Thoroughly Revised and Updated

Reasoning & Aptitude *for* GATE 2023 and ESE Pre 2023

Comprehensive Theory *with* **Examples** *and* **Solved Questions of GATE** *and* **ESE Prelims**

Also useful for

UPSC (CSAT), MBA Entrance, Wipro, SSC, Bank (PO), TCS , Railways, Infosys, various Public Sector Units and other Competitive Exams conducted by UPSC

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Reasoning & Aptitude for GATE 2023 & ESE Prelims 2023

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Director's Message

Engineering is one of the most chosen graduation fields, choosing to become an engineer after high school is usually a matter of interest but this eventually develops into "the purpose of being an engineer" and then a student thinks of cracking various competitive exams like ESE, GATE, PSUs exams, and other state engineering services exams. With the objective nature of these competitive exams and with increasing competition, it becomes necessary for the student to study and practice every topic and also get acclimatize with the style of questions asked in the exam.

Studying engineering in university is one aspect but studying to crack different prestigious competitive exams requires altogether different strategies, crystal clear concepts and rigorous practice of previous years' questions. Every student can achieve great results through proper guidance and exam-oriented study material, and hence we have come up with this book covering all the previous years' questions. This book will help aspirants to develop an understanding of important and frequently asked areas in the exam and will also help in strengthening concepts. MADE EASY Team has put sincere efforts in framing accurate and detailed explanations for all the previous years' questions. The explanation provided for each question is not only question specific but it will also give insight on the concept as a whole which will beneficial for the student from the exam point of view to handle similar questions.

All the previous years' questions are segregated subject wise and further, they have been categorized topic-wise for easy learning and this certainly assists aspirants to solve all previous years' questions of a particular area in one place. I would like to acknowledge the efforts of the entire MADE EASY team who worked hard to solve previous years ' questions with accuracy. I hope this book will stand up to the expectations of aspirants and my desire to serve the student community by providing the best study material will get accomplished.

B. Singh (Ex. IES)
CMD, MADE EASY Group

Contents

Section A

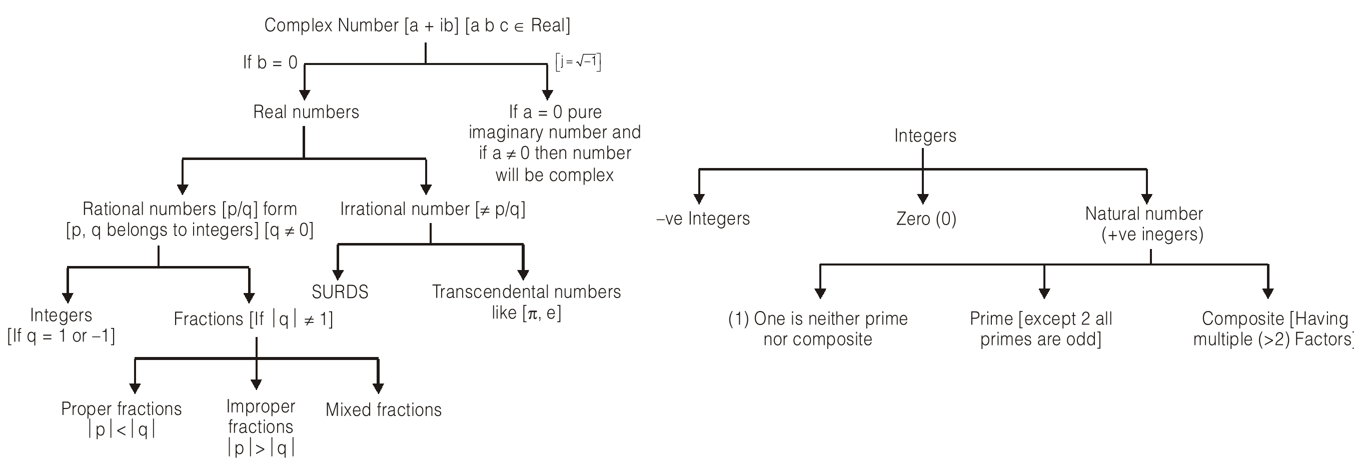
Arithmetic

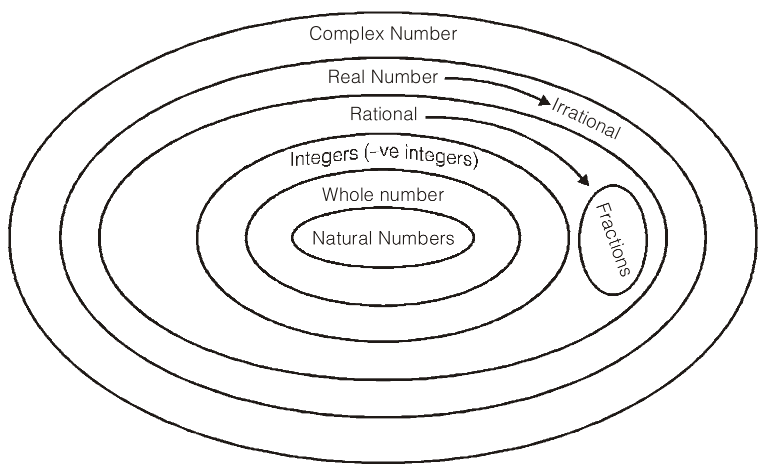
1.1
CHAPTER

Number System

In Quantitative Aptitude (QA), Number System is one of the modules which is of critical importance. We can consider this module as the back bone as well as basic foundation and building block for QA as well as for reasoning. Applications of concepts of numbers can be easily found in puzzles, reasoning based questions, number series and many more reasoning areas. This is why it is our suggestion to students to understand the concepts discussed in the module thoroughly alongwith understanding of applications.

Classifications of Numbers





Our main focus in this module of numbers in on **real number system**. However in context of imaginary numbers only following property is important.

Imaginary Numbers

$i = \sqrt{-1} \Rightarrow i^{4K+1} \equiv \sqrt{-1} \equiv i$

$i^2 = -1 \Rightarrow i^{4K+2} \equiv -1 \equiv i^2$

$i^3 = -i \Rightarrow i^{4K+3} \equiv -i \equiv i^3$

$i^4 = 1 \Rightarrow i^{4K} \equiv 1 \equiv i^4$

Ex.1

What is the value of expression

$$\frac{i^{12}+i^{13}+i^{14}+i^{15}}{i^{18}+i^{19}+i^{20}+i^{21}}?$$

(a) i^2 (b) -1

(c) $1/i^2$ (d) None of these

Ans. (d)

$$\frac{i^{12}\left(1+i+i^2+i^3\right)}{i^{18}\left(1+i+i^2+i^3\right)}$$

If we commit a mistake of cancelling out common terms in numerator and denominator options a, b, c all one correct hence my answer should be (d) but

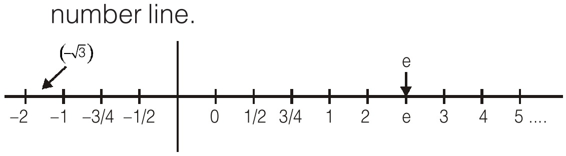
Expression $1 + i + i^2 + i^3$

$= 1 + i + (-1) + (-i) = 0$

Hence expression in question leading to undetermined form $\left[\frac{0}{0}\right]$ hence correct answer is option (d).

