

*Theory & Problems  
With Explanations*



# Reasoning & Aptitude



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Nem Singh, IRS



## Number System

The chapter of number system is amongst the most important chapter in the whole of mathematics syllabus for Competitive Examinations.

We can consider this chapter as the backbone of mathematics. The students are advised to go through this chapter with utmost care; understanding each and every aspect of this topic.

In this chapter basic definition of different types of numbers are given. Then on the basis of this, various questions with solved examples are given for easy understanding.

### Number System

#### Natural Numbers

Counting numbers 1, 2, 3, 4, 5 ..... are known as natural numbers.

The set of natural numbers can be represented by  $N = \{1, 2, 3, 4, 5, \dots\}$

#### Whole Numbers

If we include 0 among the natural numbers, then the numbers 0, 1, 2, 3, 4, 5 etc. are called whole numbers.

Whole number  $W = \{0, 1, 2, 3, 4, 5, \dots\}$

Clearly, every natural number is a whole number but 0 is a whole number which is not a natural number.

#### Integers

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

#### The set of integers

$$I = \{\dots, -3, -2, -1, 0, 1, 2, 3, 4, \dots\}$$

#### Positive Integers

The set  $\{1, 2, 3, 4, 5, \dots\}$  is a set of all positive integers.

Positive Integers and natural numbers are synonyms.

#### Negative Integers

The set  $\{-1, -2, -3, \dots\}$  is a set of all negative integers. 0 is neither positive nor negative.

#### Rational Numbers

The numbers of the form  $p/q$ , where  $p$  and  $q$  are integers and  $q \neq 0$  are known as rational numbers.

$$\text{eg.: } \frac{2}{3}, \frac{5}{7}, \frac{-4}{9} \text{ etc.}$$

#### Irrational Numbers

Those numbers which when expressed in decimal form are neither terminating nor repeating decimals, are known as irrational numbers

$$\text{eg.: } \sqrt{2}, \sqrt{3}, \sqrt{5}, \pi \text{ etc.}$$

Note: That the exact value of  $\pi$  is not  $\frac{22}{7}$ .  $\frac{22}{7}$  is rational number while  $\pi$  is an irrational number.

Some times  $\pi$  is also considered equivalent to  $\frac{355}{113}$ . This value is also approximate value of  $\pi$  and not the exact value.  
Similarly 3.14 is not an exact value of  $\pi$ .

### Real Numbers

The rational and irrational numbers combined together are called real numbers.

eg.:  $\frac{12}{19}, \sqrt{5}, 4 + \sqrt{2}, 6 + \sqrt{5}$  etc. are all real numbers.

The set of all real numbers are denoted by R.

### Complex Numbers

Complex numbers can be represented in form of  $a+bi$ , where a and b are real numbers and  $i = \sqrt{-1}$ . Thus  $3+4i, 6+2i, i, 2i$  etc are Complex numbers:

### Even Numbers

All those numbers which are exactly divisible by 2 are called even numbers.

eg.: 2, 4, 6, 8, 10, etc.

### Odd Numbers

All those numbers which are not exactly divisible by 2 are called odd number.

Eg.: 1, 3, 5, 7, 9 etc.

### Prime Numbers

Number divisible by 1 and itself and not divisible by any other number are called prime number.

Eg.: 2, 3, 5, 7, 11 etc.

**Note:** 2 is the only Prime number which is even. Rest all are odd Prime numbers.

### Composite Numbers

Natural numbers greater than 1 which are not prime are composite numbers.

eg.: 4, 6, 9, 15, etc.

### Co prime Numbers

Two numbers which have only 1 as the common factors are called Coprimes or relatively prime to each others

eg.: (3, 7) (8, 9) (36, 25) etc.

**Note:** Here 8 & 9 are not prime numbers but since they have only one common factor i.e. 1. So they are coprime numbers.

(6, 15) are coprime numbers because they have two common factors i.e. 1 & 3.

## 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 is 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 digits is divisible by 9.  
e.g., 108936 here  $1+0+8+9+3+6 = 27$  which is divisible by 9 & hence 108936 is divisible by 9.

**8. Divisibility by 10**

A number is divisible by 10 if its unit digit is 0.  
e.g.: 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.  
e.g.: 1331, the sum of digit 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.

Where denominator is not equal to zero,

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

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

**Example:** Find H.C.F & L.C.M 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**

$$1. (a+b)^2 = a^2 + 2ab + b^2$$

$$2. (a-b)^2 = a^2 - 2ab + b^2$$

$$3. (a-b)(a+b) = a^2 - b^2$$

$$4. (a+b)^2 + (a-b)^2 = 2(a^2 + b^2)$$

$$5. (a+b)^2 - (a-b)^2 = 4ab$$

$$6. (a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3 \\ = a^3 + b^3 + 3ab(a+b)$$

$$7. (a-b)^3 = a^3 - 3a^2b + 3ab^2 - b^3 \\ = a^3 - b^3 - 3ab(a-b)$$

$$8. a^3 + b^3 = (a+b)(a^2 - ab + b^2)$$

$$9. a^3 - b^3 = (a-b)(a^2 + ab + b^2)$$

$$10. \frac{a^3 + b^3 + c^3 - 3abc}{a^2 + b^2 + c^2 - ab - bc - ca} = (a+b+c)$$

**HCF and LCM of Numbers****H.C.F.**

(Highest Common Factor) of two or more numbers is the greatest number that divides each one of them exactly.

For example 8 is the highest common factor of 16 and 40.

H.C.F is also called greatest common divisor (G.C.D.) or G.C.M. i.e. Greatest Common measure.

**L.C.M.**

(Least Common Multiple) of two or more numbers 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  $\frac{\text{Numerator}}{\text{Denominator}}$ .

$$11. a^4 - b^4 = (a^2)^2 - (b^2)^2 = (a^2 + b^2)(a^2 - b^2) \\ = (a^2 + b^2)(a+b)(a-b)$$

#### Condition of Divisibility for Algebraic 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 exactly divisible by  $(a-b)$  (whether  $n$  is odd or even)

Ex.:  $a^2 - b^2 = (a-b)(a+b)$  so it is divisible by  $a-b$ .

$a^3 - b^3 = (a-b)(a^2 + ab + b^2)$  so it is divisible by  $(a-b)$ ;

$a^4 - b^4 = (a^2) - (b^2) = (a^2 - b^2)(a^2 + b^2) = (a-b)(a+b)(a^2 + b^2)$  so it is divisible by  $(a-b)$

Similarly

$a^9 - b^9$  is exactly divisible by  $(a-b)$  also

$a^{12} - b^{12}$  is also exactly divisible by  $(a-b)$ .

#### FACTORS OF COMPOSITE NUMBER

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

For ex.: 8 is a composite number since it can be factorized into

$$8 = 2 \times 2 \times 2$$

Similarly 9 is also a composite number, i.e

$$9 = 3 \times 3$$

Composite number  $= P_1^{\lambda_1} \times P_2^{\lambda_2} \times P_3^{\lambda_3} \dots P_n^{\lambda_n}$   
here,  $P_1, P_2, P_3, \dots, P_n$  are prime numbers and

$\lambda_1, \lambda_2, \dots, \lambda_n$  are their respective powers.  
Factors of composite number  $= (\lambda_1 + 1)(\lambda_2 + 1) \dots (\lambda_n + 1)$

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

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

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

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

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

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

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

Ex. 1 Find the factors of composite number

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

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

Ex. 2. Find all the factors of 120.

$$\text{Sol.: } 120 = 2 \times 2 \times 2 \times 3 \times 5 \\ = 2^3 \times 3^1 \times 5^1$$

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

Ex. 3. Find all the factors of 1800.

$$\text{Sol.: } 1800 = 2 \times 2 \times 2 \times 3 \times 3 \times 5 \times 5 \\ = 2^3 \times 3^2 \times 5^2$$

Factors  $= (3+1)(2+1)(2+1) = 36$

Ex. 4. Find all the factors of 64.

$$\text{Sol.: } 64 = 2^6$$

Factors of 64  $= (6+1) = 7$

1, 2, 4, 8, 16, 32, 64

All are factors of 64.

Ex. 5. Find all the factors of 1024.

$$\text{Sol.: } 1024 = 2^{10}$$

So total factors  $= (10+1) = 11$

Ex. 6. Find all the factors of 625.

$$\text{Sol.: } 625 = 5 \times 5 \times 5 \times 5 = 5^4$$

Factors  $= (4+1) = 5$

1, 5, 25, 125, 625

All are factors of 625.

Ex. 7. Find all the factors of 17.

$$\text{Sol.: } 17 = 17^1$$

Factors  $= (1+1) = 2$

Note: 17 is a prime number and have two factors 1 and 17.

Ex. 8. Find all the factors of 47.

Sol.: 47 = 47  
So factors are 1 and 47.

Sometimes we have to find the number of factors of a number.

$$10! = 10 \times 9 \times 8 \times \dots \times 1$$

Here basic formula because multiplication will result in 10 factors and will have 2 fives.

Short Cut

Counting :

Value will increase

The integer number of factors

Ex. 1

$$\frac{10}{5} + \frac{10}{5^2}$$

here

Note: Here

Ex. 2

Sol.:

**Note:** 17 is a prime number and all prime numbers have two factors 1 & itself.

**Ex. 8.** Find all the factors of 47.  
Sol.:  $47 = 47^1$

$$\text{So factors} = (1 + 1) = 2$$



## Counting Number of 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.

**Short Cut:**

Counting number of zeros at the end of  $n!$

$$\text{Value will be } \frac{n}{5} + \frac{n}{5^2} + \frac{n}{5^3} + \frac{n}{5^4} \dots$$

The integral value of this sum will be the total number of zeros.

**Ex. 1** Number of zeros at the end of  $10!$

$$\frac{10}{5} + \frac{10}{5^2} \dots$$

here integral value is 2.

**Note:** Here  $\frac{10}{5^2}$  is less than 1 so will not count it.

**Ex. 2** Number of zeros at the end of  $100!$

$$\text{Sol.: } \frac{100}{5} + \frac{100}{5^2} + \frac{100}{5^3} + \dots$$

integral value will be  
 $20 + 4 = 24$  zeros



**Ex. 3** Number of zeros at the end of  $126!$

$$\text{Sol.: } \frac{126}{5} + \frac{126}{5^2} + \frac{126}{5^3} + \frac{126}{5^4} + \dots$$

integral value will be  
 $25 + 5 + 1 = 31$  zeros.

**Ex. 4** Number of zeros at the end of  $500!$

$$\text{Sol.: } \frac{500}{5} + \frac{500}{5^2} + \frac{500}{5^3} + \frac{500}{5^4} + \dots$$

integral value will be  
 $100 + 20 + 4 = 124$  zeros.

**Ex. 5** Number of zeros at the end of  $1000!$

$$\text{Sol.: } \frac{1000}{5} + \frac{1000}{5^2} + \frac{1000}{5^3} + \frac{1000}{5^4} + \frac{1000}{5^5} + \dots$$

$200 + 40 + 8 + 1 = 249$  zeros

**Ex. 6** Number of zeros at the end of  $50!$

$$\text{Sol.: } \frac{50}{5} + \frac{50}{5^2} + \frac{50}{5^3} \dots$$

Integral value will be  
 $10 + 2 = 12$  zeros

**Ex. 7** Number of zeros at the end of  $90!$

$$\text{Sol.: } \frac{90}{5} + \frac{90}{5^2} + \frac{90}{5^3} \dots$$

Integral value will be  
 $18 + 3 = 21$  zeros



## Cyclicity

Cyclicity of a number is used mainly for the calculation of unit digits.

1. **Cyclicity of 1.**

In  $1^n$ , unit digit will always be 1.

2. **Cyclicity of 2.**

$$2^1 = 2$$

$$2^2 = 4$$

$$2^3 = 8$$

$$2^4 = 16$$

$$2^5 = 32$$

$$2^6 = 64$$

$$2^7 = 128$$

$$2^8 = 256$$

After every fourth interval 2, 4, 8, 6 are repeated.  
so cycle of 2 is 2, 4, 8, 6.

**Ex.1** Find unit digit of number  $2^{54}$ .

**Sol.:** Here unit digit will repeat as 2, 4, 8, 6 after every four interval till 52 next 53 will be 2 and 54 will be 4. So unit digit will be 4.

**Ex.2** Find unit digit of  $2^{323}$ .

**Sol.:** Here 2, 4, 8, 6 will repeat after every four interval till 320 next digit will be 2, 4, [8]. So unit digit of  $2^{323}$  will be 8.

**Ex.3** Find unit digit of  $12^{12} \times 22^{22}$

**Sol.:** Unit digit of  $12^{12}$  will be 6 and  $22^{22}$  will be 4. So unit digit of  $12^{12} \times 22^{22}$  will be  $6 \times 4 = 2$  [4]; 4 Ans.

### 3. Cyclicity of 3.

$$3^1 = 3$$

$$3^2 = 9$$

$$3^3 = 27$$

$$3^4 = 81$$

$$3^5 = 243$$

$$3^6 = 729$$

$$3^7 = 2187$$

$$3^8 = 6561$$

After every fourth interval 3, 9, 7 and 1 are repeated. So cycle of 3 is 3, 9, 7, 1.

**Ex.1** Find unit digit of  $3^{81}$ .

**Sol.:** Cycle of 3 is 3, 9, 7, 1 which repeats after every four interval till  $3^{80}$ . So next unit digit will be 3.

**Ex.2** Find unit digit of  $133^{133}$ .

**Sol.:** Cycle of 3 is 3, 9, 7, 1 which repeats after every fourth interval till  $133^{132}$ . So next unit digit will be 3.

**Ex.3** Find unit digit of  $963^{63} \times 73^{73}$

**Sol.:** Unit digit of  $963^{63}$  will be 7 and unit digit of  $73^{73}$  will be 3. So unit digit of  $963^{63} \times 73^{73}$  will be  $7 \times 3 = 21$  i.e. 1 Ans.

**Ex.4** Find unit digit of  $122^{122} \times 133^{133}$

**Sol.:** Unit digit of  $122^{122}$  will be 4 because cycle of 2 is 2, 4, 8, 6 and unit digit of  $133^{133}$  will be 3. So unit digit of  $122^{122} \times 133^{133}$  will be  $4 \times 3 = 12$  i.e. 2 Ans.

### 4. Cyclicity of 4.

$$4^1 = 4$$

$$4^2 = 16$$

$$4^3 = 64$$

$$4^4 = 256$$

Cycle is 4, 6, i.e.

Unit digit of  $4^n$  depends on value of n.

If n is odd unit digit is 4 and if n is even digit is 6.

**Ex.1** Find unit digit of  $4^{425}$ .

**Sol.:** Since 425 is odd number unit digit will be 4.

**Ex.2** Find unit digit of  $4^{1024}$ .

**Sol.:** Since 1024 is even number unit digit will be 6.

**Ex.3** Find unit digit of  $133^{63} \times 4^{49}$ .

**Sol.:** Unit digit of  $133^{63}$  is 7 and unit digit of  $4^{49}$  is 4 so unit digit of  $133^{63} \times 4^{49}$  will be  $7 \times 4 = 28$  i.e. 8.

### 5. Cyclicity of 5.

$$5^1 = 5$$

$$5^2 = 25$$

$$5^3 = 125$$

$$5^4 = 625$$

Unit digit will always be 5.

### 6. Cyclicity of 6.

$$6^1 = 6$$

$$6^2 = 36$$

$$6^3 = 216$$

$$6^4 = 1296$$

Unit digit will always be 6.

MADE  
EASY

Ex. 1  
Sol.:

Ex. 2  
Sol.:

7. C

7

7

7

7

Ex. 1  
Sol.:

Ex. 2  
Sol.:

Ex. Sol.

8.

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**Ex. 1** Find unit digit of  $4^{69} \times 6^5$

**Sol.:** Unit digit of  $4^{69}$  is 4 and unit digit of  $6^5$  is 6 so unit digit of  $4^{69} \times 6^5$  will be  $4 \times 6 = 24$  i.e. 4.

**Ex. 2** Find unit digit of  $144^{145} \times 126^{126}$

**Sol.:** Unit digit of  $144^{145}$  is 4 and unit digit of  $126^{126}$  is 6. So unit digit of  $144^{145} \times 126^{126}$  will be  $4 \times 6 = 24$  i.e. 4.

### 7. Cyclicity of 7.

$$7^1 = 7$$

$$7^2 = 49$$

$$7^3 = 343$$

$$7^4 = 2401$$

$$7^5 = 16807$$

$$7^6 = 117649$$

$$7^7 = 823543$$

$$7^8 = 5764801$$

Cycle of 7 is 7, 9, 3, 1

**Ex. 1** Find unit digit of  $17^{17}$ .

**Sol.:** Cycle of 7 repeats 7, 9, 3, 1 till  $17^{16}$  next digit will be 7. So ans. is 7.

**Ex. 2** Find unit digit of  $17^{17} \times 27^{27}$

**Sol.:** Unit digit of  $17^{17}$  is 7 and unit digit of  $27^{27}$  is 3. So unit digit of  $17^{17} \times 27^{27}$  will be  $7 \times 3 = 21$  i.e. 1.

**Ex. 3** Find unit digit of  $17^{17} \times 27^{27} \times 37^{37}$

**Sol.:** Unit digit of  $17^{17}$  is 7, unit digit of  $27^{27}$  is 3 and unit digit of  $37^{37}$  is 7. So unit digit of  $17^{17} \times 27^{27} \times 37^{37}$  will be  $7 \times 3 \times 7 = 147$  i.e. 7.

### 8. Cyclicity of 8.

$$8^1 = 8$$

$$8^2 = 64$$

$$8^3 = 512$$

$$8^4 = 4096$$

$$8^5 = 32768$$

So cycle of 8 is 8, 4, 2, 6.

**Ex. 1** Find unit digit of  $18^{18}$ .

**Sol.:** Cycle of 8 repeats 8, 4, 2, 6 after every

four intervals till  $18^{16}$  next digits will be 8 and 4. So unit digit of  $18^{18}$  will be 4.

**Ex. 2** Find unit digit of  $18^{18} \times 28^{28} \times 288^{288}$ .

**Sol.:** Unit digit of  $18^{18}$  is 4, unit digit of  $28^{28}$  is 6, unit digit of  $288^{288}$  is 6. So unit digit of  $18^{18} \times 28^{28} \times 288^{288}$  will be  $4 \times 6 \times 6 = 144$  i.e. 4.

### 9. Cyclicity of 9.

$$9^1 = 9$$

$$9^2 = 81$$

$$9^3 = 729$$

$$9^4 = 6561$$

Cycle of 9 is 9, 1.

In  $9^n$  unit digit will be 9 if n is odd and unit digit will be 1 if n is even.

**Ex. 1** Find unit digit of

$$11^{11} + 12^{12} + 13^{13} + 14^{14} + 15^{15}$$

**Sol.:** Unit digit of  $11^{11}$  is 1

Unit digit of  $12^{12}$  is 6

Unit digit of  $13^{13}$  is 3

Unit digit of  $14^{14}$  is 6

Unit digit of  $15^{15}$  is 5

So unit digit of given sum will be  
 $1 + 6 + 3 + 6 + 5 = 21$  i.e. 1.

**Ex. 2** Find unit digit of

$$21^{21} \times 22^{22} \times 23^{23} \times 24^{24} \times 25^{25}$$

**Sol.:**  $25^{25}$  will give 5 in unit place, when multiplied by any even number i.e. 0, 2, 4, 6, 8 it will give zero at unit place. So, zero will be the unit digit of given question.

### CYCPLICITY TABLE

1 : 1

2 : 2, 4, 8, 6

3 : 3, 9, 7, 1

4 : 4, 6

5 : 5

6 : 6

7 : 7, 9, 3, 1

8 : 8, 4, 2, 6

9 : 9, 1

0 : 0



### Remainder Theorem

Remainder of expression  $\frac{a \times b \times c}{n}$  [i.e.  $a \times b \times c$  when divided by  $n$ ] is equal to the remainder of expression  $\frac{a_r \times b_r \times c_r}{n}$  [i.e.  $a_r \times b_r \times c_r$  when divided by  $n$ ], where  
 $a_r$  is remainder when  $a$  is divided by  $n$ ,  
 $b_r$  is remainder when  $b$  is divided by  $n$ , and  
 $c_r$  is remainder when  $c$  is divided by  $n$ .

**Ex.1** Find the remainder of  $15 \times 17 \times 19$  when divided by 7.

**Sol.:** Remainder of expression  $\frac{15 \times 17 \times 19}{7}$  will be equal to  $\frac{1 \times 3 \times 5}{7} \Rightarrow \frac{15}{7} \Rightarrow \frac{1}{7}$ . i.e. 1.  
 On dividing 15 by 7 we get 1 as remainder  
 On dividing 17 by 7 we get 3 as remainder  
 On dividing 19 by 7 we get 5 as remainder and combined remainder will be equal to remainder of  $\frac{15}{7}$  i.e. 1.

**Ex.2** Find remainder of expression  $\frac{19 \times 20 \times 21}{9}$  will be equal to remainder of expression  $\frac{1 \times 2 \times 3}{9}$  which is equal to 6.

□□□□

### Polynomial Theorem

This is very powerful theorem to find the remainder. According to polynomial theorem.

$$(x+a)^n = x^n + nC_1 x^{n-1} a^1 + nC_2 x^{n-2} a^2 + nC_3 x^{n-3} a^3 \dots nC_{n-1} x^1 a^{n-1} + a^n \dots (1)$$

$$\therefore \frac{(x+a)^n}{x} =$$

$$\left( x^n + nC_1 x^{n-1} a^1 + nC_2 x^{n-2} a^2 + nC_3 x^{n-3} a^3 + \dots nC_{n-1} x^1 a^{n-1} + a^n \right) \dots (2)$$

remainder of expression (2) will be equal to

remainder of  $\frac{a^n}{x}$  because rest of the term contains  $x$  are completely divisible by  $x$ .

**Ex.1** Find the remainder of  $\frac{9^{99}}{8}$ .

$$\text{Sol. } \frac{9^{99}}{8} = \frac{(8+1)^{99}}{8}$$

According to polynomial theorem remainder will be equal to remainder of the expression  $\frac{1^{99}}{8}$  which is equal to 1

**Ex.2** Find remainder of  $\frac{8^{99}}{7}$

$$\text{Sol. } \frac{8^{99}}{7} \Rightarrow \frac{(7+1)^{99}}{7} \Rightarrow \frac{1^{99}}{7} \text{ i.e. 1.}$$

**Ex.3** Find remainder of  $\frac{11 \times 13 \times 17}{6}$ .

$$\text{Sol. } \frac{11 \times 13 \times 17}{6} \Rightarrow \frac{5 \times 1 \times 5}{6} \Rightarrow \frac{1}{6} \Rightarrow 1. \quad [\text{According to remainder theorem.}]$$

**Ex.4** Find remainder of  $\frac{9^{100}}{7}$ .

$$\text{Sol. } \frac{9^{100}}{7} \Rightarrow \frac{(7+2)^{100}}{7} \Rightarrow \frac{2^{100}}{7} \Rightarrow [3] \\ \Rightarrow \frac{2^{99} \times 2}{7} = \frac{(2^3)^{33} \times 2}{7}$$

$$\Rightarrow \frac{(7+1)^{33} \times 2}{7} = \frac{1 \times 2}{7} = 2.$$

**Ex.5** Find remainder of  $\frac{9^{50}}{7}$ .

$$\text{Sol.: } \frac{9^{50}}{7} \Rightarrow \frac{(7+2)^{50}}{7} = \frac{2^{50}}{7} \Rightarrow \frac{(2^3)^{16} \times 2^2}{7}$$

$$\Rightarrow \frac{(7+1)^{16} \times 4}{7} \Rightarrow \frac{1 \times 4}{7} \text{ i.e. 4.}$$

**Ex.6** Find remainder of  $\frac{5^{100}}{7}$

$$\text{Sol.: } \frac{5^{100}}{7} = \left[ \frac{3 \times 7 + 4}{7} \right]^{50} \Rightarrow \frac{(4)^{50}}{7}$$

$$\Rightarrow \frac{2^{100}}{7} \Rightarrow \frac{(2^3)^{33} \times 2}{7} \Rightarrow \frac{(7+1)^{33}}{7} \times 2 \Rightarrow \frac{1 \times 2}{7}$$

$\Rightarrow$  Remainder is 2.

