2 D_2 W_1$.

$\Rightarrow 6\times 15\times x = 9\times 12\times 1400 \Rightarrow \frac{9\times 12\times 1400}{6\times 15}=1680$.

8)3; Here, a = 16 and b = 4;

∴ Time taken by A and B, working together to complete the job is $\sqrt{ab}$ hours = $\sqrt{16\times 4}$ = 8 hours.

9)1; (Amar + Manoj + Akash)'s 1 day work= $\frac{1}{8}$

(as they can finish job in 8 days)

Amar's 1 day work = $\frac{1}{32}$; Manoj's 1 day work= $\frac{1}{24}$

∴ Akash's 1 day work = $\frac{1}{8}-\left(\frac{1}{32}+\frac{1}{24}\right)=\frac{5}{96}$

∴ Then Akash alone can complete in $\frac{96}{5}=19\frac{1}{5}$ *days.*

10)3; Let, 1 man's 1 day work = x

1 woman's 1 day work = y

Then, $4x+6y=\frac{1}{16}$ and $3x+7y=\frac{1}{20}$

Solving this, we will get $y=\frac{1}{800}$

∴ 1 woman's 1 day work = $\frac{1}{800}$

∴ 10 woman's 1 day work = $10\times\left(\frac{1}{800}\right)=\frac{1}{80}$

Hence, 10 women requires 80 days to complete.

11)2; B's 5 day work = $\frac{2}{15}\times 5=\frac{2}{3}$

Remaining work = $1-\frac{2}{3}=\frac{1}{3}$

A's work in 1 day = $\frac{1}{9}$

∴ $\frac{1}{3}$work can be done in $9\times\left(\frac{1}{3}\right)=3$ days

12)2; Let, sum of money = 500;

A's 1 day wage = $\frac{500}{10}=50$

∴ B's 1 day wage = $\frac{500}{5}=100$

∴ (A + B)'s 1 day wage = 150

∴ This money is sufficient for $\frac{500}{150}=3\frac{1}{3}$ days.

13)4; B alone can finish in 24 days.

A works twice as fast as B.

∴ A alone can finish in 12 days.

Work done by (A+B) together in 1 day = $\frac{1}{24}+\frac{1}{12}=\frac{1}{8}$

∴ A and B can finish in 8 days.

14)1; 10 women = 16 days,

∴ 1 women = 160 days

8 men = 15 days ,

∴ 1 men = 120 days

∴ 1 woman's 1 day work = $\frac{1}{160}$

∴ 1 man's 1 day work = $\frac{1}{120}$

∴ Required Ratio = $\frac{1/120}{1/160}=\frac{160}{120}=\frac{4}{3}=4:3$

15)1;

Days	**Efficiency**
40	100%
x	125%

$\frac{40}{x}=\frac{125}{100}\Rightarrow x=32$

PIPES AND CISTERNS

CONCEPTS

1) If a pipe can fill a tank in $'x'$ hours, then a part of the tank filled in 1 hour is $\frac{1}{x}$.

2) If a pipe can empty a tank in $'y'$ hours, then a part of the full tank emptied in 1 hour is $\frac{1}{y}$.

3) If two pipes can fill a tank in $'x'$ and $'y'$ hours respectively and both the pipes are opened simultaneously then time taken to fill the tank = $\frac{xy}{x+y}$ hours.

4) If a tap fills a cistern in $'x'$ hours and another empties it in $'y'$ hours. If both the taps kept open then the amount of cistern filled in 1 hour = $\frac{1}{x}-\frac{1}{y}$.

5) A tap fills a cistern in $'x'$ hours and the other can empty the cistern in $'y'$ hours. If both the taps are opened simultaneously then time taken to fill the tank = $\frac{xy}{y-x}$ hours.

6) If two taps A and B together can fill a tank in $'x'$ hours and only tap A can fill the tank in y hours then the time taken by B alone to fill the tank is $\frac{xy}{y-x}$ hours.

7) Two pipes can fill a cistern in $'x'$ and $'y'$ hours respectively. After how much time second pipe should be turned off so that the cistern is filled in $'z'$ hours, if both the pipes are opened.

Required time = $\frac{y(x-z)}{x}$ hours.

8) Three taps A, B and C can fill a tank in x, y and z hours respectively. If all the three taps are opened simultaneously, then time taken to fill the tank is $\frac{xyz}{xy+yz+zx}$ hours.

9) Two pipes A and B can fill a cistern in $'x'$ hours and $'y'$ hours respectively. The third pipe C can empty the cistern in $'z'$ hours. If all the three pipes are opened at the same time, then time taken to completely fill the cistern = $\frac{xyz}{zx+zy-xy}$ hours.

CONCEPTUAL EXAMPLES

1) A pipe can fill a cistern in 8 minutes where as the cistern when full can be emptied by a leak in 16 minutes. When both pipes are opened, find the time taken for cistern be full.

1) 48 *min* b) 32 *min* 3) 16 *min* 4) 20 *min*

Explanation:

Work done by the first pipe in 1 *min* = $\frac{1}{8}$

Work done by the leak in 1 *min* = $\frac{1}{16}$

Here, both the pipes are opened. So, work done by both the pipes in 1 *min* is $\frac{1}{8}-\frac{1}{16}=\frac{1}{16}$.

$\therefore$ Total time required to fill the cistern is 16 *min.*

(or) Using the formula: $\frac{xy}{y-x}$

Cistern will be full in $\frac{8\times16}{16-8}=16$ *min.*

Alternate Method:

Fill in 1 *min* = Inflow in 1 *min* – Outflow in 1 *min*

Let, capacity of cistern = 16 *lit* (Since it the common factor of 8 and 16).

Inflow takes 8 *min* $\Rightarrow$ Speed = 2 *lit per min*

Outflow takes 16 *min* $\Rightarrow$ Speed = 1 *lit per min.*

$\therefore$ Fill in 1 *min* = 2–1 = 1 *lit*

$\therefore$ 16 *lit* fill requires 16 *min* at speed of 1 *lit per min.*

2) A tank is usually filled by a tap in $3\frac{1}{2}$ hours. Due to a leak in the bottom of the tank, it takes half an hour longer to fill the tank. If the tank is full how long will the leak take to empty it.

1) 7 hours b) 8 hours 3) 14 hours 4) 28 hours

Explanation:

Let the time taken by the leak to empty = x hours.

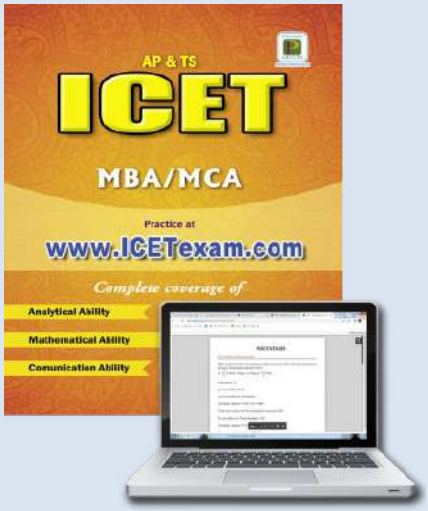
Then, work done in 1 hour = $\frac{2}{7}-\frac{1}{x}=\frac{1}{4}\Rightarrow\frac{1}{x}=\frac{1}{28}\Rightarrow x=28$

Alternate Method: Let, capacity is 7 lit.

then 1 hour fill by tap = 2 lit and half an hour fill = 1 lit

As half an hour extra required. So, 4 hours leak will outflow 1 lit. Therefore, for 7 lit, 4 × 7 = 28 lit.

Hint: Calculate the speed of outflow.



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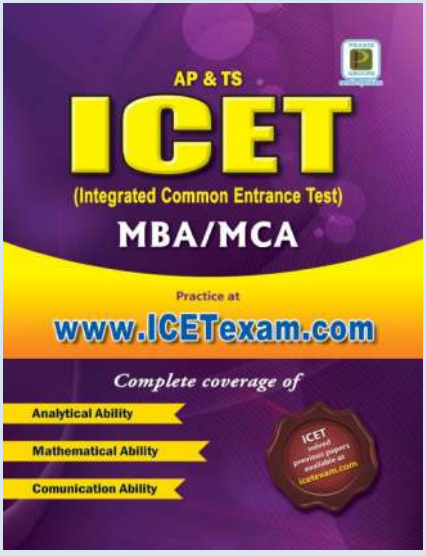

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9)2; Three taps in 1 hour fills 42 + 56 – 48 = 50 liters.
The tank is filled in 16 hours.
∴ The capacity of the tank = 50 × 16 = 800 liters.

10)3; Let the leak will empty the tank in x hours.
Then $\frac{1}{4}-\frac{1}{x}=\frac{2}{9}$ *i.e.* $\frac{1}{x}=\frac{1}{36}\Rightarrow x=36$
∴ Leak will empty tank in 36 hours.

11)3; Suppose pipe A takes x hours.
∴Pipe-B will take $\frac{x}{2}$ hour and Pipe-C take $\frac{x}{4}$ hours
$\therefore \frac{1}{x}+\frac{2}{x}+\frac{4}{x}=\frac{1}{20}\Rightarrow\frac{7}{x}=\frac{1}{20}\Rightarrow x=140$ hours.

12) 3; First half the tank is filled in 6 hours.
Second half is filled by 4 taps.
Work done by the 4 taps in 1 hour =
$\left(\frac{1}{12}+\frac{1}{12}+\frac{1}{12}+\frac{1}{12}\right)=\frac{4}{12}=\frac{1}{3}$
Then time taken to fill $\frac{1}{2}$ part of the tank
$=\frac{3}{2}$ hours *i.e.* 1 *hour* 30 *min.*

13) 2; First, the work done in 10 *min*
$=10\times\left(\frac{1}{40}+\frac{1}{120}\right)\Rightarrow 10\times\left(\frac{4}{120}\right)=\frac{1}{3}$
∴ Remaining work = $1-\frac{1}{3}=\frac{2}{3}$
By tap 2, work done in 1 *min* = $\frac{1}{120}$
Time taken by tap-2 to fill $\frac{2}{3}$ of the tank =
$x\times\frac{1}{120}=\frac{2}{3}\Rightarrow x=\frac{120\times 2}{3}=80$ min.

14) 4; If capacity of A = x lit then capacity of B = $\frac{x}{3}$ *lit.*
∴ Capacity of drum = 90 x.
Now, required number of turns = $\frac{90x}{x+\frac{x}{3}}=90x\left(\frac{3}{4x}\right)$
= 67.5
≅ 68 turns

15) 2; Let, B be turned off after x minutes. Now, Part filled by (A+B) in x *min* + Part filled by A in (60–x) *min.*
$x\left(\frac{1}{75}+\frac{1}{90}\right)+(60-x)\frac{1}{75}=1\Rightarrow\frac{x}{75}+\frac{x}{90}+\frac{60}{75}-\frac{x}{75}=1$
$\frac{x}{90}+\frac{60}{75}=1\Rightarrow\frac{x}{90}=1-\frac{4}{5}\Rightarrow x=\frac{90}{5}=18\,min$

16) 3; 3 inlet and 1 outlet. Each pipe takes 4 hours either to fill or empty the tank.
∴ Work done in 1 hour = $\frac{1}{4}+\frac{1}{4}+\frac{1}{4}-\frac{1}{4}=\frac{1}{2}$
∴ Total time taken = 2 hours.

17) (i)3; Check from options: Let us consider A and B.
∴ In 1 hour, $\frac{1}{2}+\frac{1}{1}=$ *Positive (i.e.* Tank will be filled).
Consider B and D: $\frac{1}{1}-\frac{1}{3}=$ Positive
(Tank will be filled)
Consider C and E: $\frac{1}{5}-\frac{1}{5}=0$
i.e. Total Inlet = Total Outlet.

(ii)1; From the given data, tank-II takes double time to fill than tank-I.
∴ Size of tank-II is double than tank-I.
By pipe B and D, in 1 hour, $\frac{1}{1}-\frac{1}{3}=\frac{2}{3}$
By pipe A and E, in 1 hour, $\frac{1}{4}-\frac{1}{10}=\frac{3}{20}$
Comparing $\frac{2}{3}$ and $\frac{3}{20}$ $\Rightarrow$ $\frac{2}{3}>\frac{3}{20}$
∴ Tank-I will be filled faster.

(iii)2; Combining tank-I and tank-II,
Individual time taken by pipes is
A = 2 + 4 = 6; B = 1 + 2 = 3; C = 5+10=15; E = 5+10=15
∴ Work done in 1 hour = $\frac{1}{6}+\frac{1}{3}+\frac{1}{15}-\frac{1}{15}=\frac{1}{2}$
∴ Total time taken = 2 hours.

18) 4; Bucket is half filled. Remaining half bucket needs to be filled.
Work done by Tap-1 and Tap-2 in 1 *min*= $\frac{1}{8}-\frac{1}{16}=\frac{1}{16}$
∴ Total time taken = $x\times\left(\frac{1}{16}\right)=\frac{1}{2}\Rightarrow x=8$ min

SOLID MENSURATION

CONCEPTS

• **Solids:**

1) Solids figures have 3 dimensions.

2) When plane surfaces are forming a solid, they are called it Faces and the solid is called a polyhedron.

3) The lines which bind the faces of a solid figure (or solid) are called its Edges.

4) The volume of a solid figure is the amount of space enclosed by its binding surfaces.

5) The area of the whole surface is equal to the sum of the areas of its binding surfaces.

• **Cuboid:** It is a figure bounded by six rectangular faces which are perpendicular to each other. The opposite faces of a cuboid are equal rectangles lying in parallel planes.

l = length b = breadth h = height

1) Total number of faces = 6

2) Rectangular side face = 4

3) Top and bottom rectangular faces = 2

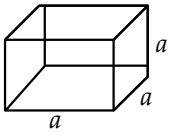
4) Curved surface area or Lateral surface area = $2(bh+lh)$

5) Total surface area = $2(bh + lh + lb)$

6) Volume = $l \times b \times h$

7) Diagonal of cuboid = $\sqrt{l^2+b^2+h^2}$

•**Cube:** It is a solid figure bound by 6 equal dimensional faces which are perpendicular to each other.



1) Curved surface area or Lateral surface area = $4a^2$

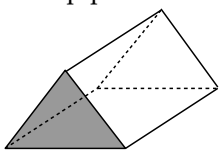
2) Total surface area = $6a^2$

3) Volume = a^3

4) If the total surface area of a cube be 's', then its volume = $\left(\sqrt{\frac{s}{6}}\right)^3$

• **Prism:** It is a solid whose sides are parallelograms and whose both ends lie on parallel planes. The end on which a prism may be supposed to stand is called the base and the perpendicular distance between both the ends of a prism is called the height of a prism. A prism is called a Right Prism when its edges formed by side faces adjacent to one another are perpendicular to its ends. Otherwise it is said to be an Oblique Prism. When the ends of a prism are parallelograms, the prism is called a parallelepiped.

• **Right Prism:**

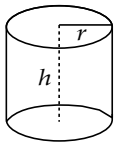


1) Base Polygon (may be triangle rectangle, etc.)

2) Curved surface area or Lateral surface area = (Base Perimeter) × (Height).

3) Volume = Base Area × Height

• **Cylinder :**



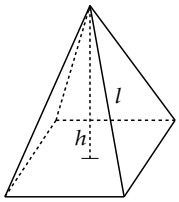
r = radius of base; h = height;

1) Curved surface area or Lateral surface area = Base Perimeter × (Height) = $2\pi\, r\, h$.

2) Total surface area = $2\pi\, r\, (h + r)$

3) Volume = $\pi\, r^2 h$

• **Pyramid:** It is a solid whose sides are triangles, having a common vertex and whose base is a plane rectilinear figure. The perpendicular drawn from the vertex of a pyramid to its base is called the height of the pyramid. The straight line joining the vertex to the middle point of the base is called the axis of the pyramid and if this axis is perpendicular to the base, then the pyramid will be a Right Pyramid.



l = slant height; h= altitude;

1) Surface is of triangles

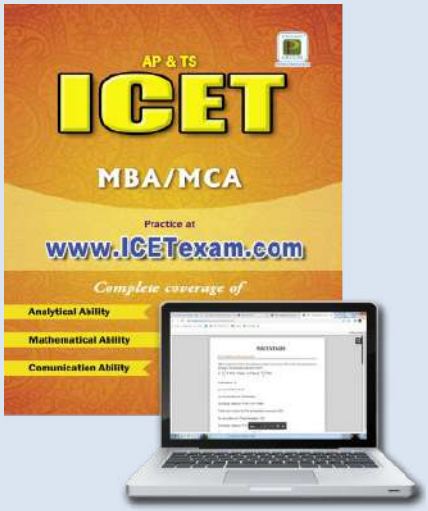
2) Base is a Polygon

3) Curved Surface Area or Lateral Surface = $\frac{1}{2}\times p\times l$.

where p = base perimeter; l = slant height

4) Volume = $\frac{1}{3}\times(base\,area)\times(altitude)$

• **Cone:** It may be defined as the limit of a pyramid whose number of sides of the base in indefinitely increased.



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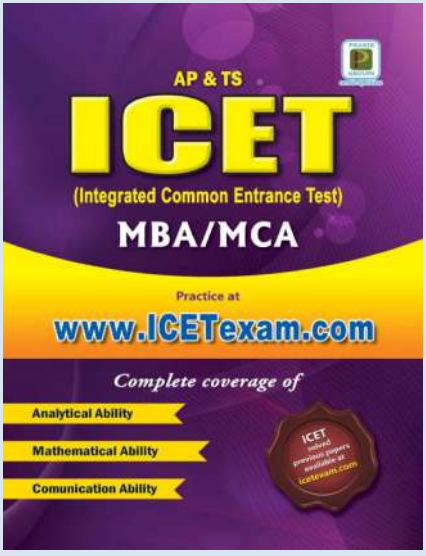

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11)2; Given, Surface area $= 3\pi r^2 = 462 \Rightarrow \pi r^2 = 154$
Curved surface area $= 2\pi r^2 = 2\times154 = 308$ cm^2

12)4; Initial volume $= \pi r^2 h = \pi(3r)^2\left(\frac{h}{2}\right) = \pi r^2 h\left(\frac{9}{2}\right)$

Ratio of initial volume to new volume $= \frac{\pi r^2 h}{\pi r^2 h\left(\frac{9}{2}\right)}$

Hence, required ratio = 2:9.