Real Number System

Entire real numbers group of rational and irrational numbers combined forms the set of real number, which is represented by symbol → R. All real numbers can be represented as points on a real number line.



Rational Number

All the numbers in p/q ($q \neq 0$) form are rational numbers [p, q are integers]. Set of rational number is represented by → Q.

Rational Numbers have following forms of representations.

(a) Terminating decimal forms

for example 0.125

$$\Rightarrow 0.125 = \frac{125}{1000} \Rightarrow \text{Rational}$$

(b) Nonterminating but recurring decimal forms.

(i) For example

Q = 0.37373737 ...

100 Q = 37.373737...

99Q = 37 ⇒ Q = 37/99 ⇒ rational

(ii) For example

Q = 0.37292929 ...

100Q = 37.292929 ...

10000Q = 3729.292929 ...

9900Q = (3729 – 37)

$$Q = \left(\frac{3729-37}{9900}\right)$$

$$= \frac{p}{q} \text{ form} \Rightarrow \text{rational}$$

Fraction

All rational numbers in which $|q| \neq 1$ comprise the set of fractions.

Proper Fraction

If $|p| < |q|$

then fraction is proper fraction. Value of proper fraction is always in between (–1 to +1) i.e., $[-1 < p/q < 1]$

Improper Fraction

If $|p| > |q|$

than fraction is improper fraction. Value of improper fraction is < –1 or > 1.

Mixed Fraction

Just a modified form of improper fraction.

Eg. $\underbrace{\frac{13}{4}}_{\text{Improper fraction}} \Rightarrow \underbrace{3\frac{1}{4}}_{\text{equivalent mixed fraction}}$

Integers

The set of all rational numbers in p/q form $[|q| = 1]$ is called as integers. It is denoted by

I = { .... –3, –2, –1, 0, 1, 2, 3, ...}

It includes.

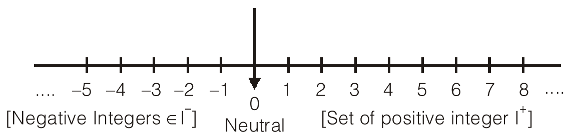
Negative Integers

$I^- = \{... -7, -6, -5, -4, -3, -2, -1\}$

Positive Integers

$I^+ = \{1, 2, 3 .... \}$

Note: Status of 0 (zero) is neutral neither positive nor negative.



Natural Numbers

All counting numbers or set of positive integers is considered as set of natural numbers. It denoted by set [N or I^+]

N = {1, 2, 3, 4, ...}

Whole Number

Set of all nonnegative integers are considered as whole number; it is denoted by set W = {0, 1, 2, 3, 4 ......}

Note: If terms "numbers" is used without any qualifier than it means natural number henceforth.

Even Numbers & Odd Numbers

1. **Even Numbers**

   All numbers divisible by 2 are considered as even numbers.

   Note: Property evenness is applicable in entire integral number line. Hence [–2, –4, –6, ...] are even integers but they are not even numbers.

2. **Odd Number**

   All numbers not divisible by 2 are odd.

   [1, 3, 5, 7, ...] are odd numbers.

   [.......... –5, –3, –1 ....] are odd integers.

Properties of numbers based on even & odd

Even + Even = Even
Odd + Odd = Even
Odd + Odd + Odd = Odd
Odd × Odd = Odd
Odd × Even = Even
Even × Even = Even
$(\text{Even})^{\text{Odd}} \Rightarrow$ Even
$(\text{Odd})^{\text{Even}} \Rightarrow$ Odd
$(\text{Even})^{\text{Odd}} \Rightarrow$ Even
$(\text{Odd})^{\text{Odd}} \Rightarrow$ Odd

These properties can be used extensively to find out alternative method to get answers quickly with the help of options. Here are few examples.

Ex. 1

There are two, 2-digit numbers ab and cd, ba is the another two digit number prepared by reversing the digits of ab, if ab × cd = 493, ba × cd = 2059, what is value 'g' sum of (ab + cd) = ?

(a) 43 (b) 45
(c) 47 (d) 46

Ans: (d)

Value 'g' = ab × cd is odd.

It means ab and cd both are odd.

Hence there sum must be even, only one option is there which is even. Hence answer is option d.

Ex. 2

I have multiple gift vouchers of value, Rs. 101, 107, 111, 121, 131, 141, 151, 171. I have to pick exactly 10 vouchers to make payment of Rs. 1121. In how many ways I can do that?

(a) one (b) two
(c) more than two (d) none of these

Ans. (d)

Reasoning is very simple, if I'll add 10 odd numbers their sum will be always even. Hence there is no way to accomplish this.

Prime Number & Composite Numbers

Prime Numbers

Number which are perfectly divisible either by 1 or by itself only are called prime numbers. 25 prime number are there which are less than 100. 2 is the only even prime number. All prime numbers greater than 5 can be expressed as (6K ± 1) (K ∈ N) form but all the numbers in form of (6K ± 1) form are not necessarily prime.

Composite Numbers

All the numbers which can be factorized into multiple prime numbers are called composite number.

Number (1) one is neither prime nor composite.

How to check whether given number is prime or not?

1. Take the square root of number
2. Consider the prime numbers, starting from 2 till the number. Take all prime numbers upto this square root value or nearest higher integer.

3. If number is divisible by any of these prime numbers, then number is composite.

Learn it by example:

Suppose we want to check, is 629 prime or not?
Square root of 627 is just more than 25. Then prime no. till 25 are 2, 3, 7, 5, 11, 13, 17, 19, 23, 29.
629 is not divisible by 2, 3, 5, 7, 11, 13 but is divisible by 17.
Hence it is not prime number

One more example: 179

Square root of 179 is more than 13. Hence we need to check divisibility of 179 against 2, 3, 5, 7, 11, 13, 17
179 is not divisible by either of these hence it is a prime number.

Test of Divisibility

1. **Divisibility by 2**
   A number is divisible by 2 if the unit digit is zero or divisible by 2.
   Eg.: 22, 42, 84, 3872 etc.

2. **Divisibility by 3**
   A number is divisible by 3 if the sum of digit in the number is divisible by 3.
   Eg.: 2553
   Here 2 + 5 + 5 + 3 = 15, which is divisible by 3 hence 2553 is divisible by 3.

3. **Divisibility by 4**
   A number is divisible by 4 if its last two digit are divisible by 4.
   Eg.: 2652, here 52 is divisible by 4 so 2652 is divisible by 4.
   Eg.: 3772, 584, 904 etc.

4. **Divisibility by 5**
   A number is divisible by 5 if the units digit in number is 0 or 5.
   Eg.: 50, 505, 405 etc.