**Ex.7** Find remainder of  $\frac{3^{50}}{7}$ .

$$\text{Sol.: } \frac{3^{50}}{7} \Rightarrow \frac{(3^2)^{25}}{7} \Rightarrow \frac{(7+2)^{25}}{7} \Rightarrow \frac{2^{25}}{7}$$

$$\Rightarrow \frac{(2^3)^8 \times 2}{7} = \frac{(7+1)^8 \times 2}{7} \Rightarrow \frac{1 \times 2}{7}$$

$\Rightarrow$  Remainder is 2.

**Ex.8** Find remainder of  $\frac{3^{250}}{7}$ .

$$\text{Sol.: } \frac{(3^2)^{125}}{7} \Rightarrow \frac{(7+2)^{125}}{7} \Rightarrow \frac{2^{125}}{7}$$

$$\frac{(2^3)^{41} \times 2^2}{7} \Rightarrow \frac{1 \times 4}{7}$$

$\Rightarrow$  Remainder is 4.

## MORE ON REMAINDERS

### Case-I

On dividing a number by a, b & c if we get a-k, b-k and c-k as remainder respectively then that number will be  $n * \text{LCM of } [a, b, c] - k$ . For ex. 1: On dividing a number by 4, 5 & 6 we get 3, 4, & 5 as remainder. Find the number.

Sol.:

Remainder	4,	5,	6
	3,	4,	5,

which is equal to  $(4-1), (5-1), (6-1)$ , so that number will be:

$$n * \text{LCM of } (4, 5, 6) - 1,$$

$$\text{i.e. } 60 - 1 = 59.$$

Note: n such numbers are possible. Here we have taken n as 1. Other numbers are 119, 179, 239, etc. Where value of n is 2, 3, & 4 respectively.

**Ex.2** On dividing a number by 5, 6 and 7 we get 3, 4 and 5 as remainder. Find the number.

Sol.:

Remainder	5,	6,	7
	3,	4,	5

which is equal to  $(5-2), (6-2), (7-2)$

that number will be:

$$n * \text{LCM of } (5, 6, 7) - 2 = 210 - 2 = 208.$$

Note: Here we have taken value of n as 1.

**Ex.3** On dividing a number by 4 and 5 we get 2 & 3 as remainders. Find the highest double digit such number.

Sol.:

Remainder	4,	5
	2,	3

which is equal to  $(4-2), (3-2)$

that number will be:

$$n * \text{LCM of } [4, 5] - 2.$$

We get 18, 38, 58, 78, 98, 118 when value of n is 1, 2, 3, 4, 5 and 6 respectively.

Highest double digit such number will be 98 Ans.

- Ex.4** On dividing a number by 4, 5 and 6 we get 2, 3 and 4 as remainder find highest possible three digit such number.

Sol.:

$$\begin{array}{ccc} 4, & 5, & 6 \\ \text{Remainder} & 2, & 3, & 4 \\ \text{which is equal to } (4-2), & (5-2), & (6-2) \\ \text{that number will be:} & & \\ n * \text{LCM of } [4, 5, 6] - 2 = n * 60 - 2 & & \\ \text{When } n = 1 \text{ we get } 58. \text{ Highest possible} & & \\ \text{three digit such number will be } 958. & & \end{array}$$

- Ex.5** On dividing a number by 5, 6 and 7 we get 3, 4 and 5 as remainder. Find highest possible three digit such number.

Sol.:

$$\begin{array}{ccc} 5, & 6, & 7 \\ \text{Remainder} & 3, & 4, & 5 \\ \text{which is equal to } (5-2), & (6-2), & (7-2) \\ \text{that number will be:} & & \\ n * \text{LCM } (5, 6, 7) - 2 = n * 210 - 2 & & \\ \text{Highest possible three digit number will} & & \\ \text{be } 838. & & \end{array}$$

### Case-II

On dividing a number by a, b and c if we get k as remainder always, then that number will be

$$n * \text{LCM of } (a, b, c) + k.$$

- Ex.1** On dividing a number by 5, 6 and 7 if we get 2 as remainder always, find that number

Sol.: That number will be

$$\begin{aligned} n * \text{LCM of } [5, 6, 7] + 2 \\ \Rightarrow 210 + 2 = 212. \end{aligned}$$

- Ex.2** On dividing a number by 6 and 7 we get 4 as remainder always, find the highest possible three digit such number.

Sol.:  $n * \text{LCM } [6, 7] + 4$

$$= n * 42 + 4; \text{ three digit}$$

highest possible such number will be  
 $966 + 4 = 970$  Ans.

### Case-III

If a number after adding k is exactly divisible by a, b and c then that number will be,

$$n * \text{LCM } (a, b, c) - k$$

- Ex.1** Find a number which after adding 5 is divisible by 6 and 7.

Sol.: That number will be

$$\begin{aligned} n * \text{LCM of } (6, 7) - 5 \\ \text{if } n = 1 \text{ then} \\ 42 - 5 = 37. \end{aligned}$$

- Ex.2** Find a number which after adding 7 is divisible by 10, 11 and 12.

Sol.: That number will be

$$\begin{aligned} n * \text{LCM of } [10, 11, 12] - 7 \\ \text{if } n = 1 \text{ then} \\ 660 - 7 = 653 \text{ Ans.} \end{aligned}$$



### Squares of Numbers

Squares of numbers are frequently used for calculations on various types of problems. It is advisable to remember square of at least first thirty numbers.

$1^2 = 1$	$11^2 = 121$
$2^2 = 4$	$12^2 = 144$
$3^2 = 9$	$13^2 = 169$
$4^2 = 16$	$14^2 = 196$
$5^2 = 25$	$15^2 = 225$
$6^2 = 36$	$16^2 = 256$
$7^2 = 49$	$17^2 = 289$
$8^2 = 64$	$18^2 = 324$
$9^2 = 81$	$19^2 = 361$
$10^2 = 100$	$20^2 = 400$

From following table we come to know that square of a number always ends with 0, 1, 4, 5, 6 & 9 as unit digit.

Square of a number can never have 2, 3, 7 & 8 in its unit place.

MAT A

On ob  
to 29

Note:

Short  
numbe

Ex.1

Ex.2  
Sol.:

Ex.3  
Sol.:

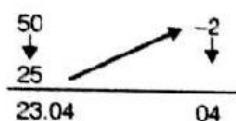
On observing squares of numbers between 21 to 29 we get following pattern.

$$\begin{array}{ll} 21^2 = 441 & 29^2 = 841 \\ 22^2 = 484 & 28^2 = 884 \\ 23^2 = 529 & 27^2 = 729 \\ 24^2 = 576 & 26^2 = 676 \\ 25^2 = 625 & \end{array}$$

**Note:** Here last two digits are common.

**Shortcuts for calculation of squares of numbers between 41 to 50.**

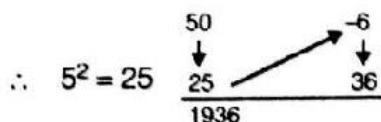
**Ex.1** Find square of 48?



Square of  $-2$  is equal to 04 so we have written 04 in last two places. Square of 5 is 25, from which we added  $-2$  and get 23. So square of 48 is 2304.

**Ex.2**  $44^2 = ?$

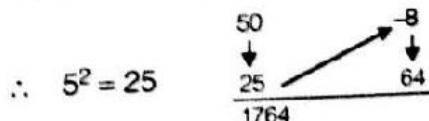
**Sol.:** 44 is  $-6$  number away from 50



Square of  $-6$  is equal to 36 so we have written 36 in last two places. Square of 5 is 25, from which we added  $-6$  and get 19. So square of 44 is 1936.

**Ex.3**  $42^2 = ?$

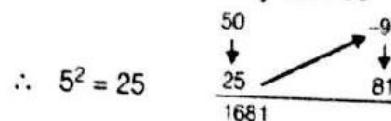
**Sol.:** 42 is  $-8$  number away from 50



Square of  $-8$  is equal to 64 so we have written 64 in last two places. Square of 5 is 25, from which we added  $-8$  and get 17. So square of 42 is 1764.

**Ex.4**  $41^2 = ?$

**Sol.:** 41 is  $-9$  number away from 50

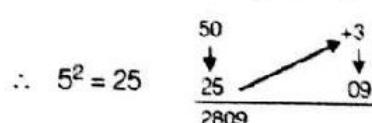


Square of  $-9$  is equal to 81 so we have written 81 in last two places. Square of 5 is 25, from which we added  $-9$  and get 16. So square of 41 is 1681.

Similarly, we can find squares of other square of number between 50 & 60.

**Ex.1**  $53^2 = ?$

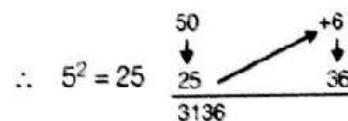
**Sol.:** 53 is  $+3$  number away from 50



Square of 3 is equal to 09 so we have written 09 in last two places. Square of 5 is 25, from which we added 3 and get 28. So square of 53 is 2809.

**Ex.2**  $56^2 = ?$

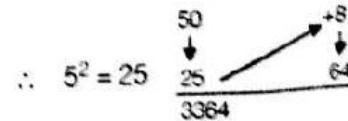
**Sol.:** 56 is  $+6$  number away from 50



Square of 6 is equal to 36 so we have written 36 in last two places. Square of 5 is 25, from which we added 6 and get 31. So square of 56 is 3136.

**Ex.3**  $58^2 = ?$

**Sol.:** 58 is  $+8$  number away from 50



Square of 8 is equal to 64 so we have written 64 in last two places. Square of 5 is 25, from which we added 8 and get 33. So square of 58 is 3364.

is 25, from which we added 8 and get 33.  
So square of 58 is 3364.

Ex.4  $59^2 = ?$

Sol.: 59 is +9 number away from 50

$$\therefore 5^2 = 25 \quad \begin{array}{r} 50 \\ \downarrow \\ 25 \end{array} \quad \begin{array}{r} +9 \\ \nearrow \\ \downarrow \\ 81 \end{array}$$

$$3481$$

Square of 9 is equal to 81 so we have written 81 in last two places. Square of 5 is 25, from which we added 9 and get 34.  
So square of 59 is 3581.

Similarly, we can find square of other numbers between 50 and 60 speedily.

□□□□

### OBSERVATIONS

Square of two digit number having 5 in unit places can be calculated very easily  
n5 here n may be any number between 1 to 9.

$$(n5)^2 = [n \times (n+1)]25$$

Ex.2  $(15)^2 = ?$

$$15^2 =$$

$$[1 \times (1+1)]25 = 225$$

Sol.:  $25^2 = ?$

$$(25)^2 = [2 \times (2+1)]25$$

$$\Rightarrow 625$$

Ex.3  $45^2 = ?$

Sol.:  $[4 \times (4+1)]25 = 2025$

Ex.4  $65^2 = ?$

Sol.:  $[6 \times (6+1)]25 = 4225$

Ex.5  $85^2 = ?$

Sol.:  $[8 \times (8+1)]25 \Rightarrow 7225$

Ex.6  $95^2 = ?$

Sol.:  $[9 \times (9+1)]25 \Rightarrow 9025$

Similarly, we can find square of 35, 55, ... also.

### Some Multiplication Techniques

Multiplication usually takes longer time than addition and subtraction. While solving problems related to ratio and proportion and percentage we have to multiply numbers in and around 100 frequently. Here, we have some tricks, which will make the task of multiplication very enjoyable.

#### Case-I

When both numbers are greater than 100.

Ex.1  $106 \times 103 = ?$

Sol.: 106 is + 6 number away from 100 and 103 is + 3 number away from 100.

$$\begin{array}{r} 106 \\ \times 103 \\ \hline 109 & 18 \end{array}$$

So  $106 \times 103$  will be equal to 10918

(Here either we are adding 106 & 3 or we are adding 103 & 6, in both case we will get 109.)

Ex.2  $104 \times 105 = ?$

Sol.:  $\begin{array}{r} 104 \\ \times 105 \\ \hline 109 & 20 \end{array}$

$= 10920$  Ans.

Ex.3  $108 \times 111 = ?$

Sol.:  $\begin{array}{r} 108 \\ \times 111 \\ \hline 119 & 88 \end{array}$

$= 11988$  Ans.

Ex.4  $121 \times 105 = ?$

Sol.:  $\begin{array}{r} 121 \\ \times 105 \\ \hline 126 & 1 & 1/05 \end{array}$

$= 12705$

Note: Multiplication of 21 and 5 will be 105 we will write 05 in first two place and 1 will become

carry which will be added to  $(105 + 21)$  and finally we get 12705 as answer.

**Ex.5**  $118 \times 118 = ?$

$$\begin{array}{r} 118 \\ \times 118 \\ \hline 139 & 3/24 \end{array}$$

Multiplication of 18 and 18 will be 324, we will write 24 in first two place and 3 will become carry which will be added to  $(118 + 18)$  and finally we get 13924 as answer.

**Ex.6**  $117 \times 177 = ?$

$$\begin{array}{r} 117 \\ \times 177 \\ \hline 136 & 2/89 \end{array}$$

Multiplication of 17 and 17 will be 289, we will write 89 in first two place and 2 will become carry which will be added to  $(117 + 18)$  and finally we get 13689 as answer.

**Ex.7**  $115 \times 108 = ?$

$$\begin{array}{r} 115 \\ \times 108 \\ \hline 124 & 1/20 \end{array}$$

Multiplication of 15 and 08 will be 120, we will write 20 in first two place and 1 will become carry which will be added to  $(108 + 15)$  and finally we get 12420 as answer.

**Ex.8**  $125 \times 103 = ?$

Sol.:  $\begin{array}{r} 125 \\ \times 103 \\ \hline 128 & 75 \end{array}$

= 12875 Ans.

**Ex.9**  $111 \times 107 = ?$

$$\begin{array}{r} 111 \\ \times 107 \\ \hline 118 & 77 \end{array}$$

= 11877 Ans.

**Ex.10**  $113 \times 112 = ?$

Sol.:  $\begin{array}{r} 113 \\ \times 112 \\ \hline 126 & 1/52 \end{array}$

Multiplication of 13 and 12 will be 152, we will write 52 in first two place and 1 will become carry which will be added to  $(112 + 12)$  and finally we get 12652 as answer.

### Case-II

When both numbers are less than 100.

**Ex.1**  $92 \times 93 = ?$

Sol.: 92 is -8 number away from 100, and 93 is -7 number away from 100, thus

$$\begin{array}{r} 92 \\ \times 93 \\ \hline 85 & 56 \\ = 8556 \text{ Ans.} \end{array}$$

**Ex.2**  $88 \times 95 = ?$

Sol.: 88 is -12 number away from 100, and 95 is -5 number away from 100, thus

$$\begin{array}{r} 88 \\ \times 95 \\ \hline 83 & 60 \\ = 8360 \text{ Ans.} \end{array}$$

Note: Here we are adding 95 and -12 or 88 and -5.

**Ex.3**  $93 \times 87 = ?$

Sol.:  $\begin{array}{r} 93 \\ \times 87 \\ \hline 80 & 91 \\ = 8091 \text{ Ans.} \end{array}$

**Ex.4**  $89 \times 88 = ?$

Sol.:  $\begin{array}{r} 89 \\ \times 88 \\ \hline 78 & 1/32 \end{array}$

Note: Here we get 132 by multiplying -11 and -12, where 1 is carry. We have to add 1 with 88 and -11 or 89 and -12 and we get desired result as 7832.

$$\text{Ex. } 5 \quad 97 \times 94 = ?$$

Sol.: 
$$\begin{array}{r} 97 \\ \times 94 \\ \hline 91 & 18 \\ = 9118 \text{ Ans.} \end{array}$$

**Ex.6**  $85 \times 98 = ?$

$$\begin{array}{r} \text{Sol.: } \\ \begin{array}{r} 85 \\ \times 96 \\ \hline 8330 \end{array} \end{array}$$

Ans.

**Ex.7**  $94 \times 98 = ?$

$$\begin{array}{r} \text{Sol.: } \\ \begin{array}{r} 94 \\ 98 \\ \hline 92 \end{array} \end{array}$$

= 9212 Ans.

**Ex.8**  $82 \times 82 = ?$

Sol.: 
$$\begin{array}{r}
 82 \\
 \times -18 \\
 \hline
 67 \quad 3/24
 \end{array}$$

Here we get 324 by multiplying -18 and -18, where 3 is carry. We have to add 3 with 82 and -18 we get desired result as 6734.

### **Case-III**

When one number is greater than 100 and another number is less than 100.

**Ex.1**  $105 \times 93 = ?$

**Sol.:** 105 is +5 number away from and 93 is -7 number away from 100.

$$\begin{array}{r}
 105 \\
 \times 93 \\
 \hline
 98 & 00 \\
 9800 & -35 \\
 \hline
 -35 \\
 \hline
 9765
 \end{array}$$

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and final result will be: 9765.

$$\begin{array}{r} \text{Ex.2} & 111 & +11 \\ & & \times \\ & \underline{88} & -12 \\ & 99 & 00 \\ & & -132 \end{array}$$

9900

-132

9768

Note: Here we have to subtract 132 from 9900 and final result will be 9768.



## Solved Examples



Last digit will be multiplication of  
 $1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 9$   
 Since 5 and 2 are given here, their multiplication will result in zero as last digit.



**Ans: (a)**  
Going through options we get  $82 - 28 = 54$



Ans: (a)

$$x^2 - 5x + 6 = (x - 3)(x - 2)$$

$$x^2 - 7x + 10 = (x - 5)(x - 2)$$

$$\text{So, HCF} = (x - 2)$$

$$\text{LCM} = (x - 2)(x - 3)(x - 5)$$

Directions for questions 12-14: Given two different prime numbers P and Q. Find the number of divisors of the following:

12.  $P \times Q$

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

Ans: (b)

$$P \times Q = P^1 \times Q^1$$

$$\Rightarrow \text{Number of divisor} = (1+1)(1+1) = 4$$

13.  $P^2 \times Q$

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

Ans: (c)

$$P^2 Q$$

$$\text{Number of divisor} = (2+1)(1+1) = 4$$

14.  $P^3 \times Q^2$

- |       |        |
|-------|--------|
| (a) 2 | (b) 4  |
| (c) 6 | (d) 12 |

Ans: (d)

$$P^3 \times Q^2$$

$$\text{Number of divisors} = (3+1)(2+1) = 12$$

15. A milkman has three different qualities of milk. 403 gallons of 1st quality, 465 gallons of 2nd quality and 496 gallons of 3rd quality. Find the least possible number of bottles of equal size in which different milk of different qualities can be filled without mixing?

- |        |        |
|--------|--------|
| (a) 34 | (b) 46 |
| (c) 26 | (d) 44 |

Ans: (d)

It is given that milk of

Ist quality : 403 gallons

IIInd quality : 465 gallons

IIIrd quality : 496 gallons

least number of bottles of equal size will be possible, when we have bottle having highest or largest size. Largest size bottle can be found by finding HCF of 403, 465 & 496.

$$403 = 13 \times 31$$

$$465 = 15 \times 31$$

$$496 = 16 \times 31$$

$$\text{HCF} = 31$$

$$\begin{aligned} \text{Total numbers of gallon required} \\ = 13 + 15 + 16 = 44 \text{ gallons.} \end{aligned}$$

16. What is the greatest number of 4 digits that when divided by any of the numbers 6, 9, 12, 17 leaves a remainder of 1?

- |          |          |
|----------|----------|
| (a) 9997 | (b) 9793 |
| (c) 9895 | (d) 9487 |

Ans: (b)

$$\text{LCM of } 6, 9, 12, 17 = 612$$

greatest number of 4 digit divisible by 612 is 9792, to get remainder 1 number should be 9792+1.

17. Which of the following is not a perfect square?

- |            |                  |
|------------|------------------|
| (a) 100858 | (b) 3, 25, 137   |
| (c) 945723 | (d) All of these |

Ans: (d)

Square of number never ends up with 2, 3, 7, 8

18. Which of the following can never be in the ending of a perfect square?

- |         |        |
|---------|--------|
| (a) 6   | (b) 00 |
| (c) 000 | (d) 5  |

Ans: (c)

19. The LCM of 5, 8, 12, 20 will not be a multiple of

- |       |       |
|-------|-------|
| (a) 3 | (b) 9 |
| (c) 8 | (d) 5 |

Ans: (b)

LCM of 5, 8, 12, 20 will not be a multiple of 3

20. The LCM of  $(16 - x^2)$  and  $(x^2 + x - 6)$  is

- |                               |
|-------------------------------|
| (a) $(x - 3)(x + 3)(4 - x^2)$ |
| (b) $4(4 - x^2)(x + 3)$       |

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(c) (4 -)

(d) None

Ans: (d)

$16 - x^2 =$

$(x^2 + x - 6)$

LCM will (

21. GCD of  $x^2 -$

(a)  $x + 2$

(c)  $x^2 - 2$

Ans: (b)

$x^2 - 4 = (x -$

$(x^2 + x - 6)$

GCD =  $(x -$

22. Decomposi

such that th

(a)  $x_1 = x_2$

(c)  $x_1 = 8, x_2$

Ans: (a)

If  $x + y = cc$

when  $x = y$

here,  $x_1 + x_2$

$x_1 = x_2 = 10$

23. Which of t

divisible by

(a) 432156

(c) 136248

Ans: (c)

A number c

3 and 8

Only 13624

24. For a numb

be

(a) Divisibl

(b) Divisibl

(c) Divisibl

(d) Both b

MADE EASY

MADE EASY



28. Find the pairs of natural numbers whose least common multiple is 78 and the greatest common divisor is 13.

- (a) 58 and 13 or 16 and 29
- (b) 38 and 23 or 36 and 49
- (c) 18 and 73 or 56 and 93
- (d) 78 and 13 or 26 and 39

Ans. (d)

$$\text{LCM} = 78 \text{ and GCD} = 13$$

Clearly 13, 78 and 26, 39 are the two numbers.

29. Find two natural numbers whose sum is 86 and the least common multiple is 102.

- (a) 30 and 56
- (b) 17 and 68
- (c) 35 and 56
- (d) 51 and 34

Ans. (d)

$$\text{Sum } x + y = 86$$

$$\text{LCM} = 102$$

going by options we can easily find that 51 and 34 are only numbers.

30. What digits should be put in place of c in  $38c$  to make it

- (1) divisible by 2 (2) divisible by 3
- (3) divisible by 4 (4) divisible by 5
- (5) divisible by 6 (6) divisible by 9
- (7) divisible by 10

Ans. The given number is  $38c$ .

- (1) → to make it divisible by 2, c should be 0, 2, 4, 6, 8
- (2) → to make it divisible by 3, c should be 1, 4, 7
- (3) → to make it divisible by 4, c should be 0, 4, 8
- (4) → to make it divisible by 5, c should be 0, 5
- (5) → to make it divisible by 6, c should be 4
- (6) → to make it divisible by 9, c should be 7
- (7) → to make it divisible by 10, c should be 0



### Solved Examples

1. Fill in the blank indicated by a star \* in the number  $4^* 56$  so as to make it divisible by 3.

- (a) 3
- (b) 4
- (c) 5
- (d) None of these

Ans. (a)

$4^* 56$  is divisible by 3 if and only if it is divisible by 3 and 11.

$4^* 56$  will be divisible by 3 if \* will be equal to 0, 3, 6, 9.

$4^* 56$  is divisible by 11 if  $(4 + 5) - (*) - 6$  will be divisible by 11 so \* should be 3.