13)4; Per copy area covered $= \frac{75}{100}\times\frac{50}{100}\times4$

$\therefore$ Area covered by 12000 copies

$= 12000\times\frac{75}{100}\times\frac{50}{100}\times4 = 18000$ sq.m = 18 hectare.

14)3; Volume of Cylinder $= \pi r^2 h$

Ratio of their volumes $= \frac{\pi\times(3)^2\times h}{\pi\times\left(\frac{3}{2}\right)^2\times h} = 4$

(Since velocity and length of the pipe is same)

15)4; Let height be x, by Pythagoras theorem,
$13^2 = 5^2 + x^2 \Rightarrow x^2 = 144 \Rightarrow x = 12$

$\therefore$ Area $= \frac{1}{2}\times b\times h \Rightarrow \frac{1}{2}\times5\times12 = 5\times6 = 30$

16)2; Area $= \frac{\sqrt{3}}{4}a^2 \Rightarrow \sqrt{3} = \frac{\sqrt{3}}{4}a^2$

$\Rightarrow a^2 = 4$

$\Rightarrow a = 2\ cm.$

17)2; $AB^2 = AP^2 + BP^2 = 3^2 + \left(\frac{8}{2}\right)^2 = 3^2 + 4^2 = 25;$

AB = 5

In isosceles triangle, AB = AC

$\therefore$ Perimeter = AB + AC + BC = 5 + 5 + 8 = 18 units

18)1; Let $\angle A = x$; $\angle B = 2x$; $\angle C = 3x$; $\angle D = 4x$

Also, in quadrilateral, $\angle A+\angle B+\angle C+\angle D = 360^0$

$\Rightarrow x + 2x + 3x + 4x = 360^0 \Rightarrow 10x = 360^0 \Rightarrow x = 36^0$

$\angle B = 2x = 2\times36 = 72^0$

19)4; By given condition, inner radius = 6 × w

i.e. $3 = 6 \times w \Rightarrow w = 0.5\ cm$

(Area of outer circle) – (Area inner circle) =

$\pi R^2 - \pi r^2 = \pi(3.5)^2 - \pi(3)^2 = \pi(12.25-9) = 3.25\pi\ sq.cm$

20)2; Given, $l = 8\ cm$, $b = 11\ cm$,

$h = \frac{1}{2}\times l = \frac{1}{2}\times8 = 4\ cm$

Diagonal of cuboid $= \sqrt{l^2+b^2+h^2} = \sqrt{8^2+11^2+4^2}$

$= \sqrt{64+121+16} = \sqrt{201}\ cm$

21)4; If edge of cube is increased by 20%, then whole surface of the cube is increased by $\left[2a+\left(\frac{a}{10}\right)^2\right]\%$

Here, $a = 20\%$.

$\therefore \left[2(20)+\left(\frac{20}{10}\right)^2\right]\% = (40+22) = 44$.

22)3; If the height of two cylinders are equal then
Ratio of volumes = (Ratio of radii)^2

$\therefore \frac{V_1}{V_2} = \frac{r_1^2}{r_2^2} = \frac{2^2}{5^2} = \frac{4}{25}$

23)3; Total surface area = $\pi\ r\ (l + r)$
where l = slant height; here, $l = 2r$
$\therefore$ Total surface area = $\pi r\ (2r + r) = \pi\ r\ (3r)$. here, $r = \pi$
$\therefore$ Total surface area = $\pi(\pi)(3\pi) = 3\pi^3$

24)3; Radius of larger sphere = R = 16 m.

Radius of smaller sphere $= \frac{\text{diameter}}{2} = r = \frac{4}{2} = 2\ cm$

If a sphere of radius R is melted to form smaller spheres each of radius r, then number of smaller spheres $= \left(\frac{R}{r}\right)^3$

By this formula, $n = \left(\frac{16}{2}\right)^3 = 8^3 = 512.$

25)2; Colouring should be done on total surface area.

$\therefore$ Total surface area of sphere $= 4\pi r^2$

$\Rightarrow 4\pi2^2 = 16\pi\ cm^2$

$\therefore$ Cost $= 16\times3.14\times3$

$\approx$ Rs150

SETS, RELATIONS AND FUNCTIONS

CONCEPTS

SETS

A set is a 'well defined collection of objects'.

e.g.: $A = a$ set of vowels in English alphabet = $\{a,e,i,o,u\}$

There are two methods to define a set.

1) Roster Form (Tabulation Method): In this method a set is described by listing the elements separated by commas within the braces.

e.g.: A = set of odd natural number less than 9 = {1,3,5,7}

2) Set Builder Form (Rule Method): In this method a set is described by properties satisfied by the elements.

e.g.: A = set of even natural numbers less than 8 = $\{x : x$: odd natural number and $x < 8\}$

Types of Sets:

Null Set: A set with no elements is called a null set or empty set and is denoted by ϕ or { }.

Unit Set or Singleton: A set with one and only one element is called singleton or unit set.

Subset: If every element of a set A is also an element of a set B, then A is called subset of B, and written as $A \subseteq B \Leftrightarrow (x \in A \Rightarrow x \in B, \forall\, x \in A)$

e.g.: The sets $\{x\},\{y\},\{y,z\}$ are the subsets of the set $\{x,y,z\}$.

Proper Subset: Set A is said to be proper subset of set B if every element of A is an element of B and has at least one element in B which is not an element of A and is denoted by $A \subset B$.

e.g.: If A = {1, 2, 4, 5} and B = {5, 1, 2, 4, 3}

Power Set: The set of all the subsets of a given set A is called power set and is denoted by P(A).

e.g.: If $A = \{a, b, c\}$ then P(A)= {ϕ, {a}, {b}, {c}, {a,b}, {b,c}, {c, a}, {a, b, c}} $n\{P(A)\} = 2^3 = 8$

Super Set: In the statement $A \subseteq B$, B is called the super set of A.

Equal Sets: Two sets A and B are said to be equal if every element of A is an element of B, and every element of B is an element of A. If A and B are equal, we write $A = B$ *i.e.* $A \subseteq B$ and $B \subseteq A \Rightarrow A = B$.

e.g.: Sets {1, 2, 3} and {2, 3, 1} are equal sets.

Finite and Infinite Set : A set in which the elements are countable is called a finite set, otherwise it is called an infinite set.

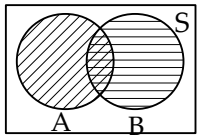
e.g.: Set of natural number less than 400 (finite set)
Set of all integers (infinite set)

Universal Set: If all the sets under consideration are likely to be subsets of a set then the set is called the universal set and is denoted by U or S.

$A = \{a, e, i, o, u\}$ as a set of vowels which is subset of $U = \{a, b, c, ... x, y, z\}$ then U is a universal set.

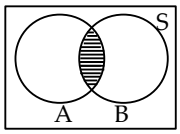
Number of elements in a finite set is called cardinal number or order of a finite set. The total number of subsets of a finite set containing n elements is 2^n.

Union of Sets : is set of elements which belong either to A or B or both A and B.



e.g.: A = $\{x : x$ is the first six prime number$\}$,
B = $\{x : x$ is the first five natural numbers$\}$,
⇒ A = {2, 3, 5, 7, 11, 13}; B = {1, 2, 3, 4, 5}
$A \cup B = \{1, 2, 3, 4, 5, 7, 11, 13\}$

Intersection of Sets: $A \cap B$ (A intersection B) means set of elements which belong to both sets A and B.

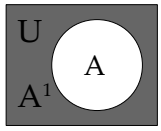


$A \cap B = \{x : x \in A$ and $x \in B\}$
$A \cap B = \{x : x \in A \cap x \in B\}$ or $x \in A \cap B \Leftrightarrow x \in A$ and $x \in B$

e.g.: A = {2,3,4,5}, B = {1,2,3,4,5} then $A \cap B$ = {2,3,4,5}.

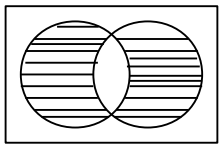
Disjoint Sets: Two non–empty sets A and B are said to be disjoint if $A \cap B = \Phi$.

Complement Set or A^c (A complement) means set of elements which are not in set A (i.e. U–A).



Difference of Sets: A–B means the set of elements belong to A but do not belong to B. This can also be written as $A \cap B^c$.

Symmetric Difference of two sets Let A and B be two non–empty sets. The set $(A - B) \cup (B - A)$ is called symmetric difference of two sets and is denoted by $A \Delta B$.

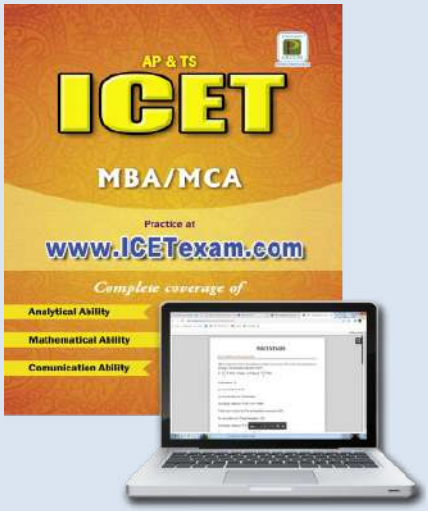


$\therefore A \Delta B = (A–B) \cup (B–A)$ ..... (1)
A – B = $A \cap B^c = AB^c$
Symbolically, $A - B = \{x : x \in A$ and $x \notin B\}$
Similarly elements belong to only $B = B–A$ or $A^c \cap B$.

e.g.: A = {1, 2, 3}, B = {3, 4, 5}
$A - B = A \cap B^c = \{1, 2\}$ and $B - A = A^c \cap B = \{4, 5\}$

Note: $A–B$ means deleting the numbers /elements from A which also lies in B.

e.g. A = {1, 2, 3, 4, 5} B = {5, 10, 15, 20}
$A–B$ = {1, 2, 3, 4} as 5 which is in A also lies in B.



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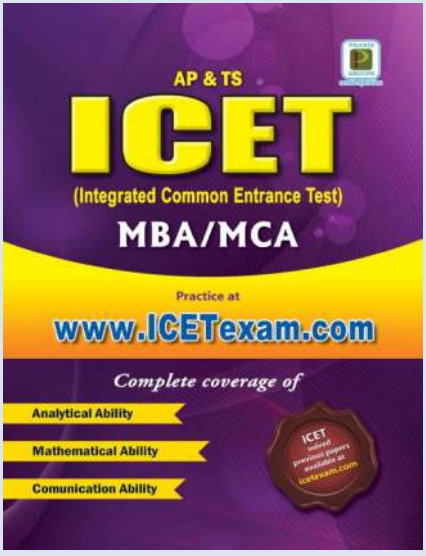

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63)c; $A_2 = \{2,4,6,8,10,....\}$ and $A_5 = \{5,10,15,20,....\}$
$A_2 \cap A_5 = \{10,20,30,----\} = A_{10}$
(A_n = set of all positive multiples of n)

64)d; no. of injections = ${}^4p_3 = \frac{4!}{3!} = 4$

65)c; Given n(x) = 5.
The no. of subsets that contain at most 2 elements
= The no. of subsets containing
{no elements + one element + two elements}
$= {}^5c_0 + {}^5c_1 + {}^5c_2 = 1 + 5 + 10 = 16.$

66)d; Given, $2f(x) - 3f\left(\frac{1}{x}\right) = x^2$

put $x = 8 \Rightarrow 2f(8) - 3f\left(\frac{1}{8}\right) = 64 \rightarrow (1)$

put $x = \frac{1}{8} \Rightarrow 2f\frac{1}{8} - 3f(8) = \frac{1}{64} \rightarrow (2)$

(1) × 2 + (2) × 3

$$4f(8) - 6f\left(\frac{1}{8}\right) = 128$$

$$6f\left(\frac{1}{8}\right) - 9f(8) = \frac{1}{64} \times 3$$

$$-5f(8) = \frac{8195}{64}$$

$$f(8) = \frac{-1639}{64}$$

67)a; Given that A and B are disjoint sets and
n(A) = 4 and n(B) = 6
$\therefore$ $n(A \cup B) = 4 + 6 = 10$

68)b; Given n(B) = 5
no. of subsets of $B = 2^5 - 1 = 32 - 1 = 31$
The no. of subsets except null set = 31 – 1 = 30

TRIGONOMETRY

CONCEPTS

Measures of angles

Trigonometry is the study of the relationship between the sides and angles of right angled triangles. Angles are measured in degrees or radians.

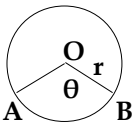
360^o measured in terms of radians will be 2 π radians.

Therefore,

$\Pi \text{ radians} = 180^o, \frac{\Pi}{2} \text{ radians} = 90^0, \frac{\Pi}{6} \text{ radians} = 30^o \text{ and } \frac{3\Pi}{2} = 270^o$

Note: 1 degree = 60 min.

Length of an arc and area of a sector:



The length of arc = θr. (where θ is the central angle in radians).

Area of sector OAB = $\frac{1}{2} r^2 \theta$ or $\frac{1}{2} \times 1(arc\,AB) \times \text{radius}\, r$

Illustrative Example 1

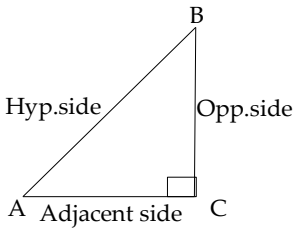
What is the length of the arc of a circle subtending an angle of 30^0 if the circumference of the circle is 12 π ?

Circumference of the circle = 2 π r = 12 π ⇒ r = 6 units.

Therefore, length of the arc = r *θ $= 6 \times \frac{\pi}{6} = 6$ units.

Trigonometric ratios and relationship to the sides of Right angle or right angled triangle.

In ABC, ∠C = 90^0



$\sin A = \frac{\text{Opposite side}}{\text{hypotenuse}}$

$\cos A = \frac{\text{Adjacent side}}{\text{hypotenuse}}$

$\tan A = \frac{\text{Opposite side}}{\text{hypotenuse}}$

Their reciprocal ratios are

$\frac{1}{\sin A} = cosec\, A$; $\frac{1}{\cos A} = sec\, A$; $\frac{1}{\tan} A = \cot A$

Trigonometric ratios of certain common angles in degrees.

	0^0	30^0	45^0	60^0	90^0
sin	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
cos	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
Tan	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	undefined

Note: The values of sin ratios are the square roots of the fractions $\frac{0}{4}, \frac{1}{4}, \frac{2}{4}, \frac{3}{4}, \frac{4}{4}$.

The values of cos ratios are written in the reverse order and the values of tan ratios are got by dividing sine ratios by cos ratios for acute angles.

	120^0	135^0	150^0	180^0	270^0	360^0
sin	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0	-1	0
cos	$-\frac{1}{2}$	$-\frac{1}{\sqrt{2}}$	$-\frac{\sqrt{3}}{2}$	-1	0	1
Tan	$-\sqrt{3}$	-1	$-\frac{1}{\sqrt{3}}$	0	undefined	0

Ratios and Quadrants

In the first quadrant (0 to 90^0) all the ratios are positive

In the second quadrant (90^0 to 180^0) sin and cosec are positive. The remaining four ratios are negative.

In the third quadrant (180^0 to 270^0) tan and cot are positive. The remaining four ratios are negative.

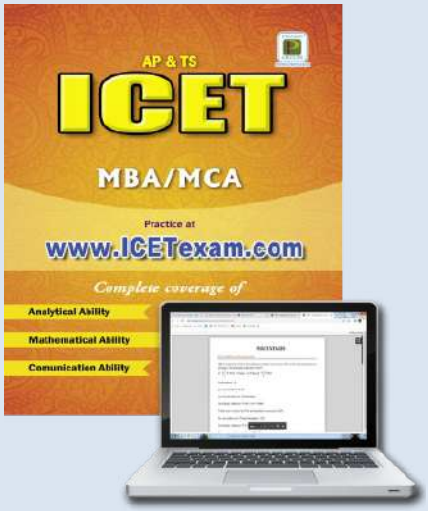
In the fourth quadrant (270^0 to 360^0) cos and sec are positive. The remaining four ratios are negative.

This is usually remembered using the mnemonic – All silver Tea Cups to denote A (Q I), S (Q II), T(Q III) and C (Q IV).