5. **Divisibility by 6**
   A number is divisible by 6 if the number is even and sum of digits is divisible by 3.
   Eg.: 4536 is an even number also sum of digit 4 + 5 + 3 + 6 = 18 is divisible by 3.
   Eg: 72, 8448, 3972 etc.

6. **Divisibility by 8**
   A number is divisible by 8 if last three digit of it is divisible by 8.
   Eg.: 47472 here 472 is divisible by 8 hence this number 47472 is divisible by 8.

7. **Divisibility by 9**
   A number is divisible by 9 if the sum of its digit is divisible by 9.
   Eg.: 108936 here 1+0+8+9+3+6 is 27 which is divisible by 9 and hence 108936 is divisible by 9.

8. **Divisibility by 10**
   A number is divisible by 10 if its unit digit is 0.
   Eg.: 90, 900, 740, 34920 etc.

9. **Divisibility by 11**
   A number is divisible by 11 if the difference of sum of digit at odd places and sum of digit at even places is either 0 or divisible by 11.
   Eg.: 1331, the sum of digits at odd place is 1+3 and sum of digit at even places is 3+1 and their difference is 4 – 4 = 0. so 1331 is divisible by 11.

HCF and LCM of Numbers

H.C.F.

(Highest Common Factor) of two or more number is the greatest number that divides each one of them exactly. For example 8 is the highest common factor of 16 and 40.

HCF is also called greatest common divisior (G.C.D.)

L.C.M.

(Least Common Multiple) of two or more number is the least or a lowest number which is exactly divisible by each of them.

For example LCM of 8 and 12 is 24, because it is the first number which is multiple of both 8 and 12.

LCM and HCF of Fractions

Fractions are written in form of $\frac{\text{Numerator}}{\text{Denominator}}$. Where denominator is not equal to zero.

$$\text{H.C.F of Fraction} = \frac{\text{(H.C.F. of Numerators)}}{\text{(LCM of Denominators)}}$$

$$\text{L.C.M of Fraction} = \frac{\text{(LCM of Numerators)}}{\text{(HCF of Denominators)}}$$

All Fractions have to be in their simplest form:

Example: Find HCF & LCM of $\frac{1}{2}, \frac{2}{3}$ and $\frac{3}{7}$

$$\text{H.C.F.} = \frac{\text{H.C.F. of } (1,2,3)}{\text{L.C.M } (2,\ 3,\ 7)} = \frac{1}{42}$$

$$\text{L.C.M} = \frac{\text{L.C.M of } (1,2,3)}{\text{H.C.F. of } (2,\ 3,\ 7)} = \frac{6}{1} = 6$$

Important Algebraic Formulae

1. $(a+b)^2 = a^2 + 2ab + b^2$
2. $(a-b)^2 = a^2 - 2ab + b^2$
3. $(a-b)(a+b) = a^2 - b^2$
4. $(a+b)^2 + (a-b)^2 = 2(a^2 + b^2)$
5. $(a+b)^2 - (a-b)^2 = 4ab$
6. $(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$
   $= a^3 + b^3 + 3ab(a+b)$
7. $(a-b)^3 = a^3 - 3a^2b + 3ab^2 - b^3$
   $= a^3 - b^3 - 3ab(a-b)$
8. $a^3 + b^3 = (a+b)(a^2 - ab + b^2)$
9. $a^3 - b^3 = (a-b)(a^2 + ab + b^2)$
10. $\dfrac{a^3 + b^3 + c^3 - 3abc}{a^2 + b^2 + c^2 - ab - bc - ca} = (a+b+c)$
11. $a^4 - b^4 = (a^2)^2 - (b^2)^2 = (a^2 + b^2)(a^2 - b^2)$
    $= (a^2 + b^2)(a+b)(a-b)$

[Condition of Divisibility for Algebric Function

1. $a^n + b^n$ is exactly divisible by a+b only when n is odd
   Ex.: $a^3 + b^3 = (a+b)(a^2 - ab + b^2)$ is divisible by a+b, also $a^5 + b^5$ is divisible by a+b
2. $a^n + b^n$ is never divisible by a-b (whether n is odd or even)
   Ex.: $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$ is not divisible by (a-b)
   $a^7 + b^7$ is also not divisible by (a – b)
3. $a^n - b^n$ is always divisible by (a – b) (whether n is odd or even)
   Ex.: $a^9 - b^9$ is exactly divisible by (a – b) also $a^{12} - b^{12}$ is also exactly divisible by (a – b).
4. $a^n - b^n$ is divisible by a + b only when 'n' is even natural number.
   Ex. : $a^4 - b^4 = (a^2 - b^2)(a^2 + b^2) = (a - b)(a + b)(a^2 + b^2)$. Hence $a^4 - b^4$ is always divisible by (a + b) but $a^3 - b^3$ will not be.]

Factors of Composite Number

Composite numbers are the numbers which can be factorised into prime factors, or simply we can say that composite number are those numbers which are not prime.

For eg.: 8 is a composite number since it can be factorised into

$8 = 2 \times 2 \times 2$

Similarly 9 is also a composite number, i e

$9 = 3 \times 3$

Composite number $= P_1^{\lambda_1} \times P_2^{\lambda_2} \times P_3^{\lambda_3} \ldots\ldots P_n^{\lambda_n}$ here, $P_1, P_2, P_3 \ldots\ldots P_n$ are distinct prime numbers and $\lambda_1, \lambda_2, \ldots\ldots \lambda_n$ are their respective powers.

Factors of composite number =

$(\lambda_1 + 1).(\lambda_2 + 1)\ldots(\lambda_n + 1)$

For eg.: $18 = 2 \times 3 \times 3 = 2^1 \times 3^2$

Factors of 18 = $(1 + 1) \times (2 + 1) = 2 \times 3 = 6$

Clearly it contains six factors 1, 2, 3, 6, 9 and 18

Factors of other Composite numbers $6 = 2^1 \times 3^1$

Factors = $(1 + 1) \times (1 + 1) = 4$ = 1, 2, 3 and 6

$72 = 2 \times 2 \times 2 \times 3 \times 3 = 2^3 \times 3^2$

Factors = $(3 + 1) \times (2 + 1) = 12$

Ex.1 Find the factors of composite number 360

Sol.: $360 = 2 \times 2 \times 2 \times 3 \times 3 \times 5$
$= 2^3 \times 3^2 \times 5^1$

Factors $= (3 + 1)(2 + 1)(1 + 1) = 24$.

□□□□

Counting Number of Trailing Zeros

Sometimes we come across problems in which we have to count number of zeros at the end of factorial of any number. For example

Number of zero at the end of 10!

$10! = 10 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$

Here basically we have to count number of fives, because multiplication of five by any even number will result in 0 at the end of final product. In 10! we have 2 fives thus total number of zeros are 2.