2. Find the least number which being divided by 9, 12, 16 and 30 leaves in each case a remainder 3.

- (a) 623
- (b) 723
- (c) 728
- (d) None of these

Ans. (b)

LCM of 9, 12, 16 and 30 is 720 so required number is  $\text{LCM} + 3 = 723$

3. Find the number which being increased by 1 will be exactly divisible by 17, 22, 33 and 102.

- (a) 1131
- (b) 1121
- (c) 1001
- (d) None of these

Ans. (b)

LCM of 17, 22, 33 and 102 is 1122

So the desired number is  $1122 - 1 = 1121$

4. Find the greatest number less than 1000 which is divisible by 48, 60 and 64.

- (a) 9600
- (b) 8500
- (c) 7600
- (d) None of these

Ans. (a)

The required number will be the largest 3-digit number in form of  $n^{\text{th}}$  LCM of 48, 60 and 64.

LCM of 48, 60 and 64 is 960

So the largest four digit number will be 960.

5. Find the least multiple of 11 which when divided by 8, 9, 12, 14 leaves 4 as remainder in each case.

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- (a) 1172
- (b) 1190
- (c) 1210
- (d) 1230

Ans. (a)

The required number is 1172

- (a) 3652
- (b) 1120
- (c) 1130
- (d) 1112

Ans. (a)

The required number is 1130

- (a) 521, 530
- (b) 721, 1030
- (c) 1131
- (d) 1121

Ans. (a)

Going by option option (a) is same

6. The LCM of two numbers is 100. The sum of the two numbers is 80. Find the HCF of the two numbers.

- (a) 134
- (b) 128
- (c) 125
- (d) 120

Ans. (b)

It is given that LCM  $\times$  HCF = 100  $\times$  HCF = LCM  $\Rightarrow$  HCF =  $100 / \text{LCM}$

$$\Rightarrow 100 / 100 = 1$$

7. If a person wants to spend Rs. 1100 from his savings to buy a television set worth Rs. 1000 and a refrigerator worth Rs. 200, then he has to save

- (a) 100
- (b) 105
- (c) 110
- (d) 115

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The average of a number is a measure of central tendency of a set of Numbers. In other words, it is an estimate of where the center point of a set of numbers lies.

$$\text{Average} = \frac{\text{Sum of set of } N \text{ number}}{N}$$

This also means

$$\text{Average} \times N = \text{sum of set of numbers.}$$

**Illustration:** Let suppose the score of Sachin Tendulkar in last 5 matches are 90, 150, 10, 70, 45, then average score will be

$$Av = \frac{90+150+10+70+45}{5} = \frac{365}{5} = 73$$

### Concept of Weighted Average

When we have two or more groups whose individual averages are known, then to find the combined average of all the elements of all the groups we use weighted average. Thus, if we have K groups with Averages  $A_1, A_2, \dots, A_k$  and having  $n_1, n_2, \dots, n_k$  elements then the weighted average is given by formula:

$$A_w = \frac{n_1 A_1 + n_2 A_2 + n_3 A_3 + \dots + n_k A_k}{n_1 + n_2 + n_3 + \dots + n_k}$$

**Illustration:** Let Rahul's average score in 5 test of maths is 75, 4 test of physics is 80 and 3 test of

chemistry is 90 the find the overall average marks obtained by him in these subjects.

Here we have to calculate weighted average which can be calculated by

$$A_w = \frac{75 \times 5 + 80 \times 4 + 90 \times 3}{5 + 4 + 3} = \frac{965}{12} \\ = 80.4 \text{ approx}$$

Sometimes weighted average is used to find merit order of students in competition examinations. Like for examples if in a Pre Engineering Test (PET) sum of scores obtained by two students are equal then their weighted average is calculated to find order of ranking

**Illustration:** RAHUL & Ravi Scored following marks in PET exam.

Subject	Rahul	Ravi
Maths	90	80
Physics	70	60
Chemistry	60	80

In this case total scores are equal for Rahul and Ravi. To find ranking weights can be given in following manner. Maths 3, Physics 2, and Chemistry 1 in this case weighted average can be calculated as

$$A_w(\text{Rahul}) = \frac{90 \times 3 + 70 \times 2 + 60 \times 1}{6}$$













**Ans. (d)**

The required average

$$= \frac{20 \times 30 + 30 \times 20}{50} = \frac{1200}{50} = 24$$

30. The average temperature on Monday, Tuesday and Wednesday was  $41^{\circ}\text{C}$  and on Tuesday, Wednesday and Thursday it was  $40^{\circ}\text{C}$ . If on Thursday it was exactly  $39^{\circ}\text{C}$ , then on Monday, the temperature was

- (a)  $42^{\circ}\text{C}$       (b)  $46^{\circ}\text{C}$   
 (c)  $23^{\circ}\text{C}$       (d)  $26^{\circ}\text{C}$

**Ans. (a)**

The sum of temp. on Tuesday and Wednesday  
 $= 3 \times 40 - 39 = 81^{\circ}\text{C}$

The sum of temp. on Monday, Tuesday and Wednesday  $= 3 \times 41 = 123$

Then temp. on Monday will be  
 $123 - 81 = 42^{\circ}\text{C}$



### Average



#### Practice Exercise: I

1. The daily earnings of a taxi driver during a week are : Rs. 60, Rs. 65, Rs. 70, Rs. 52.50, Rs. 63, Rs. 73 and Rs. 68. What is his average daily earning for the week?  
 (a) Rs 74.50      (b) Rs 54.50  
 (c) Rs 64.50      (d) Rs 84.50
2. The average of 10 numbers is 7. What will be the new average if each of the numbers is multiplied by 8?  
 (a) 45      (b) 52  
 (c) 56      (d) 55
3. There are 35 students in a hostel. If the number of students increased by 7, the expenses of the mess were increased

by Rs. 42 per day while the average expenditure per head diminished by Rs 1. Find the original expenditure of the mess.

- (a) Rs. 480      (b) Rs. 440  
 (c) Rs. 520      (d) Rs. 420

4. An aeroplane travels distances 2500 km, 1200 km and 500 km at the rate of 500 km/hr, 400 km/hr and 250 km/hr respectively. The average speed of the aeroplane is

- (a) 420 km/hr      (b) 410 km/hr  
 (c) 405 km/hr      (d) 575 km/hr

5. The average weight of 24 students of section A of a class is 58 kg whereas the average weight of 26 students of section B of the same class is 60.5 kg. Find the average weight of all the 50 students of the class.

- (a) 57.4 Kg.      (b) 59.3 kg  
 (c) 58.9 kg      (d) 59.7 kg

6. The average age of 5 members is 21 years. If the age of the youngest member be 5 years, find the average age of the family at the birth of the youngest member.

- (a) 24 years      (b) 25 years  
 (c) 20 years      (d) 28 years

7. The average monthly salary of a staff of 9 persons is Rs. 2450. One member of the staff whose monthly salary is Rs. 2650 is transferred. Find the average salary of the remaining 8 persons of the staff.

- (a) Rs. 2425      (b) Rs. 2625  
 (c) Rs. 3025      (d) Rs. 2825

8. The average of five consecutive even numbers starting with 4, is

- (a) 6      (b) 7  
 (c) 8      (d) 7.5

9. 3 years ago the average age of a family of 5 members was 17 years. With the birth of a new baby the average remains the same even today. Find the age of the baby.

- (a) 1 year  
 (c)  $2\frac{1}{2}$  yrs

10. The average average of 11 numbers is 11. The 11th number is

- (a) 11.8  
 (c) 10.9

11. A batsmen's runs in 10 matches are 55, 85, and the remaining 8 matches are 3. What is his average? He had never been out.

- (a) 47  
 (c) 39

12. The sum of the first 5 numbers between first 5 numbers between second number and 58 is

- (a) 30  
 (c) 58

13. A number  $x$  is such that  $x + 5, 7, 14$  and  $x + 26$  are in AP. Then  $x$  is

- (a) 13  
 (c) 39

14. It rained as much as the others did in a month. The average rainfall for the month was 10 cm. How much did it rain on the last day?

- (a) 2.625 cm  
 (c) 10.5 cm

15. The average age of a family of 2 years who have 20 years a child replaced by a new baby. The age of the baby is

- (a) 36 years  
 (c) 40 years

- |  |         |          |
|--|---------|----------|
| 10. The author's work is not open to<br>criticism by other people because the<br>author is the only person who can<br>interpret his own writing. | A. True | B. False |
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| 20. The author's work is not open to<br>criticism by other people because the<br>author is the only person who can<br>interpret his own writing. | A. True | B. False |

## \* CROPPING TO PASTURES

## Solutions

- 1. Ans. (c)**

Total earning for 7 days  
 $= \text{Rs } (60 + 65 + 70 + 52.50 + 63 + 73 + 68)$   
 $= \text{Rs } 451.50$   
 Average daily earning  
 $= \text{Rs } \frac{451.50}{7} = \text{Rs } 64.50$

**2. Ans. (c)**

The average of 10 numbers = 7  
 Total of 10 numbers =  $10 \times 7 = 70$

New total of 10 numbers after each given numbers is multiplied by 8 =  $70 \times 8 = 560$

$$\therefore \text{New average} = \frac{560}{10} = 56.$$

**3. Ans. (d)**

Let the original expenditure = Rs.  $x$

$$\text{Original average expenditure} = \frac{x}{35}$$

$$\text{New average expenditure} = \frac{x+42}{42}$$

$$\Rightarrow \frac{x}{35} - \frac{x+42}{42} = 1 \Rightarrow x = 420$$

$\therefore$  Original expenditure = Rs. 420

**4. Ans. (a)**

The total time taken can be calculated as shown below :

Distance	Speed	Time
2500 km	500 km/hr	5 hrs.
1200 km	400 km/hr	3 hrs.
500 km	250 km/hr	2 hrs.
Total 4200 km		10 hrs.

$$\text{Average speed} = \frac{4200}{10} = 420 \text{ km/hr.}$$

**5. Ans. (b)**

$$\text{Average weight} = \frac{24 \times 58 + 26 \times 60.5}{50}$$

$$= \frac{2965}{50} = 59.3 \text{ kg}$$

**6. Ans. (c)**

Total age of 5 members

$$= 21 \times 5 = 105 \text{ year}$$

Total age of 4 members at the birth of the younger member, that is, 5 years ago

$$= 105 - (5 \times 5) = 80 \text{ years}$$

Before the birth of the youngest member, the family consisted of only 4 members.

Average age of 4 members 5 years ago

$$= \frac{80}{4} = 20 \text{ years.}$$

**7. Ans. (a)**

Average salary of 9 persons = Rs. 2450

Total salary of 9 persons

$$= \text{Rs. } 2450 \times 9 = \text{Rs. } 22050$$

Total salary of the person who is transferred

$$= \text{Rs. } 2650$$

Thus, the total salary of remaining 8 persons

$$= \text{Rs. } 22050 - 2650 = \text{Rs. } 19400$$

The average salary of the remaining 8 persons

$$= \text{Rs. } \frac{19400}{8} = \text{Rs. } 2425.$$

**8. Ans. (c)**

The five even consecutive numbers are

4, 6, 8, 10 and 12

Their average

$$= \frac{4+6+8+10+12}{5} = \frac{40}{5} = 8.$$

**9. Ans. (d)**

Present age of 5 members

$$= (5 \times 17 + 3 \times 5) \text{ years.}$$

$$= 100 \text{ years.}$$

Present age of 5 members and a baby

$$= 17 \times 6 = 102 \text{ years.}$$

$\therefore$  Age of the baby =  $(102 - 100)$  yrs = 2 years.

**10. Ans. (a)**

Sum of first nine numbers + sum of last nine number =  $10.5 \times 9 + 11.4 \times 9$

$$= 21.9 \times 9 = 197.1$$

Hence, the middle number

$$= 197.1 - 17 \times 10.9$$

$$= 197.1 - 185.3 = 11.8.$$

**11. Ans. (b)**

Average score before 17th innings

$$= 85 - 3 \times 17 = 34$$

$\therefore$  Average score after 17th innings

$$= 34 + 3 = 37.$$

**12. Ans. (a)**

It is given that  $A : B = 2 : 3$  and  $B : C = 5 : 8$

Combined ratio of  $A : B : C$  will be  $10 : 15 : 24$

Since  $A + B + C = 98$

therefore  $A = 20$

$$B = 30$$

$$C = 48$$

Note: Please refer Ratio & Proportion to find out combined ratio of three numbers.

**13. Ans. (c)**

$$\text{Average of } 5, 7, 14 \text{ and } y = \frac{5+7+14+y}{4}$$

$$\text{It is given that, } x = 80\% \text{ of } \frac{5+7+14+y}{4}$$

$$= \frac{80}{100} \times \frac{26+y}{4}$$

$$\Rightarrow x = \frac{26+y}{5} \quad \dots(i)$$

$$\text{Also } \frac{x+y}{2} = 26 \quad \dots(ii)$$

From (i) and (ii), we get

$$5x - y = 26 \quad \dots(iii)$$

$$x + y = 52 \quad \dots(iv)$$

Solving (iii) & (iv) we get  $y = 39$ .

**14. Ans. (c)**

Let the rainfall on Wednesday be  $x$  cm so that on the other 6 days, the total is also  $x$ .

Since average rainfall for the week = 3 cm.  
 $\therefore x + x = 3 \times 7$  or,  $x = 10.5$  cm.

**15. Ans. (b)**

Let the average age of 8 men be  $x$  years

$\therefore$  Sum of the ages of 8 men =  $8x$  years

Now, according to the condition of the question, average age of (6 men + 2 women)

$$= (x + 2) \text{ years}$$

$\therefore$  Sum of the ages of (6 men + 2 women) =  $8(x + 2) = 8x + 16$  years

Hence, it is clear that on replacing two men by two women, sum of their ages increased by 16 years

Therefore, sum of the ages of two women

$$= (20 + 24) + 16 = 60 \text{ years}$$

$\therefore$  Average age of two women

$$= \frac{60}{2} = 30 \text{ years}$$

**16. Ans. (b)**

$$\text{Average speed} = \frac{\text{Total distance covered}}{\text{Total time taken}}$$

$$\Rightarrow \frac{100+100+100}{\frac{100}{30} + \frac{100}{40} + \frac{100}{50}} = 38.3 \text{ km/hr}$$

**17. Ans. (c)**

$$\text{Weight of D} = (80 \times 4 - 84 \times 3) \text{ kg} = 68 \text{ kg}$$

$$\text{Weight of E} = (68 + 3) \text{ kg} = 71 \text{ kg}$$

(B + C + D + E)'s Weight

$$= (79 \times 4) \text{ kg} = 316 \text{ kg}$$

$\therefore$  (B+C)'s weight = [316 - (68 + 71)] kg

$$= 177 \text{ kg}$$

Hence, A's weight = [(84 × 3) - 177] kg = 75 kg

**18. Ans. (d)**

go by option

**19. Ans. (a)**

Correct average

$$= \frac{50 \times 36 - 73 + 37}{36} = \frac{1764}{36} = 49 \text{ kg}$$

**20. Ans. (a)**

Let the number of candidates who passed =  $x$ .

$$\text{Then, } 39 \times x + 15 \times (120 - x) = 120 \times 35$$

$$\therefore 24x = 4200 - 1800$$

$$\text{or, } x = \frac{2400}{24}, x = 100.$$

**21. Ans. (a)**

Total decrease =  $(20 \times 2)$  months

= 3 years 4 months  
 $\therefore$  Age of the new boy = 18 years - 3 years  
 4 months  
 = 14 years 8 months.

## 22. Ans. (d)

Let the numbers be  $x$  and  $y$ ,  $x < y$   
 Then,  $x + y = 124$ ;

$$\frac{x+2}{y} = \frac{1}{2} \Rightarrow y = 2x + 4.$$

Solving above equations, we get  
 $y = 84$ ,  $x = 40$ .

## 23. Ans. (c)

Let daily wages of C =  $x$   
 Then, daily wages of A =  $2x$   
 and, daily wages of B =  $x + 40$   
 Hence, average daily wages of A, B and C

$$= \frac{x+2x+x+40}{3} = \frac{4x+40}{3}$$

$$\therefore \frac{4x+40}{3} = 120 \text{ or, } 4x+40 = 360$$

$$\Rightarrow 4x = 320 \text{ or, } x = 80$$

$\therefore$  Wages of A per day =  $2 \times 80$  = Rs. 160.

## 24. Ans. (c)

Let the distance be  $x$  km  
 Then it is given that

$$\frac{x}{35} - \frac{x}{40} = \frac{15}{60}$$

$$\text{or } \frac{5x}{35 \times 40} = \frac{1}{4}$$

$$\text{or } x = \frac{35 \times 40}{5 \times 4} = 70$$

## 25. Ans. (c)

Let the number of candidates be  $x$ . Then, total marks obtained by all the candidates =  $45x$

Marks reduced for 90 candidates

$$= 30 \times 90 = 2700$$

Total reduced marks =  $45x - 2700$

$$\text{Reduced average} = \frac{45x - 2700}{x}$$

$$\therefore 40 = \frac{45x - 2700}{x}$$

$$\text{or, } 40x = 45x - 2700$$

$$\Rightarrow 5x = 2700 \text{ or, } x = 540$$

## 26. Ans. (a)

Let the number of wickets taken before the last match =  $x$

Total run scored after last match  
 $= 12.4x + 26$

After last match average is reduced by 0.4 runs  
 So it becomes 12

Then total run scored

$$\begin{aligned} &= \text{Average} \times \text{Number of wickets taken} \\ &= 12 \times (x + 5) \end{aligned}$$

$$\Rightarrow 12.4x + 26 = 12x + 60$$

$$\Rightarrow 0.4x = 34$$

$$\Rightarrow x = 85$$

## 27. Ans. (b)

Suppose the average expenditure was Rs.  $x$ . Then, total expenditure =  $35x$

When 7 more students join the mess, total expenditure =  $35x + 42$

Now, the average expenditure

$$= \frac{35x + 42}{35 + 7} = \frac{35x + 42}{42}$$

$$\text{Now, we have } \frac{35x + 42}{42} = x - 1$$

$$\therefore x = 12$$

Thus, the original expenditure of the mess

$$35 \times 12 = \text{Rs. } 420$$

## 28. Ans. (c)

Let the number be  $n - 1$ ,  $n$  and  $n + 1$ .

Their average =  $n$

Next two consecutive numbers are  $n + 2$  and  $n + 3$

42 | • Average

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Therefore, the average of five numbers

$$\begin{aligned} &= \frac{(n-1) + n + (n+1) + (n+2) + (n+3)}{5} \\ &= \frac{5n+5}{5} = n+1. \end{aligned}$$

29. Ans. (c)

Let the number be  $x, 2x, \frac{2}{3}x$

$$\text{Average} = \frac{x + 2x + \frac{2}{3}x}{3} \Rightarrow \frac{11x}{9} = 44$$

$$\therefore x = \frac{44 \times 9}{11} = 36$$

So, the numbers are 36, 72 and 24  
Hence, the largest one is 72.

30 Ans. (b)

New average of the committee (in years)

$$= \frac{8 \times 40 - 55 + 39}{8} = \frac{320 - 16}{8} = \frac{304}{8}$$

= 38 years.



### Ratio

A ratio is a comparison by division. It is a comparison between two or more quantities. A ratio means the relationship between two or more quantities.

If a and b are two quantities, then the ratio of a to b is a/b or a : b. The first term a is called antecedent and the second term b is called consequent.

For Example:

Antecedent 5 : Consequent 3

### Note

- 1. A ratio is a comparison by division.
- 2. A ratio is a comparison between two or more quantities.
- 3. A ratio means the relationship between two or more quantities.
- 4. If a and b are two quantities, then the ratio of a to b is a/b or a : b.
- 5. The first term a is called antecedent and the second term b is called consequent.



## Ratio & Proportion

### Ratio

A ratio is a comparison of two quantities by division. It is a relation that one quantity bears to another with respect to magnitude. In other words, ratio means what part one quantity is of another. The quantity may be same kind or different kinds.

If  $a$  and  $b$  are two numbers, then the ratio of  $a$  to  $b$  is  $a/b$  or  $a+b$  and is denoted by  $a : b$ . The two quantities that are being compared are called terms. The first is called antecedent and second term is called consequent.

For Example, the ratio  $5 : 8$  represent  $\frac{5}{8}$  with antecedent 5 and consequent 8.

#### Note:

1. A ratio is a number, so to find the ratio of two quantities, they must be expressed in the same units.
2. A ratio does not change if both of its terms are multiplied or divided by the same number. Thus,  $\frac{3}{4} = \frac{6}{8} = \frac{12}{16}$  etc.

### Type of Ratios

1. **Duplicate Ratio:** The ratio of squares of two number is called the duplicate ratio of the two numbers.

For example:

$\frac{2^2}{5^2} = \frac{4}{25}$  is called the duplicate ratio of  $\frac{2}{5}$ .

2. **TriPLICATE Ratio:** The ratio of the cubes of two number is called the triplicate ratio of the two numbers.

For examples,

$\frac{2^3}{5^3}$  or  $\frac{8}{125}$  is triplicate ratio of  $\frac{2}{5}$ .

3. **Sub-duplicate Ratio:** The ratio of the square root of two number is called the sub-duplicate ratio of two numbers for example,

$\frac{2}{3}$  is sub-duplicate ratio of  $\frac{4}{9}$ .

4. **Sub-triplicate Ratio:** The ratio of the cube roots of two numbers is called the sub-triplicate ratio of two numbers.

For example

$\frac{3}{4}$  is sub-triplicate ratio of  $\frac{27}{64}$ .

5. **Inverse Ratio or Reciprocal Ratio:** If the antecedent and consequent of a ratio interchange their places, the new ratio is called the inverse ratio of the first.

Thus, if  $a : b$  be the given ratio, then

$\frac{1}{a} : \frac{1}{b}$  or  $b:a$  is its inverse ratio.

For example,

$\frac{4}{3}$  is the inverse ratio of  $\frac{3}{4}$ .

6. **Compound Ratio:** The ratio of the product of the antecedent to that of the consequent of two or more given ratios is called the compound ratio. Thus if  $a:b$  and  $c:d$  are two given ratios, then  $ac:bd$  is the compound ratio of the given ratios.

For example if  $\frac{1}{2} : \frac{3}{4} : \frac{5}{7}$  be the given ratios,

then their compound ratio is  $\frac{1 \times 3 \times 5}{2 \times 4 \times 7} = \frac{15}{56}$



## Proportion

The equality of two ratios is called proportion if  $\frac{a}{b} = \frac{c}{d}$ , then  $a, b, c$  and  $d$  are said to be in proportion and we write

$a:b :: c:d$

This is read as "a is to be as c is to d"

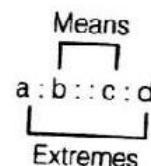
For example, since  $\frac{3}{5} = \frac{15}{25}$ , we write

$3:5 :: 15:25$  and say 3, 5, 15, 25 are in proportion.

Each term of the ratio  $\frac{a}{b}$  and  $\frac{c}{d}$  is called a proportion.  $a, b, c$  and  $d$  are respectively the first, second, third and fourth proportional. Here  $a, d$  are known as extremes and  $b, c$  are known as means.

## SOME BASIC FORMULAE

1. If four quantities are in proportion, the product of means = Product of Extremes for example, in proportion  $a:b::c:d$ , we have  $b \times c = a \times d$



From this relation we see that if any three of the four quantities are given, the fourth can be determined.

### 2. Fourth Proportional

If  $a:b::c:x$ ,  $x$  is called the fourth proportional of  $a, b, c$ .

We have,  $\frac{a}{b} = \frac{c}{x}$  or  $x = \frac{b \times c}{a}$

Thus, fourth proportional of  $a, b, c$ , is  $\frac{b \times c}{a}$

**Example:** Find the fourth proportional to the numbers 3, 8, 6

**Solution:** Let  $x$  be the fourth proportional, then

$$3:8 :: 6:x \text{ or } \frac{3}{8} = \frac{6}{x}$$

$$\therefore x = \frac{6 \times 8}{3} = 16.$$

### 3. Third Proportional

If  $a:b::b:x$  is called the third proportional of  $a, b$

We have  $\frac{a}{b} = \frac{b}{x}$  or  $x = \frac{b^2}{a}$

Thus, third proportional of  $a, b$  is  $\frac{b^2}{a}$ .