	X	**sinX**	**cosX**	**tanX**
Q-I	360+A	sinA	cosA	tanA
	90-A	cosA	sinA	cotA
Q-II	90+A	cosA	-sinA	-cotA
	180-A	sinA	-cosA	-tanA
Q-III	180+A	-sinA	-cosA	tanA
	270-A	-cosA	-sinA	cotA
Q-IV	270+A	-cosA	sinA	-cotA
	360-A	-sinA	cosA	-tanA

Important Results

1. $\sin^2 \theta + \cos^2 \theta = 1$
2. $1 + \tan^2 \theta = \sec^2 \theta$
3. $1 + \cot^2 \theta = \text{cosec}^2 \theta$
4. sin(A + B) = sin A cosB + cosA sinB
5. sin 2A = 2 sin A cosA
6. sin(A-B) = sin A cosB - cosA sinB
7. cos(A+B) = cos A cosB - sinA sinB



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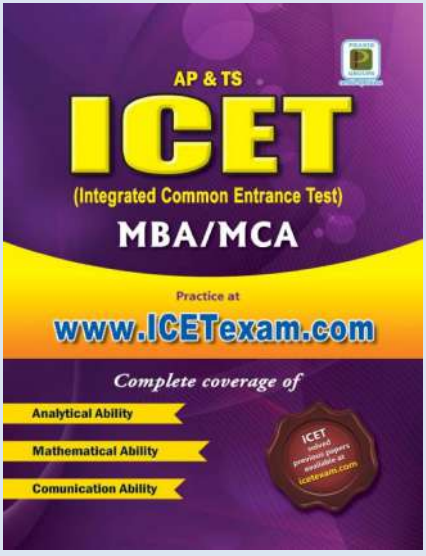

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43) (c) $\tan(A+B)=\frac{tanA+tanB}{1-tanA.tanB}$

$\tan(65+70)^o=\tan-135^o=-1=\frac{\tan65^o+tan70^o}{1-tan65^o.tan70^o}$

$\tan65^o.\tan70^o - 1 = \tan65^o + \tan70^o$

$= \tan65^o + \tan70^o + 1 = \tan65^o.\tan70^o$

$\Rightarrow 1 + \tan65^o + \tan B - \tan \tan65^o.\tan70^o$

$= \tan65^o.\tan70^o - \tan65^o.\tan70^o = 0$

$\cos^2\frac{\pi}{4}+\cos^2\frac{3\pi}{4}+\cos^2\frac{5\pi}{4}+\cos^2\frac{7\pi}{4}$

44)(a) $=\left(\frac{1}{\sqrt{2}}\right)^2+\left(\frac{-1}{\sqrt{2}}\right)^2+\left(\frac{-1}{\sqrt{2}}\right)^2+\left(\frac{1}{\sqrt{2}}\right)^2$

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

45)(a) $\cos^2-\frac{1}{2}=0$; $\cos^2\theta=\frac{1}{2}$; $cos\theta=\frac{1}{\sqrt{2}}$

$\cos\theta = \cos45^0 \Rightarrow \theta = 45^0$

46)(b) We know that

$\sin\theta = \frac{2\tan\theta/2}{1+\tan^2\theta/2}$ and $\cos\theta = \frac{1-\tan^2\theta/2}{1+\tan^2\theta/2}$

$\Rightarrow 2\left[\left(\frac{2\tan\theta/2}{1+\tan^2\theta/2}\right)\left(\frac{1-\tan^2\theta/2}{1+\tan^2\theta/2}\right)\right]=2\sin\theta\,cos\theta=sin2\theta$

Since $\theta = 15^0$, $\sin2\theta = \sin30^0 = \frac{1}{2}$

47)(b) $\tan15^o = \tan(45^0 - 30^0) = \frac{tan45^0-tan30^0}{1+tan45^0tan30^0}$

$\frac{1-\frac{1}{\sqrt{3}}}{1+1\left(\frac{1}{\sqrt{3}}\right)}=\frac{\frac{\sqrt{3}-1}{\sqrt{3}}}{\frac{\sqrt{3}+1}{\sqrt{3}}}$ $\tan15^0 = \frac{\sqrt{3}-1}{\sqrt{3}+1}$

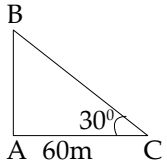
48)(a) $\tan18^o\ \tan72^0\ \tan24^0\tan66^0\tan32^0\tan58^0$

$= \tan18^0\ \cot18^0\ \tan24^0\cot24^0\tan32^0\cot32^0 = 1$

49)(a) $\theta = 30^0$ AC = 60m

$\tan30^0 = \frac{AB}{AC}\ \frac{1}{\sqrt{3}}=\frac{AB}{60}$

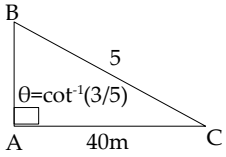
$AB = \frac{60}{\sqrt{3}}=\frac{20\times\sqrt{3}\times\sqrt{3}}{\sqrt{3}}=20\sqrt{3}\,m$



50)(a) $\theta = \cot^{-1}\left(\frac{3}{5}\right)$ $\cot\theta = \frac{3}{5}$

From the diagram $\cot\theta = \frac{40}{AB}$

$\therefore \frac{3}{5}=\frac{40}{AB}$ $AB = \frac{200}{3}\,m$



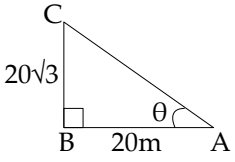
AB is the Tower.

51)(a) AB = shadow = 20 *m*

BC = height of the pole

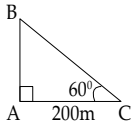
$\tan\theta = \frac{20\sqrt{3}}{20}=\sqrt{3}=tan60^o$

$\theta = 60^o$



52)(b) AB = height of the church

$\tan60^o=\frac{AB}{200}\Rightarrow\sqrt{3}=\frac{AB}{200}\Rightarrow AB=200\sqrt{3}\,m$

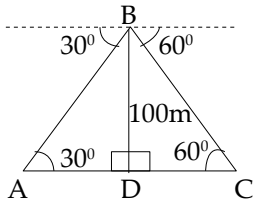


53)(c) BD is the tower and AC is the required distance.

From ΔABD,

$\tan30^0 = \frac{100}{AD}\Rightarrow\frac{1}{\sqrt{3}}=\frac{100}{AD}$

$100\sqrt{3}$ = AD



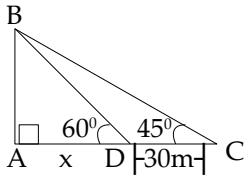
From ΔBCD, $\tan60^o=\frac{BD}{CD}\Rightarrow\sqrt{3}=\frac{100}{CD}\Rightarrow CD=\frac{100}{\sqrt{3}}$

AC = AD + DC = $100\sqrt{3}+\frac{100}{\sqrt{3}}\Rightarrow\frac{300+100}{\sqrt{3}}=\frac{400}{\sqrt{3}}\,m$

54)(c) AB is the tower.

$\tan45^0=\frac{AB}{AC}\Rightarrow x+30=AB$

$\tan60^0=\frac{AB}{x}\Rightarrow\sqrt{3}=\frac{x+30}{x}$



$\sqrt{3}x=x+30$; x = $\frac{30}{\sqrt{3}-1}=\frac{30}{\sqrt{3}-1}$

$\therefore$ height of the tower = x + 30= $\frac{30\sqrt{3}}{(\sqrt{3}-1)}\,m$

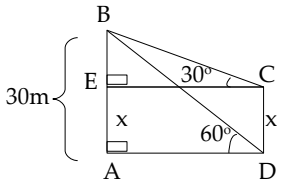
55)(b) CD = height of the pole ='x'

AECD is a rectangle.

$\therefore$ AE = 'x'

From ΔABD, $\tan60^o=\frac{30}{AD}$

$\sqrt{3}\,\frac{30}{AD}\Rightarrow AD=\frac{30}{\sqrt{3}}=10\sqrt{3}\,m$



Since AD=CE, $\tan30^o=\frac{BE}{CE}\Rightarrow\frac{1}{\sqrt{3}}=\frac{30-x}{10\sqrt{3}}$

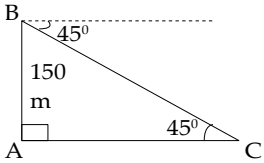
30 – *x* = 10 or x = 20 *m*

56)(c) Required Dist. = AC

AB = Height of the ship mast.

'C' is the position of the boat.

$\tan45^0 = \frac{150}{AC}$ AC = 150m



Polynomials

CONCEPTS

A Polynomial over the real numbers is a function f(x) of the form

$f(x) = A_0 + A_1 x + A_2 x^2 + ...+A_n x^n$

where, A_i is the coefficient andn is the power.

The exponent of the highest power term of the polynomial it is called the **degree** of the polynomial:

e.g. The degree of the polynomial $1 – 2x+3x^2+ 5x^6$ is 6., as the exponent of the highest power term ($5x^6$) is 6

The Sum and difference of two given polynomials is found out by grouping like powers, retaining their signs and adding the coefficents of like powers.

Let, $f_1(x) = x^3 – 3x^2 + 6x – 4$

$f_2(x) = x^2 – x + 4$

Hence, the **sum = $f_1(x) + f_2(x)$**

$= x^3 + (–3x^2 + x^2) + (6x – x) + (– 4 + 4) = x^3 – 2x^2 + 5x$

And the **difference = $f_1(x) – f_2(x)$**

$= x^3 – (–3x^2 - x^2) + (6x – (-x)) – (– 4 – 4) = x^3 – 4x^2 + 7x – 8$

The Product of two polynomials is found by applying the distributive law for the product of algebraic expressions and then grouping like powers to add or subtract as the case may be.

Polynomial Function: If $a_0, a_1, a_2 \ldots a_n$, are real and 'n' is a positive integer, then $f(x)= a_0+a_1x+a_2x^2+.....+a_nx^n$ is called a polynomial function in x.

Polynomial Equation: If $a_0, a_1, a_2 \ldots a_n$, are real and 'n' is a positive integer, then $f(x)= a_0+a_1x+a_2x^2+.....+a_nx^n=0$ is called polynomial equation in 'x' with real coefficients.

Degree of the Polynomial: The highest power of 'x' for which the coefficient is nonzero in a polynomial function, is called the degree of the function.

Zero Polynomial: If the coefficients of a polynomial are all zeros, then that polynomial is called zero polynomial. Zero polynomial has no degree.

The domain of a zero polynomial is R.

Polynomial equations of degrees 1, 2, 3 and 4 are called as linear, quadratic, cubic and biquadratic equations respectively.

Root of an equation: The value of x which satisfies f(x) =0 is called root of the equation f(x) =0. If f(a)=0, then x=a is a root of equation f(x)=0. Also (x–a) is a factor of the polynomial f(x).

QUADRATIC EQUATIONS

Definition: An equation of the form $ax^2+bx+c = 0$ where a, b, c belong to the real numbers and $a\neq0$ is a quadratic equation.

If $a = 0$ then the equation becomes a linear equation.

If $ax^2 + bx + c = 0$ is a quadratic equation given then the quantity $b^2 – 4ac$ is known as Discriminant. And is denoted by 'D'. The roots of a quadratic equation $ax^2+ bx+ c= 0$ are $\alpha=\frac{-b+\sqrt{b^2-4ac}}{2a}$, $\beta=\frac{-b-\sqrt{b^2-4ac}}{2a}$

The roots are of the form $p+\sqrt{q}$ if D is not a perfect square. If 'D' is a perfect square then both the roots are rational numbers

Nature of the Roots:

1) If $D > 0$, the roots are real and distinct.

2) If $D = 0$, the roots are real and equal.

3)If $D < 0$, the roots are complex with non zero imaginary.

4) If a, b, c are rational and if 'D' is a perfect square then the roots are rational.

5) If a=1 and b, c belongs to integers and the roots are rational numbers then the roots must be integers.

6) In the quadratic equation $ax^2+bx+c=0$, if $a=b=c=0$ then it has infinitely many roots because it is an identity in x. Let us have an example for this

e.g.: The number of values of 'a' for which $(a^2–3a+2)x^2+(a^2–5a+6)x+a^2–4=0$ is an identity in x.

Explanation: It is an identity in x if $a^2–3a+2=0$, $a^2–5a+6=0$, $a^2–4=0$. Solving these equations, a = 1, 2 and a = 2,3 and a = 2,-2. Therefore, the equation is an identity if a=2 which is common in all the three.

7) If the roots are α and β then the quadratic equation is $x^2–(\alpha+\beta)x+\alpha\beta =0$.

Transformation of Equations:

If α,β are the roots of quadratic equation $ax^2+bx+c=0$, $a\neq0$, then,

1. Sum of roots $\alpha+\beta=-\frac{b}{a}=-\frac{\text{coefficient of } x}{\text{coefficient of } x^2}$

2. Product of roots $\alpha\beta=\frac{c}{a}=\frac{\text{constant term}}{\text{coeffiecient of } x^2}$

3. The equation whose roots are reciprocals

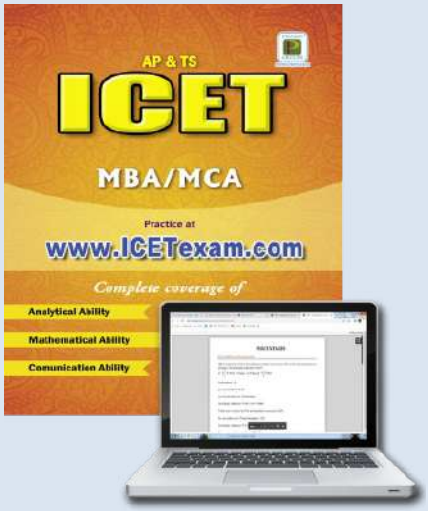
i.e. $\frac{1}{\alpha},\frac{1}{\beta}$ is $f\left(\frac{1}{x}\right)=0$.

4. The equation whose roots are K times of given roots

i.e. $K\alpha$, $K\beta$ is $f=\left(\frac{x}{k}\right)=0$

5. The equation whose roots are $\alpha+k$, $\beta+k$ *is* $f(x–k) =0$.

6. An expression in α , β is called a symmetric function if the function is not affected by interchanging α and β



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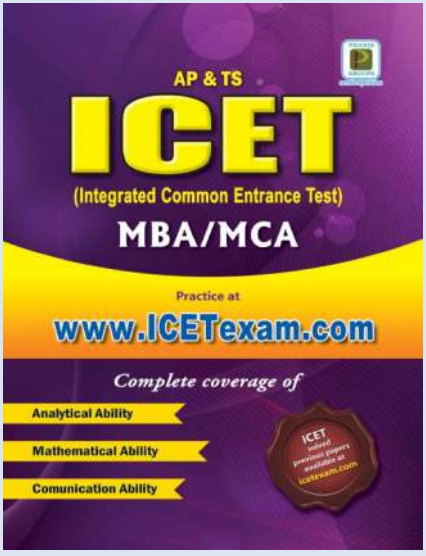

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22)a; Given that (x-30), is a factor of f(x).
$\therefore f(30) = 0$
$6x^2 - 24 = 30 \Rightarrow x^2 = 9 \Rightarrow x = 3, -3$
$\therefore$ From the given options, (x-3) is a factor of $f(6x^2 - 24)$.
23)b; Let $f(x) = 7x^3 - 3x^2 + 5x - 3$ is divided by 3x-2
To get the remainder when f(x) is divided by 3x-2, we calculate f(2/3), if f(2/3) is zero 3x-2 is a factor of f(x) else the value obtained is the remainder.

$$\therefore f\left(\frac{2}{3}\right) = 7\left(\frac{2}{3}\right)^3 - 3\left(\frac{2}{3}\right)^2 + 5\left(\frac{2}{3}\right) - 3 \quad f\left(\frac{2}{3}\right) = \frac{29}{27}$$

24)c; Let $f(x) = x^5 - ax + b$ and f(x) is divided by $x^2 - 4 = (x+2)(x-2)$.
$\therefore f(2) = (2)^5 - a(2) + b \Rightarrow 32 - 2a + b = 0 \Rightarrow -2a + b = -32$
$f(-2) = (-2)^5 - a(-2) + b \Rightarrow -32 + 2a + b = 0 \Rightarrow 2a + b = 32$
$\therefore a = 16$ and $b = 0$
$\therefore (a, b) = (16, 0)$
Hence, the required answer is (16,0).
25)d; Let $f(x) = 2x^2 - kx + 2$ divided by (x-2) with remainder 4.
$\therefore f(2) = 2(2)^2 - k(2) + 2 = 4$
$= 8 - 2k + 2 = 4 \Rightarrow k = 3$
26)a; Let $f(x) = 3x^2 + mx + 4$
Since x-1 is a factor of the polynomial,
$f(1) = 3(1)^2 + m(1) + 4 \quad m = -7$
27)b; The roots of f(x) are 3,5,2 and -2. the roots factors of f(x) are (x-3) , (x-5) , (x-2) and (x+2)
$\therefore f(x) = (x-3)(x-5)(x-2)(x+2)$
$= (x^2 - 8x + 15)(x^2 - 4)$
$f(x) = x^4 - 8x^3 + 11x^2 + 32x - 60$
28)d; Given roots of required polynomial are 3,5 and 6.
$\therefore f(x) = (x-3)(x-5)(x-6)$
$= (x^2 - 8x + 15)(x-6)$
$f(x) = x^3 - 24x^2 + 63x - 90$
29) a; From the given polynomial, $27x^2 - 33x + 10$,
$a = 27$, $b = -33$ and $c = 10$.

$$\text{Product of roots} = \frac{c}{a} = \frac{10}{27}$$

30)c; From the given polynomial $27x^2 - 33x + 10$,
$a = 27$, $b = -33$ and $c = 10$.

$$\text{Sum of roots} = \frac{-b}{a} = \frac{-(-33)}{27} = \frac{11}{9}$$

31)b; If α, β are root of a polynomial, then the polynomial $= x^2 - (\alpha+\beta)x + \alpha\beta = x^2 - (\sqrt{3}-\sqrt{3})x + (\sqrt{3})(-\sqrt{3})$
Required polynomial $f(x) = x^2 - 3$
32)d; From the given polynomial $5x^2 - 7x + 3$,
$a = 5$, $b = -7$ and $c = 3$.
Discriminant $= b^2 - 4ac \Rightarrow 49 - 60 = -11$

33)a; $\alpha + \beta = 9$ and $\alpha\beta = 18$ $\quad \frac{\alpha\beta}{\alpha+\beta} = 2$

34)a; Given polynomial $72x^2 - 102x + 35$.

$$\alpha + \beta = \frac{102}{72} \text{ and } \alpha\beta = \frac{35}{72}$$

$$\frac{\alpha\beta}{\alpha+\beta} = \frac{\frac{35}{72}}{\frac{102}{72}} = \frac{35}{102}$$

MATRICES

CONCEPTS

A matrix is the rectangular arrangement of numbers in rows and columns and is denoted as A($m\times n$) or A_{mn} i.e, a matrix, A, with m rows and n columns. An element in the matrix is represented as A[i,j] where 'i' represents the row and 'j' represents the column. $m\times n$ is known as the order of the matrix.

e.g. A 2×3 matrix is represented as $A=\begin{bmatrix}10 & 20 & 60\\ 5 & 15 & 25\end{bmatrix}$.