I Practice Exercise

1. $\sqrt{3\sqrt{80}+\dfrac{3}{9+4\sqrt{5}}}=?$
(a) $\sqrt{3\sqrt{5}}$ (b) 3
(c) $3\sqrt{3}$ (d) $3+2\sqrt{5}$

2. x and y are integers and If $\dfrac{x^2}{y^3}$ is even integer then which of the following must be an even integer?
(a) $x - y$ (b) y + 1
(c) $\dfrac{x^2}{y^4}$ (d) xy

3. What is the tens' digit of the sum of the first 50 terms of 1, 11, 111, 1111, 11111, 111111,.......................?
(a) 2 (b) 4
(c) 5 (d) 8

4. If $81^y = \dfrac{1}{27^x}$, in terms of y, x=?
(a) $\dfrac{3y}{4}$ (b) $-\dfrac{3y}{4}$
(c) $\dfrac{4y}{3}$ (d) $-\dfrac{4y}{3}$

5. If $\dfrac{1}{n+1}<\dfrac{1}{31}+\dfrac{1}{32}+\dfrac{1}{33}<\dfrac{1}{n}$; then n ?
(a) 9 (b) 10
(c) 11 (d) 12

6. If one integer is greater than another integer by 3, and the difference of their cubes is 117, what could be their sum?
(a) 11 (b) 7
(c) 8 (d) 9

7. Which of these has total 24 positive factors?
(a) $21^5 \times 2^3$ (b) $2^7 \times 12^3$
(c) $2^6 \times 3^4$ (d) 63×55

8. Two numbers, x and y are such that when divided by 6, they leave remainder 4 and 5 respectively. Find the remainder when $x^3 + y^3$ is divided by 6?
(a) 2 (b) 3
(c) 4 (d) 5

9. What is the remainder when N = $(1! + 2! + 3!+...1000!)^{40}$ is divided by 10?
(a) 1 (b) 3
(c) 7 (d) 8

10. Set A is formed by selecting some of the numbers from the first 100 natural numbers such that the HCF of any two numbers in the set A is 5, what is the maximum number elements that set A can have?
(a) 7 (b) 8
(c) 9 (d) 10

11. Let x and y be positive integers such that x is prime and y is composite. Then,
(a) $y - x$ cannot be an even integer
(b) $\dfrac{x+y}{x}$ cannot be an even integer
(c) $(x + y)$ cannot be even.
(d) None of the above statements are true

12. Let N = 1421 × 1423 × 1425. What is the remainder when N is divided by 12?
(a) 0 (b) 9
(c) 3 (d) 6

13. When a four digit number is divided by 85 it leaves a remainder of 39. If the same number is divided by 17 the remainder would be ?
(a) 2 (b) 5
(c) 7 (d) 9

14. Integers 34041 and 32506 when divided by a three-digit integer n leave the same remainder. What is n?
(a) 289 (b) 367
(c) 453 (d) 307

15. A box contains 100 tickets, numbered from 1 to 100. A person picks out three tickets from the box, such that the product of the numbers on two of the tickets yields the number on the third ticket. Which of the following tickets can never be picked as third ticket?
(a) 10 (b) 12
(c) 25 (d) 26

16. N is a natural number , then how many values of N are possible such that $\dfrac{6N^3+3N^2+N+24}{N}$ is also a Natural Number?
(a) 6 (b) 7
(c) 8 (d) 9

17. What is the unit digit of $39^{53} \times 27^{23} \times 36^{12}$?

(a) 2 (b) 4
(c) 6 (d) 8

18. How many number of zeros are there if we multiply all the prime numbers between 0 and 200.

(a) 1 (b) 2
(c) 3 (d) 4

19. A man wrote all the natural numbers starting from 1 in a series. What will be the 50^{th} digit of the number?

(a) 1 (b) 2
(c) 3 (d) 4

20. N = n(n + 1) (n + 2) (n + 3) (n + 4); where n is a natural number. Which of the following statement/s is/are true?

1. Unit digit of N is 0.
2. N is perfectly divisible by 24.
3. N is perfect square.
4. N is odd.

(a) 3 only (b) 3 and 4 only
(c) 1 only (d) 1 and 2 only

21. How many factors of
$N = 12^{12} \times 14^{14} \times 15^{15}$ are multiple of
$K = 12^{10} \times 14^{10} \times 15^{10}$

(a) $2 \times 4 \times 5$ (b) $3 \times 5 \times 6$
(c) $8 \times 7 \times 4 \times 5$ (d) $9 \times 8 \times 6 \times 5$

22. In a certain base
137 + 254 = 402 then
What is the sum of 342 + 562 in that base

(a) 904 (b) 1014
(c) 1104 (d) 1024

Answers

1. (c)	2. (d)	3. (b)	4. (d)	5. (b)
6. (b)	7. (d)	8. (b)	9. (a)	10. (c)
11. (d)	12. (c)	13. (b)	14. (d)	15. (c)
16. (c)	17. (a)	18. (a)	19. (c)	20. (d)
21. (d)	22. (b)			

Solutions

1. (c)

Method (i) $\sqrt{3\sqrt{80}+\dfrac{3}{9+4\sqrt{5}}}$ using rationalization

$$= \sqrt{3\sqrt{80}+\frac{3}{9+4\sqrt{5}}\times\left(\frac{9-4\sqrt{5}}{9-4\sqrt{5}}\right)}$$

$$= \sqrt{3\sqrt{80}+\frac{(3\times 9-3\times 4\sqrt{5})}{9^2-(4\sqrt{5})^2}}$$

$$= \sqrt{3\sqrt{80}+\frac{27-12\sqrt{5}}{81-80}}$$

$$= \sqrt{3\sqrt{16\times 5}+27-12\sqrt{5}}$$

$$= \sqrt{3\times 4\times \sqrt{5}+27-12\sqrt{5}}$$

$$= \sqrt{12\sqrt{5}+27-12\sqrt{5}}$$

$$= \sqrt{27} = 3\sqrt{3}$$

Alternative Method

$$\sqrt{\left(3\sqrt{80}+\frac{3}{9+4\sqrt{5}}\right)}$$

$$3\sqrt{80} \cong 3\sqrt{81} \cong 27$$

and $\dfrac{3}{9+4\sqrt{5}} < 1$

Thus, $\sqrt{3\sqrt{80}+\dfrac{3}{9+4\sqrt{5}}} \cong \sqrt{3\sqrt{81}}$

$$\cong \sqrt{3\times 9} = 3\sqrt{3}$$

2. (d)

if $\dfrac{x^2}{y^3}$ = even

$x^2 = y^3$ even

$\Rightarrow$ $x^2 \Rightarrow$ even

and x is integer

$\Rightarrow$ x = even

so only xy must be even.

3. (b)

$$\begin{array}{r} 1 \\ 1\ 1 \\ 1\ 1\ 1 \\ \vdots\ \vdots\ \vdots \\ \text{50 terms..............}1\ 1\ 1 \\ \hline 40 \end{array}$$

unit digit (1 + 1...... 50 times)= 0

and carry = 5

tens digit (1 + 1 + ... 49 times)+ carry 5 = 4

D
Section

Previous GATE & ESE Solved Questions

Previous GATE Solved Questions
(General Aptitude)

1. 25 persons are in a room. 15 of them play hockey, 17 of them play football and 10 of them play both hockey and football. Then the number of persons playing neither hockey nor football is

(a) 2 (b) 17
(c) 13 (d) 3

[2010, 1 Mark]

2. If 137 + 276 = 435 how much is 731 + 672?

(a) 534 (b) 1403
(c) 1623 (d) 1531

[2010, 2 Marks]

3. 5 skilled workers can build a wall in 20 days; 8 semiskilled workers can build a wall in 25 days; 10 unskilled workers can build a wall in 30 days. If a team has 2 skilled, 6 semiskilled and 5 unskilled workers, how long will it take to build the wall?