**Example:** Find a third proportional to the numbers 3, 6

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$4:x ::$

$\frac{4}{x} = \frac{x}{64}$

5. If  $\frac{a}{b} = \frac{c}{d}$

(i)  $\frac{a+b}{b}$

(ii)  $\frac{a-b}{b}$

(iii)  $\frac{a+t}{a-t}$

(iv)  $\frac{a}{b} = \frac{b}{d}$

Example

their quo

Solutio

Given

and

**Solution:** If third proportional is  $x$  then  
 $3 : 6 :: 6 : x$

$$\text{So } x = \frac{36}{3} = 12$$

#### 4. Mean Proportional

If  $a : x :: x : b$ ,  $x$  is called the mean or second proportional of  $a, b$ .

We have,  $\frac{a}{x} = \frac{x}{b}$  or  $x^2 = ab$

$$x = \sqrt{ab}$$

∴ Mean proportional of  $a$  and  $b$  is  $\sqrt{ab}$

We also say that  $a, x, b$  are in continued proportion

**Example:** Find the mean proportional between 4 and 64.

**Solution:** Let  $x$  be the mean proportional. Then  $4 : x :: x : 64$  or

$$\frac{4}{x} = \frac{x}{64} \text{ or } x^2 = 4 \times 64, x = 16$$

5. If  $\frac{a}{b} = \frac{c}{d}$  then

$$(i) \frac{a+b}{b} = \frac{c+d}{d} \text{ (componendo)}$$

$$(ii) \frac{a-b}{b} = \frac{c-d}{d} \text{ (Dividendo)}$$

$$(iii) \frac{a+b}{a-b} = \frac{c+d}{c-d} \\ \text{(Componendo and Dividendo)}$$

$$(iv) \frac{a}{b} = \frac{a+c}{b+d} = \frac{a-c}{b-d}$$

**Example:** The sum of two numbers is  $c$  and their quotient is  $P/Q$ . Find the numbers.

**Solution:** Let the numbers be  $x, y$

$$\text{Given } x+y=c \quad \dots(i)$$

$$\text{and } \frac{x}{y} = \frac{P}{Q} \quad \dots(ii)$$

$$\text{So } \frac{x}{x+y} = \frac{P}{P+Q} = \frac{x}{c} = \frac{P}{P+Q} \quad (\text{using (i)})$$

$$\Rightarrow x = \frac{Pc}{P+Q}$$



## Partnership

To run a business or any organization, we need to have partnerships. There are two types of partners.

1. **Working Partner:** Those partners who invest the money and manage the business or affairs of organization are called working partners.
2. **Sleeping Partners:** Those partners who merely invest money and do not involve in business affairs are called sleeping partners.

Mainly there are four types of conditions related to distribution of profit in business.

(Here we will use following notations.

Ratio of Profit =  $P_1 : P_2 : P_3 : \dots : P_n$

Ratio of Capital invested =  $C_1 : C_2 : C_3 : \dots : C_n$

Ratio of Time period of investments =  $t_1 : t_2 : t_3 : \dots : t_n$ )

### Condition I:

When time period of investment is constant then profit of partners will be divided into ratio

$C_1 : C_2 : C_3 : \dots : C_n$ , where

$C_1, C_2, C_3 : \dots : C_n$  are investments of respective partners.

**Ex.1** What will be ratio of profit if three partners

A, B and C are investing 20000, 45000 and Rs. 60000 for one year.

**Sol.:** Ratio of profits of A, B and C will be

$$20000 : 45000 : 60000$$

$$\Rightarrow 4 : 9 : 12 \text{ Ans.}$$

### Condition II:

When amount invested is same for different partners but time period is different

then profit will be divided into ratio of their time invested i.e.

1. What is the name of the  
country where the  
people speak English?  
2. What is the name of the  
country where the  
people speak French?  
3. What is the name of the  
country where the  
people speak Spanish?  
4. What is the name of the  
country where the  
people speak German?  
5. What is the name of the  
country where the  
people speak Italian?  
6. What is the name of the  
country where the  
people speak Chinese?  
7. What is the name of the  
country where the  
people speak Arabic?  
8. What is the name of the  
country where the  
people speak Russian?  
9. What is the name of the  
country where the  
people speak Portuguese?  
10. What is the name of the  
country where the  
people speak Polish?  
11. What is the name of the  
country where the  
people speak Vietnamese?  
12. What is the name of the  
country where the  
people speak Korean?  
13. What is the name of the  
country where the  
people speak Japanese?  
14. What is the name of the  
country where the  
people speak Turkish?  
15. What is the name of the  
country where the  
people speak Hebrew?  
16. What is the name of the  
country where the  
people speak Farsi?  
17. What is the name of the  
country where the  
people speak Punjabi?  
18. What is the name of the  
country where the  
people speak Bengali?  
19. What is the name of the  
country where the  
people speak Marathi?  
20. What is the name of the  
country where the  
people speak Telugu?  
21. What is the name of the  
country where the  
people speak Malayalam?  
22. What is the name of the  
country where the  
people speak Punjabi?  
23. What is the name of the  
country where the  
people speak Bengali?  
24. What is the name of the  
country where the  
people speak Marathi?  
25. What is the name of the  
country where the  
people speak Telugu?  
26. What is the name of the  
country where the  
people speak Malayalam?



Note: If there are two numbers  $N_1$  &  $N_2$  then  $N_1 \times N_2 = \text{HCF of } (N_1, N_2) \times \text{LCM of } (N_1, N_2)$

7. The incomes of A and B are in the ratio 3 : 2 and their expenditures are in the ratio 5 : 3. If each saves Rs. 1000, then, A's income is  
 (a) Rs. 3000      (b) Rs. 4000  
 (c) Rs. 6000      (d) Rs. 9000

Ans. (c)

Let incomes are  $3x : 2x$   
 expenditures are  $5y : 3y$   
 then

$$\begin{aligned} 3x - 5y &= 1000 & \dots(\text{i}) \text{ also} \\ 2x - 3y &= 1000 & \dots(\text{ii}) \\ \text{from (i) and (ii) we get} \\ 6x - 10y &= 2000 \\ + 6x - 9y &= 3000 \\ \Rightarrow -y &= -1000 \\ y &= 1000, x = 2000 \\ \text{A's income is } 6000 \end{aligned}$$

8. If the ratio of sines of angles of a triangle is  $1 : 1 : \sqrt{2}$ , then the ratio of square of its greatest side to sum of the squares of other two sides is

- (a) 3 : 4  
 (b) 2 : 1  
 (c) 1 : 1  
 (d) Can't be determined

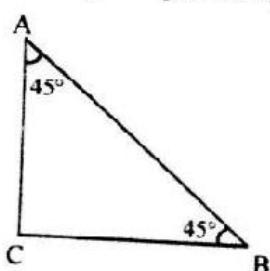
Ans. (c)

$$\sin A : \sin B : \sin C = 1 : 1 : \sqrt{2}$$

$$\sin A : \sin B = 1 : 1$$

angle are equal

So it is a right angled triangle.



$$\text{the } AB^2 : (AC + CB)^2 = 1 : 1$$

9. Divide Rs. 680 among A, B and C such that A gets  $\frac{2}{3}$  of what B gets and B gets  $\frac{1}{4}$  of what C gets. Now the share of C is?

- (a) Rs. 480      (b) Rs. 300  
 (c) Rs. 420      (d) None of these

Ans. (a)

$$680 = A + B + C$$

$$A = \frac{2}{3}B \text{ and } B = \frac{1}{4}C, 4B = C$$

$$A = \frac{2}{3}B, C = 4B$$

$$680 = \frac{2}{3}B + B + 4B$$

$$680 = \frac{17}{3}B, B = 120, C = 480$$

10. The students in three batches at Made Easy are in the ratio 2 : 3 : 5. If 20 students are increased in each batch, the ratio changes to 4 : 5 : 7. The total number of students in the three batches before the increase were.

- (a) 10      (b) 90  
 (c) 100      (d) 150

Ans. (c)

Let students are  $2x : 3x : 5x$  now

According to the given condition

$$2x + 20 : 3x + 20 : 5x + 20 = 4 : 5 : 7$$

$$x = 10$$

$$20 : 30 : 50 = 2 : 3 : 5 \text{ and after adding 20}$$

$$40 : 50 : 70$$

11. The speeds of three cars are in the ratio 2 : 3 : 4. The ratio between the times taken by these cars to travel the same distance is

- (a) 2 : 3 : 4      (b) 4 : 3 : 2  
 (c) 4 : 3 : 6      (d) 6 : 4 : 3

Ans. (d)

Speeds are in the ratio 2 : 3 : 4

ratio of time taken will be  $\frac{1}{2} : \frac{1}{3} : \frac{1}{4}$

$$\Rightarrow \frac{6}{12} : \frac{4}{12} : \frac{3}{12} = 6 : 4 : 3$$



**Ans. (a)**

$$\frac{1}{2} : \frac{2}{3} : \frac{3}{4} = \frac{6:8:9}{12}$$

Bananas are in ratio  $6x : 8x : 9x$ 

It is given that

$$6x + 8x + 9x = 391$$

$$23x = 391, x = 17$$

first monkey get 102 bananas

19. A mixture contains milk and water in the ratio

5 : 1. On adding 5 litres of water, the ratio of milk to water becomes 5 : 2. The quantity of milk in the mixture is:

- (a) 16 litres      (b) 25 litres  
 (c) 32.5 litres      (d) 22.75 litres

**Ans. (b)**Let milk and water are  $5x : x$ 

$$\text{Now, } \frac{5x}{x+5} = \frac{5}{2} \Rightarrow 10x = 5x + 25$$

$$5x = 25, x = 5$$

milk : water = 25 : 10

20. Vijay has coins of the denomination of Re. 1, 50p and 25 p in the ratio of 12 : 10 : 7. The total worth of the coins he has is Rs. 75. Find the number of 25 p coins that Vijay has

- (a) 48      (b) 72  
 (c) 60      (d) None of these

**Ans. (d)**Coins are  $12x : 10x : 7x$ 

$$\text{It is given that } 12x + 10x + \frac{1}{2} + \frac{7}{4}x = 75$$

$$\frac{48x + 20x + 7x}{4} = 75$$

$$75x = 4 \times 75, x = 4$$

21. If two numbers are in the ratio of 5 : 8 and if 9 be added to each, the ratio becomes 8 : 11. Now find the lower number.

- (a) 5      (b) 10  
 (c) 15      (d) None of these

**Ans. (c)**Let number are  $5x$  and  $8x$  then it is given that

$$\frac{5x+9}{8x+9} = \frac{8}{11}$$

$$55x + 99 = 64x + 72$$

$$27 = 9x, x = 3$$

Number are 15 and 24

MATHS

Ans.  
14

Ques.

Ans.

Ans.

But

hen

25. Ans.

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wn

(a)

(c)

Ans.

Let

22. If
- $x$
- varies as
- $y$
- , and
- $y = 7$
- when
- $x = 18$
- . find
- $x$
- when
- $y = 21$

- (a) 36      (b) 54  
 (c) 72      (d) 18

**Ans. (b)** $x$  is directly proportional to  $y$ 

$$\text{So, } x = k y$$

$$18 = 7k$$

$$\text{So, } k = \frac{18}{7}$$

$$\text{Now, } x = \frac{18}{7} \times 21 = 54$$

23. A varies jointly as B and C; and
- $A = 6$
- when
- $B = 3, C = 2$
- ; find A when
- $B = 5, C = 7$
- .

- (a) 17.5      (b) 35  
 (c) 70      (d) 105

**Ans. (b)**Let  $A = k(BC)$  then

$$6 = k(3 \cdot 2)$$

So,  $k = 1$  then

$$A = k(BC)$$

$$= 1 \times (5 \times 7) = 35$$

24. If
- $x$
- varies as
- $y$
- directly, and as
- $z$
- inversely and
- $x = 14$
- , when
- $y = 10$
- , find
- $z$
- when
- $x = 49$
- ,
- $y = 45$
- .

- (a)  $14/10$   
 (b) 10  
 (c)  $10/14$   
 (d) Cannot be determined

**Ans. (d)**

$$x = k_1 y \quad x = \frac{k_2}{z}$$

NK

96

71

1. F

4

2. F

6

MAC





**6. Ans. (b)**

Let the shares of Amit, Sumeet and Puneet be

$3x$ ,  $4x$  and  $5x$  respectively

It is given that

$$3x + 4x + 5x = 660$$

$$12x = 660$$

$$x = 55$$

So

$$5x = 275$$

**7. Ans. (b)**

Let the price of Scooter and Television be  $3x$  &  $2x$  respectively

It is given that  $3x - 2x = 600$

$$\Rightarrow x = 6000$$

∴ Television's price  $2x = 1200$

**8. Ans. (b)**

$$A : B = 7 : 5 \quad \dots(i)$$

$$B : C = 9 : 11 \quad \dots(ii)$$

B is common in eq. (i) & (ii)

To equate the ratios of B we will multiply eq. (i) by 9 and eq. (ii) by 5

$$\text{Then } A : B = 63 : 45$$

$$B : C = 45 : 55$$

$$\therefore A : B : C = 63 : 45 : 55$$

**9. Ans. (c)**

$$A : B = 4 : 3 \quad \dots(i)$$

$$B : C = 5 : 4 \quad \dots(ii)$$

B is common in eq. (i) & (ii)

To equate ratios of B in eq. (i) and (ii)

we will multiply eq. (i) by 5 & eq. (ii) by 3

$$\text{then } A : B = 20 : 15 \quad \dots(iii)$$

$$B : C = 15 : 12 \quad \dots(iv)$$

$$\text{Hence } A : B : C = 20 : 15 : 12$$

**10. Ans. (b)**

$$A : B = 4 : 5 \quad \dots(i)$$

$$B : C = 5 : 6 \quad \dots(ii)$$

B is common among them

$$\text{So } A : B : C = 4 : 5 : 6$$

Thus, ratio of money with Anju, Sanju and Manju is  $4 : 5 : 6$ . Since Anju has

Rs. 280, the amount of money Manju has

$$= \frac{280}{4} \times 6 = \text{Rs. } 420.$$

**11. Ans. (a)**

$$A : B = 2 : 3 \quad \dots(i)$$

$$B : C = 7 : 9 \quad \dots(ii)$$

$$\Rightarrow A : B : C = 14 : 21 : 27$$

$$A + B + C = 124 \text{ then}$$

$$C = 54$$

**12. Ans. (b)**

Let the two numbers be  $2x$  &  $3x$

$$\text{then } \frac{2x+4}{3x+4} = \frac{5}{7}$$

$$\Rightarrow 14x + 28 = 15x + 20$$

$$\Rightarrow x = 8$$

So numbers are 16 & 24.

**13. Ans. (c)**

Let ages of Suresh & Mahesh be  $7x$  &  $5x$

$$\text{Then } \frac{7x+6}{5x+6} = \frac{4}{3} \text{ on solving}$$

$$\text{We get } x = 6$$

Then present age of Mahesh i.e.  $5x = 30$  years

**14. Ans. (c)**

Let the numbers be  $5x$  and  $7x$

$$\text{Then } \frac{5x-25}{7x-25} = \frac{35}{59} \text{ on solving}$$

$$\text{We get, } x = 12$$

Difference between two numbers

$$7x - 5x = 2x = 24$$

**15. Ans. (b)**

According to given condition

$$7+k : 16+k :: 43+k : 79+k$$

$$\Rightarrow \frac{7+k}{16+k} = \frac{43+k}{79+k}$$

going by options we can find that  $x = 5$

16. Ans. (a)

Let  $x$  be the desired number then

$$\frac{8+x}{21+x} = \frac{13+x}{31+x}$$

going by options we can easily find that

$$x = 5$$

17. Ans. (b)

Let income be  $3x : 2x$

and expenditure be  $5y : 3y$

$$\text{then } 3x - 5y = 1000$$

$$2x - 3y = 1000$$

$$\Rightarrow x = 2000$$

$$\Rightarrow y = 1000$$

So A's income will be  $3x = 6000$ .

18. Ans. (b)

Ratio of Alcohol & Water is  $12 : 5$

Let Alcohol be  $12x$  then Water will be  $5x$

$$\text{Now } \frac{12x}{5x+14} = \frac{4}{3}$$

$$\Rightarrow 36x = 20x + 56$$

$$16x = 56$$

$$\Rightarrow x = \frac{7}{2}$$

So  $12x = 42$  liters



## Partnership



### Practice Exercise: I

1. Aman and Pranjal enter into a partnership investing Rs. 50000 and Rs. 40000, respectively. They agree to share profits in the ratio of their capitals. Find the share of Aman in a profit of Rs. 22500 after one year.
- (a) Rs. 12500      (b) Rs. 9500  
 (c) Rs. 10500      (d) None of these

2. Amit, Nitin and Ravindra entered into a partnership. Amit invested Rs. 16000 for 9 months, Nitin invested Rs. 12000 for 6 months and Ravindra invested Rs. 8000 for 12 months. At the end of a year there was a profit of Rs. 26000. Find the share of Nitin in the profit.
- (a) Rs. 8000      (b) Rs. 7500  
 (c) Rs. 6000      (d) None of these

3. Sakshi starts business with Rs. 3500 and 5 months after Divya joins Sakshi as her partner. After a year the profits are divided in the ratio of 2 : 3. How much did Divya contribute?
- (a) Rs. 7000      (b) Rs. 11000  
 (c) Rs. 9000      (d) None of these

4. Arvind began a business with Rs. 550 and was joined afterwards by Naveen with Rs. 330. When did Naveen join if the profits at the end of the year were divided in the ratio 10 : 3?
- (a) After 4 months      (b) After 6 months  
 (c) After 4.5 months      (d) None of these

5. A, B and C invested capitals in the ratio 3 : 5 : 9; the timing of their investments being in the ratio 2 : 3 : 1. In what ratio would their profits be distributed?
- (a) 2 : 5 : 3      (b) 3 : 2 : 5  
 (c) 7 : 5 : 3      (d) None of these

6. A, B and C start a business. If the ratio of their periods of investments are 2 : 3 : 6 and their profits are in the ratio of 4 : 5 : 6, then the ratio of capitals of A, B and C is
- (a) 6 : 8 : 10      (b) 12 : 10 : 6  
 (c) 10 : 12 : 6      (d) None of these

7. A, B, C and D enter into partnership. A subscribes  $\frac{1}{3}$  of the capital, B  $\frac{1}{4}$ , C  $\frac{1}{5}$  and D the rest. What is the share of D out of a profit of Rs. 6000?
- (a) Rs. 2000      (b) Rs. 1600  
 (c) Rs. 1200      (d) Rs. 1300

MADE EASY

8. A and invest in their pr period investe
- (a) 6 r
- (c) 10

9. A, B, C
- the rati
- his sha
- of one
- the pr
- (a) R
- (c) F

10. B is a
- in Rs
- 12.5
- and
- cap
- Rs
- (a)
- (c)

11. A s
- B :
- 3 a
- a
- 2
- in
- (a)
- (c)

1. F
- F
- F

## Solutions

1. Ans. (a)  
 Here,  $C_1 = 50000$ ,  $C_2 = 40000$  and  $P = 22500$ .  
 Here time period of investment is constant  
 So ratio in which profit will be divided is  
 $C_1 : C_2 \Rightarrow 50k : 40k = 5 : 4$

Now Aman's share

$$= \frac{5}{9} \times 22500 = \text{Rs. } 12500.$$

2. Ans. (c)

Here,  $C_1 = 16000$ ,  $C_2 = 12000$ ,  $C_3 = 8000$ ,  
 $t_1 = 9$ ,  $t_2 = 6$ ,  $t_3 = 12$  and  $P = 26000$ .

Ratio in which profit will be divided i.e.

$$P_1 : P_2 : P_3 \text{ will be } C_1 t_1 : C_2 t_2 : C_3 t_3$$

$$\Rightarrow P_1 : P_2 : P_3 = 6 : 3 : 4$$

Nitin's share = 6000

3. Ans. (c)

Let suppose Divya's contribution is  $x$  then  
 We have,  $C_1 \times t_1 = 3500 \times 12 = 42000$  and  
 $C_2 \times t_2 = x \times 7 = 7x$ .

$$\text{Then, } \frac{\text{Profit for Sakshi}}{\text{Profit for Divya}} = \frac{C_1 \times t_1}{C_2 \times t_2}$$

$$\Rightarrow \frac{2}{3} = \frac{42000}{7x}$$

$$\text{or, } x = \frac{42000 \times 3}{2 \times 7} = \text{Rs. 9000.}$$

**Ex7** Divya's contribution is Rs. 9000.

4. Ans. (b)

Let Naveen remain in the business for  $x$  months.

$$\text{We have, } C_1 \times t_1 = 550 \times 12 = 6600$$

$$C_2 \times t_2 = 330 \times x = 330x.$$

$$\therefore \frac{\text{Arvind's share of profit}}{\text{Naveen's share of profit}} = \frac{C_1 \times t_1}{C_2 \times t_2}$$

$$\Rightarrow \frac{10}{3} = \frac{6600}{330}$$

$$\Rightarrow x = \frac{6600 \times 3}{330 \times 10} = 6 \text{ months.}$$

5. Ans. (a)

Ratio of capitals of A, B and C are 3 : 5 : 9

Let the capitals o

Ratio of timing of their investments are  $2 : 3 : 1$ . Let A, B and C invest their capitals for  $2x$ ,  $3y$  and  $y$  months, respectively.

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• Ratio & Proportion

Then, profit of A : profit of B : Profit of C  
 $= C_1 \times t_1 : C_2 \times t_2 : C_3 \times t_3$   
 $= 3x \times 2y : 5x \times 3y : 9x \times y$   
 $= 6 : 15 : 9 \text{ or, } 2 : 5 : 3.$

6. Ans. (b)

Ratio in which profit will be divided i.e.

$$P_1 : P_2 : P_3 \text{ is } C_1 t_1 : C_2 t_2 : C_3 t_3$$

$$\text{We have, } P_1 : P_2 : P_3 = 4 : 5 : 6$$

$$\text{and } t_1 : t_2 : t_3 = 2 : 3 : 6.$$

$$\therefore \text{Required ratio} = \frac{P_1}{t_1} : \frac{P_2}{t_2} : \frac{P_3}{t_3} = \frac{4}{2} : \frac{5}{3} : \frac{6}{6}$$

$$\text{or, } 12 : 10 : 6$$

Thus, A, B and C invested their capitals in the ratio 12 : 10 : 6.

7. Ans. (d)

$$\text{D's Capital} = 1 - \frac{1}{3} - \frac{1}{4} - \frac{1}{5} = \frac{13}{60}$$

$$\text{Profit ratio of A, B, C, D is } \frac{1}{3} : \frac{1}{4} : \frac{1}{5} : \frac{13}{60}$$

$$\therefore 20 : 15 : 12 : 13$$

$$\therefore \text{Share of D} = \frac{13}{60} \times \text{Rs. } 6000 = \text{Rs. } 1300.$$

8. Ans. (c)

Let investments of A and B respectively be  $5x$  and  $7x$  and period of B's investment be  $y$  months.

$$\text{Then, } \frac{(5x) \times 7}{(7x) \times y} = \frac{1}{2} \Rightarrow y = 10.$$

9. Ans. (d)

$$\text{Given ratio} = \frac{7}{2} : \frac{4}{3} : \frac{6}{5} = 105 : 40 : 36$$

Let the initially invest Rs. 105, Rs. 40, Rs. 36, respectively.

Ratio of investments

$$\begin{aligned} &= [105 \times 4 + (150\% \text{ of } 105) \times 8] : [40 \times 12] \\ &\quad : (36 \times 12) \\ &= 1680 : 480 : 432 = 35 : 10 : 9 \end{aligned}$$

$$\text{B's share} = \text{Rs. } \left( 21600 \times \frac{10}{54} \right) = \text{Rs. } 4000$$

10. Ans. (d)

A's share for managing the business

$$= 12.5\% \text{ of Rs. } 880 = \text{Rs. } 110$$

Remaining profit = Rs. 770.