Types of Matrices

a) Row Matrix has only 1 row.

e.g. A = [10 20 60]

b) Column Matrix has only 1 column.

e.g. $A=\begin{bmatrix}10\\5\end{bmatrix}$

c) Rectangular Matrix has m rows and n columns.

d) Square Matrix has m rows and m columns.

e.g. $A=\begin{bmatrix}10 & 20\\5 & 25\end{bmatrix}$

e) Diagonal Matrix has every element as zero except those in the positions A[i,i]

e.g. $A=\begin{bmatrix}10 & 0\\0 & 15\end{bmatrix}$

f) Transpose is a matrix that can be obtained by interchanging the rows and columns of a matrix and is denoted with an apostrophe or a superscript 'T'.

e.g. $A=\begin{bmatrix}10 & 20 & 60\\5 & 15 & 25\end{bmatrix}$; $A' = A^T=\begin{bmatrix}10 & 5\\20 & 15\\60 & 25\end{bmatrix}$

g) Symmetric Matrix is a square matrix that is equal to its transpose i.e., A[i,j] =A[j,i] for every element in the matrix.

e.g. $A=\begin{bmatrix}10 & 15\\15 & 10\end{bmatrix}$

h) Skew-symmetric matrix satisfies the condition $A^T = -A$

e.g. $A=\begin{bmatrix}0 & 2 & -6\\-2 & 0 & -4\\6 & 4 & 0\end{bmatrix}$; $A^T=\begin{bmatrix}0 & -2 & 6\\2 & 0 & 4\\-6 & -4 & 0\end{bmatrix}=-A$

i) Triangular Matrix either has every element either above or below the principal diagonal as zero.

e.g. $A=\begin{bmatrix}2 & 0 & 0\\-2 & 1 & 0\\6 & 4 & 3\end{bmatrix}$; $B=\begin{bmatrix}2 & 1 & 7\\0 & 1 & 4\\0 & 0 & 3\end{bmatrix}$

j) Scalar Matrix has every element except those in the principal diagonal as zero.

e.g. $A=\begin{bmatrix}10 & 0\\0 & 25\end{bmatrix}$

k) Identity Matrix is a scalar matrix with every element in the principal diagonal as 1.

e.g. $A=\begin{bmatrix}1 & 0\\0 & 1\end{bmatrix}$

l) Null or zero Matrix has every element as zero.

e.g. $A=\begin{bmatrix}0 & 0\\0 & 0\end{bmatrix}$

Basic Matrix Operations

a) $A_{m\times n} + B_{m\times n} = C_{m\times n}$, where C[i,j] = A[i,j]+B[i,j]

The number of rows and columns of A and B need to be the same to perform matrix addition.

b) $A_{m\times p} + B_{p\times n} = C_{m\times n}$, where $C[i,j]=\sum_{k=1}^{m} A_{ik}\times B_{kj}$

The number of columns in matrix A must be equal to the number of rows in matrix B to perform matrix multiplication.

Determinant of a square matrix A (represented as det(A), det A, or |A|), is the scaling factor of the transformation described by the matrix.

For a 2×2 matrix $A=\begin{bmatrix}a & b\\c & d\end{bmatrix}$, |A| = ad – bc

For a 3×3 matrix

$A=\begin{bmatrix}a & b & c\\d & e & f\\g & h & i\end{bmatrix}$, $|A|=a\begin{bmatrix}e & f\\h & i\end{bmatrix}-b\begin{bmatrix}d & f\\g & i\end{bmatrix}+c\begin{bmatrix}d & e\\g & i\end{bmatrix}$,

|A| = aei +bfg + cdh – ceg – bdi - afh

Minor of a matrix is the determinant of some smaller square matrix, cut down from A by removing one or more of its rows or columns.

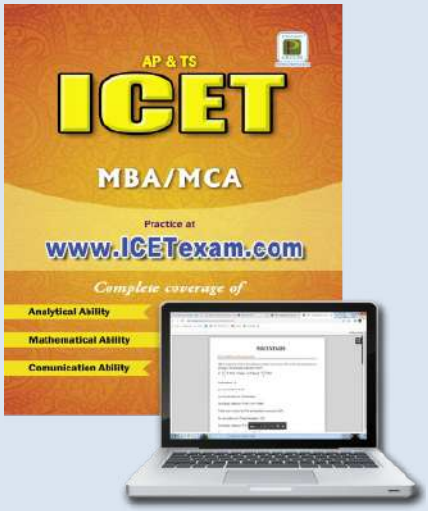
e.g. for $A=\begin{bmatrix}a & b & c\\d & e & f\\g & h & i\end{bmatrix}$; $M_{1,1}=A_{1,1}=\begin{bmatrix}e & f\\h & i\end{bmatrix}$

Hence, for the 3×3 matrix above,

$|A|=A[1,1]\times\det(M_{1,1})-A[1,2]\times\det(M_{1,2})+A[1,3]\times\det(M_{1,3})$

In general for n×n matrix A,

$|A|=\sum_{k=1}^{n}(-1)^{k-1}\times A[1,k]\times M_{1,k}$



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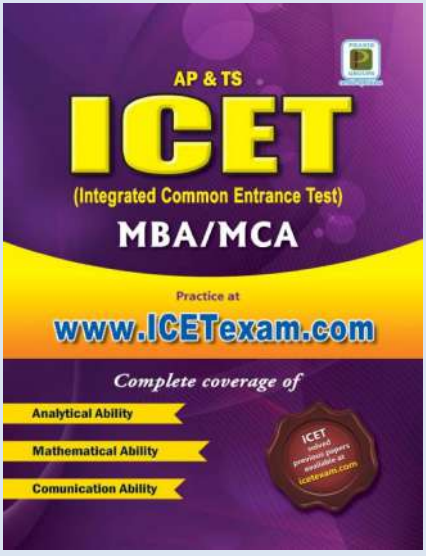

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7)b; A matrix with no inverse is a singular matrix.

$\therefore |Z| = 0 \Rightarrow \cos^2\theta \times \text{cosec}^2\theta - 1 \times 1 = 0$

$\cot^2\theta = 1; \quad \cot\theta = 1; \quad \theta = 45^0$

8)a; $(A+B)^2 = A^2 + AB + BA + B^2$

$= A^2 - BA + BA + B^2 \quad (\because AB = -BA)$

$= A^2 + B^2$

9)a; $A^{-1} = \frac{adj(A)}{det(A)} = \frac{1}{12-11}\begin{bmatrix} 3 & -11 \\ -1 & 4 \end{bmatrix} = \begin{bmatrix} 3 & -11 \\ -1 & 4 \end{bmatrix}$

10)b; $\begin{bmatrix} 3 & -2 \\ 1 & 2 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 8 \\ 4 \end{bmatrix}$;

$\begin{bmatrix} 3x-2y \\ x+2y \end{bmatrix} = \begin{bmatrix} 8 \\ 4 \end{bmatrix}$;

$\Rightarrow x = 3$ and $y = \frac{1}{2}$

$\Rightarrow 3x + 6y = 9 + 3 = 12$

11)c; $A.A^{-1} = I$ (Property of matrices)

12)d; Given matrix, $A = \begin{bmatrix} sec\theta & -tan\theta \\ tan\theta & -sec\theta \end{bmatrix}$

$A^{-1} = \frac{1}{|A|}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix} = \frac{1}{-sec^2\theta + \tan^2\theta}\begin{bmatrix} -sec\theta & tan\theta \\ -tan\theta & sec\theta \end{bmatrix}$

$= -1\begin{bmatrix} -sec\theta & tan\theta \\ -tan\theta & sec\theta \end{bmatrix} = \begin{bmatrix} sec\theta & -tan\theta \\ tan\theta & -sec\theta \end{bmatrix}$

13)a; Given matrix, $A = \begin{bmatrix} cosec\theta & -cot\theta \\ cot\theta & -cosec\theta \end{bmatrix}$

$A^{-1} = \frac{1}{|A|}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix} = \frac{1}{-cosec^2\theta + \cot^2\theta}\begin{bmatrix} -cosec\theta & cot\theta \\ -cot\theta & cosec\theta \end{bmatrix}$

$= -1\begin{bmatrix} -cosec\theta & cot\theta \\ -cot\theta & cosec\theta \end{bmatrix} = \begin{bmatrix} cosec\theta & -cot\theta \\ cot\theta & -cosec\theta \end{bmatrix} = A$

14)a; $A = \begin{bmatrix} 0 & \alpha \\ \beta & 0 \end{bmatrix} \Rightarrow A^2 = \begin{bmatrix} \alpha\beta & 0 \\ 0 & \alpha\beta \end{bmatrix}$

$\Rightarrow A^2 = \alpha\beta.I$

$\Rightarrow A^4 = \alpha^2\beta^2.I = 16I \quad (\because A^4 = 16I)$

$\Rightarrow (\alpha\beta)^2 = 16$

$\therefore \alpha\beta = 4$

15)b; Given: $f(\theta) = \begin{bmatrix} sec\theta & tan\theta \\ tan\theta & sec\theta \end{bmatrix}$

$f(-\theta) = \begin{bmatrix} sec(-\theta) & \tan(-\theta) \\ \tan(-\theta) & sec(-\theta) \end{bmatrix} = \begin{bmatrix} sec\theta & -tan\theta \\ -tan\theta & sec\theta \end{bmatrix}$

$f^{-1}(\theta) = \frac{1}{sec^2\theta - \tan^2\theta}\begin{bmatrix} sec\theta & -tan\theta \\ -tan\theta & sec\theta \end{bmatrix}$

$= \begin{bmatrix} sec\theta & -tan\theta \\ -tan\theta & sec\theta \end{bmatrix}$ (Since, $\sec^2\theta - \tan^2\theta = 1$)

$= f(-\theta)$

16)c; Given, $f(\theta) = \begin{bmatrix} sin\theta & tan\theta \\ cot\theta & cos\theta \end{bmatrix}$

$\Rightarrow f\left(\frac{\pi}{2} - \theta\right) = \begin{bmatrix} \sin(\frac{\pi}{2} - \theta) & \tan(\frac{\pi}{2} - \theta) \\ \cot(\frac{\pi}{2} - \theta) & \cos(\frac{\pi}{2} - \theta) \end{bmatrix} = \begin{bmatrix} cos\theta & cot\theta \\ tan\theta & sin\theta \end{bmatrix}$

17)b; $f(\theta) = \begin{bmatrix} sec\theta & tan\theta \\ tan\theta & sec\theta \end{bmatrix}$

$\Rightarrow f^{-1}(\theta) = \frac{1}{sec^2\theta - \tan^2\theta}\begin{bmatrix} sec\theta & -tan\theta \\ -tan\theta & sec\theta \end{bmatrix}$

$f^{-1}(\theta) = \begin{bmatrix} sec\theta & -tan\theta \\ -tan\theta & sec\theta \end{bmatrix} = f^{-1}(-\theta) = \begin{bmatrix} sec\theta & tan\theta \\ tan\theta & sec\theta \end{bmatrix}$

18)d; $\begin{bmatrix} 3 & 4 \\ 2 & 5 \end{bmatrix}\begin{bmatrix} 5 & -4 \\ -2 & 3 \end{bmatrix} = \begin{bmatrix} 15-8 & -12+12 \\ 10-10 & -8+15 \end{bmatrix}$

$= \begin{bmatrix} 7 & 0 \\ 0 & 7 \end{bmatrix} = 7I$

19)b; Given $f(\alpha) = \begin{bmatrix} sec\theta & tan\theta \\ tan\theta & sec\theta \end{bmatrix}$

$\sec\theta \cdot f(\alpha) = \begin{bmatrix} sec^2\theta & tan\theta.sec\theta \\ tan\theta.sec\theta & sec^2\theta \end{bmatrix}$

$\tan\theta \cdot f(\alpha) = \begin{bmatrix} tan\theta.sec\theta & \tan^2\theta \\ \tan^2\theta & tan\theta.sec\theta \end{bmatrix}$

$\det(\sec\theta.f(\alpha)) = \sec^4\theta - \tan^2\theta.\sec^2\theta$

$\det(\tan\theta.f(\alpha)) = \tan^2\theta.\sec^2\theta - \tan^4\theta$

$\det(\sec\theta.f(\alpha)) + \det(\tan\theta.f(\alpha))$

$= \sec^4\theta - \tan^2\theta.\sec^2\theta + \tan^2\theta.\sec^2\theta - \tan^4\theta$

$= \sec^4\theta - \tan^4\theta = (\sec^2\theta + \tan^2\theta)(\sec^2\theta - \tan^2\theta)$

$= \sec^2\theta + \tan^2\theta$

20)a; $A.adj(A) = \det(A).I = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{bmatrix} = 2I$

$\det(A).I = 2I$

$\det(A) = 2$

$\det(6A)$

$= 6^3 (\det A)$

$= 216 \times 2$

$= 432$

Limits and Derivatives

CONCEPTS

LIMITS

If f(x) is defined in the neighbourhood of some real value a, then *l* is the limit of f(x) as x approaches 'a'.

$$\lim_{x\to a} f(x)=l$$

Left limit: When x<a and x→a, $\lim_{x\to a-} f(x)=\lim_{h\to 0} f(a-h)$

Right limit: When x>a and x→a, $\lim_{x\to a+} f(x)=\lim_{h\to 0} f(a+h)$

$$\lim_{x\to a+} f(x)=\lim_{x\to a-} f(x)=\lim_{x\to a} f(x)$$

L'Hospital rule

If $\lim_{x\to a}\frac{f(x)}{g(x)}=\frac{0}{0}$ (or) $\frac{\infty}{\infty}$, then $\lim_{x\to a}\frac{f(x)}{g(x)}=\lim_{x\to a}\frac{f'(a)}{g'(a)}$

Standard Limits

1) $\lim_{x\to a}\frac{x^n-a^n}{x-a}=n a^{n-1}$

2) $\lim_{x\to 0}\frac{e^{mx}-1}{x}=m$

3) $\lim_{x\to 0}\frac{a^x-1}{x}=\log_e a$

4) $\lim_{x\to 0}[1+ax]^{\frac{1}{x}}=e^a$

5) $\lim_{x\to\infty}\left[1+\frac{a}{x}\right]^x=e^a$

6) $\lim_{x\to 0}\frac{\cos x-1}{x}=0$

7) $\lim_{x\to 0}\left[\sin\frac{(mx)}{x}\right]=\lim_{x\to 0}\left[\tan\frac{(mx)}{x}\right]=m$

8) $\lim_{x\to 0}\left[\frac{1-\cos ax}{x^2}\right]=\frac{a^2}{2}$

9) $\lim_{x\to\infty}\left[\frac{a^x+b^x}{2}\right]^{\frac{1}{x}}=\sqrt{ab}$

10) $\lim_{x\to 0}\left[\cos bx+a\sin bx\right]^{\frac{1}{x}}=e^{ab}$

DERIVATIVES

The calculation of rate of change is called a derivative.

Derivative = $\frac{d}{dx}[f(x)]$, where f is a function of x.

If f(x) is denoted as y, then derivative = $\frac{dy}{dx}$ =f′(x)

f'(x) is a first order derivative. Successive derivations of the function gives the higher order derivatives.

(i) The rate of change of a constant is zero.

(ii) If y = cu, where c is a constant and u is a differentiable function of x then $\frac{dy}{dx}=c\frac{du}{dx}$

(iii) If y = x^n, $\frac{dy}{dx}=\frac{d}{dx}(x^n)=nx^{n-1}$

(iv) The derivative of the sum of two differentiable functions is equal to the sum of the derivatives of each of these functions. If y = u ± v, where u and v are both differentiable functions of x, then $\frac{dy}{dx}=\frac{du}{dx}\pm\frac{dv}{dx}$

(v) If y = uv, where u and v are differentiable functions of x, then $\frac{dy}{dx}=v\frac{du}{dx}+u\frac{dv}{dx}$

(vi) If $y=\frac{u}{v}$ find $\frac{dy}{dx}$ where u and v are functions of x and v ≠ 0, then $\frac{dy}{dx}=\frac{v\frac{du}{dx}-u\frac{dv}{dx}}{v^2}$

(vii) If y = w^n where w is a function of x, then

$$\frac{dy}{dx}=\frac{\frac{d(w^n)}{dw}\times dw}{dx}=n\,w^{n-1}\times\frac{dw}{dx}$$

(viii) $\frac{d(e^x)}{dx}=e^x$ (ix) $\frac{d(a^x)}{dx}=a^x\log a$

(x) $\frac{d(\log_e x)}{dx}=\frac{1}{x}$ (xi) $\frac{d(\log_a x)}{dx}=\frac{1}{x\log a}$

(xii) $\frac{d(\sin x)}{dx}=\cos x$ (xiii) $\frac{d(\sin^{-1}x)}{dx}=\frac{1}{\sqrt{1-x^2}}$

(xiv) $\frac{d(\cos x)}{dx}=-\sin x$ (xv) $\frac{d(\cos^{-1}x)}{dx}=\frac{-1}{\sqrt{1-x^2}}$

(xvi) $\frac{d(\tan x)}{dx}=sec^2 x$ (xvii) $\frac{d(\tan^{-1}x)}{dx}=\frac{1}{1+x^2}$

(xviii) $\frac{d(sec\,x)}{dx}=sec\,x\tan x$

(xix) $\frac{d(cosec\,x)}{dx}=-cosec\,x\cot x$

(xx) If $y=\sqrt{f(x)+\sqrt{f(x)+\sqrt{f(x)+\ldots}}}$, $\frac{dy}{dx}=\frac{f'(x)}{2y-1}$

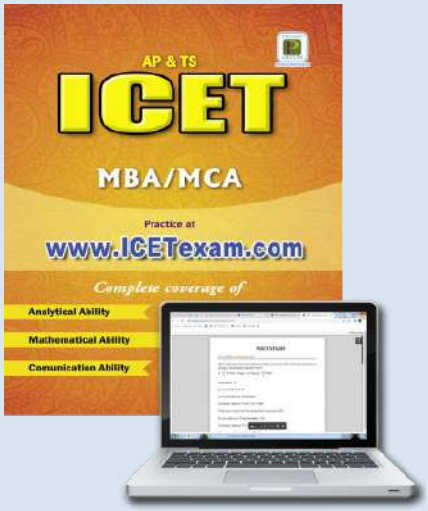
Higher order derivatives

$\frac{d}{dx}[f'(x)]$ is called a 'second order derivation' and is denoted by f''(x) or $f_2(x)$.

$f''(x)=\frac{d^2y}{dx^2}$ where y = f(x)

Similarly, f'''(x) = $\frac{d}{dx}[f''(x)]=\frac{d^3y}{dx^3}$ where y = f(x), if it exist. f'''(x) is known as the third order derivative'.

Note : In general n^{th} derivative of a function f(x) is denoted by $f_n(x)$, n ∈ W.