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

[2010, 2 Marks]

4. Given digits 2, 2, 3, 3, 3, 4, 4, 4, 4 how many distinct 4 digit numbers greater than 3000 can be formed?

(a) 50 (b) 51
(c) 52 (d) 54

[2010, 2 Marks]

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

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

In what order were they born (oldest first)?

(a) HSIG (b) SGHI
(c) IGSH (d) IHSG

[2010, 2 Marks]

6. If Log(P) = (1/2)Log(Q) = (1/3)Log(R), then which of the following options is TRUE?

(a) $P^2 = Q^3R^2$ (b) $Q^2 = PR$
(c) $Q^2 = R^3P$ (d) $R = P^2Q^2$

[CE, ME, CS 2011, 1 Mark (Set-1)]

7. A container originally contains 10 litres of pure spirit. From this container 1 litre of spirit is replaced with 1 litre of water. Subsequently, 1 litre of the mixture is again replaced with 1 litre of water and this processes is repeated one more time. How much spirit is now left in the container?

(a) 7.58 litres (b) 7.84 litres
(c) 7 litres (d) 7.29 litres

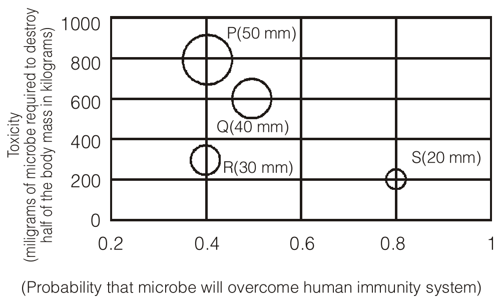
[CE, ME, CS 2011, 2 Marks (Set-1)]

8. The variable cost (V) of manufacturing a product varies according to the equation V = 4q, where q is the quantity produced. The fixed cost (F) of production of same product reduces with q according to the equation F = 100/q. How many units should be produced to minimize the total cost (V + F)?

(a) 5 (b) 4
(c) 7 (d) 6

[CE, ME, CS 2011, 2 Marks (Set-1)]

9. P, Q, R and S are four types of dangerous microbes recently found in a human habitat. The area of each circle with its diameter printed in brackets represents the growth of a single microbe surviving human immunity system within 24 hours of entering the body. The danger to human beings varies proportionately with the toxicity, potency and growth attributed to a microbe shown in the figure below:



A pharmaceutical company is contemplating the development of a vaccine against the most dangerous microbe. Which microbe should the company target in its first attempt?

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

[CE, ME, CS 2011, 2 Marks (Set-1)]

10. A transporter receives the same number of orders each day. Currently, he has some pending orders (backlog) to be shipped. If he uses 7 trucks, then at the end of the 4th day he can clear all the orders. Alternatively, if he uses only 3 trucks, then all the orders are cleared at the end of the 10th day. What is the minimum number of trucks required so that there will be no pending order at the end of the 5th day?

(a) 4 (b) 5
(c) 6 (d) 7

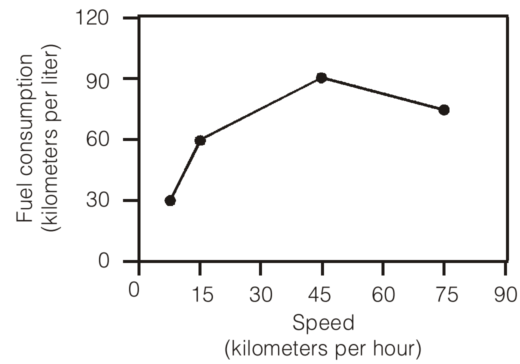
[CE, ME, CS 2011, 2 Marks (Set-1)]

11. There are two candidates P and Q in an election. During the campaign 40% of the voters promised to vote for P, and rest for Q. However, on the day of election 15% of the voters went back on their promise to vote for P and instead voted for Q . 25% of the voters went back on their promise to vote for Q and instead voted for P. Suppose, P lost by 2 votes, then what was the total number of voters?

(a) 100 (b) 110
(c) 90 (d) 95

[EE, EC 2011, 1 Mark (Set-2)]

12. The fuel consumed by a motorcycle during a journey while travelling at various speeds is indicated in the graph below



The distance covered during four laps of the journey are listed in the table below:

Lap	Distance (kilometers)	Average speed (kilometers per hour)
P	15	15
Q	75	45
R	40	75
S	10	10

From the given data, we can conclude that the fuel consumed per kilometre was least during the lap

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

[EE, EC 2011, 2 Marks (Set-2)]

13. Three friends, R, S and T shared toffee from a bowl. R took $1/3^{rd}$ of the toffees, but returned four to the bowl. S took $1/4^{th}$ of what was left but returned three toffees to the bowl. T took half of the remainder but returned two back into the bowl. If the bowl had 17 toffees left, how many toffees were originally there in the bowl?

(a) 38 (b) 31
(c) 48 (d) 41

[EE, EC 2011, 2 Marks (Set-2)]

14. Given that $f(y) = |y|/y$, and q is any non-zero real number, the value of $|f(q) - f(-q)|$ is

(a) 0 (b) –1
(c) 1 (d) 2

[EE, EC 2011, 2 Marks (Set-2)]