Profit ratio of A and B = 5 : 6

$$\text{A's share} = \frac{5}{11} \text{ of Rs. } 770 = \text{Rs. } 350.$$

$$\text{A's total profit} = \text{Rs. } 350 + \text{Rs. } 110 = \text{Rs. } 460$$

11. Ans. (a)

Profit ratio of A, B and C is

$$(1200 \times 12) : (x \times 9) : (y \times 6) = 2 : 3 : 5$$

Taking first and second terms we get

$$1200 \times 12 : 9x = 2 : 3$$

$$\Rightarrow 1200 \times 12 \times 3 = 9x \times 2$$

$$\therefore x = \frac{1200 \times 12 \times 3}{18} = 2400$$





## Percentage

The term percent means "for every 100". It is derived from french word "Cent" which is 100 for french.

The basic utility of percentage arises from the fact that it is one of the most powerful tool for comparison of numerical data and information. It is also one of the simplest tool for comparison of data.

In the context of business and economic performance, it is specifically, useful for comparing data such as profits, growth rates, magnitude and so on.

### Calculation

Since percentage represent the value obtained out of every 100, calculation can be done in following manner

$$\text{Percentage} = \frac{\text{Value obtained}}{\text{Total value}} \times 100$$

For example, let in IIT JEE examination Sanjay scored 135 marks out of 300 marks. Then Marks obtained by Sanjay in % term is equal to

$$\frac{135}{300} = 45\%$$

As discussed earlier, percentage is amongst the most powerful tool for comparison, let for example

Shweta scored 120 marks out of 150 and Rahul scored 360 marks out of 500 then Percentage

$$\text{score of Shweta} = \frac{120}{150} = 80\%$$

$$\text{Percentage score of Rahul} = \frac{360}{500} = 72\%$$

Thus, it clearly shows that Shweta's performance is better than Rahul's performance.

### Other Comparison

Let in Annual Examination Megha obtained 200 marks out of 300 and Sangeeta obtained 100 marks out of 300, Now to compare marks of Megha and Sangeeta two question arise

1. Megha's marks is how much percentage greater than Sangeeta's marks?
2. Sangeeta's marks is how much percentage less than Megha's marks obtained?

Megha 200

Sangeeta 100

Clearly Megha's marks is 100 greater than Sangeeta's marks. Its means

$$\frac{\text{difference of marks}}{\text{Sangeeta marks}} = \frac{100}{100} = 100\%$$

Now Sangeeta's marks is 100 less than Megha's it means

$$\frac{\text{Difference of marks}}{\text{Megha's marks}} = \frac{100}{200} = 50\%$$

From this we can come to the conclusion that Megha's marks is 100% greater than Sangeeta's marks while Sangeeta's marks is 50% less than Megha's marks.

#### Some Useful Shortcut Methods

- 1.(a) If A is  $x\%$  more than that of B then B is less than that of A by

$$\left[ \frac{x}{100+x} \times 100 \right] \%$$

- 1.(b) If A is  $x\%$  less than that of B then B is more than that of A by

$$\left[ \frac{x}{100-x} \times 100 \right] \%$$

- Ex. 1. If Shailendra's salary is 20% more than that of Surendra, then how much percent is salary of Surendra less than that of Shailendra?

Sol: Here  $x = 20$

$$\therefore \text{Required Answer} = \left[ \frac{x}{100+x} \times 100 \right] \%$$

$$= \frac{20}{120} \times 100\% = 16.66\%$$

- Ex. 2. If A's income is 30% less than that of B's income, then how much percent is B's income more than that of A's income?

Sol: Here  $x = 30$

$$\therefore \text{Required Answer} = \left[ \frac{x}{100-x} \times 100 \right] \%$$

$$= \left( \frac{30}{70} \times 100 \right) \% = 42.8\%$$

2. If A is  $x\%$  of C and B is  $y\%$  of C then

$$A = \left( \frac{x}{y} \times 100 \right) \% \text{ of B}$$

- Ex. 1. If A is 20% of C and B is 25% of C, what percentage is A of B?

Sol. Here  $x = 20, y = 25$

$$A = \frac{x}{y} \times 100 = \frac{20}{25} \times 100 = 80\% \text{ of B}$$

- 3.(a) If the price of a commodity increases by  $P\%$ , then the reduction in consumption so as not to increase the expenditure is

$$\left( \frac{P}{100+P} \times 100 \right) \%$$

- 3.(b) If the price of a commodity decreases by  $P\%$  then the increase in consumption so as not to decrease the expenditure is

$$\left( \frac{P}{100-P} \times 100 \right) \%$$

- Ex. 3(a). If the price of sugar increase by 25%. Find how much percent its consumption be reduced so as not to increase the expenditure?

Sol. Reduction in consumption

$$= \left( \frac{P}{100+P} \times 100 \right) \%$$

$$= \frac{25}{125} \times 100\% = 20\%$$

- Ex. 3(b) If price of commodity decrease by 25% find how much percent its consumption be increased so as not to decrease the expenditure?

Sol. Increase in consumption

$$= \frac{P}{100-P} \times 100\%$$

$$= \frac{25}{100-25} \times 100\%$$

4. If a number is changed (increased/decreased) successively by  $x\%$  and  $y\%$  then net% change is given by

$$\left( x + y + \frac{xy}{100} \right)\% \text{ which represent increase}$$

or decrease in value according as the sign in (+)ve or (-)ve.

If  $x$  or  $y$  indicates decrease in percentage then put (-)ve sign before  $x$  or  $y$ , otherwise (+)ve sign.

- Ex. 4.(a)** If salary or a person is increased by 10% and 20% successively then, what is the change in his salary?

Sol. Here  $x = 10, y = 20$

∴ The net % change in the salary

$$= \left( 10 + 20 + \frac{10 \times 20}{100} \right)\% = 32\%$$

- Ex. 4(b)** The price of a commodity first increased by 20% then decreased by 10% then what is the net change in price of commodity.

Sol: Here  $x = 20, y = -10$  then net percent change in price is

$$\left[ 20 - 10 + \frac{20 \times (-10)}{100} \right]\% = 8\%$$

Here sign is (+ve) hence the net is (+ve) increase in price.

- Ex. 4.(c)** If price of a commodity decreased first by 20% and then by 30% then find the net change in price?

Sol. Here  $x = -20, y = -30$

∴ Net % change is

$$\left[ -20 - 30 + \frac{-20 \times -30}{100} \right]\% = -44\%$$

Since sign is (-)ve the net change is reduction in price

5. If the present population of a town (or value of an item) be  $P$  and the population

(or value of item) changes in  $r\%$  per annum, then

- (a) Population (or value of an item) after

$$n \text{ years} = P \left( 1 + \frac{r}{100} \right)^n$$

- (b) Population (or value of an item)  $n$  years ago

$$\text{ago} = \frac{P}{\left( 1 + \frac{r}{100} \right)^n}$$

Where  $r$  is (+ve) or (-)ve according as the population (or value of item) increase or decreases.

- Ex: 5.(a)** The population of a town increases 10% annually. If its present population is 120000, what will it be in 2 years time?

Sol. Here  $P = 120000, r = 10, n = 2$ .

∴ Population after 2 years

$$= P \left( 1 + \frac{r}{100} \right)^n = 120000 \left[ 1 + \frac{10}{100} \right]^2$$

$$= 120000 \times \frac{110}{100} \times \frac{110}{100} = 145200$$

- Ex. 5.(b)** The population of a town increase at the rate of 20% annually due to excessive migration. If present population is 144000 find population two years ago.

Sol: Here  $P = 144000, r = 20$

∴ Population of the town two years ago

$$= \frac{P}{\left( 1 + \frac{r}{100} \right)^n}$$

$$= \frac{144000}{\left( 1 + \frac{20}{100} \right)^2} = \frac{144000}{\frac{120}{100} \times \frac{120}{100}} = 100000$$

6. If a number  $A$  is increased by  $x\%, y\%$  and  $z\%$  successively then final value of  $A$  will

$$\text{be } A \left( 1 + \frac{x}{100} \right) \left( 1 + \frac{y}{100} \right) \left( 1 + \frac{z}{100} \right)$$

In case if a given value decrease by an percentage, we will use a (-)ve sign before that.

**Ex. 6.** The income of Ramesh increase by 10%, 20% and 30% successively in three years find change in his income if present income is 150000 Rs. per annum

Sol. Here  $x = 10, y = 20, z = 30$ .

$$A = 150000$$

So, percent change in income

$$A \left(1 + \frac{x}{100}\right) \left(1 + \frac{y}{100}\right) \left(1 + \frac{z}{100}\right)$$

$$= 150000 \times \left[ \left(1 + \frac{10}{100}\right) \left(1 + \frac{20}{100}\right) \left(1 + \frac{30}{100}\right) \right]$$

$$= 150000 \times \frac{110}{100} \times \frac{120}{100} \times \frac{130}{100} = \text{Rs.} 257400$$

### 1. To convert fraction into percent

To convert any fraction  $\frac{l}{m}$  into percent multiply it by 100.

$$\text{For Ex. } 1. \quad \frac{3}{5} = \frac{3}{5} \times 100 = 60\%$$

$$\text{For Ex. } 2. \quad \frac{5}{6} = \frac{5}{6} \times 100 = 83.33\%$$

### 2. To convert a percent into a fraction

To convert percent into fraction, drop the % sign and divide the number by 100.

**Ex. :** What fraction is  $16\frac{2}{3}\%$

$$\text{Sol. : } 16\frac{2}{3}\% = \frac{50/3}{100} = \frac{50}{300} = \frac{1}{6}$$

### 3. To find a percentage of given number

$$x\% \text{ of given number } N = \frac{x}{100} \times N$$

Ex. 1.

65% of 300

$$\text{Sol: } \frac{65}{100} \times 300 = 795$$

Ex. 2. Find a number whose 4% is 72.

$$\text{Sol.: Here } 72 = \frac{4}{100} \times x$$

$$72 = \frac{1}{25}x, x = 72 \times 25 = 1800$$

Ex. 3. What percentage of 30 kg is 2.5 kg?

$$\text{Sol.: } \frac{2.5}{30} \times 100 = \frac{1}{12} \times 100 = 8.33\%$$



### Solved Examples

#### 1. Which of the following is the largest number?

- (a) 20% of 200      (b) 7% of 500  
 (c) 1300% of 3      (d) 600% of 7

**Ans. (d)**

$$20\% \text{ of } 200 = 40$$

$$7\% \text{ of } 500 = 35$$

$$1300\% \text{ of } 3 = 39$$

$$600\% \text{ of } 7 = 42$$

#### 2. If 25% of a number is 75, then 45% of the number is:

- (a) 145      (b) 125  
 (c) 150      (d) 135

**Ans. (d)**

$$= \frac{25}{100} \times x = 75$$

$$x = \frac{75 \times 100}{25}, x = 300$$

$$45\% \text{ of } 300 = 135$$



subtracting. Find the percentage change in the result?

- (a) 300%
- (b) 88.88%
- (c) 50%
- (d) Cannot be determined

Ans. (d)

This cannot be determined because after adding or subtracting % to different numbers, variable results are obtained.

10. In a mixture of 80 litres of milk and water, 25% of the mixture is milk. How much water should be added to the mixture so that milk becomes 20% of the mixture?

- (a) 20 litres
- (b) 15 litres
- (c) 25 litres
- (d) None of these

Ans. (a)

Total mixture 80 litres

Milk is 25% i.e.  $\frac{25}{100} \times 80 = 20$  litres and so Water is 60 litres.

To make it 20% let the amount of water required is add  $x$  litres.

$$\Rightarrow \frac{20+x}{80+x} \times 100 = 20\%$$

$$2000 + 100x = 1600 + 20x \\ 20x = 400, x = 20$$

11. A manufacturer increased the length and the breadth of a rectangular plot by 10% and 20% respectively. Find the percentage change in the cost of the plot assuming land prices are uniform throughout the plot.

- (a) 30%
- (b) 25%
- (c) 22.22%
- (d) None of these

$$\text{Let } x_1 = 10, x_2 = 20.$$

$$\% \text{ change in area} = \left( x_1 + x_2 + \frac{x_1 x_2}{100} \right) \\ = 10 + 20 + \frac{10 \times 20}{100} \\ = 30 + 2 = 32\%$$

12. The areas of two adjacent faces of a rectangular prism are 200 cm<sup>2</sup> and 150 cm<sup>2</sup>. If the height of the rectangular prism is 10 cm, what is the percentage change in the volume of the rectangular prism?

- (a) 77%
- (b) 17%
- (c) 88%
- (d) 30%

Ans. (d)

Let l, b, h be original height and width of the cuboid.

Volume  $= l \times b \times h$

Now l, b, h are increased by 77%, 17%, 88% respectively

$$l' = \left[ l + \frac{77}{100} l \right], b' = \left[ b + \frac{17}{100} b \right], h' = \left[ h + \frac{88}{100} h \right] \\ = 1.77l, 1.17b, 1.88h \\ \% \text{ change} = 30\%$$

13. The salary of Amit is 30% more than that of Varun. Find by what percentage is Varun's salary less than that of Amit?

- (a) 28.12%
- (b) 29.07%
- (c) 21.20%
- (d) None of these

Ans. (b)

Let Varun's salary is 100.

Amit salary = 30% more than

Varun's salary = 130

% salary of Varun less than Amit's salary

$$= \frac{30}{130} \times 100 = 23.07\%$$

14. The price of sugar is reduced by 25% & its rate of the decrease. Aayush and his increasing his expenditure on sugar to 25%. What is the percentage change in the consumption of sugar?

- (a) +50%
- (b) -10%
- (c) +33.33%
- (d) 50%

Ans. (a)

Let price of sugar be  $x$  & expenditure  $y$ .

Now it is reduced by 25%. So it is  $\frac{3}{4}$  of  $y$

MADE EASY





**Ans. (a)**

Here  $P = 100000$ ,  $r = 10$ ,  $n = 3$

Population at the starting of fourth year  
i.e. at the end of third year is

$$100000 \left[ 1 + \frac{10}{100} \right]^3 = 133100$$

**25.** A cow and a calf cost Rs. 2000 and Rs. 1400 respectively. If the price of the cow and that of the calf is increased by 20% and 30% respectively then the price of 1 dozen cows and 2 dozens calves is:

- (a) 72,480      (b) 71,360  
(c) 74,340      (d) None of these

**Ans. (a)**

Price of cow = Rs. 2000

Price of calf = 1400

Price of 1 dozen cow & 2 dozens calves at increased rate

$$= 12 \times \left( \frac{120}{100} \times 2000 \right) + 24 \times \left( \frac{130}{100} \times 1400 \right)$$

$$= 72480$$

**26.** Ram sells his goods 20% cheaper than Bobby and 20% dearer than Amit. How much percentage is Amit's goods cheaper/dearer than Bobby's.

- (a) 33.33%      (b) 50%  
(c) 42.85%      (d) None of these

**Ans. (a)**

Let Bobby's sale price is Rs. 100

Ram's sale price = Rs. 80

Ram's sale price is 20% dearer than Amit's

So, Amit's sale price i.e. AP

$$\Rightarrow AP \times \frac{120}{100} = 80, AP = 66.66$$

Now Amit's good is Rs. 33.33 cheaper than Bobby's i.e.

$$= \frac{33.33}{100} \times 100 = 33.33\%$$

**27.** During winters, an athlete can run  $x$  meters on one bottle of Glucose. But in the summer he can only run  $0.5x$  meters on one bottle of Glucose. How many bottles of Glucose are required to run 400 meters during summer?

- (a)  $800/x$       (b)  $890/x$   
(c)  $98$       (d)  $454/x$

**Ans. (a)**

During summer to run  $0.5x$  meter one bottle of glucose is required

then to run 1 km  $\frac{1}{0.5x}$  bottles

$\therefore$  to run 400 m  $\frac{1}{0.5x} \times 400 = \frac{800}{x}$  bottle

**28.** Out of the total production of iron from hematite, an ore of iron, 20% of the ore gets washed away, and out of the remaining iron, only 25% is pure iron. If the pure iron obtained in a year from a mine of hematite was 80,000 kg, then the quantity of hematite mined from that mine in the year is

- (a) 5,00,000 kg      (b) 4,00,000 kg  
(c) 4,50,000 kg      (d) None of these

**Ans. (b)**

Let  $x$  kg ore is there

20% washed away so remaining is

80% i.e.  $\frac{4}{5}x$

out of  $\frac{4}{5}x$ , 25% is pure iron i.e.  $\frac{1}{5}x$  now

$\therefore \frac{1}{5}x$  kg is obtained from  $x$  kg

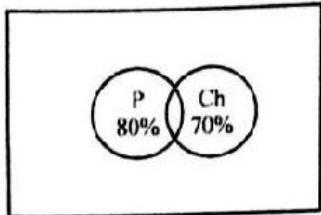
then 1 kg is obtained from 5 kg

$\therefore 80000$  kg is obtained from

$$5 \times 80000 = 400000 \text{ kg}$$

**29.** In an examination, 80% students passed in Physics, 70% in Chemistry while 15% failed in both the subjects. If 325 students passed in both the subjects. Find the total number of students who appeared in the examination

**Ans. (a)**



So total passed = 85%

According to set theory

$$\Rightarrow 80 + 70 = 85 + x, x = 65\%$$

65% of total = 325

Total = 500.

30. Ram spends 30% of his salary on house rent, 30% of the rest he spends on his children's education and 24% of the rest salary he spends on clothes. After his expenditure, he is left with Rs. 2500. What is Ram's salary?

- (a) Rs. 6713.2      (b) Rs. 20,000  
 (c) Rs. 10,000      (d) Rs. 15,000

**Ans. (a)**

Let total salary is Rs.  $x$

30% on house rent = x

30% of remaining on Childrens education

$$= \psi$$

24% of remaining on clothes - 3

$$P \left[ 1 + \frac{x}{100} \right] \left[ 1 + \frac{y}{100} \right] \left[ 1 + \frac{z}{100} \right] = 2500$$

$$P \left[ 1 + \frac{-30}{100} \right] \left[ 1 + \frac{-30}{100} \right] \left[ 1 + \frac{-24}{100} \right] = 2500$$

**[(-)ve sign because of spending]**

$$P\left[\frac{70}{100}\right]\left[\frac{70}{100}\right]\frac{76}{100} = 2500$$

P = Rs. 6713.21



## Percentage



### **Practice Exercise: I**



- (g) 61 lacs. The price after 3 years ago was nearly  
 (h) 62 lacs  
 (i) 63 lacs  
 (j) None of these

24. The value of a machine is Rs. 6250. It decreases by 10% during the first year, 20% during the second year and 30% during the third year. What will be the value of the machine after 3 years?

- (a) Rs. 2650      (b) Rs. 3050  
 (c) Rs. 3150      (d) None of these

25. An army lost 10% its men in war, 10% of the remaining due to diseases and 10% of the rest were disabled. Thus, the strength was reduced to 729000 active men. Find the original strength.

- (a) 1000000      (b) 1200000  
 (c) 1500000      (d) None of these

26. In an examination, 30% and 35% students respectively failed in History and Geography while 27% students failed in both the subjects. If the number of students passing the examination is 248, find the total number of students who appeared in the examination.

- (a) 425      (b) 390  
 (c) 400      (d) None of these

27. In an examination, there were 2000 candidates, out of which 900 candidates were boys and rest were girls. If 32% of the boys and 38% of the girls passed, then the total percentage of failed candidates is

- (a) 35.3%      (b) 64.7%  
 (c) 68.6%      (d) 70%

28. If the price of gold increases by 30%, find by how much the quantity of ornaments must be reduced so that the expenditure may remain the same as before?

- (a)  $2\frac{2}{3}\%$   
 (b)  $23\frac{1}{13}\%$   
 (c) 30%  
 (d) 19%

29. The price of an article is 520/- 20% increase in its original price. The new price is increased by  
 (a) 22.5%  
 (b) 20%  
 (c) 25%  
 (d) 40%

30. In a fraction, numerator is increased by 20% and the denominator is diminished by 10%. The new fraction obtained is  $\frac{5}{9}$ . The original fraction is

- (a)  $\frac{2}{5}$   
 (b)  $\frac{5}{9}$   
 (c)  $\frac{3}{5}$   
 (d) None of these

## Solutions

1. Ans. (a)

$$5 \frac{1}{4} = \frac{21}{4} = \frac{21}{4} \times 100 = 525\%$$

2. Ans. (b)

$$6 \frac{2}{3}\% = \left( \frac{20}{3} \right) = \left( \frac{20}{3} \times \frac{1}{100} \right) = \frac{1}{15}$$

3. Ans. (c)

$$\frac{84}{12} \times 100 = 700$$

4. Ans. (c)

$$37 \frac{1}{2}\% \text{ of Rs. } 48 = 48 \times \frac{75}{2 \times 100} = \text{Rs. } 18.$$

5. Ans. (c)

Let 75% of 480 =  $x \times 15$ .

Then,

$$\frac{75}{100} \times 480 = 15x \text{ or } x = \frac{75 \times 480}{100 \times 15} = 24.$$

**6. Ans. (c)**

Let the number be  $x$ , then

$$37\frac{1}{2}\% \text{ of } x = 45 \Rightarrow \frac{75}{2} \times \frac{1}{100} \times x = 45$$

$$\text{or, } \frac{3}{8}x = 45 \Rightarrow x = \frac{45 \times 8}{3} = 120.$$

$$\therefore 87\frac{1}{2}\% \text{ of } 120 = \frac{175}{2} \times \frac{1}{100} \times 120 = 105.$$

**7. Ans. (b)**

$$\begin{aligned} x\% \text{ of } y + y\% \text{ of } x &= \left( \frac{x}{100} \times y \right) + \left( \frac{y}{100} \times x \right) \\ &= \frac{2}{100}xy = 2\% \text{ of } xy. \end{aligned}$$

**8. Ans. (b)**

Let the missing figure be  $a$ .

We have,

$$\frac{x}{100} \times y + \frac{a}{100} \times x = \frac{x}{100} \times (x+y)$$

$$\Rightarrow xy + ax = x(x+y) \Rightarrow ax = x^2.$$

$$\therefore a = x$$

**9. Ans. (b)**

25% of 25%

$$= \frac{25}{100} \times \frac{25}{100} = \frac{625}{10000} = 0.0625.$$

**10. Ans. (b)**

20% and 30% of 20% of 850

$$= \frac{20}{100} \times \frac{30}{100} \times \frac{20}{100} \times 850 = \frac{1020}{100}$$

= Rs. 10.20

**11. Ans. (a)**

$$40\% \text{ of } 20\% = \frac{40}{100} \times \frac{20}{100} = \frac{8}{100} = 8\%$$

$$30\% \text{ of } 25\% = \frac{30}{100} \times \frac{25}{100} = \frac{75}{100} = 7.5\%$$

$$\text{and } 50\% \text{ of } 28\% = \frac{50}{100} \times \frac{28}{100} = \frac{14}{100} = 14\%$$

$$\therefore (40\% \text{ of } 20\% + 30\% \text{ of } 25\% + 50\% \text{ of } 28\%) \\ = 8\% + 7.5\% + 14\% = 29.5\%.$$

**12. Ans. (b)**

Here,  $x = 20$

$$\begin{aligned} \therefore \text{Required answer} &= \left( \frac{x}{100+x} \times 100 \right)\% \\ &= \left( \frac{20}{100+20} \times 100 \right)\% = 16\frac{2}{3}\%. \end{aligned}$$

**13. Ans. (b)**

Let third number be 100 then

first number = 7

second number = 28

$$\Rightarrow \frac{7}{28} \times 100 = 25\%$$

**14. Ans. (b)**

Reduction in consumption

$$= \left( \frac{P}{100+P} \times 100 \right)\%$$

$$= \left( \frac{15}{100+15} \times 100 \right)\% \text{ or } 13\frac{1}{23}\%.$$

**15. Ans. (b)**

Here,  $x = -50$  and  $y = 50$ .