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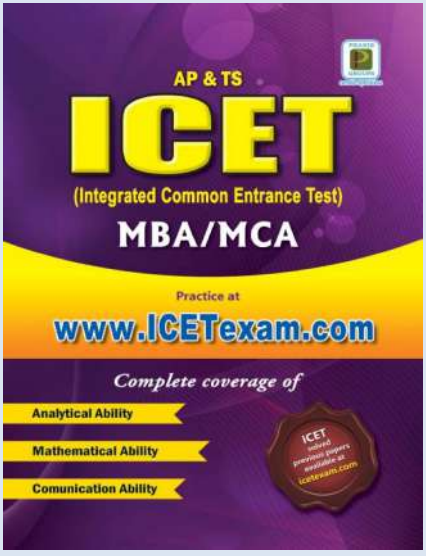

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17)b; We know that $\frac{d}{dx}(sec^{-1}(x))=\frac{1}{|x|\sqrt{x^2-1}}$

$\frac{d}{dx}(sec^{-1}(x^2+1))=\frac{1}{|(x^2+1)|\sqrt{(x^2+1)^2-1}}\times\frac{d}{dx}(x^2+1)$

$=\frac{2x}{|(x^2+1)|\sqrt{(x^2+1)^2-1}}=\frac{4}{5\sqrt{(24)}}=\frac{2}{5\sqrt{6}}=\frac{\sqrt{6}}{15}$

18)c; We know that $\frac{d}{dx}[\cos^{-1}(x)]=\frac{-1}{\sqrt{1-x^2}}$

$\therefore\frac{d}{dx}[\cos^{-1}(x^2+1)]=\frac{-1}{\sqrt{1-(x^2+1)^2}}\times\frac{d}{dx}(x^2+1)$

$=\frac{-1}{\sqrt{1-(x^2+1)^2}}\times 2x$

when x = 5,

$\frac{d}{dx}[\cos^{-1}(x^2+1)]=\frac{-10}{\sqrt{1-26^2}}=\frac{-10}{\sqrt{-676}}=\frac{-10}{5i\sqrt{27}}=\frac{2i}{\sqrt{27}}$

19)d; $f(x)=\frac{x^3+1}{x^3-1}$

Let u = x^3+1 and v = 1/(x^3-1)

du = $3x^2$; dv = $-3x^2/(x^3-1)^2$

f′(x) = du.v + u.dv

$=\frac{3x^2}{x^3-1}+\frac{-3x^2(x^3+1)}{(x^3-1)^2}=\frac{3x^2}{x^3-1}[1-\frac{x^3+1}{x^3-1}]=\frac{-6x^2}{(x^3-1)^2}$

when x = 3, f '(3) = $\frac{-54}{676}$

20)a; $f(x)=\frac{1}{\sqrt{x^3}}\Rightarrow f(x)=x^{-3/2}\Rightarrow f'(x)=\frac{-3}{2}x^{\frac{-5}{2}}$

x = 9 ⇒ f′(9) = $\frac{-3}{2}(3^2)^{-5/2}=\frac{-3}{2}\times\frac{1}{3x3x3x3x3}=\frac{-1}{162}$

21)b; x = $\sqrt{5y+\sqrt{5y+\sqrt{5y+....+\infty}}}$,

x^2 = 5y + x

2x = 5y' + x

y' = (2x-1)/5

22)c; $y=\sqrt{f(x)+\sqrt{f(x)+\sqrt{\sqrt{f(x)}....+\infty}}}$, $then\ \frac{dy}{dx}=\frac{f'(x)}{2y-1}$

$\therefore$ when $y=\sqrt{(6x^2+5)+\sqrt{(6x^2+5)+....+\infty}}$, $\frac{dy}{dx}=\frac{12x}{2y-1}$

23)a; $y=\sqrt{f(x)+\sqrt{f(x)+\sqrt{\sqrt{f(x)}....+\infty}}}$, $then\ \frac{dy}{dx}=\frac{f'(x)}{2y-1}$

when $3y=\sqrt{3x^2+\sqrt{3x^2+\sqrt{3x^2+....+\infty}}}$,

$\frac{dy}{dx}=\frac{6x}{2(3y)-1}=\frac{6x}{6y-1}$

24)b; $\lim_{x\to\infty}\frac{2x+3}{3x+5}=\lim_{x\to\infty}\frac{x\left(2+\frac{3}{x}\right)}{x\left(3+\frac{5}{x}\right)}=\frac{2}{3}$

25)a; $1-\frac{1}{2}+\frac{1}{4}-\frac{1}{8}+..\infty$ is a G.p a=1; $r=-\frac{1}{2}$

Sum of infinite terms in G.P = $\frac{a}{1-r}=\frac{1}{1+\frac{1}{2}}=\frac{2}{3}$

Thus, the limit of $1-\frac{1}{2}+\frac{1}{4}-\frac{1}{8}+...+\infty$ is $\frac{2}{3}$

26)b; $\lim_{x\to 2}\left[\frac{1}{x-2}-\frac{2}{x(x-1)(x-2)}\right]$

$\lim_{x\to 2}\left[\frac{x(x-1)-2}{x(x-1)(x-2)}\right]\Rightarrow\lim_{x\to 2}\left[\frac{(x-2)(x+1)}{x(x-1)(x-2)}\right]=\frac{3}{2}$

27)c; $\lim_{x\to 2}\frac{2x^2-7x+6}{5x^2-11x+2}=\lim_{x\to 2}\frac{(x-2)(2x-3)}{(5x-1)(x-2)}=\frac{1}{9}$

28)d; $\lim_{x\to 0}\frac{x^2+5x}{x}=\lim_{x\to 0}\frac{x(x+5)}{x}=5$

29)a; $\lim_{x\to a}\frac{\sqrt{x+a}-\sqrt{2a}}{x-a}\times\frac{\sqrt{x+a}+\sqrt{2a}}{\sqrt{x+a}+\sqrt{2a}}$

$=\lim_{x\to a}\frac{1}{\sqrt{x+a}+\sqrt{2a}}=\frac{1}{2\sqrt{2a}}$

30)b; $\lim_{x\to a}\frac{x^{-5}-a^{-5}}{x^3-a^3}$

$=\frac{\lim_{x\to a}\frac{x^{-5}-a^{-5}}{x-a}}{\lim_{x\to a}\frac{x^3-a^3}{x-a}}=\frac{-5.a^{-5-1}}{3a^{3-1}}=\frac{-5.a^{-6}}{3a^2}=\frac{-5}{3a^8}$

31)a; $\lim_{x\to\infty}\frac{5x^3-7x+6}{x^3+8}=\lim_{x\to\infty}\frac{x^3(5-\frac{7}{x^2}+\frac{6}{x^3})}{x^3(1+\frac{8}{x^3})}=5$

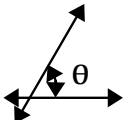
32)c; $\lim_{x\to\infty}\frac{(3x-1)(2x+5)}{(x-3)(3x+7)}=\lim_{x\to\infty}\frac{x^2(3-\frac{1}{x})(2+\frac{5}{x})}{x^2(1-\frac{3}{x})(3+\frac{7}{x})}=\frac{3(2)}{1(3)}=2$

33)b; $\lim_{x\to 2}\frac{x^{3/2}-2^{3/2}}{x-2}=\frac{3}{2}(2)^{3/2-1}=\frac{3}{2}(2)^{1/2}=\frac{3\times\sqrt{2}}{\sqrt{2}\times\sqrt{2}}=\frac{3}{\sqrt{2}}$

PLANE GEOMETRY

CONCEPTS

Angle: When two non-parallel and co-planar lines (lines in the same plane) intersect, at the point of intersection the measure of rotational displacement is called an angle.



Types of Angles: If θ is an angle such that

1) If θ = 0° then θ is *zero angle.*
2) If 0° < θ < 90° then θ is called an *acute angle.*
3) If θ = 90° then θ is *right angle.*
4) If θ > 90^0 then θ is *obtuse angle.*
5) If θ = 180° then θ is called a *straight angle.*
6) If 180° < θ < 360° then θ is called *reflex angle.*
7) If θ = 360° then θ is called *complete angle.*

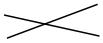
Parallel and Non-Parallel lines:

1) Two lines are said to be parallel lines if they are co-planar (in the same plane) and non intersecting.

The point of intersection of parallel lines is at infinite places which is not real.

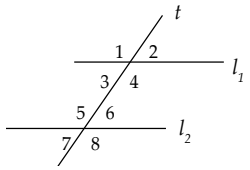
2) The angle between parallel lines is undefined, or it can be either 0° or 180° or any multiple of 180°.

3) Two lines are said to be non parallel (inclined lines) if they are co-planar and intersect at a real point.



The point of intersection of inclined lines is real.

Transversal: A line that intersects two parallel lines is called a *transversal.* Suppose l_1 , l_2 are two parallel lines and '*t*' is a transversal, then we will have eight angles as shown in figure.



•**Vertical Opposite Angles:** The angles ∠1∠4, ∠2∠3, ∠5∠8, ∠6∠7 pair wise are called pairs of *vertical angles.* The corresponding pairs of vertical angles are always equal *i.e.* ∠1=∠4, ∠2=∠3, ∠5=∠8, ∠6=∠7.

•**Corresponding Angles:** The angles ∠1∠5, ∠2∠6, ∠3∠7, ∠4∠8 pair wise are called *corresponding angles.* The pairs of corresponding angles are always equal. *i.e.* ∠1=∠5, ∠2=∠6, ∠3=∠7, ∠4=∠8.

•**Alternate Interior Angles:** The angles ∠3∠6, ∠4∠5 are called pairs of *alternate interior angles.*
The corresponding pairs of alternate angles are equal.
i.e. ∠3=∠6, ∠4=∠5

•**Alternate Exterior Angles:** The angles ∠1∠8,∠2∠7 are called pairs of *alternate exterior angles*. ∠1=∠8,∠2=∠7

•**Complementary Angles:** Two angles whose sum is 90° are called *complementary angles*.

•**Supplementary Angles:** Two angles whose sum is 180° are called *supplementary angles.*

POLYGONS

•A closed plane figure made up of several line segments that are joined together is called a Polygon.

•If all the sides of a polygon are equal then it is called Regular Polygon.

Regular polygons are both equiangular and equilateral.
Equiangular = all angles are equal.
Equilateral = all sides are the same length.

Exterior angle: The angle subtended by a side of the regular polygon at the vertex outside.

Sum of the exterior angles of any polygon = 360°.

Each exterior angle (regular polygon) = $\frac{360}{n}$.

(where 'n' is the number of sides in a polygon).

Interior angle:

Sum of the interior angles of a polygon = (n–2)×180°.

Each interior angle of a regular polygon = $\frac{180(n-2)}{n}$.

• The number of diagonals in a polygon = $\frac{n(n-3)}{2}$.

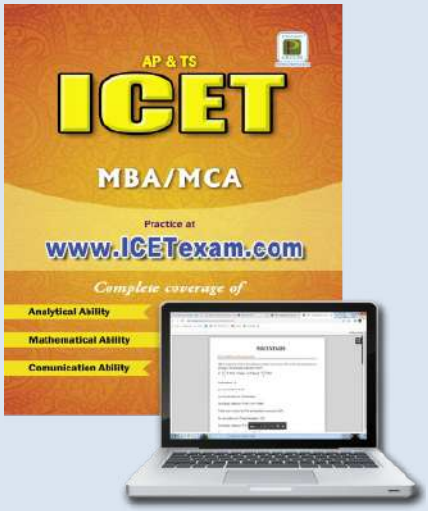
• The number of triangles (when you draw all the diagonals from one vertex) in a polygon = (n–2).

Polygon Names:

Sides	Name
3	Triangle
4	Quadrilateral
5	Pentagon
6	Hexagon
7	Heptagon
8	Octagon
10	Decagon

Special Triangles: Equilateral, Isosceles, Scalene, Right Angled, Acute, Obtuse.

Special Quadrilateral: Square, Rhombus, Parallelogram, Rectangle, Trapezium and Trapezoid.



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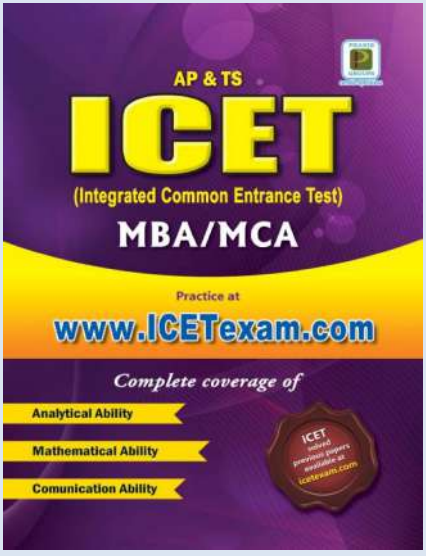

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10)3; Side of an equilateral triangle,

$a=\frac{2h}{\sqrt{3}}; h=\sqrt{3}\ \ a=\frac{2\times\sqrt{3}}{\sqrt{3}}=2$ units.

Area of equilateral triangle = $\frac{\sqrt{3}}{4}a^2=\frac{\sqrt{3}}{4}2^2=\sqrt{3}\ sq.ut$

11)3; Area of regular hexagon= $\frac{6\sqrt{3}}{4}a^2; Side(a)=4\sqrt{3}$

$\therefore \text{Area}=\frac{6\sqrt{3}}{4}(4\sqrt{3})^2\Rightarrow\frac{6\sqrt{3}\times4\sqrt{3}\times4\sqrt{3}}{4}\Rightarrow72\sqrt{3}$ sq.units

12)2; Since XY||BC, ΔAXY~ΔABC

$\Rightarrow\frac{\Delta AXY}{\Delta ABC}=\frac{AX^2}{AB^2}=\frac{4}{9}$

The ratio of the areas of two similar triangles is equal to ratio the of the square of their corresponding sides.

13)3; Here ΔABC is a right angled triangle at 'A'.

$\therefore y^2=5x$ and $AC^2=DC\times BC\Rightarrow 300=x(x+5)\Rightarrow x=15$

(From 'similarity in right angle triangles' concept)

14)2; From the diagram, ΔEBA ~ ΔEDC.

So, ratio of the corresponding sides are equal.

$\Rightarrow\frac{AB}{CD}=\frac{AE}{CE}=\frac{4}{6}\Rightarrow\frac{2}{3}$

15)2; Number of diagonals of polygon with sides *'n'*

$=\frac{n(n-3)}{2}\Rightarrow14=\frac{n(n-3)}{2}$

$n(n–3)=28\Rightarrow n^2-3n-28=0\Rightarrow n^2-7n+4n-28=0$

$\Rightarrow(n–7)(n+4)=0\Rightarrow n=7$ (or) $n=-4$

Sides cannot be negative.

$\therefore n=7$

16)1; The interior angle of regular polygon

$=180^0-\frac{360^0}{n}=180^0-\frac{360^0}{6}=180^0-60^0=120^0.$

17)2; ABCD is a cycle quadrilateral.

$\therefore \angle B+\angle D=180^0\Rightarrow 70^0+\angle D=180^0\Rightarrow\angle D=110^0.$

18)3; Given, $d_1=d_2$;

Area of rhombus $=\frac{1}{2}d_1d_2=\frac{1}{2}d_1d_1$

$32=\frac{1}{2}d_1^2\Rightarrow d_1^2=64\Rightarrow d_1=\pm8$

Length of the diagonal cannot be negative.

$\therefore d_1=8\ cm$

19)4; Radius of in-circle of a triangle of area (*a*), and semi–Perimeter (*s*) = $\frac{a}{s}=\frac{60}{2}=30$

$\therefore$ Radius = $\frac{50}{30}=\frac{5}{3}cm.$

20)1; $h=\frac{1}{5}\times a=\frac{1}{5}\times10=2\ cm$

$\therefore$ Area of trapezium =

$\frac{1}{2}(a+b)h=\frac{1}{2}(10+8)2=18\ sq.cm.$

21)4; If *'h'* is height and *'a'* is side, then

$h=\frac{\sqrt{3}}{2}a=\frac{\sqrt{3}}{2}.4\sqrt{3}$ = (2)(3) = 6 units.

22)3; In rhombus PQRS, $4PQ^2=PR^2+QS^2=9+5^2=9+25=34$

$\therefore PQ^2=\frac{34}{4}\Rightarrow PQ=\frac{\sqrt{34}}{2}$

23)2; By the properties of circle,

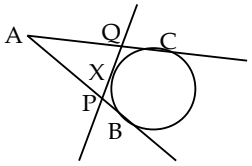
$\angle POR=2\angle PQR$ ..... (1)

Given, $\angle PQR+\angle POR=120^0$

$\angle PQR+2\angle PQR=120^0$ (from(1))

$3\angle PQR=120^0\Rightarrow\angle PQR=40^0$

24)2; Let us observe the diagram.



Since AB and AC are the tangents from the same point

$\therefore$ AB = AC = 5 cm. Similarly BP = PX and XQ = QC.

Perimeter of ΔAPQ = AP + AQ + PQ.

= AP +AQ +(PX+XQ) ⇒ (AP + PX) + (AQ + XQ)

= (AP + PB) + (AQ + QC) ⇒AB + AC ⇒ 5 + 5 = 10 cm

25)1; Here, OA = 2 × Radius = 2 × 8 = 16 *cm*

OB = Radius = 8 *cm*

$\therefore OA^2=OB^2+AB^2$ (hypotenuse property)

$16^2=8^2+AB^2\Rightarrow AB^2=16^2-8^2=256–64=192$

$AB=\sqrt{192}=2\sqrt{48}$

26)3; If two chords PQ and ST intersect internally then, PR × RQ = SR×RT. But PR = RQ.

$\therefore$ PR × PR = SR×RT ⇒ $PR^2=5\times6=30\Rightarrow PR=\sqrt{30}\,cm$

CO-ORDINATE GEOMETRY

CONCEPTS

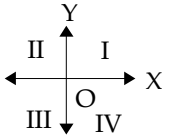
•Cartesian Plane:

1) The plane in which x-axis and y-axis, two mutually perpendicular lines intersect at origin O is called x-y plane or Cartesian plane.

2) These lines divide the plane into 4 quadrants. Any point in this plane is represented by P(x, y).

3) Here $|x|$ = distance of the point from y-axis (abscissa of the point).

4) $|y|$ = Distance of the point from x-axis (ordinate of the point).



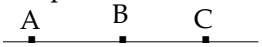
Quadrant-I: (x, y)
Quadrant-II : ($-x$, y)
Quadrant-III : ($-x$, $-y$)
Quadrant-IV : (x, $-y$)

•Distance Between two points:

The distance between two points A(x_1, y_1) and B(x_2, y_2) is AB = $\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$.

•Condition for Collinearity of Three Point:

If 3 points A(x_1, y_1), B(x_2, y_2), C(x_3, y_3) are collinear, then area of ΔABC=0. (Because you cannot make a triangle using collinear points as shown below).