15. The sum of n terms of the series 4 + 44 + 444 + ... is

(a) $(4/81)\,[10^{n+1} - 9n - 1]$
(b) $(4/81)\,[10^{n-1} - 9n - 1]$

ANSWER KEY

1. (d)	43. (d)	85. (d)	127. (a)	169. (b)	211. (d)
2. (c)	44. (b)	86. (b)	128. (c)	170. (d)	212. (c)
3. (d)	45. (560)	87. (180)	129. (b)	171. (c)	213. (c)
4. (b)	46. (d)	88. (d)	130. (c)	172. (b)	214. (b)
5. (b)	47. (b)	89. (b)	131. (2.064)	173. (c)	215. (d)
6. (b)	48. (b)	90. (25)	132. (b)	174. (a)	216. (a)
7. (d)	49. (45)	91. (a)	133. (b)	175. (7)	217. (d)
8. (a)	50. (c)	92. (a)	134. (280)	176. (120)	218. (a)
9. (d)	51. (163)	93. (d)	135. (c)	177. (c)	219. (b)
10. (c)	52. (d)	94. (c)	136. (b)	178. (b)	220. (c)
11. (a)	53. (a)	95. (0.4896)	137. (c)	179. (c)	221. (c)
12. (b)	54. (16)	96. (b)	138. (a)	180. (c)	222. (a)
13. (c)	55. (d)	97. (c)	139. (c)	181. (a)	223. (b)
14. (d)	56. (b)	98. (4.54)	140. (c)	182. (c)	224. (d)
15. (c)	57. (d)	99. (b)	141. (d)	183. (d)	225. (a)
16. (a)	58. (4)	100. (b)	142. (c)	184. (d)	226. (b)
17. (b)	59. (20000)	101. (b)	143. (c)	185. (c)	227. (d)
18. (b)	60. (0.81)	102. (a)	144. (c)	186. (a)	228. (c)
19. (c)	61. (a)	103. (d)	145. (b)	187. (c)	229. (c)
20. (a)	62. (495)	104. (4536)	146. (d)	188. (b)	230. (a)
21. (d)	63. (c)	105. (d)	147. (d)	189. (b)	231. (d)
22. (a)	64. (b)	106. (a)	148. (c)	190. (b)	232. (b)
23. (c)	65. (b)	107. (c)	149. (b)	191. (b)	233. (c)
24. (d)	66. (22)	108. (c)	150. (c)	192. (d)	234. (d)
25. (a)	67. (b)	109. (b)	151. (a)	193. (d)	235. (c)
26. (d)	68. (96)	110. (8)	152. (d)	194. (c)	236. (b)
27. (a)	69. (d)	111. (a)	153. (c)	195. (c)	237. (a)
28. (d)	70. (850)	112. (b)	154. (b)	196. (d)	238. (d)
29. (b)	71. (48)	113. (a)	155. (a)	197. (b)	239. (b)
30. (a)	72. (6)	114. (a)	156. (d)	198. (b)	240. (22.22)
31. (c)	73. (b)	115. (32)	157. (b)	199. (a)	241. (d)
32. (d)	74. (c)	116. (c)	158. (d)	200. (c)	242. (c)
33. (c)	75. (d)	117. (c)	159. (b)	201. (a)	243. (c)
34. (b)	76. (140)	118. (a)	160. (b)	202. (a)	244. (b)
35. (b)	77. (a)	119. (c)	161. (a)	203. (b)	245. (b)
36. (c)	78. (c)	120. (c)	162. (d)	204. (a)	246. (b)
37. (c)	79. (c)	121. (3)	163. (a)	205. (d)	247. (d)
38. (d)	80. (d)	122. (d)	164. (c)	206. (b)	248. (a)
39. (b)	81. (c)	123. (b)	165. (c)	207. (c)	249. (b)
40. (a)	82. (c)	124. (d)	166. (a)	208. (b)	250. (c)
41. (a)	83. (c)	125. (b)	167. (a)	209. (c)	251. (b)
42. (16)	84. (1300)	126. (800)	168. (d)	210. (c)	252. (c)

EXPLANATIONS

1. (d)

Using the set theory formula

n(A) : Number of people who play hockey = 15

n(B) : Number of people who play football = 17

$n(A \cap B)$: Persons who play both hockey and football = 10

$n(A \cup B)$: Persons who play either hockey or football or both

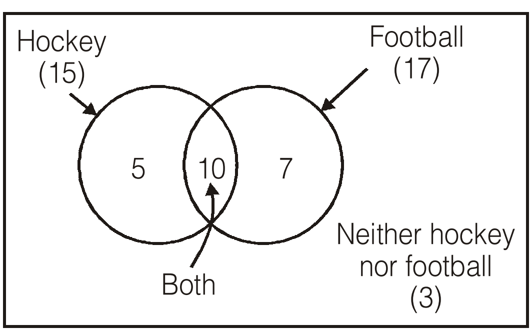
Using the formula

$$n(A \cup B) = n(A) + n(B) - n(A \cap B)$$
$$n(A \cup B) = 15 + 17 - 10 = 22$$

Thus people who play neither hockey nor football = 25 – 22 = 3

Alternative Method

Refer to Venn diagram given below:



Number of people playing nither of the two games is equal to 3.

2. (c)

137 + 276 = 435

This an addition on base 8.

Hence, 731 + 672(8) = 1623

Alternative Method

7 and 6 added is becoming five means the given two numbers are added on base 8.

$$\begin{array}{r} (137)_8 \\ +(276)_8 \\ \hline (435)_8 \end{array}$$

Hence we have to add the another two given set of numbers also on base 8.

$$\begin{array}{r} (731)_8 \\ +(672)_8 \\ \hline (1623)_8 \end{array}$$

Hence the overall problem was based on identyfying base, which was 8, and adding number on base 8.

3. (d)

Per day work or rate of 5 skilled workers = $\frac{1}{20}$

$\Rightarrow$ Per day work or rate of one skill worker

$$= \frac{1}{5 \times 20} = \frac{1}{100}$$

Similarly Per day work or rate of 8 semiskilled workers = $\frac{1}{25}$

$\Rightarrow$ Per day work or rate of one semi-skill worker

$$= \frac{1}{8 \times 25} = \frac{1}{200}$$

And per day work or rate of 10 unskilled workers

$$= \frac{1}{30}$$

$\Rightarrow$ Per day work or rate of one semi-skill worker

$$= \frac{1}{10 \times 30} = \frac{1}{300}$$

Thus total per day work of 2 skilled, 6 semiskilled and 5 unskilled workers

$$= \frac{2}{100} + \frac{6}{200} + \frac{5}{300} = \frac{12+18+10}{600}$$

$$= \frac{40}{600} = \frac{1}{15}$$

Thus time to complete the work is 15 days.

Alternative Method

Let one day work of skilled semi-skilled and unskilled worker be a, b, c units respectively.

5a × 20 = 8b + 25 = 10c × 30 = Total unit of work

$$100a = 200b = 300c$$
$$a = 2b = 3c$$

$$\Rightarrow \quad b = \frac{a}{2} \text{ and } c = \frac{a}{3}$$

Given that 2 skilled, 6 semi-skilled and 5 unskilled workers are working. Let they finish the work in 'x' days.

$(2a + 6b + 5c)x = 5a + 20$

$= \text{Total units of work}$

$$\left(2a + 3a + \frac{5}{3}a\right)x = 5a \times 20$$

$$\frac{20a}{3}x = 5a \times 20$$

$$x = 15 \text{ days}$$

4. (b)

We have to make 4 digit numbers, so the number should be start with 3 or 4, two cases possible;

Case (1) thousands digit is 3

Now other three digits may be any of 2, 2, 3, 3, 4, 4, 4, 4.

(a) Using 2, 2, 3

$\Rightarrow$ 223, 232, 322 -------

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(b) Using 2, 2, 4 $\Rightarrow$ 224, 242, 422

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(c) Using 2, 3, 3 $\Rightarrow$ 233, 323, 332

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(d) Using 2, 3, 4 $\Rightarrow$ 234, 243, 324, 342, 423, 432

(3! = 6 numbers are possible)

(e) Using 2, 4, 4 $\Rightarrow$ 244, 424, 442

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(f) Using 3, 3, 4 $\Rightarrow$ 334, 343, 433

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(g) Using 3, 4, 4 $\Rightarrow$ 344, 434, 443

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(h) Using 4, 4, 4 $\Rightarrow$ 444

$\left(\frac{3!}{3!} = 1 \text{ numbers are possible}\right)$

Total 4 digit numbers in case 1 = 3 + 3 + 3 + 6 + 3 + 3 + 3 + 1 = 25

Case (2) thousands digit is 4 ; Now other three digits may be any of 2, 2, 3, 3, 4, 4, 4.