$\therefore$  The net % change in wages

$$= \left( x+y + \frac{xy}{100} \right)\%$$

$$= \left( -50+50 - \frac{50 \times 50}{100} \right)\% \text{ or } -25\%.$$

Since the sign is  $-ve$ , he has a loss of 25%.

**16. Ans. (b)**

The equivalent discount of two successive discounts of 20% and 20%.

$$= \left( x+y + \frac{xy}{100} \right)\%$$

$$= \left( -20 - 20 + \frac{20 \times 20}{100} \right) \% \text{ or } -36\%.$$

Given:  $36\% - 35\% = \text{Rs. } 22$ .

$\therefore$  Amount of the bill  $= 22 \times 100 = \text{Rs. } 2200$ .

**17. Ans. (c)**

The equivalent discount of two successive discounts of 20% and 10%

$$= \left( x + y + \frac{xy}{100} \right) \%$$

$$= \left( -20 - 10 + \frac{20 \times 10}{100} \right) \% \text{ or } 28\%$$

$\therefore$  Discount on the list price of radio offered by the first shopkeeper

$$= 28\% \text{ of } 1000 = \frac{28}{100} \times 1000 = \text{Rs. } 280.$$

Also, the equivalent discount of two successive discounts of 15% and 15%

$$= \left( x + y + \frac{xy}{100} \right) \%$$

$$= \left( -15 - 15 + \frac{15 \times 15}{100} \right) \% \text{ or } 27\frac{3}{4}\%$$

$\therefore$  Discount on the list price of radio offered by the second shopkeeper.

$$= 27\frac{3}{4}\% \text{ of } 1000 = \frac{111}{400} \times 1000$$

$$= \text{Rs. } 277.50$$

$\therefore$  Difference in discounts offered by the two shopkeepers  $= \text{Rs. } 280 - \text{Rs. } 277.50$   
 $= \text{Rs. } 2.50$ .

**18. Ans. (a)**

Since tax  $\times$  consumption = revenue

$\therefore$  Net % change in revenue

$$= \left( x + y + \frac{xy}{100} \right) \%$$

$$= \left( -10 + 10 - \frac{10 \times 10}{100} \right) \%$$

(here  $x = -10$  and  $y = 10$ )  $= -1\%$

$\therefore$  The revenue decreases by 1%.

**19. Ans. (a)**

Since  $4\pi \times \text{radius} \times \text{radius} = \text{surface area}$

$\therefore$  Net % change in area

$$= \left( x + y + \frac{xy}{100} \right) \%$$

$$= \left( 10 + 10 + \frac{10 \times 10}{100} \right) \% = 21\%.$$

**20. Ans. (b)**

Since side  $\times$  side = area

$\therefore$  Net % change in area

$$= \left( x + y + \frac{xy}{100} \right) \%$$

$$= \left( 30 + 30 + \frac{30 \times 30}{100} \right) \% = 69\%.$$

$\therefore$  The area is increased by 69%.

**21. Ans. (a)**

Since  $\text{side}_1 \times \text{side}_2 = \text{area}$

$\therefore$  Error % in area  $= \left( x + y + \frac{xy}{100} \right) \%$

$$= \left( 10 - 20 - \frac{10 \times 20}{100} \right) \%$$

(Here,  $x = 10$  and  $y = -20$ )

$= -12\%$ , i.e. 12% deficit.

**22. Ans. (a)**

Since tax  $\times$  consumption = expenditure

$\therefore$  Net % change in expenditure

$$= \left( x + y + \frac{xy}{100} \right) \%$$

$$= \left( 20 - 20 - \frac{20 \times 20}{100} \right) \% \quad [x = 20 \text{ & } y = -20]$$

$= -4\%$ .

$\therefore$  Expenditure decreases by 4%.

## 23. Ans. (b) [yoursmahboob.wordpress.com](http://yoursmahboob.wordpress.com)

We have,  $P = 90.51$ ,  $t = 10$  and  $x = 3$   
 $\therefore$  The population 3 years ago

$$\begin{aligned} &= \frac{P}{\left(1 + \frac{x}{100}\right)^t} = \frac{90.51}{\left(1 + \frac{10}{100}\right)^3} \\ &= \frac{90.51}{100} \times \frac{100}{110} \times \frac{100}{110} \times \frac{100}{110} = 68 \text{ lakh} \end{aligned}$$

### 24. Ans. (c)

Here,  $A = 6250$ ,  $x = -10$ ,  $y = -20$  and  $z = -30$   
 $\therefore$  Value of the machine after 3 years

$$\begin{aligned} &= A \left(1 + \frac{x}{100}\right) \left(1 + \frac{y}{100}\right) \left(1 + \frac{z}{100}\right) \\ &= 6250 \left(1 - \frac{10}{100}\right) \left(1 - \frac{20}{100}\right) \left(1 - \frac{30}{100}\right) \\ &= \frac{6250 \times 90 \times 80 \times 70}{100 \times 100 \times 100} = \text{Rs. } 3150. \end{aligned}$$

### 25. Ans. (a)

Let  $A$  be the original strength.

$$\begin{aligned} \text{Then, } A \left(1 + \frac{x}{100}\right) \left(1 + \frac{y}{100}\right) \left(1 + \frac{z}{100}\right) \\ = 729000 \text{ (Given)} \\ \text{Here, } x = -10, y = -10 \text{ and } z = -10. \\ \therefore A \left(1 - \frac{10}{100}\right) \left(1 - \frac{10}{100}\right) \left(1 - \frac{10}{100}\right) \\ = 729000 \end{aligned}$$

$$\begin{aligned} \therefore A &= \frac{729000 \times 100 \times 100 \times 100}{90 \times 90 \times 90} \\ &= 1000000 \text{ men} \end{aligned}$$

### 26. Ans. (c)

Percentage of students passing the examination

$$\Rightarrow (100 - 40) \times 100 = 600\%$$

But,  $100 \times 100 \times 100 = 1000000$

$$\Rightarrow (100 - 40)\% = 60\%$$

1 of the total number of students appeared in the examination is 60.

Given, 60% of  $x = 348$

$$\text{or, } \frac{60}{100} \times x = 348 \text{ or, } x = \frac{348 \times 100}{60} = 580$$

Therefore, 580 students appeared in the examination.

### 27. Ans. (b)

Boys = 900, Girls = 1100

$$\begin{aligned} \text{Passed} &= (32\% \text{ of } 900) + (38\% \text{ of } 1100) \\ &= 288 + 418 = 706 \end{aligned}$$

$$\text{Failed} = 2000 - 706 = 1294$$

$$\text{Failed \%} = \left( \frac{1294}{2000} \times 100 \right)\% = 64.7\%$$

### 28. Ans. (b)

$$\text{Reduction} = \frac{30}{100 + 30} \times 100\% = 23.1\%$$

### 29. Ans. (c)

New price must be increased by

$$\left( \frac{20}{100 - 30} \times 100 \right)\% = 25\%$$

### 30. Ans. (a)

For the fraction  $\frac{a}{b}$

$$\text{Then, } \frac{a+10}{b+10} \approx \frac{a}{b} \quad \text{if } \frac{10}{b+10} \ll 1$$

$$\frac{a+10}{b+10} \approx \frac{a}{b} \Rightarrow \frac{a}{b} \approx \frac{a}{b}$$

0.0000

### Percentage

II

### Practice Exercise 11

- (a) Rs. 1880      (c) Rs. 1000  
 (b) Rs. 960      (d) Rs. 2160
16. If  $x\%$  of a is the same as  $y\%$  of b, then  $z\%$  of c is
- (a)  $\frac{yz}{x}\%$  of a      (b)  $\frac{xy}{z}\%$  of a  
 (c)  $\frac{xz}{y}\%$  of a      (d) None of these
17. As marks in Biology is 20 less than 25% of the total marks obtained by him in Biology, Maths and Drawing. If his marks in Drawing be 50, what is his marks in Maths?
- (a) 40      (b) 45  
 (c) 50      (d) Can't be determined
18. From a container having pure milk, 20% is replaced by water and the process is repeated thrice. At the end of the third operation, the milk is
- (a) 40% pure      (b) 50% pure  
 (c) 51.2% pure      (d) 56.8% pure
19. The salaries of A and B together amount to Rs. 2000. A spends 95% of his salary and B 95% of his. If now, their savings are same, what is A's salary?
- (a) Rs. 1500      (b) Rs. 1250  
 (c) Rs. 1600      (d) Rs. 750
20. 300 grams of sugar solution has 40% sugar in it. How much sugar should be added to make it 50% in the solution?
- (a) 10 gms      (b) 40 gms  
 (c) 60 gms      (d) 80 gms
21. The price of an article is cut by 20%. To restore it to the former value, the new price must be increased by
- (a) 20%      (b) 25%  
 (c)  $+\frac{2}{3}\%$       (d) 24%
22. In an examination, there are 3 papers of Mathematics of 100 marks each. A boy secures 60% in the first paper and 70% in the second paper. In order to secure 75% in the aggregate the percentage of marks he should secure in third paper will be
- (a) 90%      (b) 80%  
 (c) 75%      (d) 70%
23. Two numbers are less than a third number by 30% and 37% respectively. How much percent is the second number less than the first?
- (a) 10%      (b) 7%  
 (c) 4%      (d) 3%
24. In an examination, A got 10% marks less than B. B got 25% marks more than C and C got 20% less than D. If A got 360 marks out of 500, the percentage of marks obtained by C was
- (a) 70      (b) 75  
 (c) 80      (d) 85
25. If the numerator of a fraction be increased by 15% and its denominator be diminished by 8%, the value of the fraction  $\frac{15}{13}$  the original fraction is
- (a)  $\frac{3}{5}$       (b)  $\frac{3}{4}$   
 (c)  $\frac{3}{7}$       (d)  $\frac{2}{3}$
26. Arvind spends 75% of his income. His income is increased by 20% and he increased his expenditure by 10%. His savings are increased by
- (a) 10%      (b) 25%  
 (c)  $37\frac{1}{2}\%$       (d) 50%
27. In an examination, 35% candidates failed in one subject and 42% failed in another subject.

MAY

MADE IN



## Solutions

1. Ans. (c) 6.  

$$25\% \text{ of } 25\% = \frac{25}{100} \times \frac{25}{100} = 0.625.$$

2. Ans. (d) 7  
 Let the number be  $x$  then  

$$\frac{1}{4} \times \frac{1}{3} \times \frac{2}{5} \times x = 15.$$
  
 Then,  $x = 15 \times 30 = 450$   
 Now,  $40\% \text{ of } 450 = \frac{40}{100} \times 450 = 180.$

3. Ans. (d)  
 Let the number be  $x$   
 then  $200\% \text{ of } x = 140.$   
 Then,  $\frac{200}{100} \times x = 140 \text{ or } x = 70.$   
 Now,  $160\% \text{ of } 70 = \frac{160}{100} \times 70 = 112.$

4. Ans. (c)  
 Let the number be  $x$ , then  

$$\frac{3}{5}x - 40\% \text{ of } x = 40$$

$$\Rightarrow \frac{3}{5}x - \frac{40}{100}x = 40.$$

$$\text{or } \frac{3}{5}x - \frac{2}{5}x = 40 \text{ or } \frac{x}{5} = 40$$

or  $x = (40 \times 5) = 200.$

5. Ans. (d)

$$X = \frac{90}{100}Y \Rightarrow X = \frac{9}{10}Y \Rightarrow Y = \frac{10}{9}X$$

$$\Rightarrow \frac{Y}{X} = \frac{10}{9}.$$

$\therefore$  Required percentage

$$= \left( \frac{Y}{X} \times 100 \right) = \left( \frac{10}{9} \times 100 \right)\% = 111.1.$$

6. Ans. (c)

$$\frac{x}{100}y + \frac{y}{100}x = \frac{2xy}{100} = 2\% \text{ of } xy.$$

7. Ans. (b)

$$\frac{90}{100}A = \frac{30}{100}B \Rightarrow B = \frac{90}{100} \times \frac{100}{30}A$$

$$= \frac{300}{100}A = 300\% \text{ of } A.$$

$$\therefore x = 300$$

8. Ans. (c)

Note that 1 metric tonne = 10 quintals.

$\therefore$  2 metric tonnes = 20 quintals

$\therefore$  Required percentage

$$= \left( \frac{40}{20} \times 100 \right)\% = 200\%$$

9. Ans. (b)

40% of  $x = 178 + 22$

$$\text{or } \frac{40}{100}x = 200 \text{ or } x = \left( 200 \times \frac{100}{40} \right) = 500.$$

10. Ans. (b)

Purchases = 20% of  $x = \frac{x}{5}$

Balance =  $x - \frac{x}{5} = \frac{4x}{5}$

Transportation = 5% of  $\frac{4x}{5}$

$$\Rightarrow \frac{5}{100} \times \frac{4x}{5} = \frac{x}{25}$$

$$\text{Balance} = \frac{4x}{5} - \frac{x}{25} = \frac{19x}{25}$$

$$\therefore \frac{19x}{25} = 1520 \Rightarrow x = \frac{1520 \times 25}{19} = 2000.$$

11. Ans. (d)

$$80\% \text{ of } x = 800 \Rightarrow \frac{80}{100}x = 800$$

$$\Rightarrow x = 800 \times \frac{100}{80} = 1000.$$

12. Ans. (a)

Suppose he ate  $x$  apples.

Then, apples sold = 140% of  $x$

$$\Rightarrow \left( \frac{140}{100} \times x \right) = \frac{7x}{5}$$

$$\frac{7x}{5} = 70 \Rightarrow x = 70 \times \frac{5}{7} = 50.$$

13. Ans. (c)

Let, total population =  $x$ . Males =  $\frac{5}{9}x$

Married males = 30% of  $\frac{5}{9}x$

$$\Rightarrow \frac{30}{100} \times \frac{5}{9}x = \frac{x}{6}$$

Married females =  $\frac{x}{6}$

Total females =  $\left( x - \frac{5}{9}x \right) = \frac{4x}{9}$

$$\text{Unmarried females} = \left( \frac{4x}{9} - \frac{x}{6} \right) = \frac{5x}{18}$$

∴ Required percentage

$$= \left( \frac{5x}{18} \times \frac{1}{x} \times 100 \right) \% = 27\frac{7}{9}\%$$

14. Ans. (a)

Number of passed candidates

$$= \left( \frac{10}{100} \times 40 + \frac{20}{100} \times 50 + \frac{10}{100} \times 60 \right) \\ = (4 + 10 + 6) = 20$$

$$\text{Passed percentage} = \frac{20}{(40+50+60)} \times 100$$

$$= \left( \frac{20}{150} \times 100 \right) \% = 13\frac{1}{3}\%$$

15. Ans. (c)

$$30\% A = 20\% \text{ of } \frac{3}{5}B \Rightarrow \frac{30A}{100} = \frac{20}{100} \times \frac{3}{5}B$$

$$\therefore A = \frac{20}{100} \times \frac{3}{5} \times \frac{100}{30} B = \frac{2}{5}B$$

$$= \left( \frac{2}{5} \times 2400 \right) = 960.$$

16. Ans. (c)

$$x\% \text{ of } a = y\% \text{ of } b \Rightarrow \frac{x}{100}a = \frac{y}{100}b \Rightarrow b$$

$$= \left( \frac{x}{100} \times \frac{100}{y} \right) a = \left( \frac{x}{y} \right) a$$

$$\therefore z\% \text{ of } b = \left( z\% \text{ of } \frac{x}{y} \right) a$$

$$= \left( \frac{xz}{y \times 100} \right) a = \left( \frac{xz}{y} \right) \% \text{ of } a.$$

17. Ans. (d)

Let  $B + M + D = x$ .

Then,  $B = (25\% \text{ of } x - 20)$

$$\Rightarrow \left( \frac{25}{100}x - 20 \right) = \left( \frac{x}{4} - 20 \right)$$

∴ It is given that  $D = 50$

$$\therefore \frac{x}{4} - 20 + M + 50 = x \text{ or } M = \left( \frac{3x}{4} - 30 \right)$$

So, marks in Maths cannot be determined

18. Ans. (c)

Let total quantity of original milk = 1000 gm.

Milk after first operation

$$= 80\% \text{ of } 1000 = 800 \text{ gm.}$$

Milk after second operation

$$= 80\% \text{ of } 800 = 640 \text{ gm.}$$

Milk after third operation

$$= 80\% \text{ of } 640 = 512 \text{ gm.}$$

∴ Strength of final mixture = 51.2%.

19. Ans. (a)

Let A's salary =  $x$ , Then, B's =  $(2000 - x)$

5% of A = 15% of B, i.e.

$$\frac{5}{100}x = \frac{15}{100}(2000 - x) \text{ or } x = 1500.$$

20. Ans. (c)

$$\text{Sugar} = \left( \frac{40}{100} \times 300 \right) \text{ gms} = 120 \text{ gms.}$$

Water = 180 gms.

Let  $x$  gm sugar may be added.

$$\text{Then, } \frac{120+x}{300+x} \times 100 = 50$$

$$\Rightarrow 240 + 2x = 300 + x \Rightarrow x = 60$$

21. Ans. (b)

Let original price = 100. New price = 80

Increase on 80 = 20

$$\text{Increase \%} = \left( \frac{20}{80} \times 100 \right) \% = 25\%$$

22. Ans. (b)

$$60 + 70 + x = \frac{70}{100} \times 300 \text{ or } x = 80\%$$

23. Ans. (a)

Let, third number be  $x$ . Then,

$$\text{First number} = 70\% \text{ of } x = \frac{7x}{10} = \frac{70x}{100}$$

$$\text{Second number} = 63\% \text{ of } x = \frac{63x}{100}$$

$\Rightarrow$  Second number is  $\frac{7x}{100}$  less than first number so in percentage term

$$= \left( \frac{7x/100}{7x/10} \times 100 \right) \% = 10\%$$

24. Ans. (c)

$$A = \frac{90}{100} B, B = \frac{125}{100} C \text{ and } C = \frac{80}{100} D.$$

$$\therefore B = \frac{10}{9} A, C = \frac{4}{5} B \text{ and } D = \frac{5}{4} C.$$

$$B = \frac{10}{9} \times 360 = 400, C = \frac{4}{5} \times 400 = 320$$

$$\text{and } D = \frac{5}{4} \times 320 = 400$$

$$\text{Percentage of } D = \left( \frac{400}{500} \times 100 \right) \% = 80\%$$

25. Ans. (b)

Let the given fraction be  $x/y$ .

$$\text{Then, } \frac{115\% \text{ of } x}{92\% \text{ of } y} = \frac{15}{16} \Rightarrow \frac{115x}{92y} = \frac{15}{16}$$

$$\Rightarrow \frac{x}{y} = \left( \frac{15}{16} \times \frac{92}{115} \right) = \frac{3}{4}$$

26. Ans. (d)

Let income = 100, Expenditure = 75 and

Savings = 25

New income = 120, New expenditure

$$= \left( \frac{110}{100} \times 75 \right) = \frac{165}{2}$$

$$\text{New savings} = \left( 120 - \frac{165}{2} \right) = \frac{75}{2}$$

$$\text{Increase in savings} = \left( \frac{75}{2} - 25 \right) = \frac{25}{2}$$

$$\text{Increase percent} = \left( \frac{25/2}{25} \times 100 \right) \% = 50\%$$

27. Ans. (b)

$$\text{Failed in 1st subject} = \left( \frac{35}{100} \times 2500 \right) = 875.$$

$$\text{Failed in 2nd subject} = \left( \frac{42}{100} \times 2500 \right) = 1050$$

$$\text{Failed in both} = \left( \frac{15}{100} \times 2500 \right) = 375$$

$$\text{Failed in 1st subject only} = (875 - 375) = 500.$$

$$\text{Failed in 2nd subject only} = (1050 - 375) = 675$$

$$\text{Passed in 2nd only} + \text{Passed in 1st only} \\ = (675 + 500) = 1175$$

28. Ans. (c)

Suppose boys =  $3x$  and girls =  $2x$

$$\text{Not adults} = \left( \frac{80}{100} \times 3x \right) + \left( \frac{75}{100} \times 2x \right)$$

$$= \left( \frac{12x}{5} + \frac{3x}{2} \right) = \frac{39x}{10}$$

Required percentage

$$= \left( \frac{39x}{10} \times \frac{1}{5x} \times 100 \right) \% = 78\%$$

29. Ans. (a)

Let original consumption = 100 units & original price = Rs. 100/unit.

$$\text{Original expenditure} = \text{Rs. } (100 \times 100) \\ = \text{Rs. } 10000$$

$$\text{New expenditure} = \text{Rs. } (120 \times 75) = \text{Rs. } 9000$$

$\therefore$  Decrease in expenditure

$$= \left( \frac{1000}{10000} \times 100 \right) \% = 10\%.$$

30. Ans. (d)

$$72900 \left(1 + \frac{10}{100}\right)^n = 133100 \times \left(1 - \frac{10}{100}\right)^n$$

$$\therefore \left(\frac{11}{10}\right)^n \times \left(\frac{10}{9}\right)^n = \frac{133100}{72900} = \frac{1331}{729}$$

$$\therefore \left(\frac{11}{9}\right)^n = \left(\frac{11}{9}\right)^3 \Rightarrow n = 3.$$

31. Ans. (a)

Let original price = Rs.  $x/\text{kg}$ . Reduced price

$$= \left(\frac{79}{100}x\right)/\text{kg.}$$

$$\frac{100}{79x} - \frac{100}{x} = 10.5 \Rightarrow \frac{10000}{79x} - \frac{100}{x} = 10.5$$

$$10000 - 7900 = 10.5 \times 79x$$

$$\text{or } x = \frac{2100}{10.5 \times 79}$$

∴ Reduced price

$$= \text{Rs.} \left( \frac{79}{100} \times \frac{2100}{10.5 \times 79} \right) / \text{kg} = \text{Rs.} 2 / \text{kg}$$

32. Ans. (d)

Let  $A = x$ ,  $B = 2x$  and  $C = 3x$ ,

Then,  $2x + 3x = 6000 \Rightarrow x = 1200$ .

∴  $A = 1200$  and  $C = 3600$ .

Required excess

$$= \left( \frac{2400}{1200} \times 100 \right) \% = 200\%$$

33. Ans. (a)

Let length =  $l$  and breadth =  $b$ .

Let the required decrease in breadth be  $x$ .

$$\text{Then, } \frac{160}{100}l \times \frac{(100-x)}{100} \times b = lb$$

$$\Rightarrow 160(100-x) = 100 \times 100$$

$$\text{or } 100-x = \frac{10000}{160} = \frac{125}{2}$$

$$\Rightarrow x = \left(100 - \frac{125}{2}\right) = 37\frac{1}{2}$$

34. Ans. (c)

$$\text{Surface area } 4\pi R^2 = \frac{3}{R} \left( \frac{4}{3} \pi R^3 \right)$$

$$= \frac{3}{R} \times \text{Volume}$$

When  $R = 10$ , we have

$$S = \frac{3}{10} V = \left( \frac{3}{10} \times 100 \right) \% \text{ of } V = 30\% \text{ of }$$

35. Ans. (a)

$$40\% \text{ of } x + 50\% \text{ of } x + 20 = x$$

$$\Rightarrow \frac{40}{100}x + \frac{50}{100}x + 20 = x \text{ or } x = 200.$$





Profit and loss are part and parcel of every commercial transaction. In fact, the entire economy and concept of capitalism is based on the so called 'profit and loss'.

Business transactions have now-a-days become common feature of life. When a person deals in purchase and sale of any item, he either gains or loses some amount generally. The aim of entire business is to earn profit.

The commonly used term in dealing with questions involving sales and purchase are:

### **Cost Price**

The cost price of an article is the price at which an article has been purchased. It is abbreviated as C.P.