Collinear

(or) write the equation of straight line using any two points and check whether third point satisfies it or not.

•Section Formula:

1) If P(x, y) divides the line joining A(x_1, y_1), B(x_2, y_2) in the ratio m : n then

$x=\frac{mx_2+nx_1}{m+n}; y=\frac{my_2+ny_1}{m+n}$ (internally)

$x=\frac{mx_2-nx_1}{m-n}; y=\frac{my_2-ny_1}{m-n}$ (externally)

2) If P(x, y) lies in the line joining A(x_1, y_1), B(x_2, y_2) then P divides AB in the ratio $(x_1–x) : (x–x_2)$ (or)$(y_1–y):(y–y_2)$.

3) X-axis divides the line segment joining (x_1, y_1), (x_2, y_2) in the ratio $y_1 : y_2$.

4) Y-axis divides the line segment joining (x_1, y_1), (x_2, y_2) in the ratio $x_1 : x_2$.

•Centroid: The point of intersection of the medians is called centroid of triangle. This point divides each median in the ratio 2 : 1. Its coordinates are

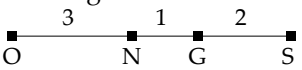
$\left(\frac{x_1+x_2+x_3}{3}, \frac{y_1+y_2+y_3}{3}\right)$.

where$(x_1,y_1),(x_2,y_2),(x_3,y_3)$ are the vertices of the triangle

•Incentre: If the three vertices of triangle ABC are located at $(x_a,y_a),(x_b,y_b),(x_c,y_c)$ and the sides opposite to these vertices are a,b *and* c, then the incentre is locatted at $\left(\frac{ax_a+bx_b+cx_c}{a+b+c}, \frac{ax_a+bx_b+cx_c}{a+b+c}\right)$

$=\frac{a(x_a, y_a)+b(x_b, y_b)+c(x_c, y_c)}{a+b+c}$

•Observe the following.



N divides O and G in the ratio 3 : 1 internally
G divides O and S in the ratio 2 : 1 internally
S divides O and G in the ratio 3 : 1 externally
G divides N and S in the ratio 1 : 2 internally
N divides O and S in the ratio 1 : 1 internally

•Straight Line: Equation of the line, $y = mx + c$.

*h*ere, m = slope, c = intercept.

If line passes through the points $A(x_1, y_1)$ and $B(x_2, y_2)$ then $m=\frac{y_2-y_1}{x_2-x_1}, (x_1\neq x_2)$

1) The equation of a straight line passing through two points (x_1, y_1), (x_2, y_2) is $(y-y_1)=\left(\frac{y_2-y_1}{x_2-x_1}\right)(x-x_1)$.

2) Equation of a straight line whose x intercept and y intercept are a, b respectively is $\frac{x}{a}+\frac{y}{b}=1$.

3) The general equation of a straight line is $ax + by + c$=0

4) The area of the triangle formed by the line $ax + by + c = 0$ with the coordinate axes is $\frac{c^2}{2|ab|}$

5) If $a_r x+b_r y+c_r=0$, (r = 1, 2, 3) are the vertices of a triangle, then the area is $=\frac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$

6) Area of Triangle with vertices A(x_1 , y_1), B(x_2 , y_2), C(x_3, y_3) $\frac{1}{2}\left|\left[x_1(y_2-y_3)+x_2(y_3-y_1)+x_3(y_1-y_2)\right]\right|$

Translation of Axes:

A point P in the plane has two sets of coordinates: (x, y) in the original system and (x^1, y^1) in the translated system. If the coordinates of the origin of the translated system are (h, k) relative to the original system, then the old and new coordinates are given as

Old Coordinates: $x = x^1 + h$; $y = y^1 + k$

New Coordinates: $x^1 = x – h$; $y^1 = y – k$

6)3; Mid-point of AB is D(-1, -1)

CD = $\sqrt{6^2+49}=\sqrt{85}$

7)2; Determinant = 0 *i.e.* points are collinear.

Collinear points lies on straight line.

8)3; Divide by 5 on both sides. $\therefore \frac{3x}{5}+\frac{4y}{5}=\frac{1}{5}$

9)2; Set of lines passes through intersection point of $x-2y+1=0$ and $x+y=0$ which is $\left(-\frac{1}{3},\frac{1}{3}\right)$.

10)1; Since diagonals in parallelogram bisect each other $\Rightarrow \frac{2+a}{2}=\frac{5+1}{2}$ and $\frac{3+b}{2}=\frac{2+7}{2} \Rightarrow a=4, b=6$.

11)1; Here we have to find the new coordinates.

i.e. $(x^1, y^1) = (x-h, y-k) \Rightarrow (4-7, 5+4) = (-3, 9)$

12)2; Mid point joining the points (x_1, y_1) and (x_2, y_2) is given by $\left(\frac{x_1+x_2}{2},\frac{y_1+y_2}{2}\right)$.

$\therefore x_{mid}=\frac{2-10}{2}=\frac{-8}{2}=-4; y_{mid}=\frac{-4+4}{2}=0$

$\therefore$ (-4, 0) is mid point

13)2; We must find slope of all four sides. So that we will check the slope of opposite sides. Hence, we need to check slope of two pairs of opposite sides.

14)3; Let center = (a, b) and radius = 'r'.

Then equation is given by, $(x-a)^2+(y-b)^2=r^2$

$(x-4)^2+(y-3)^2=r^2 \Rightarrow x^2-8x+16+y^2-6y+9=r^2$

$x^2+y^2-8x-6y+25=r^2 \Rightarrow x^2+y^2-8x-6y+25=4^2$

$\therefore x^2+y^2-8x-6y+9=0$

15)1; Slope of AB = $\frac{y_2-y_1}{x_2-x_1}=\frac{6-(-2)}{3-(-2)}=\frac{8}{5}$

Slope of AC = $\frac{y_3-y_1}{x_3-x_1}=\frac{2-(-2)}{8-(-2)}=\frac{4}{10}$

$\therefore$ Ratio of slope = $\frac{\overline{AB}}{\overline{AC}}=\frac{8/5}{4/10}=\frac{8\times10}{4\times5}=\frac{4}{1}$

16)1; X–intercept = 3, Y–intercept = 4

$\therefore$ By equation of line, $y = mx + c$

Here, $(x_1, y_1) = (3, 0)$; $(x_2, y_2) = (0, 4)$

Slope = $m = \frac{y_2-y_1}{x_2-x_1}=\frac{4-0}{0-3}=-\frac{4}{3}$

$\therefore y=\frac{-4}{3}x+c$

Substitute$(x_1,y_1)=(3,0)$ in

$y=\frac{-4}{3}(x)+c \Rightarrow 0=-4+c \Rightarrow c=4$

$\therefore y=\frac{-4}{3}x+4$

$\Rightarrow 3y + 4x = 12$

17)2; Area of triangle = $\frac{1}{2}\times b\times h$

height = |1-(-3)| = 4

$\therefore 6=\frac{1}{2}\times base\times 4$

$\Rightarrow$ base×2 = 6 $\Rightarrow$ base = 3

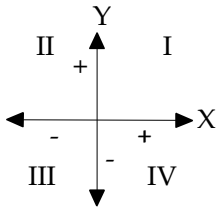
$\therefore$ R is 3 units from Q.

$\therefore$ x of R = 1+3 = 4 y of R = y of Q = -3

$\therefore$ (4, -3) is the coordinate

18)2; Abscissa refers to the horizontal co-ordinate of a point in two-dimensional structure *i.e.* x–axis.

Ordinate refers to the vertical co-ordinate of a point in two-dimensional structure *i.e.* y-axis.



$\therefore$ In third quadrant, from the above figure both abscissa and ordinate is negative *i.e.* (-, -).

19)4; $(a, b) = (1, 1)$; $r = 15$

$\therefore (x-a)^2+(y-b)^2 = 15^2$

$(x-1)^2+(y-1)^2 = 15^2$

$x^2-2x+1+y^2-2y+1 = 225$

$x^2+y^2-2x-2y = 223$

20)2; Radius $=\frac{1}{2}\times$ Diameter

$\therefore$ If we find the distance between these two points and divide by 2, we have radius.

$\therefore$ Distance = $\sqrt{(12-4)^2+(-6-(-2)^2)}$

$=\sqrt{8^2+4^2}=\sqrt{64+16}=2\sqrt{20}$

$\therefore$ Radius $=\frac{2\sqrt{20}}{2}=\sqrt{20}$

21)3; Slope of given line $y+3x = 12$

$y = -3x+12$

$\Rightarrow y = mx+c \Rightarrow m = -3$

Slope of perpendicular lines, *i.e.* $m_1 \times m_2 = -1$.

$-3 \times m_2 = -1 \Rightarrow m_2 = \frac{1}{3}$

22)2; Distance between (x_2, y_2) and (x_1, y_1) is

$\sqrt{\left(x_2-x_1\right)^2+\left(y_2-y_1\right)^2}$

$5=\sqrt{\left(4-a\right)^2+\left(2-(-3)\right)^2}$

$5=\sqrt{\left(4-a\right)^2+5^2}$

By squaring on both side,

$25 = (4-a)^2+25 \Rightarrow (4-a)^2 = 0$

$\therefore a = 4$

STATISTICS

CONCEPTS

Statistics is the branch of mathematics describing the measures of a given data.

Frequency Distributions: For some sets of measurements, it is more convenient and informative to display the measurements in a frequency distribution. For example, the following values represent the number of dependent children in each of 25 families living on a particular street.

1, 2, 0, 4, 1, 3, 3, 1, 2, 0, 4, 5, 2, 3, 2, 3, 2, 4, 1, 2, 3, 0, 2, 3, 1

These data can be grouped into a frequency distribution by listing each different value (*X*) and the frequency (f) of occurrence for each value.

X	0	1	2	3	4	5	Total
f	3	5	7	6	3	1	25

The frequency distribution format not only provides a quick summary of the data, but it also simplifies the calculation of the central location and dispersion measures. For these data, the *X*-es can be summed by multiplying each *X* by its frequency and then adding the products. So, the arithmetic mean is

$$\frac{(0)(3)+(1)(5)+(2)(7)+(3)(6)+(4)(3)+(5)(1)}{25}=2.16$$

The median is the middle (13^{th}) *X* value in order of size. The f values show that the 13^{th} *X* value must be a 2.

The range is 5 minus 0, or 5. The standard deviation can also be calculated more easily from a frequency distribution.

Example: A family drove through 6 Indian states on their summer vocation. The price per gallon of petrol varied from state to state and is listed below. What is the range of petrol prices paid (in Rs.)?

State	1	2	3	4	5	6
Price	72.32	72.58	72.01	71.52	73.56	74.23

Explanation: Ordering the data from least to greatest, we get:71.52, 72.01, 72.32, 72.58, 73.56, 74.23

Range = 74.23 – 71.52 = 2.71

ARITHMETIC MEAN:

The aggregate total of the data divided by the total number of values in the set is the arithmetic mean.

Example: A student took 7 model ICET tests . What is the mean of his following percentages?

89, 73, 84, 91, 87, 77, 94.

Explanation: The sum of these percentages is 595.

Arithmetic Mean = $\frac{595}{7}=85$

The mean of $x_1, x_2, x_3, \ldots x_n$ is given as

$$\bar{x}=\frac{x_1+x_2+x_3+....+x_n}{n}$$

a) The mean of $x_1 \pm a, x_2 \pm a, x_3 \pm a \ .... + (x_n \pm a)$ is $(\bar{x} \pm a)$

b) The mean of $ax_1, ax_2, ax_3, ..., ax_n$ is $a\bar{x}$

c) In the case of frequency distributions the mean is known as weighted mean, $\bar{x} = \frac{\Sigma fx}{\Sigma f}$

Example: Find the arithmetic mean of the pocket money received by 50 students of a class from the following table.

Pocket money (Rs.)	40	80	120	160	200
Number of students	20	15	8	5	2

Explanation:

Pocket money (Rs) (*x*)	**no. of students (f)**	**fx**
40	20	800
80	15	1200
120	8	960
160	5	800
200	2	400
Total	50	4160

Mean = $\frac{\Sigma fx}{\Sigma f}=\frac{4160}{50}=83.2$

Arithmetic mean of pocket money = Rs. 83.2

MEDIAN: The median of a set of data is the central value in the set. The median is the number that is half way into the set. To find the median, the data must be first arranged in order. If the number of values (N) in the data is odd, Median = $\left(\frac{N+1}{2}\right)$ th value

If the number of values (N) is even,

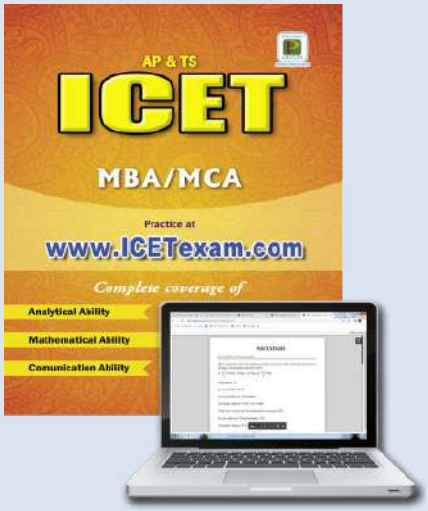
$$\text{Median}=\frac{1}{2}\left[\left(\frac{N}{2}\right)\text{observation}+\left(\frac{N}{2}+1\right)\text{observation}\right]$$

Example: A family has 5 children, aged 9, 12, 7, 16 and 13. what is the age of the middle child?

Explanation: Ordering the children's ages from least to greatest, we get: 7,9, 12, 13, 16. The age of the middle child is 12. Median of their ages is 12.

Example: Find the median for the following distribution

Marks	20	21	22	23	24	25
No. Of Students	2	6	10	8	5	3



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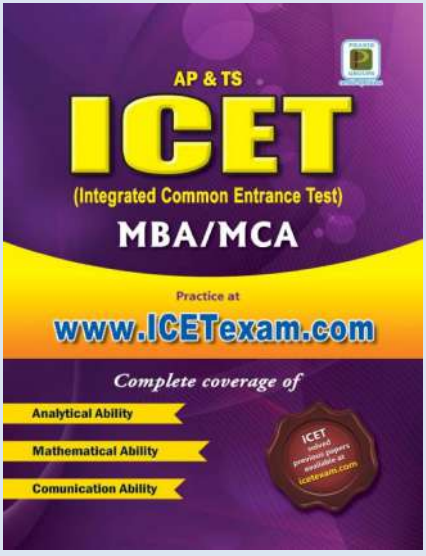

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43)a; Probability of getting head in a single throw = $\frac{1}{2}$

Similarly the probability of getting 5 heads in 5 tosses is $\left(\frac{1}{2}\right)\left(\frac{1}{2}\right)\left(\frac{1}{2}\right)\left(\frac{1}{2}\right)\left(\frac{1}{2}\right)=\left(\frac{1}{2}\right)^5=\frac{1}{32}$

44)a; The total number on a roulette wheel is 36

One number is chosen in ${}^{36}C_1 = 36$ ways.

The possible numbers that are divisible by 3 are {3, 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36}. Total are 12 numbers.

Probability of getting a number divisible by 3 = $\frac{12}{36}=\frac{1}{3}$

Probability of not getting a number divisible by 3 is $1-\frac{1}{3}=\frac{2}{3}$

Probability of not getting divisible of 3 in 4 times is $\left(\frac{2}{3}\right)\left(\frac{2}{3}\right)\left(\frac{2}{3}\right)\left(\frac{2}{3}\right)=\left(\frac{2}{3}\right)^4$

The probability of winning at least once is $1-\left(\frac{2}{3}\right)^4$

45)d; Here we have to find that, if she is late on one morning, then what is the probability that she comes late by bus. So, let us first find the probability that she is late on a particular morning.

P(she is late) = $\left(\frac{1}{6}\times\frac{1}{5}\right)+\left(\frac{1}{3}\times\frac{1}{4}\right)+\left(\frac{1}{2}\times\frac{1}{20}\right)=\frac{17}{120}$

Now, let us find the probability that she comes late and she comes by bus.

i.e. P(she comes by bus | she arrives late)

$$P(A\mid B) = \frac{P(A\cap B)}{P(B)}=\frac{\frac{1}{6}\cdot\frac{1}{5}}{\frac{17}{120}}=\frac{4}{17}$$

46)a; Given P(A) = 0.4, P(B) = 0.3, $P(A\mid B) = 0.5$

$$P(A\mid B) = \frac{P(A\cap B)}{P(B)}=P(A\mid B)P(B)=P(A\cap B)$$

= (0.5).(0.3) = $P(A\cap B) = 0.15$

47)a; $P(W\mid T) = \frac{P(W\cap T)}{P(T)}$

$$= \frac{\left(\frac{2}{3}\right)\times\left(\frac{7}{10}\right)}{\left(\frac{2}{3}\right)\times\left(\frac{7}{10}\right)+\left(\frac{1}{3}\right)\times\left(\frac{8}{10}\right)}=\frac{\frac{7}{15}}{\frac{7}{15}+\frac{4}{15}}=\frac{7}{11}$$

48)a; The probability of failing are 0.1 and 0.05.