(a) Using 2, 2, 3 $\Rightarrow$ 223, 232, 322

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(b) Using 2, 2, 4 $\Rightarrow$ 224, 242, 422

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(c) Using 2, 3, 3 $\Rightarrow$ 233, 323, 332

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(d) Using 2, 3, 4 $\Rightarrow$ 234, 243, 324, 342, 423, 432

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(e) Using 2, 4, 4 $\Rightarrow$ 244, 424, 442

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(f) Using 3, 3, 3 $\Rightarrow$ 333

$\left(\frac{3!}{3!} = 1 \text{ number is possible}\right)$

(g) Using 3, 3, 4 $\Rightarrow$ 334, 343, 433

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(h) Using 3, 4, 4 $\Rightarrow$ 344, 434, 443

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(i) Using 4, 4, 4 $\Rightarrow$ 444

$\left(\frac{3!}{3!} = 1 \text{ number is possible}\right)$

Total 4 digit numbers in case 2 = 3 + 3 + 3 + 6 + 3 + 3
= 1 + 3 + 1 = 26

Thus total 4 digits numbers using case (1) and case (2)
= 25 + 26 = 51

*** Alternative Method / Shortcut method**

As the number is greater than 3000. So thousand's place can be tiehr 3 or 4.

Let's consider the following two cases

Case (I) When thousand's place is 3.

$\underline{3}$ $\underline{a}$ $\underline{b}$ $\underline{c}$

If there is no restricton on number of two's, three's and four's. Then each of a, b, c can be filled with 2 or 3 or 4 each in 3 ways.
So $3 \times 3 \times 3 = 27$ numbers are there. Out of which 3222, 3333 are invalid as 2 can be used twice & three thrice only so number of such valid numbers begining with 3 are $27 - 2 = 25$. ...(i)

Case (II) When thousand's place is 4
4 a b c
Without restriction on number of 2's, 3's and 4's a, b, c (as explained in case I) can be filled in 27 ways.
Out of these 27 numbers, 4 2 2 2 is only invalid as two have to be used twice only.
So valid numbers are $27 - 1 = 26$. ...(ii)
Total numbers from Case (I) & Case (II) 25 + 26 = 51.

5. (b)
Suppose: Hari's age : H, Gita's age : G,
Saira's age : S, Irfan's age : I
- H +G > I + S
- Using Statement (2) both $G - S = 1$ or $S - G = 1$; G can't be oldest and S can't be youngest.
- There are no twins thus using statement (2) either GS or SG possible.

(A) HSIG: not possible as there is I between S and G which is not possible using statement (3)
(B) SGHI: SG order is possible,
S > G > H > I and G + H > S +I (possible)
Because if { S = G + 1; and G = H+1 and H = I +2 then G + (I+2) > (G+1) +I }
(C) IGSH: according to this I > G and S > H thus adding these both inequalities we get I + S > G + H which is opposite of statement (2) thus not possible.
(D) IHSG: according to this I > H and S > G thus adding both inequalities I + S > H + G which is opposite of statement (2). Thus not possible.

6. (b)

$$\log(P) = \frac{1}{2}\log(Q) = \frac{1}{3}\log(R)$$

$$\Rightarrow \log(P) = \log(Q)^{1/2} = \log(R)^{1/3} = K$$

$\Rightarrow$ $P = (Q)^{1/2} = (R)^{1/3} = K$
$\Rightarrow$ $P = K, Q = K^2, R = K^3$ ...(i)
Now, only option (B) $Q^2 = PR$ satisfies
$Q^2 = (K^2)^2 = K^4$ From ...(i)
$P.R = K * K^3 = K^4$ From...(i)
Here, $Q^2 = PR$ holds true

7. (d)
Shortcut Method
Every time if we take 1 litre of mixture out and replace with water, content of pure spirit will keep on reducing by 10%.
So, final quantity of spirit after 3 such operations are

$$10 \times 0.9 \times 0.9 \times 0.9 = 7.29 \text{ litres}$$

Alternative Solution

$$\frac{\text{Quantity of spirit left after } n^{th} \text{ operation}}{\text{Intial quantity of spirit}}$$

$$= \left(\frac{a-b}{a}\right)^n = \left(1-\frac{b}{a}\right)^n$$

where 'a' is initial quantity of pure spirit and 'b' is quantity taken out and replaced every time.
Hence, quantity of spirit left after 3rd operation

$$= \text{initial quantity} \times \left(1-\frac{1}{10}\right)^3$$
$$= 10 \times 0.9 \times 0.9 \times 0.9$$
$$= 7.29 \text{ litres}$$

8. (a)
(T.C.) Total cost = V + f

$$\boxed{T.C = 4q + \frac{100}{q}}$$

As we have to minimize total cost.
Using options

(a) $q = 5$, T.C. $= 4 \times 5 + \frac{100}{5} = 40$

(b) $q = 4$, T.C. $= 4 \times 4 + \frac{100}{4} = 41$

(c) $q = 7$, T.C. $= 4 \times 7 + \frac{100}{7} = 42.285$

(d) $q = 6$, T.C. $= 4 \times 6 + \frac{100}{6} = 40.\overline{66}$

Hence, T.C. is minimum at q = 5, **(a) ans.**
* always put options to get answer fast.

Alternative Solution

or $\quad T.C. = 4q + \frac{100}{q}$

for minimum $\frac{d}{dq}\left(4q + \frac{100}{q}\right) = 0$

$\Rightarrow \quad q^2 = 25$ or $q = 5$

$\frac{d}{dq}\left(4q + \frac{100}{q}\right)_{q=5} > 0$

Hence, TC (Total cost) is minimum at q = 5
(a) ans.

9. **(d)**
As we can understand that the danger of a microbe to human being will be directly proportional to potency and growth. At the same time, it will be inversely proportional to toxicity defined (more dangerous will a microbe be if lesser of its milligram is required). So level of dangerous

$\alpha \frac{P\uparrow \times G\uparrow}{T\downarrow}$ where P, G and T are the potency, growth and toxicity as defined in question.

So $D_i = \frac{KPG}{T}$ ...(i)

Where K is constant of proportionality.
So level of dangerous of S will be maximum given

by $D_S = \frac{0.8 \times \pi (10 mm)^2}{200}$.

Similar calculation for D_P, D_Q, D_R can be done based on (i) to find out that D_S is maximum and so most dangerous among them.

10. **(c)**
Let 'y' we the backlog with transporter and 'x' be the number of orders each day.
So, as per conditions given in question

$4x + y = 28$ ...(i)

$10x + y = 30$ ...(ii)

Solving (i) and (ii),

$$x = \frac{1}{3} \text{ and } y = \frac{80}{3}$$

Since, we need to find out number of trucks so that no pending order will be there at the end of 5th day.