**Note:** Cost price can also be written as CP only.

### **Selling Price**

The selling price of an article is the price at which an article has been sold - It is abbreviated as S.P.

**Note:** Selling price can also be written as SP only.

### **Profit or Gain**

If the selling price of an article is more than the

cost price, then there is a gain or profit.

Thus, Profit or Gain = S.P. - C.P.

### **Loss**

If the cost price of an article is greater than the selling price, then the seller suffers a loss.

Thus, Loss = C.P. - S.P.

Profit and loss are always calculated with the respect to the cost price of the item

$$\text{Profit\%} = \frac{\text{Profit}}{\text{C.P.}} \times 100$$

$$\text{Loss\%} = \frac{\text{Loss}}{\text{C.P.}} \times 100$$

#### **Example:**

By selling an article at 500 Rs. Mohan incurs 50Rs. gain then find cost price of that article

$$\text{C.P.} = \text{S.P.} - \text{Gain}$$

$$\text{C.P.} = 500 - 50$$

$$= \text{Rs. } 450$$

#### **Example:**

Ramesh purchased a radio set at Rs. 1500 and sold it at Rs. 1200. Find loss incurred by him?

$$\begin{aligned}\text{Loss} &= \text{C.P.} - \text{S.P.} \\ &= 1500 - 1200 = 300.\end{aligned}$$

Also in this case we can calculate

$$\text{Loss\%} = \frac{300}{1500} \times 100 = 20\%$$

Thus he incurred 20% loss.

### Basic Formulae

1. When SP and Gain% are Given then

$$CP = \left( \frac{100}{100 + \text{Gain\%}} \right) \times SP$$

2. When the C.P. and Gain % are given then

$$SP = \frac{100 + \text{Gain\%}}{100} \times CP$$

3. When C.P. and loss% are given then

$$SP = \frac{100 - \text{Loss\%}}{100} \times CP$$

4. When S.P. and loss percentages are given

$$CP = \left( \frac{SP}{100 - \text{Loss\%}} \right) \times 100$$

5. If the cost price (C.P.) of m articles is equal to selling price of n article, then

$$\% \text{ gain or loss} = \left[ \frac{m-n}{n} \right] \times 100$$

If  $m > n$ , it is % gain and if  $m < n$ , it is % loss

**Example:** If the S.P. of 12 articles is equal to the cost price of 18 articles, what is profit%?

**Solution:**

Here  $m=18$ ,  $n=12$

$$\text{Profit \%} = \frac{(m-n)}{n} \times 100$$

$$= \frac{18-12}{12} \times 100 = \frac{6}{12} \times 100 = 50\%$$

**Example:** If the S. P. of a dozen apple is equal to cost price of 9 apples find gain or loss%?

**Solution:**

Here  $m=9$ ,  $n=12$

$$\Rightarrow \left( \frac{m-n}{n} \right) \times 100 = \frac{9-12}{12} \times 100$$

$$= \frac{1}{4} \times 100 = -25\%$$

(-ve) sign indicates loss

6. When two different articles are sold at the same S.P., getting gain/loss of  $x\%$  on the first and gain/loss of  $y\%$  on the second, the overall % gain or % loss in the transaction is given by

$$\left[ \frac{100(x+y)+2xy}{(100+x)+(100+y)} \right] \%$$

The above expression represent overall gain or loss according to its given (+ve or -ve).

7. When two different articles are sold at the same selling price getting gain of  $x\%$  on the first and loss of  $x\%$  on the second, then there will always be loss on such transaction. The overall loss % in such transaction is given by

$$\left( \frac{x}{10} \right)^2 \%$$

**Example:** Michael sold two T.V. sets for Rs. 3600 each gaining 20% on one and loosing 20% on the other. Find the total gain or loss percent.

**Solution:**

There will always be loss on such transaction.

Here  $x = 20$

$$\text{So, overall loss} = \left( \frac{x}{10} \right)^2 \% = \left( \frac{20}{10} \right)^2 \% = 4\%$$

Note  
then

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8. A merchant uses faulty measure and sells his goods at gain/loss of  $x\%$ . The overall % gain or loss ( $g$ ) is given by

$$\frac{100+g}{100+x} = \frac{\text{True measure}}{\text{Faulty measure}}$$

Note: If merchant sells his goods at cost price then  $x = 0$ .

**Example:** A dishonest shopkeeper professes to sell his goods at the cost price but use faulty measure. His 1 kg weight measures 950 gms only. Find his gain percent.

**Solution:**

Here, True measure = 1000 gms

False measure = 950 gms

Since the Shopkeeper sells the goods at cost price.

$$\therefore x = 0,$$

$\therefore$  overall gain % is given by

$$\frac{\text{True measure}}{\text{Faulty measure}} = \frac{100+g}{100+x}$$

$$\Rightarrow \frac{1000}{950} = \frac{100+g}{950}$$

$$\text{So, } 100+g = \frac{1000 \times 100}{950}, g = 5\frac{5}{19}\%.$$

**Note:** If  $g$  is (-)ve then shopkeeper incurs loss.

## Discounts

9. If two successive discount of an article are  $m\%$  and  $n\%$  respectively, then a single discount equivalent to the two successive discounts will be  $\left(m+n-\frac{mn}{100}\right)\%$

$$\text{discounts will be } \left(m+n-\frac{mn}{100}\right)\%$$

It can also be calculated as

$$\left[100 - 100 \times \frac{(100-m)}{100} \times \frac{(100-n)}{100}\right]\%$$

- Ex.1.** Two successive discounts of 10% and 20% is equivalent to a single discount of

$$\left(10 + 20 - \frac{10 \times 20}{100}\right) = 28\%$$

Which is less than 30%.

- Ex.2** Find the single discount which is equivalent to a successive discounts of 50% and 40%.

**Sol.:** Single discount will be equal to

$$\left(m+n-\frac{mn}{100}\right)\%$$

$$\Rightarrow \left(50 + 40 - \frac{50 \times 40}{100}\right)\%$$

$$\Rightarrow 70\%$$

- Ex.3** Find the single discount which is equivalent to three successive discounts of 10%, 20% and 30%.

**Sol.:** Here first of all we will determine the single discount, which is equivalent to two successive discounts of 10% and 20%.

$$\Rightarrow \left[10 + 20 - \frac{10 \times 20}{100}\right]\%$$

$$\Rightarrow 28\%$$

Now, we will find a single discount which is equivalent to two successive discounts of 28% and 30%

$$\Rightarrow \left[28 + 30 - \frac{28 \times 30}{100}\right]\%$$

$$\Rightarrow 49.6\% \text{ Ans.}$$

- Ex.4** Find a single discount which is equivalent to three successive discounts of 50%, 40% and 20%.

Sol.: Single Discount equivalent to two successive discounts of 50% and 40% is equal to

$$= \left[ 50 + 40 - \frac{50 \times 40}{100} \right] \% \\ = 70\%$$

Now we will find single discount which is equivalent to two successive discounts of 70% & 20%

$$= \left[ 70 + 20 - \frac{70 \times 20}{100} \right] \% \\ = 76\%$$

Ex.5 Find a single discount which is equivalent to three successive discounts of 20%, 30% and 20%

Sol.: Single discount equivalent to 20% and 30% is

$$= \left[ 20 + 30 - \frac{20 \times 30}{100} \right] \% \\ = 44\%$$

Now we will find single discount which is equivalent to two successive discounts of 44% and 20%

$$= \left[ 44 + 20 - \frac{44 \times 20}{100} \right] \% \\ = 55.2\%$$



### Solved Examples

- By selling a watch for Rs. 495 a shopkeeper incurs a loss of 10%. Find the cost price of the watch for the shopkeeper.  
(a) Rs. 545      (c) Rs. 560  
(b) Rs. 555      (d) None of these

Ans. (b)

Here SP = 495

Loss = 10%

$$SP = \frac{CP}{(100 - Loss\%)} \times 100$$

$$495 = \frac{CP}{90} \times 100 \Rightarrow CP = Rs. 550$$

- By selling a cap for Rs. 34.40 a man gains 7.5% percent. What will be the SP if the gain

- (a) Rs. 32.80      (b) Rs. 32  
(c) Rs. 32.40      (d) Rs. 28.80

Ans. (b)

$$SP = \frac{CP}{(100 + Gain\%)} \times 100$$

$$\Rightarrow \frac{34.40}{107.5} \times 100 = 32$$

- A shopkeeper sold goods for Rs. 2400 and made a profit of 25% in the process. Find the profit percent if he had sold his good for Rs. 2040.

- (a) 6.25%      (b) 7%  
(c) 6.20%      (d) 6.5%

Ans. (a)

$$SP = 2400, Profit\% = 25$$

$$CP = \frac{SP}{(100 + Profit\%)} \times 100 = \frac{2400}{125} \times 100 = 1920$$

If sold at 2040, profit = Rs. 120

$$Profit\% \Rightarrow \frac{120}{1920} \times 100 = 6.25$$

- A digital diary is sold for Rs. 935 at a profit of 10%. What would have been the actual profit or loss on it, if it had been sold for Rs. 810?

- (a) Rs. 45      (b) Rs. 40  
(c) Rs. 48      (d) Rs. 50

Ans. (b)

$$SP = 935, Profit\% = 10\%$$

$$CP = \frac{935}{110} \times 100 = 850$$

Diary if sold at 810 incurs loss of Rs. 40



$$\text{Rate} = \frac{P}{T} = \frac{R}{T}$$

$$\text{Rate} \times T = \frac{P}{T} \times T = P$$

1. If the rate of interest is 5% then  
Simple interest on Rs. 1000 for 2 years  
will be equal to Rs. 100.

- A) 1  
B) 2  
C) 3  
D) 4

Interest payable over 2 years will be

$$100 \times 2 \times \frac{5}{100} = 100$$

∴ 2% of 1000 will be 20.

$$\frac{20}{100} \times 1000 = 200$$

$$\frac{200}{100} \times 100 = 200$$

2. If a simple interest payable in 2 years  
is Rs. 100, then it is

- A) 5% B) 10%  
C) 15% D) 20%

**Simple interest**

$$\text{SI} = \left( \frac{P \times R \times T}{100} \right)$$

$$= 100 \times 50 \times \frac{2}{100} = 100$$

3. How much percent more than the cost price  
should a shopkeeper mark his goods so that  
after allowing a discount of 10% he still  
have a gain of 5% on the day?

- A) 15% B) 16.66%  
C) 17% D) 20%

**Ans. (B)**

Let the cost price be Rs. 100 then SP is  
Rs. 125.

Hence, CP after giving a discount of 10%

$$= 100 \times \frac{90}{100}$$

$$\text{Rate} = \frac{P}{T} = \frac{R}{T}$$

$$R = \frac{P}{T} = \frac{100}{2} = 50$$

$$= \frac{50}{100} \times 100 = 50\%$$

**Simple Interest**

$$SI = \frac{P \times R \times T}{100}$$

4. If the total value of the investment  
shows a simple interest of 10% per annum  
then the principal amount is

- A) 100 B) 120  
C) 170 D) 200

**Ans. (A)**

Let the principal amount be Rs. 100.

**SI**

$$SI = \frac{P \times R \times T}{100}$$

$$= \frac{100 \times 10 \times 1}{100} = 10$$

$$P = \frac{SI}{R \times T}$$

∴ Principal amount is Rs. 100.

$$= \frac{100 \times 100 \times 1}{10 \times 1} = 1000$$

5. A shopkeeper shows a profit of 20%  
if he sells a book at Rs. 800. At what  
price should he sell the book to make  
a profit of 25%?

- A) Rs. 800 B) Rs. 820  
C) Rs. 840 D) Rs. 860

**Ans. (C)**

**SP**

$$SP = \frac{CP \times 120}{100}$$

$$= \frac{800 \times 120}{100} = 960$$

$$SP = \frac{CP \times 125}{100}$$

$$\Rightarrow x \times \frac{95}{100} = 38, \therefore x = \text{Rs. } 40$$

The buying price for the retailer

$$= 40 - 40 \times \frac{20}{100} = 32 \text{ Rs.}$$

Hence profit made by retailer  
 $= 38 - 32 = 6 \text{ Rs.}$

16. The cost of production of a cordless phone set in 2002 is Rs. 900, divided between material, labour and overheads in the ratio 3 : 4 : 2. If the cordless phone set is marked at a price that gives a 20% profit on the component of price accounted for by labour, what is the marked price of the set?
- (a) Rs. 980      (b) Rs. 1080  
 (c) Rs. 960      (d) None of these

**Ans. (a)**

Cost of phone accounted for by labour

$$= \frac{4}{3+4+2} \times 900 = 400 \text{ Rs.}$$

Component of price accounted for by labour

$$= 400 + 400 \times \frac{20}{100} = 480 \text{ Rs.}$$

Marked price of the set

$$= 480 + (900 - 400) = 980 \text{ Rs.}$$

17. If subsequently in 2003, the cost of material, labour and overheads increased by 20%, 30% and 10% respectively, calculate the cost of manufacturing in 2003.

- (a) Rs. 1150      (b) Rs. 1050  
 (c) Rs. 1080      (d) Rs. 1100

**Ans. (d)**

In 2003, cost of material

$$= 300 + 300 \times \frac{20}{100} = 360 \text{ Rs.}$$

Cost of labour

$$= 400 + 400 \times \frac{30}{100} = 520 \text{ Rs.}$$

Cost of overhead

$$= 200 + 200 \times \frac{10}{100} = 220 \text{ Rs.}$$

Hence, cost of manufacturing  
 $= 360 + 520 + 220 = 1100 \text{ Rs.}$

18. The cost price of 50 mangoes is equal to the selling price of 40 mangoes. Find the percentage profit?

- (a) 20%      (b) 25%  
 (c) 30%      (d) None of these

**Ans. (b)**

Let the cost price of each mango be Rs. 1

Then cost price of 40 mangoes = Rs. 40

Selling price of 40 mangoes = Rs. 50

$\therefore$  Percentage profit

$$= \frac{50 - 40}{40} \times 100 = 25\%$$

19. A owns a house worth Rs. 10,000. He sells it to B at a profit of 15%. After some time, B sells it back to A at 15% loss. Find A's loss or gain percent.

- (a) 2.25% gain      (b) 6.25% gain  
 (c) 17.64% gain      (d) 17.25% gain

**Ans. (d)**

Buying price of the House by B

$$= 10000 + 10000 \times \frac{15}{100} = 11500 \text{ Rs.}$$

Price at which A buys house from B.

$$= 11500 - 11500 \times \frac{15}{100} = 11500 - 1725$$

$$= \text{Rs. } 9775$$

Hence A's gain percent

$$= \frac{11500 - 9775}{10000} \times 100 = 17.25\%$$

20. Anil bought an article at Rs. 200 and sold it at a profit of 10%. What would have been the increase in the profit percent if it was sold for Rs. 230?



- (a) Rs. 500  
(d) Rs. 425

- (b) Rs. 360  
(d) Rs. 400

**Ans. (d)**

Let the cost price of the article =  $x$  Rs.

Price when it is bought at 5% less than cost price

$$= x - x \times \frac{5}{100} = \frac{95}{100}x$$

Selling price when it is sold for Rs. 2 less.

$$= x + x \times \frac{5}{100} - 2 = \frac{105}{100}x - 2$$

$$\text{Given, } \frac{105}{100}x - 2 - \frac{95}{100}x = \frac{95}{100}x \times \frac{10}{100}$$

$$\Rightarrow \frac{10}{100}x - 2 = \frac{95}{1000}x$$

$$\therefore x = \frac{2 \times 1000}{5} = 400 \text{ Rs.}$$

26. A briefcase was sold at a profit of 10%. If its cost price was 5% less and it was sold for Rs. 7 more, the gain would have been 20%. Find the cost price of the briefcase.

- (a) Rs. 175      (b) Rs. 200  
(c) Rs. 225      (d) Rs. 160

**Ans. (a)**

Let the cost price =  $x$  Rs.

Price 5% less than cost price =  $\frac{95}{100}x$

Selling price when sold for Rs. 7 more

$$= \frac{110}{100}x + 7$$

$$\text{Given, } \frac{110}{100}x + 7 - \frac{95}{100}x = \frac{95}{100}x \times \frac{20}{100}$$

$$\Rightarrow \frac{20}{500}x = 7 \quad \therefore x = \frac{7 \times 500}{20} = 175 \text{ Rs.}$$

27. A man sells a plot of land at 6% profit. If he had sold it at 10% profit, he would have

received Rs. 200 more. What is the selling price of the land?

- (a) Rs. 5000      (b) Rs. 5300  
(c) Rs. 4800      (d) Rs. 5500

**Ans. (b)**

Let the cost price of land =  $x$  Rs.

$$\text{Given, } x + x \times \frac{10}{100} = x + x \times \frac{6}{100} + 200$$

$$\Rightarrow x + \frac{4x}{100} = 200$$

$$\Rightarrow x = \frac{100 \times 200}{4} = 5000 \text{ Rs.}$$

Selling price of land

$$5000 + 5000 \times \frac{6}{100} = 5300 \text{ Rs.}$$

28. A man buys two cycles for a total cost of Rs. 900. By selling one for  $\frac{4}{5}$  of its cost and other for  $\frac{5}{4}$  of its cost, he makes a profit of Rs. 90 on the whole transaction. Find the cost price of lower priced cycle.

- (a) Rs. 360      (b) Rs. 250  
(c) Rs. 300      (d) Rs. 420

**Ans. (c)**

Let the cost of the two cycles be  $x$  and  $y$  Rs. ... (i)

$$\text{Then, } x + y = 900$$

$$\text{Again, } \frac{4x}{5} + \frac{5y}{4} - 900 = 90$$

$$\Rightarrow \frac{4x}{5} + \frac{5y}{4} = 990 \quad \dots (ii)$$

Solving (i) & (ii), we get

$$x = 300, y = 600.$$

29. A trader purchases apples at Rs. 60 per hundred. He spends 15% on the transportation. What should be the selling price per 100 to earn a profit of 20%?

- (a) Rs. 72      (b) Rs. 81.8  
(c) Rs. 82.8      (d) Rs. 83.8



8. If the selling price of 18 articles is equal to the C.P. of 21 articles, the loss or gain percent is:
- $16\frac{2}{3}\%$  gain
  - $14\frac{2}{7}\%$  gain
  - $16\frac{2}{3}\%$  loss
  - $14\frac{2}{7}\%$  loss
9. A man sold 250 chairs and had a gain equal to selling price of 50 chairs. His profit percent is:
- 5%
  - 10%
  - 25%
  - 50%
10. A vendor loses the S.P. of 4 oranges on selling 36 oranges. His loss percent is:
- $12\frac{1}{2}\%$
  - $11\frac{1}{9}\%$
  - 10%
  - None of these
11. A shopkeeper, on selling a pen for Rs. 10, loses  $\frac{1}{11}$  of what it costs him. His cost price is:
- Rs. 9
  - Rs. 10
  - Rs. 11
  - Rs. 12
12. If Amit purchased 11 books for Rs 10 and sold all the books at the rate of 10 books for Rs. 11, the profit percent is:
- 10%
  - 11%
  - 21%
  - 100%
13. Ajay bought 15 kg of dal at the rate of Rs. 14.50 per kg and 10 kg at the rate of Rs. 13 per kg. He mixed the two and sold the mixture at the rate of Rs. 15 per kg. What was his total gain in this transaction?
- Rs. 1.10
  - Rs. 16.50
  - Rs. 11
  - Rs. 27.50
14. Pure ghee costs Rs. 100 per kg. After adulterating it with vegetable oil costing Rs. 50 per kg, a shopkeeper sells the mixture at the rate of Rs. 96 per kg, thereby making a profit of 20%. In what ratio does he mix the two?
- (a) 1 : 2      (b) 3 : 2  
 (c) 3 : 1      (d) None of these
15. A dealer professes to sell his goods at cost price, uses a 900 gm weight for a kilogram. His gain percent is:
- 9
  - 10
  - 11
  - $11\frac{1}{9}$
16. Toffees are bought at the rate of 3 for a rupee. To gain 50%, they must be sold at:
- 2 for a rupees
  - 1 for a rupees
  - 4 for a rupee
  - 5 for a rupees
17. By selling 45 lemons for Rs. 40, a man loses 20%. How many should he sell for Rs. 24 to gain 20% in the transaction?
- 16
  - 18
  - 20
  - 22
18. A man gains 10% by selling a certain article for a certain price. If he sells it at double the price, the profit made is:
- 20%
  - 120%
  - 100%
  - 140%
19. A sells a bicycle to B at a profit of 20% and B sells it to C at a profit of 25%. If C pays Rs. 1500, what did A pay for it?
- Rs. 825
  - Rs. 1000
  - Rs. 1100
  - Rs. 1125
20. If the manufacturer gains 10%, the wholesale dealer 15% and the retailer 25%, then the cost of production of a table, the retail price of which is Rs. 1265 was:
- Rs. 632.50
  - Rs. 800
  - Rs. 814
  - Rs. 834.34
21. Two mixers and one T.V. cost Rs. 7000, while two T.V.'s and a mixer cost Rs. 9800. The value of one T.V. is:
- Rs. 2800
  - Rs. 2100
  - Rs. 4200
  - Rs. 8400

22. A horse and a cow were sold for Rs. 12000 each. The horse was sold at a loss of 20% and the cow at a gain of 20%. The entire transaction resulted in:

  - no loss or no gain
  - loss of Rs. 1000
  - gain of Rs. 1000
  - gain of Rs. 2000

23. An Article is sold at certain price. By selling it at  $\frac{2}{3}$  of that price one loses 10%. The gain percent at original price is:

  - 20%
  - $33\frac{1}{3}\%$
  - 35%
  - 40%

24. A grocer sells rice at a profit of 10% and uses weights which are 20% less than the market weight. The total gain earned by him will be:

  - 30%
  - 35%
  - 37.5%
  - None of these

25. Two-third of a consignment was sold at a profit of 5% and the remainder at a loss of 2%. If the total profit was Rs. 400, the value of the consignment (in rupees) was:

  - 20000
  - 15000
  - 12000
  - 10000

26. A fruit seller has 24 kg of apples. He sells a part of these at 20% gain and the balance at a loss of 5%. If on the whole he earns a profit of 10%, the amount of apples sold at loss is:

  - 6 kg
  - 4.6 kg
  - 9.6 kg
  - 11.4 kg

27. The C. P. of an article is 40% of the S. P. The percent that the S.P. is of C.P. is:

  - 250
  - 240
  - 60
  - 40

28. If an article is sold at 5% gain instead of 5% loss, the seller gets Rs. 6.72 more. The C.P. of the article is:

  - Rs. 67.20
  - Rs. 120
  - Rs. 134.40
  - Rs. 240

29. A man bought an article and sold it at a gain of 5%. If he had bought it at 5% less and sold it for Re 1 less, he would have made a profit of 10%. The C.P. of the article was:

  - Rs. 100
  - Rs. 150
  - Rs. 200
  - Rs. 500

30. A reduction of 25% in the price of eggs enables one to buy 4 dozen more eggs for Rs. 96. What is the price per dozen?

  - Rs. 6
  - Rs. 8
  - Rs. 8.50
  - Rs. 9

31. Raghu bought 4 dozen oranges at Rs. 12.00 dozen and 2 dozen oranges at Rs. 16.00 dozen. He sold them all to earn 20% profit. At what price per dozen did he sell the oranges?

  - Rs. 14.40
  - Rs. 16
  - Rs. 16.80
  - Rs. 19.20

32. The profit earned by selling an article for Rs. 900 is double the loss incurred when the same article is sold for Rs. 450. At what price should the article be sold to make 25% profit?