The probability of not failing are (1 – 0.1) and (1 – 0.05) = 0.9 and 0.95. Since they are independent, the probability that neither circuit fails is (0.9)×(0.95)=0.855

49)a; $P(C\mid A)=\frac{P(C\cap A)}{\left(\frac{4}{10}\times\frac{1}{500}\right)+\left(\frac{5}{10}\times\frac{1}{50}\right)+\left(\frac{1}{10}\times\frac{1}{10}\right)}$

$$\frac{\left(\frac{5}{10}\right)\times\left(\frac{1}{50}\right)}{\frac{4}{5000}+\frac{5}{500}+\frac{1}{100}}=\frac{\frac{1}{100}}{\frac{4+50+50}{5000}}=\left(\frac{1}{100}\right)\times\left(\frac{5000}{104}\right)=\frac{50}{104}$$

50)a; The total possible out comes is 6×6 = 36

The sum 7 is given by {(3,4),(4,3),(1,6),(6,1),(2,5),(5,2)}=6

Then the required probability = $\frac{6}{36}$

51)d; P(A) = 0.4, P(B) = 0.3, P(A∩B) = 0.25

$$P(B\mid A) = \frac{P(B\cap A)}{P(A)}=\frac{0.25}{0.4}=0.625$$

52)a; P(A) = $\frac{1}{4}$, P(B) = $\frac{1}{3}$, P(AUB) = $\frac{5}{12}$

$$P(A\mid B) = \frac{P(A\cap B)}{P(B)}=\frac{P(A)+P(B)-P(A\cup B)}{P(B)}$$

$$= \frac{\frac{1}{4}+\frac{1}{3}-\frac{5}{12}}{\frac{1}{3}}=\frac{\frac{3}{12}+\frac{4}{12}-\frac{5}{12}}{\frac{1}{3}}=\frac{1}{2}$$

53)a; $P(A\mid B)=\frac{P(A\cap B)}{P(B)}=\frac{P(A)\cdot P(B)}{P(B)}$

(Since they are independent) = P(A) = 0.2

54)d; Given P(A) = 0.3, P(B) = 0.5;

$P(A^1) = 1 - P(A) = 1 - 0.3 = 0.7$

$P(A^1\cap B) = P(A^1)\,P(B)$ [Since they are independent]

$$P(A^1\cap B)=(0.7)(0.5)=\left(\frac{7}{10}\right)\times\left(\frac{5}{10}\right)=\frac{35}{100}=0.35$$

55)a; $P(A\cap B) = P(A)+P(B)-P(AUB)= 0.7+0.4-0.8= 0.3$

56)a; $P(S^1\cup T^1) = P(S^1)+P(T^1)-P(S^1\cap T^1)$

= [1 – P(S)] + [1 – P(T)] – 0.5

= [1 – 0.6] + [1 – 0.4] – 0.5

Since S and T are mutually exclusive events.

P(S) + P(T) = 1

P(S) = 1 – P(T) = 0.4 + 0.6 – 0.5 = 0.5

SENTENCE

A sentence is a group of words which makes complete meaning or sense. Hence a sentence has 'sense'. Sentences are of four kinds depending on their function.

Declarative or assertive: these are sentences which make statements or assertions.

e.g.: Japan is an Island.
The Blue Whale is the largest mammal.
A huge earthquake destroyed many buildings.

Interrogative: these are sentences which ask questions.

e.g.: Where are you from?
How often do you come here?
Do you play chess?
Were you present for the last class?

Imperative: these sentences express command, request, suggestion, advice etc.

e.g.: Be quiet.
Don't pluck these flowers.
Take these tablets two times a day.

Exclamatory: these express sudden, strong feelings.

e.g.: Wow! What a great shot! Awesome!

All these sentences say something about a person or a thing. The person or thing about which the sentence says is the *subject* of the sentence. The subject of a sentence is usually a Noun or a Pronoun and may be just one word or more than one. The subject of a sentence usually comes at the beginning of a sentence

You may also notice that *'it'* is also a subject. *'It'* is called an implied subject.

1. *Suresh* is working for a reputed firm in Bangalore.
2. *This* is not my book.
3. *It* is an enchanting place.
4. *The children of this school* participate and win prizes in many competitions.
5. *The boy in the blue shirt* is my brother.

What the sentence tells about the subject is the *Predicate.* All the sentences given above have subject as well as predicates, the only exception being imperatives. Imperative sentences are usually addressed to the person in front of us and so the subject is omitted

1. The boys *are playing well***.**
2. This businessman *invests in shares*.
3. Apples *are healthy***.**
4. The Pacific Ocean *is the largest ocean on Earth***.**
5. The recent earthquake in Nepal *lead to a loss of lives and property***.**

Phrase: A Phrase is a group of words which make some sense but not complete sense. Phrases can also be classified as noun phrase, adjective phrase and adverb phrase, depending on the work they do. A phrase which does the work of a noun is a noun phrase, which does the work of an adjective an adjective phrase and an adverb an adverb phrase. For example,

I do not know his needs (what he needs)-- noun phrase.
He likes *mystery stories***. (**stories which are mysterious.) -- adjective phrase.
*On his return from the tournament***,** he was given a grand welcome. (when he returned from the tournament) adverb clause.
The bank is located *at the corner***.**
Her bangle is made *of gold***.**

These are all examples of phrases.

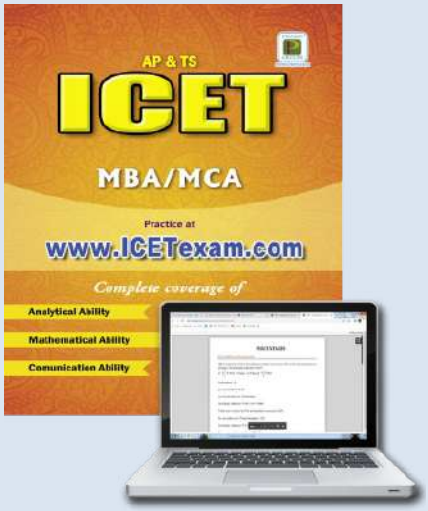
Phrasal Verbs: Verbs followed by adverbs or prepositions are called *phrasal verbs*. These are also called *idioms* as the combination of a verb and an adverb or preposition give a different meaning to phrase and cannot be taken literally. These expressions are peculiar to the language and play an important part in understanding the language.

e.g.: The examination was *put off***. (**to postpone)
The thieves *broke into* the bank. (entered by force)
The Union *called off* the strike.
She *broke down* on hear the news.

Clause: A clause is a group of words which contain a subject and a predicate but still does not make complete sense.

e.g.: He is the boy *who lost his bag***.**
(who – *subject*; lost his bag – *predicate*)
I believe *he is telling the truth***.**
(he – *subject*; is telling the truth- *predicate*)

Hence we see that a sentence needs a subject and a predicate to make complete sense. The other words in a sentence are also categorized according to the role or part they play in the sentence.



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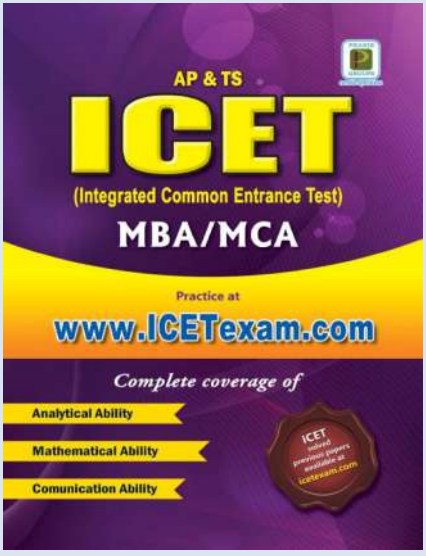

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REPORTED SPEECH

When somebody says something to us, there are two ways of reporting it. We may quote the actual words, which is called *Direct Speech***.**

e.g. : Rajesh said, "I am going to class now."

Another way of reporting this would be to say what he said, in our own way without quoting his exact words. This is called *Indirect or Reported Speech***.**

e.g.: Rajesh said that he was going to class then.

When we quote the exact words of the speaker, we place the words of the speaker within inverted commas. Further changes are also necessary when we report what a person has said in our own words. The changes that have taken place are:

1. *'I'* has become *'he'*.

2. The conjunction 'that' is used before the indirect statement.

3. Present continuous tense is changed to past continuous as there is a time lapse between when it was said and when it was reported.

4. *'Now'* has changed to *'then'*.

General rules for changing from direct speech to reported speech:

1. When the reporting verb is in present tense, there is no change of tense in the reported speech.

e.g.: The watchman says, "The gates close at 10:00 pm".

The watchman says that the gates close at 10:00 pm

This is normally used for universal truths, instructions etc.

2. Apart from the above rule, there is always a change of tense whenever something is reported. The change in tense occurs as follows:

TENSE	CHANGES TO
Simple present	Simple past
Present continuous	Past continuous
Present perfect	Past perfect
Present perfect continuous	Past perfect continuous
Simple past	Simple past/ Past perfect
Can, may, will	Could, might, would

3. Pronouns in first and second person change to third person.

4. In statements, the reported verb is usually said or told.

e.g.: He said, "I will come tomorrow".

He said that he would come the next day.

This brings us to another point. Words expressing nearness in time or places, change into words expressing distance.

e.g.:

Now	Then
Here	There
Ago	Before
Today	That day
Tomorrow	The next day
Yesterday	The day before
Last night	The night before

5. Interrogatives with '*yes*'/ '*no*' are introduced by '*if*' or '*whether*'.

e.g.: Smitha asked Rani, "Are you coming tomorrow?"

Smitha asked Rani if she was coming the next day.

Smitha asked Rani whether she was coming the next day.

6. Questions starting with '*WH*' do not require a reporting verb. Since these are indirect questions, attention must be paid to the sentence structure.

e.g.: The teacher asked Arun, "Why are you late"?

The teacher asked Arun why he was late.

7. In imperative sentences, the reporting verb indicates the mood of the speaker. Words like *ordered*, *requested*, *pleaded*, *inquired*, *urged* etc are used.

e.g.: The policeman said to the motorcyclist, "Stop!"

The policeman ordered the motorcyclist to stop.

8. While reporting exclamations, greetings or wishes, some verb expressing exclamation or wish is used.

e.g.: The student told the teacher, "Good Morning".

The student greeted the teacher.

The other common expressions for exclamations are, *exclaimed*, *congratulated*, *apologized*, *applauded* etc.

SYNONYMS

CONCEPTS

A synonym is a word or expression accepted as a figurative or a symbolic substitute for another word or expression. It has the same or almost the same meaning as that of another word in the same language.

English being the language with the largest number of words, it has many synonyms. A strong grasp of words, their **synonyms** (meanings) and **antonyms** (opposites) goes a long way towards enhancing your ability to comprehend and express clearly.

e.g.: The words *see, look, view, watch, glance* etc more or less have the same meaning so they are synonyms. They may however differ slightly in degree of abstraction

▪ **Type - 1 :- (1)** Agenda

a) Assignment b) Schedule c) Correction d) Annexure

Explanation: *Agenda* means organized plan for matters to be attended to during a meeting. In this context, *schedule* is nearest in meaning though it isn't a clear meaning of agenda. So option-*b* is correct choice.

(2) Effort

a) Attempt b) Create c) Wonder d) Overtake

Explanation: *Effort* is an action intended to do or accomplish something. So option-a is correct.

▪ **Type – 2 :-**

Four pairs of words are given below. Each pair consists of two words which have more or less similar meaning. Find the pair which have opposite meanings.

1. a) Induce/ Coax b) Fatal/ Deadly
c) Disparate/ Alike d) Abettor/ Thief

Explanation: Except option-c, all other pair of words have more or less similar meaning. Hence, option-c is correct choice.

2. a) Authentic/ Genuine b) Genius/ Aptitude
c) Ghastly/ Pretty d) Gruesome/ Grim

Explanation: Ghastly means horrifying and pretty means attractive. Hence, option-c is correct choice.

▪ **Type: 3 : Find the appropriate synonym of the word in bold in the below sentence.**

1. He changed his statement so many times that entire his message became **ambiguous**.

a) clear b) impressive c) unimpressive d) unclear

The correct answer is (d) unclear.

2. There was crazy **pandemonium** as people were trying to leave the rock concert.

a) Silence b) craziness c) chaos d) order

The correct answer is (c) chaos.

CONCEPTUAL EXAMPLES

In each of the sentences, one word is given in bold and four options are given. Select the word or phrase nearest in meaning to the word given in bold.

1) The engineers subjected the engine to **exhaustive** tests

a) Complicated b) Thorough
c) Exclusive d) Compulsory

Explanation: *Exhaustive* means thorough, complete or in-depth. Hence, option-*b* is synonym of *exhaustive*.

2) The inspector was a **vigilant** man.

a) Intelligent b) Ambitious c) Watchful d) Smart

Explanation: The root word *'vigi'* means watchful, wakeful or alert. For example, *vigilant*, *invigilate*, *surveillance*, *reveille* etc. *Vigilant* means careful or watchful. Hence, option-*c* is correct choice.

3) The Professor is one of the most **erudite** in our college

a) Boring b) Pleasant c) Learned d) Demanding

Explanation: *Erudite* means well educated or cultured. *Learned* is the synonym of *erudite.*

4) The world leader are trying to prevent the **proliferation** of nuclear weapons.

a) Use b) Increase c) Expansion d) Extension

Explanation:

Proliferation means rapid increase. Option-b is the best suitable synonym for *proliferation* than option-*c* and *d*.

5) The tribunal's order may finally nudge the two warring groups to come to an **amicable** solution.

a) Just b) Appropriate c) Durable d) Friendly

Explanation: The prefix *'am'* generally denotes friendly, casual or lovable. For example, amiable, amateur, amicable etc. *Amicable* means friendly, peaceful, polite etc. Hence, option-*d* is correct choice. *Durable* means long-lasting or strong.

6) The poor old man seems **famished.**

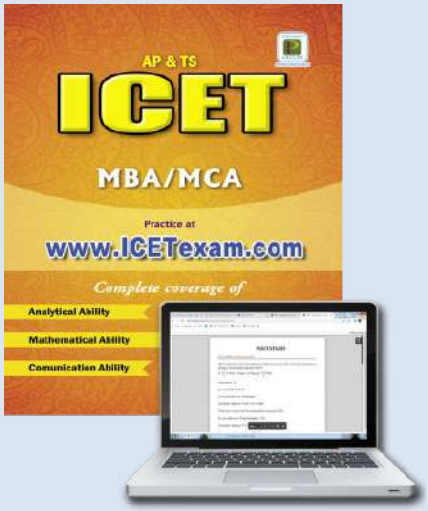
a) Exhausted b) Peevish c) Hungry d) Relaxed

Explanation: *Famished* means being extremely hungry. For example, 'After such a long walk in the mountains, they were tired and famished for food and sleep'.

7) The police is carrying out the inquiry as **expeditiously** as possible.

a) Speedily b) Fairly c) Timely d) Justly

Explanation:*Expeditiously* means in an efficient manner or acting with speed. Hence, option-a is correct.



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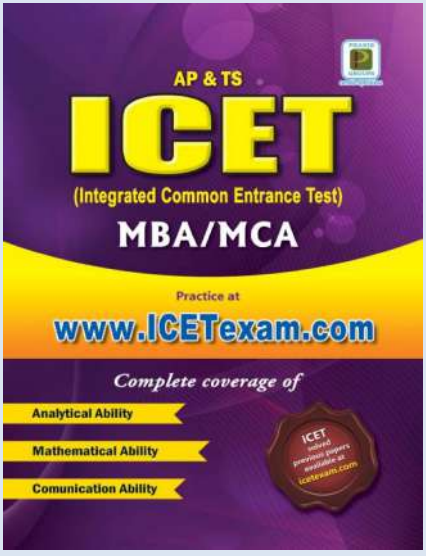

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READING COMPREHENSION

CONCEPTS

SQ3R method is used to answer reading comprehension questions.

• **Scanning** the passage provides a rapid overview to understand the subject matter.

• **Questioning** is a natural, instinctive, second step that is noted as a short list to be answered through reading. The questioning procedure helps the reader stay focused.

• Determine main idea from the title, the first paragraph, and the last paragraph.

• Determine if a large subject is divided into smaller subjects with some outlining scheme.

• Underline key words or take notes to the side what the purpose of the paragraph is. *i.e.* cause, effect, reason, example, definition, instructions, background info, etc.

• **Read** for identifying the primary purpose.

• Don't over read. Skip examples, dates, lengthy names, any details which can be referred in case something is asked explicitly.

• Don't go for choices which hold true only for one part of the author's argument.

• **Review** as often as necessary to keep focused.

• **Recite** the question and answer together to make sure they fit in.

TIPS

1. Spend a few minutes a day reading at a faster than comfortable rate (about 2 to 3 times faster than your normal speed).

2. Fast readers usually take in 3-4 words in each movement that their eye makes. Avoid focusing every word, rather look at groups of 2 to 3 words.

e.g.: The above sentence could be read as: Avoid focusing/ every word,/ rather look at/ groups of /2 to 3 words.

3. Read regularly! 15 min a day of reading at an average speed equals 18 books a year.

EXERCISE

A) From a vantage point in space, an observer could see that the Earth is engaged in a variety of motions. First, there is its rotation on its own axis, causing the alternation of day and night. This rotation, however, is not altogether steady. Primarily because of the Moon's gravitational action, the Earth's axis wobbles like that of an ill-spun top. In this motion, called 'precession', the North and South Poles each traces out the base off a cone in space, completing a circle every, 25800 years. In addition as the Sun and the Moon change their positions with respect to the Earth, their changing gravitational effects result in a slight 'nodding' of the earth's axis, called 'nutation', which is superimposed on precession. The Earth completes one of these 'nods' every 18.6 years.

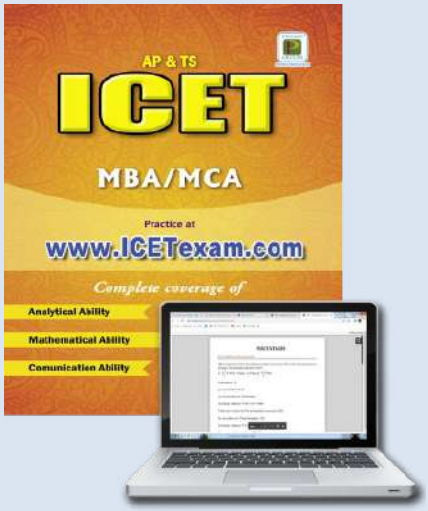
The earth also, of course, revolves around the Sun, in a 6-million mile journey that takes 365.25 days. The shape of this orbit is an ellipse, but it is not the center of the Earth that follows the elliptical path. Earth and Moon behave like an asymmetrical dumb-bell, and it is the center of mass of this dumb-bell that traces the ellipse around the sun. The center of the Earth-Moon mass lies about 3000 miles away from the center of the Earth, and the Earth thus moves in an S-curve that crosses and re-crosses its orbital path. Then too, the Earth accompanies the sun in the sun's movements; first, through its local star cloud, and second, in a great sweep around the hub of its galaxy, the Milky Way that takes 200 million years to complete.

1. Which of the following best describes the main subject of the passage?

a) The various types of the Earth's motions
b) Past changes in the Earth's position
c) The moon's gravitational effect on the earth
d) Oddities of the Earth's rotation on its axis.