$5x + y = n \times 5$

So we need to find 'n', where 'n' is the number of trucks required.

$$n = \frac{5x + y}{5} = \frac{5 \times \frac{1}{3} + \frac{80}{3}}{5} = \frac{\frac{85}{3}}{5}$$

Hence, $5.\overline{66}$ truck will be required. As number of trucks have to be natural number. Hence, 6 trucks will be required.

11. **(a)**
Let there be overall 'x' candidates. Initially those who decided to vote for P and Q are. $0.4x$ and $0.6x$ respectively. On the day of election 15% of $0.4x = 0.06x$ went from P's side to Q's side and 25% of $0.6x = 0.15x$ went from Q's side to P's side.
Now, after transfer 'p' has $0.4x - 0.06x + 0.15x = 0.49x$
and after transfer 'q' has $0.6x - 0.15x + 0.06x = 0.51x$
Given, in the question that P lost by 2 votes

Q – P = 2 votes

$0.51x - 0.49x = 0.02x = 2$ votes

Hence, ($x = 100$)
Total number of votes are 100.

Alternative Solution
Using options:
Lets take option (a) 100 as total number of voters. Initially P and Q has 40 and 60 voters on their sides respectively.
15% went from P's side to Q and 25% went from Q's side to P.

P	Q
(40)	(60)
(–) 15% of 40	– 25% of (60)
+ 25% of 60	+ 15% of (40)
40 – 6 + 15	60 – 15 + 6
= 49	= 51

Hence Q and P has 51 and 49 respectively difference in number of votes = 2. Hence answer (a).

12. **(b)**
Fuel consumed per km will we least, when mileage (kilometres per litres) mentioned on 'y' axis of graph will be maximum irrespective of number of kilometres travelled.
From the graph ('y' axis) we can observe that mileage (kilometres per litres) is maximum when vehicle is driven at 45 kilometres per hour. Hence

Previous ESE Prelims Solved Questions
(General Aptitude)

1. Three hundred passengers are travelling in white, silver and black cars; each of these cars is carrying 6, 5 and 3 passengers, respectively. If the number of white and silver cars is equal and three is only one black car, what is the total number of cars?
(a) 52 (b) 53
(c) 54 (d) 55
[ESE Pre-2017]

2. The present ages of 3 brothers are in the proportion 3 : 4 : 5. After 10 years the sum of their ages will be 78. What are their ages now?
(a) 12, 16 and 20 (b) 15, 20 and 25
(c) 21, 28 and 35 (d) 24, 32 and 40
[ESE Pre-2017]

3. A total of 324 notes comprising of ₹ 20 and ₹ 50 denominations make a sum of ₹ 12,450. The number of ₹ 20 notes is
(a) 200 (b) 144
(c) 125 (d) 110
[ESE Pre-2017]

4. Five Men can paint a building in 20 days, 8 Women can paint the same building in 25 days and 10 Boys can paint it in 30 days. If a team has 2 Men, 6 Women and 5 Boys, how long will it take to paint the building?
(a) 12 days (b) 13 days
(c) 14 days (d) 15 days
[ESE Pre-2017]

5. Rajiv spends 40% of his salary on food, 20% on house rent, 10% on entertainment and 10% on conveyance. If his savings at the month end are ₹ 2,000, then his monthly salary is:
(a) ₹ 6,000 (b) ₹ 8,000
(c) ₹ 10,000 (d) ₹ 12,000
[ESE Pre-2017]

6. A group of workers estimate to finish a work in 10 days, but 5 workers could not join the work. If the rest of them finished the work in 12 days, the number of members present in the team originally is
(a) 50 (b) 45
(c) 35 (d) 30
[ESE Pre-2017]

7. The sum of squares of successive integers 8 to 16, both inclusive, will be
(a) 1126 (b) 1174
(c) 1292 (d) 1356
[ESE Pre-2018]

8. Given that 0.8 is one root of the equation, $x^3 - 0.6x^2 - 1.84x + 1.344 = 0$. The other roots of this equation will be
(a) 1.1 and –1.4 (b) –1.2 and 1.4
(c) 1.2 and –1.4 (d) –1.1 and 1.4
[ESE Pre-2018]

9. The equation, $x^3 - 8x^2 + 37x - 50 = 0$ is factored and it has $(3 + 4i)$ as one of its roots. What is the real root of this equation?
(a) 2 (b) 4
(c) 6.5 (d) 13
[ESE Pre-2018]

10. Circle *A* is 4 cm in diameter; circle *B* is 5 cm in diameter. Circle *C* has its circumference equal to the sum of the circumferences of both *A* and *B* together. What will be the ratio of the area of circle *C*, with respect to the area of circle *A* and circle *B* respectively?
(a) 5.0625 and 1.84 (b) 3.875 and 1.84
(c) 5.0625 and 3.24 (d) 3.875 and 3.24
[ESE Pre-2018]

11. The 12 digits on the face of a clock are to be represented employing contributions of only the number 9 as either 9 or $\sqrt{9}$. The other prescribed conditions are (i) the least number of uses alone are permitted; and (ii) when alternates are possible,

ANSWER KEY

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

EXPLANATIONS

1. (d)
Since the number of passengers in Black car is 3, it leaves 300 – 3 = 297 passengers to be accommodated in White and Silver coloured cars which are equal in number ($W = S$).
We can form a linear equation:
$(6 + 5)W = 297$ giving $W = 27$ as also $S = 27$
Total number of cars being 27 + 27 + 1 = 55

2. (a)
Let $3x$, $4x$, $5x$ be the present age of 3 brothers. After 10 years, sum of their age is $12x + 30 = 78$ which gives $x = 4$
Hence the present age of three brothers is 12, 16 and 20 years.
Alt: Can be directly solved using the given options since the sum of their present age = 78 – 30 = 48 which is satisfied by option 'A' alone.

3. (c)
We can form 2 linear equations taking the number of Rs. 20 and Rs. 50 notes as T and F

$$T + F = 324 \quad \text{...(1)}$$
$$20T + 50\,F = 12450 \quad \text{...(2)}$$

Solving the 2 equations, we get $T = 125$

Alt 1: If all the notes are Rs. 50 notes, total amount = 324 × 50 = Rs. 16200 which is 16200 – 12450 = 3750
3750/(50 – 20) = 125 notes of Rs. 20.
Alt 2: This question can also be solved by putting options.

4. (d)
5 men in 20 days = 100 man days
8 women in 25 days = 200 woman days
10 boys in 30 days = 300 boy days
which means 100 MD = 200 WD = 300 BD or 1 man day = 3 boy days; 1 woman day = 1.5 Boy days 2 men, 6 women and 5 boys = 2 × 3 + 6 × 1.5 + 5 = 20 boys deployed to complete the task which will get completed in 300/20 = 15 days
Alt: $[2(1/100) + 6(1/200) + 5(1/300)]x = 1$
Which gives $x = 15$

5. (c)
The remaining percentage after expenditure 20% which equals Rs. 2000 leading to total monthly income = Rs. 10000.