2. The passage is most likely directed toward an audience of:

a) geologists
b) astronauts
c) meteorologists interested in weather prediction.
d) persons with little technical knowledge of astronomy



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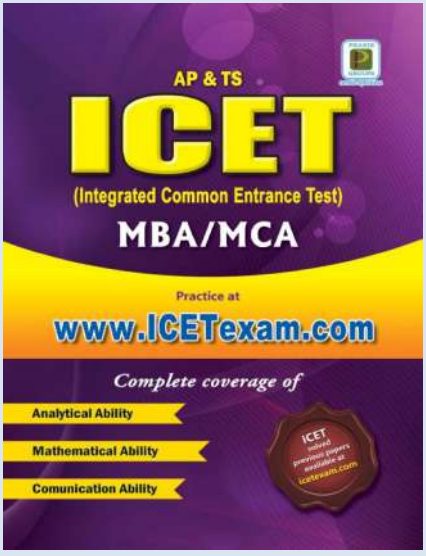

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sufficient social ties" and *"The context of his concern for social integration"* in the paragraph-2. *"Anomic suicide - increases when the social regulation of individuals is disrupted"* in the paragraph-3. So, option-d is correct.

52)c; From paragraph-2, author categorizes the suicides of individuals who do not have sufficient social ties as *Egoistic suicides*.

53)b; From paragraph-3, higher suicide rate during rapid progress in a society is a manifestation of *anomic suicide*.

54)a; From paragraph-2, *altruistic suicide*, which is more likely to occur when social integration is very strong, is the reason behind the suicide of Hindu widows on their husbands funeral pyres. Therefore, option-a is correct.

55)b; From paragraph-3, increase in the suicide rate during economic depression is an example of *anomic suicide*.

56)a; In paragraph-2, author gives an example of *"Military personnel"* for altruistic suicide. Hence option-a is correct.

57)d; The last paragraph of the passage states the indicators used by Durkheim to support several of his contentions. All the three options are correct according to the passage. Hence, option-d is correct.

58)b; From the concluding statement, we can say Durkheim was vindicated on all counts.

59)c; From paragraph-2, it is clear that all nutrient materials and waste products exchanged between the organs and the blood must traverse peri-vascular spaces occupied by connective tissue.

60)c; The first line of the passage itself encircles the originality of the connective tissues to the Embryo.

61)c; First line of paragraph-3 states, mesenteries are thin sheets from which organs are suspended.

62) Option-c is the correct answer.

63)d; From paragraph-3, adipose tissue a connective tissue in which fat is stored. Hence, option-d is correct.

64)b; The tissue which enables smooth gliding movements of neighboring surface is cartilage. Option-b is correct.

65)d; Option-a says the study of the structure and diseases of the brain and all the nerves in the body is not related to the passage. Likewise option-b says the substances that you take into your body as food and the way that they influence your health is also not the thematic concern of the passage. Similarly option-c says simple physical exercises that are done to make the body firm, able to stretch easily and more attractive. But option-d is rightly to be the answer as it says (the scientific study of) the way in which the bodies of animals and plants work. Hence, option-d is correct.

BUSINESS TREMINOLOGY

CONCEPTS

Abandonment Option: The option to close out an investment prior to the fulfilment of the original conditions for termination. It is the equivalent cash value of a project if it is liquidated immediately after reducing all debts which need to be repaid.

Absolute Monopoly: A market situation in which there is only one supplier of a good or service for which there is no acceptable substitute

Accountability: The obligation of an individual or organization to account for its activities, accept responsibility for them, and to disclose the results in a transparent manner. It also includes the responsibility for money or other entrusted property.

Administered prices: A price dictated by any entity other than market forces. Most of the time, an administered price refers to a price set by a government, but it may also be set by a private company with sufficient control over the market that it can control prices. See also: Monopoly.

Ad Valorem Tax: Charge levied as a percentage of value of the item it is imposed on, and not on the item's quantity, size, weight, or other such factor. Value added tax (VAT) and import duties are ad valorem taxes.

Appreciation is an increase in the value of an asset over time. The increase can occur for a number of reasons, including increased demand or weakening supply, or as a result of changes in inflation or interest rates. This is the opposite of depreciation, which is a decrease over time.

Arbitrage is the profit making market activity of buying and selling of same security on different exchanges or between spot prices of a security and its future contract. Here exchange refers to the stock market where shares are traded, like the NSE and BSE.

Articles of Association is a document that specifies the regulations for a company's operations, and they define the company's purpose and lay out how tasks are to be accomplished within the organization, including the process for appointing directors and how financial records will be handled

Asset: Any item of economic value owned by an individual or corporation, especially that which could be converted to cash. Examples are cash, securities, accounts receivable, inventory, office equipment, real estate, a car, and other property.

Authorised capital: The amount of capital with which a company is registered with the registrar of companies (body responsible for registration of companies). It is the maximum amount of capital which a company can raise through shares. Authorized capital is also called Registered capital or Nominal capital.

Average cost: The average-cost method is a costing method by which the value of a pool of assets or expenses is assumed to be equal to the average cost of the assets or expenses in the pool.

Average Revenue: The total amount of money received from sales of products divided by the number of products sold:

Backward Integration is a form of vertical integration that involves the purchase of, or merger with, suppliers up the supply chain. Companies pursue backward integration when it is expected to result in improved efficiency and cost savings.

Backward Linkage: Making a chart starting with the result and going backwards to make subprocesses. The goal is to create output at a specific level of quality.

Balanced Budget: A balanced budget simply refers to a budget in which expenses do not exceed revenues.

Balance Sheet: Balance sheet or statement of financial position is a summary of the financial balances of an individual or organization, whether it be a sole proprietorship, a business partnership, a corporation, private limited company or other organization such as Government or not-for-profit entity. A balance sheet is a "snapshot of a company's financial condition

Balance of Payments is the record of all international financial transactions made by a country's residents.

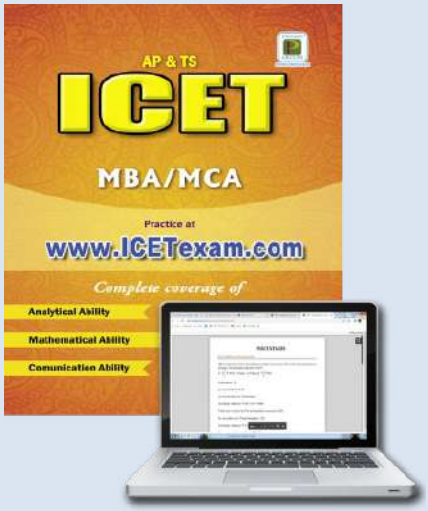
Balance of Trade is the largest component of the country's balance of payments (BOP).

Bank Deposits consist of money placed into banking institutions for safekeeping. These deposits are made to deposit accounts such as savings accounts, checking accounts and money market accounts

Bankruptcy is a legal status of a person or other entity that cannot repay the debts it owes to creditors.

Barter is a system of exchange where goods or services are directly exchanged for other goods or services without using a medium of exchange, such as money

Bear market is when securities prices fall and widespread pessimism causes the stock market's downward spiral to be self-sustaining.



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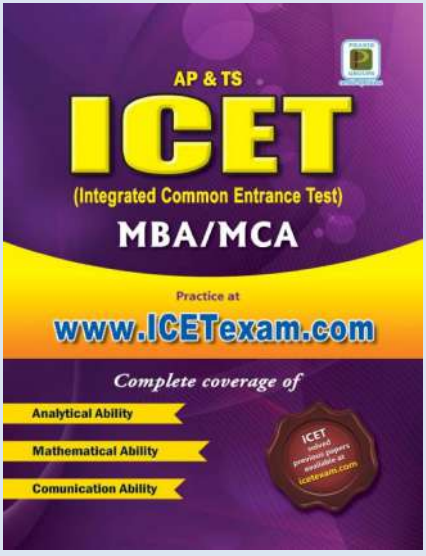

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Board of Directors – BOD : A board of directors is a recognized group of people who jointly oversee the activities of an organization, which can be either a for-profit business, non-profit organization, or a government agency.

Chief Executive Officer – CEO : Top executive responsible for a firm's overall operations and performance. He or she is the leader of the firm, serves as the main link between the board of directors (the board) and the firm's various parts or levels, and is held solely responsible for the firm's success or failure.

Chief Financial Officer – CFO : Senior-most executive responsible for financial control and planning of a firm or project.

Cash on Delivery (COD) : COD is a type of transaction in which the recipient makes payment for a good at the time of delivery. If the purchaser does not make payment when the good is delivered, then the good is returned to the seller.

Secretary : A company secretary is a senior position in a private sector company or public sector organisation, normally in the form of a managerial position or above.

Shareholder : A shareholder or stockholder is an individual or institution (including a corporation) that legally owns one or more shares of stock in a public or private corporation.

Chairman : A chairman is an executive elected by a company's board of directors that is responsible for presiding over board or committee meetings.

President : The President is a leader of an organization, company, community, club, trade union, university or other group. In many organizations, it is the legally recognized highest "titled" corporate officer, ranking above the various Vice.

General Manager : A general manager is the person in charge of a department within a company, but in small companies, the general manager may be one of the top executives.

Team Leader : A team leader is someone who provides guidance, instruction, direction and leadership to a group of other individuals (the team) for the purpose of achieving a key result or group of aligned results.

Supervisor : Person in the first-line management who monitors and regulates employees in their performance of assigned or delegated tasks.

Foreman : Experienced employee who leads, and works with, a crew or gang of workers.

Division of work : A production process in which a worker or group of workers is assigned a specialized task in order to increase efficiency.

Centralization is the process by which the activities of an organisation, particularly those regarding planning and decision-making, become concentrated within a particular location or group.

Global centralization :
The concentration of management and decision-making power at the top of an organization's hierarchy.

Remuneration : Remuneration is payment or compensation received for services or employment. This includes the base salary and any bonuses or other economic benefits that an employee or executive receives during employment.

Critical Path Analysis is a technique that identifies the activities necessary to complete a task, including identifying the time necessary to complete each activity and the relationships between the activities.

Initiation : Specific projects or programs undertaken to achieve specific objectives in the near-term, such as to reduce costs, increase efficiency, and improve sales performance

Execution: Completion of formalities or steps required to make an agreement or other document legally valid.

Business Plan : A business plan is a written document that describes in detail how a business, usually a new one, is going to achieve its goals.

Monitoring control : Monitor and control is a process of measuring performance and taking corrective action to assure that the business is on track to meet its goals.

Closure :
Closure is the term used to refer to the actions necessary when it is no longer necessary or possible for a business or other organization to continue to operate.

Life Cycle: The course of events that brings a new product into existence and follows its growth into a mature product and into eventual critical mass and decline.

Slack : Hours or days by which a job is ahead of schedule and will be completed early if continued.

Roles and Responsibilities : A duty or obligation to satisfactorily perform or complete a task (assigned by someone, or created by one's own promise or circumstances) that one must fulfill, and which has a consequent penalty for failure.

Reward management : Reward management is concerned with the formulation and implementation of strategies and policies that aim to reward people fairly, equitably and consistently in accordance with their value to the organization.

COMPUTER TERMINOLOGIES

CONCEPTS

Basic components knowledge is very important for each and every individual. As in all the competitive examinations, interviews and everywhere it has become compulsory for every individual to undergo test on computer basics. So here I am making the useful concepts along with the multiple choice questions on the basic fundamentals of the computer which everybody must and should have knowledge to undergo for the test.

Computer: a programmable electronic device designed to accept data, perform prescribed mathematical and logical operations at high speed, and display the results of these operations. Mainframes, desktop and laptop computers, tablets, and smart phones are some of the different types of computers.

Digital computer is a combination of many invention and thoughts, which were made by many people in past thousands of years. We measure technological improvement by generations. An explicit system is said to belong to an explicit "generation." Each generation indicates a major change in computer design.

Computers classifications :

Computers can be generally classified by size and power as follows, though there is considerable overlap:

1) PC: is a personal computer, originally designed by IBM way back in 1981. Many different companies make PCs, but all of them are IBM-compatible. A small, single-user computer based on a microprocessor.

a)PDA (Personal Data Assistant) is a handheld computer that is generally used to keep track of appointments and addresses.

b) Laptop, or notebook, is a lighter and more portable version of a PC or Mac that can run on batteries.

c) MAC: Developed by Apple, a Macintosh is a computer, but it is NOT a PC. Macs have a different operating system and use their own software and hardware.

2) Mainframes: A mainframe is a big, powerful, expensive computer that can support many users at the same time. Large businesses and organizations use mainframes. A powerful multi-user computer capable of supporting many hundreds or thousands of users simultaneously.

3) Workstation: A powerful, single-user computer. A workstation is like a personal computer, but it has a more powerful microprocessor and a higher-quality monitor.

4) Minicomputer: A multi-user computer capable of supporting from 10 to hundreds of users simultaneously.

5) Supercomputer: An extremely fast computer that can perform hundreds of millions of instructions per second.

6) Networked Computer: A network is a group of computers that are connected so that they can share equipment and information. Most people on a network use workstations, which are simply PCs that are connected to the network. A server is a central computer where users on the network can save their files and information.

HOW COMPUTER WORKS:

A computer collects processes, stores, and outputs information. A computer is a machine that performs the following four basic operations known as the information processing cycle (input, processing, storage, output).

Input Devices

An input device lets you communicate with a computer. You can use input devices to enter information and issue commands. A keyboard, mouse and joystick are input devices.

Processing

The Central Processing Unit (CPU) is the main chip in a computer. The CPU processes instructions, performs calculations and manages the flow of information through a computer system. The CPU communicates with input, output, and storage devices to perform tasks.

Storage Devices

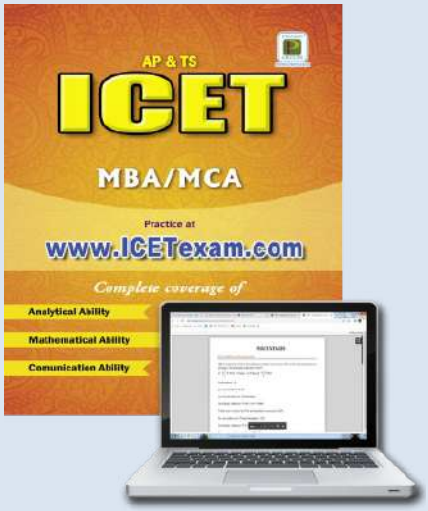
A storage device holds information. The compute r uses information stored on these devices to perform tasks. The hard drive, the tape drive, the floppy disk, and the CD -ROM drive are storage devices.

Output Devices

An output device lets a computer communicate with you. These devices display information on a screen, create printed copies or generate sound. Monitor, printers, and speakers are output devices.

Components of an Information System

The six basic components of a computer information system are hardware, software, procedures, data, people, and network.



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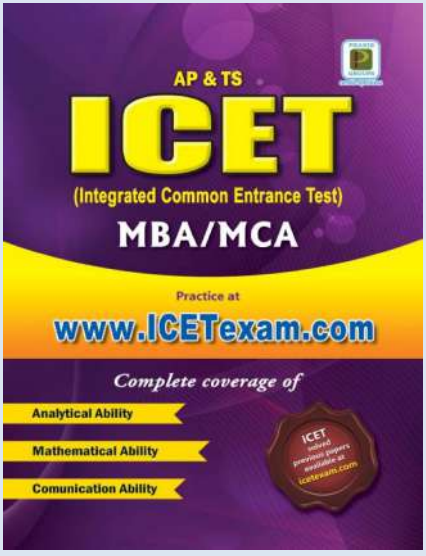

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10) The OS X has _____
a) monolithic kernel b) hybrid kernel
c) microkernel d) monolithic kernel with modules
11) The systems which allows only one process execution at a time, are called
a) uniprogramming systems
b) uniprocessing systems
c) unitasking systems
d) none of the mentioned
12) In operating system, each process has its own
a) address space and global variables
b) open files
c) pending alarms, signals and signal handlers
d) all of the mentioned
13) In Unix, Which system call creates the new process?
a) fork b) create c) new d) none
14)A process can be terminated due to
a) normal exit b) fatal error
c) killed by another process d) all of the mentioned
15) What is the ready state of a process?
a) when process is scheduled to run after some execution
b) when process is unable to run until some task has been completed
c) when process is using the CPU
d) none of the mentioned
16) What is interprocess communication?
a) Communication within the process
b) communication between two process
c) communications between two process
d) none of the mentioned
17)A set of processes is deadlock if
a) each process is blocked and will remain so forever
b) each process is terminated
c) all processes are trying to kill each other
d) none of the mentioned
18)A process stack does not contain
a) Function parameters b) Local variables
c) Return addresses d) PID of child process
19) Which system call returns the process identifier of a terminated child?
a) wait b) exit c) fork d) get
20) The address of the next instruction to be executed by the current process is provided by the
a) CPU registers b) Program counter
c) Process stack d) Pipe
21)_____ is a unique tag, usually a number, identifies the file within the file system.
a) File identifier b) File name
c) File type d) None
22) To create a file
a) allocate the space in file system
b) make an entry for new file in directory
c) allocate the space in file system & make an entry for new file in directory
d) none of the mentioned
23) By using the specific system call, we can
a) open the file b) read the file
c) write into the file d) all of the mentioned
24) File type can be represented by
a) file name b) file extension
c) file identifier d) none of the mentioned
25) Which file is a sequence of bytes organized into blocks understandable by the system's linker?
a) object file b) source file
c) executable file d) text file
26) What is the mounting of file system?
a) Creating of a file system
b) deleting a file system
c) attaching portion of the file system into a directory structure
d) removing portion of the file system into a directory structure
27) Mapping of file is managed by
a) file metadata b) page table
c) virtual memory d) file system
28) Mapping of network file system protocol to local file system is done by
a) network file system b) local file system
c) volume manager d) remote mirror
29) Which one of the following explains the sequential file access method?
a) random access according to the given byte number
b) read bytes one at a time, in order
c) read/write sequentially by record
d) read/write randomly by record
30)file system fragmentation occurs when
a) unused space or single file are not contiguous
b) used space is not contiguous
c) unused space is non-contiguous
d) multiple files are non-contiguous

KEY					
1) d	2) a	3) c	4) d	5) a	6) c
7) a	8) a	9) d	10) b	11) b	12) d
13) a	14) d	15) a	16) b	17) a	18) d
19) a	20) b	21) a	22) c	23) d	24) b
25) a	26) c	27) a	28) a	29) b	30)

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