  - Rs. 600
  - Rs. 750
  - Rs. 800
  - Data inadequate

33. A man sold an article for Rs. 75 and incurred a loss of 25%. Had he sold it for Rs. 96, his profit would have been double the former loss. The C.P. of the article is:

  - Rs. 81
  - Rs. 82
  - Rs. 83
  - Rs. 85.50

34. A single discount equivalent to a discount series of 30%, 20% and 10% is:

  - 50%
  - 49.6%
  - 49.4%
  - 51%

35. A table is offered for Rs. 300 with 20% off. If in addition, a discount of 5% is offered on cash payment, then the cash price of the table is:
- (a) Rs. 240      (b) Rs. 216      (c) Rs. 210      (d) Rs. 205.20
36. A tradesman marks his goods 30% above the C.P. If he allows a discount of  $6\frac{1}{4}\%$ , then his gain percent is:
- (a)  $23\frac{3}{4}\%$       (b) 22%      (c)  $21\frac{7}{8}\%$       (d) None of these
37. The difference between a discount of 40% on Rs. 500 and two successive discounts of 36% and 4% on the same amount is:
- (a) Nil      (b) Rs. 2      (c) Rs. 7.20      (d) Rs. 1.93
38. What price should a shopkeeper mark on an article, costing him Rs. 153, to gain 20% after allowing a discount of 15%?
- (a) Rs. 224      (b) Rs. 216      (c) Rs. 184      (d) Rs. 162
39. If the S.P. of Rs. 24 results in a 20% discount on list price, what S.P. would result in a 30% discount on list price?
- (a) Rs. 27      (b) Rs. 21      (c) Rs. 20      (d) Rs. 9
40. A shopkeeper earns a profit of 12% on selling a book at 10% discount on the printed price. The ratio of the cost price to the printed price of the book is:
- (a) 50 : 61      (b) 45 : 56      (c) 99 : 125      (d) 55 : 69
41. A retailer buys 30 articles from a wholesaler at the price of 27. If he sells this at their marked price, the gain percent in the transaction is :
- (a)  $9\frac{1}{11}\%$       (b) 10%      (c)  $11\frac{1}{9}\%$       (d)  $16\frac{2}{3}\%$
42. A cloth merchant announces 25% rebate in prices. If one needs to have a rebate of Rs. 40, then how many shirts each costing Rs. 32, he should purchase?
- (a) 5      (b) 6      (c) 7      (d) 10
43. A shopkeeper professes to sell all things at a discount of 10%, but increase the S.P. of each article by 20%. His gain on each article is:
- (a) 6%      (b) 8%      (c) 10%      (d) 12%

### Solutions

- Ans. (c)  
 $3G = 54 \times 2 = 108 \Rightarrow G = 36.$   
 $3P = 36 \times 2 = 72 \Rightarrow P = 24$   
 $3C = 24 \times 2 = 48 \Rightarrow C = 16$   
 $\therefore$  Cost of a cricket ball = Rs. 16.
- Ans. (d)  
S.P.=Rs. 100, loss= Rs. 10. So,  
 $C.P. = \left( \frac{100}{90} \times 100 \right) = \text{Rs. } \frac{1000}{9}$ .  
 $\therefore$  Loss% =  $\left( 10 \times \frac{9}{1000} \times 100 \right)\% = 9\%$ .
- Ans. (a)  
S.P.=Rs. 34.80, Loss = 25%.  
 $C.P. = \text{Rs. } \left( \frac{100}{75} \times 34.80 \right) = \text{Rs. } 46.40$
- Ans. (b)  
 $C.P. = \text{Rs. } (225 + 15) = \text{Rs. } 240$   
 $S.P. = \text{Rs. } 300$

$$\therefore \text{Gain \%} = \left( \frac{60}{240} \times 100 \right) \% = 25\%.$$

5. Ans. (c)

$$90 : 10.80 = 120 : x \text{ or } \frac{90}{10.80} = \frac{120}{x}.$$

$$\therefore x = \frac{120 \times 10.80}{90} = 14.40$$

Hence, S.P. = Rs. 14.40

6. Ans. (d)

Least C.P. = Rs.  $(200 \times 8)$  = Rs. 1600.

Greatest S.P. = Rs.  $(425 \times 8)$  = Rs. 3400.

Required profit = Rs.  $(3400 - 1600)$

= Rs. 1800.

7. Ans. (c)

Let C.P. of each article be Re 1.

C.P. of 15 articles = Rs. 15

S.P. of 15 articles = Rs. 20.

$$\therefore \text{Gain \%} = \left( \frac{5}{15} \times 100 \right) \% = 33\frac{1}{3}\%.$$

8. Ans. (c)

Let C.P. of each article be Re 1.

C.P. of 18 articles = Rs. 18.

S.P. of 18 articles = Rs. 21.

$$\therefore \text{Gain \%} = \left( \frac{3}{18} \times 100 \right) \% = 16\frac{2}{3}\%.$$

9. Ans. (c)

Gain = (S.P. of 250 chairs) – (C.P. of 250 chairs).

$$\therefore (\text{S.P. of 250 chairs}) - (\text{C.P. of 250 chairs}) = \text{S.P. of 50 chairs.}$$

S.P. of 200 chairs = C.P. of 250 chairs.

Let C.P. of each chair be Re. 1

C.P. of 200 chairs = Rs. 200.

S.P. of 200 chairs = Rs. 250.

$$\text{Gain \%} = \left( \frac{50}{200} \times 100 \right) \% = 25\%.$$

10. Ans. (c)

$$(\text{C.P. of 36}) - (\text{S.P. of 36}) = \text{Loss} = \text{S.P. of 4.}$$

$\therefore \text{S.P. of 40} = \text{C.P. of 36}$

Let C.P. of each mango = Re 1

C.P. of 40 mangoes = Rs. 40

S.P. of 40 mangoes = Rs. 36

$$\text{Loss \%} = \left( \frac{4}{40} \times 100 \right) \% = 10\%.$$

11. Ans. (c)

$$\text{Loss} = (\text{C.P.} - \text{S.P.}) \Leftrightarrow \frac{1}{11} \text{C.P.} = \text{C.P.} - 11$$

$$\Leftrightarrow \frac{10}{11} \text{C.P.} = 10$$

$$\therefore \text{C.P.} = \left( \frac{11 \times 10}{10} \right) = \text{Rs. 11}$$

12. Ans. (c)

Suppose, the number of books purchased =  $11 \times 10 = 110$

$$\text{C.P. of 110 books} = \text{Rs.} \left( \frac{10}{11} \times 110 \right) = \text{Rs. 100}$$

$$\text{S.P. of 110 books} = \text{Rs.} \left( \frac{11}{10} \times 110 \right) = \text{Rs. 121, Profit \%} = 21\%$$

13. Ans. (d)

$$\text{C.P. of 25 kg} = \text{Rs.} (15 \times 14.50 + 10 \times 12) = \text{Rs. 347.50}$$

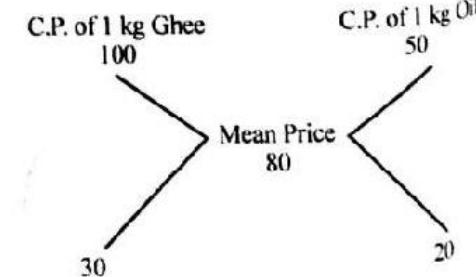
$$\text{S.P. of 25 kg} = \text{Rs.} (25 \times 15) = \text{Rs. 375}$$

$$\therefore \text{Gain} = \text{Rs.} (375 - 347.50) = \text{Rs. 27.50}$$

14. Ans. (b)

$$\text{Mean price} = \text{Rs.} \left( \frac{100}{120} \times 96 \right) = \text{Rs. 80/kg}$$

By the rule of alligation:



$$\therefore \text{Required ratio} = 30 : 20 = 3 : 2$$

15. Ans. (d)

$$\text{Gain \%} = \left( \frac{100}{900} \times 100 \right) \% = 11\frac{1}{9}\%$$

16. Ans. (a)

C. P. of 3 toffees = Re. 1

S. P. of 3 toffees = 150% of Re 1 = Rs.  $\frac{3}{2}$

For Rs.  $\frac{3}{2}$ , toffees sold = 3.

For Re 1, toffees sold =  $\left( 3 \times \frac{2}{3} \right) = 2$ .

17. Ans. (b)

Let S.P. of 45 lemons be Rs. x

$$80 : 40 = 120 : x \text{ or } \frac{80}{40} = \frac{120}{x}$$

$$\text{or } x = \frac{40 \times 120}{80} = 60$$

For Rs. 60, lemons sold = 45

For Rs. 24,

$$\text{lemons sold} = \left( \frac{45}{60} \times 24 \right) = 18.$$

18. Ans. (b)

$$110 : x = (100 + P) : 2x \text{ or}$$

$$\frac{110}{x} = \frac{100 + P}{2x} \text{ or } 100 + P = 220$$

$$\therefore P = 120\%.$$

19. Ans. (b)

125% of 120% of

$$A = 1500 \Rightarrow \frac{125}{100} \times \frac{120}{100} A = 1500$$

$$\therefore A = \left( 1500 \times \frac{2}{3} \right) = 1000$$

20. Ans. (b)

125% of 115% of 110% of P = 1265.

$$\therefore \frac{125}{100} \times \frac{115}{100} \times \frac{110}{100} P = 1265$$

$$\text{or } \frac{253}{160} P = 1265.$$

$$\therefore P = \left( \frac{1265 \times 160}{253} \right) = \text{Rs. 800}$$

21. Ans. (c)

Let C.P. of a mixer be Rs. x and that of a T.V. be Rs. y.

$$\text{Then, } 2x + y = 7000 \quad \dots(i)$$

$$\text{and } x + 2y = 9600 \quad \dots(ii)$$

Multiplying equation (ii) by 2 and subtracting equation (i) from it, we get

$$3y = 19600 - 7000 = 12600 \text{ or } y = 4200$$

$$\therefore \text{C. P. of a T. V.} = \text{Rs. 4200}$$

22. Ans. (b)

Total S.P. = Rs. 24000

C. P. of horse

$$= \text{Rs.} \left( \frac{100}{80} \times 12000 \right) = \text{Rs.} 15000.$$

C. P. of a cow

$$= \text{Rs.} \left( \frac{100}{120} \times 12000 \right) = \text{Rs.} 10000.$$

Total C.P. = Rs. 25000.

$$\therefore \text{Loss} = 24000 - 25000 = \text{Rs.} 1000$$

23. Ans. (c)

Let original S. P. be Rs. x

$$\text{New S.P.} = \frac{2}{3}x, \text{ loss} = 10\%$$

$$\therefore \text{C.P.} = \left( \frac{100}{90} \times \frac{2}{3}x \right) = \frac{20x}{27}$$

$$\text{New C.P.} = \frac{20x}{27}, \text{ S.P.} = \text{Rs.} x$$

$$\text{Gain} = \left( x - \frac{20x}{27} \right) = \frac{7x}{27}$$

$$\therefore \text{Gain \%} = \left( \frac{7x}{27} \times \frac{27}{20x} \times 100 \right)\% = 35\%$$

Let us consider a packet of rice marked 1 kg.

Its actual weight is 80% of 1000 gm = 800 gm.

Let C.P. of each gm be Re. 1.

Then, C. P. of this packet = Rs. 800.

S. P. of this packet = 110% of C.P. of 1 kg.

$$= \left( \frac{110}{100} \times 1000 \right) = \text{Rs. } 1100$$

$$\therefore \text{Gain} = \left( \frac{300}{800} \times 100 \right)\% = 37.5\%$$

### 25. Ans. (b)

Let the total value be Rs.  $x$

$$\text{Value of } \frac{2}{3} \text{ rd} = \frac{2x}{3}, \text{ Value of } \frac{1}{3} \text{ rd} = \frac{x}{3}$$

$$\text{Total S. P.} = \left( 105\% \text{ of } \frac{2x}{3} + 98\% \text{ of } \frac{x}{3} \right)$$

$$= \left( \frac{210x}{300} + \frac{98x}{300} \right) = \frac{308x}{300}$$

$$\frac{308x}{300} - x = 400 \Rightarrow \frac{308x - 300x}{300} = 400$$

$$\therefore x = \frac{300 \times 400}{8} = 15000$$

### 26. Ans. (c)

Suppose, the quantity sold at a loss be  $x$  kg and let C.P. per kg be Re. 1

Total C.P. = Rs. 24.

Total S.P. = 120% of  $(24 - x)$  + 95% of  $x$ .

$$= \frac{6}{5}(24 - x) + \frac{19x}{20} = \frac{576 - 24x + 19x}{20}$$

$$= \frac{576 - 5x}{20}$$

$$\therefore \frac{576 - 5x}{20} = 110\% \text{ of } 24$$

### 27. Ans. (a)

$$\text{C.P.} = \frac{40}{100} \times \text{S.P. i.e. S.P.} = \frac{5}{2} \text{ C.P.}$$

$$= \left( \frac{5}{2} \times 100 \right)\% \text{ of C.P.}$$

$$\therefore \text{S.P.} = 250\% \text{ of C.P.}$$

### 28. Ans. (a)

Let C.P. be Rs.  $x$

$$(105\% \text{ of } x) - (95\% \text{ of } x) = 6.72$$

$$\text{or } 10\% \text{ of } x = 6.72$$

$$\Rightarrow x = 67.20$$

### 29. Ans. (c)

Let original C.P. be Rs.  $x$  then,

$$\text{S.P.} = \frac{105}{100}x = \frac{21x}{20}$$

$$\text{New C.P.} = \frac{95}{100}x = \frac{19x}{20}$$

$$\text{New S.P.} = \frac{110}{100} \times \frac{19x}{20} = \frac{209x}{200}$$

$$\frac{21x}{20} - \frac{209x}{200} = 1 \text{ or } x = 200$$

### 30. Ans. (b)

Let original price per dozen be Rs.  $x$

$$\text{New price per dozen} = \frac{75x}{100} = \frac{3x}{4}$$

$$\text{Now, } 96 \times \frac{4}{3x} - \frac{96}{x} = 4$$

$$\text{or } (128 - 96) = 4x \text{ or } x = 8.$$

### 31. Ans. (b)

$$\text{Total C.P.} = \text{Rs. } (12 \times 4 + 16 \times 2) = \text{Rs. } 80$$

S. P. of 6 dozen oranges

$$= \text{Rs.} \left( \frac{120}{100} \times 80 \right) = \text{Rs.} 96.$$

S. P. per dozen = Rs. 16

32. Ans. (b)

Let C.P. be Rs.  $x$

$$900 - x = 2(x - 450) \Rightarrow 3x = 1800 \Rightarrow x = 600.$$

C.P. = Rs. 600, gain required = 25%.

$$\therefore \text{S.P.} = \text{Rs.} \left( \frac{125}{100} \times 600 \right) = \text{Rs.} 750$$

33. Ans. (b)

Let C.P. be Rs.  $x$ .

$$2(x - 75) = (96 - x) \Rightarrow 3x = 246 \Rightarrow x = 82.$$

34. Ans. (b)

Let marked price be Rs. 100.

Then, S. P. = 90% of 80% of 70% of 100

$$= \left( \frac{90}{100} \times \frac{80}{100} \times \frac{70}{100} \times 100 \right) = 50.4$$

$\therefore$  Single discount =  $(100 - 50.4)\% = 49.6\%$

35. Ans. (d)

Cash price = 95% of 90% of 80% of Rs. 300.

$$= \left( \frac{95}{100} \times \frac{90}{100} \times \frac{80}{100} \times 300 \right) = \text{Rs.} 205.20$$

36. Ans. (c)

Let C.P. be Rs. 100. Then, marked price = Rs. 130.

$$\text{S.P.} = \left( 100 - \frac{25}{4} \right) \% \text{ of Rs.} 130$$

$$= \left( \frac{375}{400} \times 130 \right) = 121.875$$

$$\therefore \text{Profit}\% = 21.875 = \frac{21875}{1000} = 21\frac{7}{8}\%$$

37. Ans. (c)  
1<sup>st</sup> discount = Rs. (40% of 500)

$$= \text{Rs.} \left( \frac{40}{100} \times 500 \right) = \text{Rs.} 200$$

2<sup>nd</sup> discount = (36% of 500 + 4% of 64% of 500).

$$= \text{Rs.} \left( \frac{36}{100} \times 500 + \frac{4}{100} \times \frac{64}{100} \times 500 \right)$$

$$= \text{Rs.} 192.80$$

Difference = Rs. (200 - 192.80) = Rs. 7.20.

38. Ans. (b)

C.P. = Rs. 153, Gain = 20%.

$$\therefore \text{S.P.} = \left( \frac{120}{100} \times 153 \right) = \text{Rs.} 183.60$$

Let, the marked price be Rs.  $x$

$$\frac{85}{100}x = 183.60$$

$$\Rightarrow x = \frac{183.60 \times 100}{85} = 216$$

39. Ans. (b)

Let, the list price be Rs.  $x$

$$\frac{80}{100}x = 24 \Rightarrow x = \frac{24 \times 100}{80} = 30$$

Required S.P. = 70% of Rs. 30 = Rs. 21

40. Ans. (b)

Let the C.P. be Rs. 100.

Then, S.P. = Rs. 112.

Let the printed price be Rs.  $x$

$$\text{Then, } 90\% \text{ of } x = 112 \Rightarrow \frac{90}{100}x = 112$$

$$\therefore x = \left( \frac{112 \times 100}{90} \right) = \frac{1120}{9}$$

$$\therefore (\text{C.P.}) : (\text{Printed price}) = 100 : \frac{1120}{9} \\ = 900 : 1120 = 45 : 56$$

41. Ans. (c)

Let the C.P. of each article be Re. 1.  
Then, C.P. of 30 = Rs. 27

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$$S.P. \text{ at } 32 = \text{Rs. } 30$$

$$\therefore \text{Gain \%} = \left( \frac{3}{27} \times 100 \right) \% = 11\frac{1}{9}\%$$

12. Ans. (a)

Rs. 25 is the rebate on Rs. 100

Rs. 40 will be the rebate on

$$\text{Rs. } \left( \frac{100}{25} \times 40 \right) = \text{Rs. } 160$$

$\therefore$  Number of shirts purchased

$$= \frac{160}{32} = 5$$

43. Ans. (b)

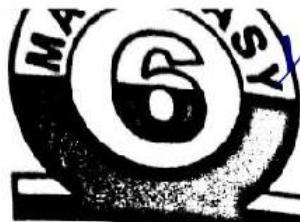
Let C.P. be Rs. 100. Then marked price = Rs. 120

$$S.P. = 108 = 120 \left( \frac{90}{100} \right)$$

$$\therefore S.P. = \text{Rs. } \left( \frac{90}{100} \times 120 \right) = \text{Rs. } 108$$

$\therefore$  Gain = 8%





## Simple Interest & Compound Interest

### Simple Interest

It is calculated on the basis of a basic amount borrowed for the entire period at a particular rate of interest.

The amount borrowed is the principal for the entire period of borrowing.

$$SI = \frac{P \times R \times T}{100}$$

Where P is Principal

R is % Rate of interest

T is the Time duration

Amount A is sum of Principal P and SI so,

$$A = P + SI$$

Note: Principal P is also referred as Principal Amount. In such condition also, Amount is different from Principal Amount

Amount = Principal + Interest incurred

Interest may be simple interest SI or compound interest CI.

### Compound Interest

The interest of the previous years are added to the principal for the calculation of the compound interest.

$$CI = P \left[ 1 + \frac{R}{100} \right]^T - P$$

Where P is Principal Amount,

R is Rate of interest,

T is Time duration,

Case1: When interest is compounded annually then total amount A will be

$$A = \left[ 1 + \frac{R}{100} \right]^T$$

Case2: When interest is compounded half yearly then

$$A = \left[ 1 + \frac{R/2}{100} \right]^{2T}$$

Case3: When interest is compounded quarterly

$$A = \left[ 1 + \frac{R/4}{100} \right]^{4T}$$

Case 4: When differential rate of interest is charged i.e. if rate of interest is

$R_1$ % for first year.

$R_2$ % for second year and

$R_3$ % for third year then

Amount A =

$$P \left[ 1 + \frac{R_1}{100} \right] \times \left[ 1 + \frac{R_2}{100} \right] \times \left[ 1 + \frac{R_3}{100} \right]$$

We will go through following examples to have a glimpse of problems based on simple interest and compound interest.

**Example 1:** Calculate the simple interest if a principal amount of Rs. 1500 is deposited in ICICI Bank at 8% rate for 5 years.

**Solution:**

$$SI = \frac{P \times R \times T}{100}$$

$$SI = \frac{1500 \times 8 \times 5}{100} = \text{Rs. } 600$$

**Example 2:** A sum of 12000 Rs. is deposited into SBI Bank for 3 years. If the bank is providing 5% rate then calculate the amount after the maturity period?

**Solution:**

$$SI = \frac{PRT}{100}$$

$$SI = \frac{12000 \times 5 \times 3}{100} = \text{Rs. } 1800$$

$$\text{Amount} = \text{Principal} + SI$$

$$13800 = 12000 + 1800$$

**Example 3:** A principal amount become double in 8 years calculate the rate of interest?

**Solution:**

Let the principal amount be  $x$  Rs

Since it become doubles in 8 years so SI in 8 years =  $x$  Rs.

$$\text{Now } SI = \frac{P \times R \times T}{100}, x = \frac{x \times R \times 8}{100}$$

$$\therefore R = \frac{100}{8} = 12\frac{1}{2}\%$$

**Example 4:** A principal amount become 3 times in 12 years calculate the rate of interest?

**Solution:**

Let the principal amount be  $x$  Rs

Since it become triple in 12 years so

SI in 12 years =  $2x$  Rs.

$$\text{Now } SI = \frac{PRT}{100}, 2x = \frac{x \times R \times 12}{100}$$

$$R = \frac{200}{12} = 16\frac{2}{3}\%$$

**Example 5:** A principal amount become 5 times in 20 years. Calculate the rate of interest given?

**Solution:**

Principal = Rs.  $x$

Total Amount = Rs.  $5x$ , So

SI = Rs.  $4x$

$$\text{now } SI = \frac{PRT}{100}, 4x = \frac{x \times R \times 20}{100}$$

$$R = \frac{400}{20} = 20\%$$

**Example 6:**

In how many years a principal amount become double if rate of interest given is 20%?

**Solution:**

Here principal =  $x$

SI =  $x$ , R=20%

$$\text{Now } SI = \frac{PRT}{100}, x = \frac{x \cdot 20 \cdot T}{100}$$

$$T = \frac{100}{20} = 5 \text{ years.}$$

**Example 7:**

A certain principal amount is deposited in a bank. If bank is giving 12% interest then calculate how many years amount will become 3 times of principal?

**Solution:**

Here  $P = x$ ,  $A = 3x$

So,  $SI = 2x$

$R = 12$

$$SI = \frac{PRT}{100}, 2x = \frac{x \times 12 \times T}{100}$$

$$T = \frac{200}{12} = 16\frac{2}{3} \text{ years.}$$

**Example 8:**

A principal amount of 25000 is deposited in Citi Bank for 2 years. Calculate the interest

incurred if rate of interest is 10% compounded annually?

Here  $P = 25000$  Rs.

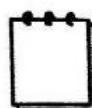
$R = 10\%$

$T = 2$  years

$$CI = P \left[ 1 + \frac{R}{100} \right]^T - P$$

$$= 25000 \left[ 1 + \frac{10}{100} \right]^2 - 25000$$

$$= 30250 - 25000 = \text{Rs.} 5250$$



### Solved Example

1. Rs. 1200 is lent out at 5% per annum simple interest for 3 years. Find the amount after 3 years.

- (a) Rs. 1380      (b) Rs. 1290  
 (c) Rs. 1470      (d) Rs. 1200

**Ans. (a)**

Here  $P = 1200$  Rs.

$R = 5\%$ ,  $T = 3$  years

$$SI = \frac{PRT}{100} = \frac{1200 \times 5 \times 3}{100} = \text{Rs.} 180$$

$$\text{Amount} = P + SI = 1200 + 180 = 1380$$

2. Interest obtained on a sum of Rs. 5000 for 3 years is Rs. 1500. Find the rate percent.

- (a) 8%      (b) 9%  
 (c) 10%      (d) 11%

**Ans. (c)**

Here  $P = 5000$ ,  $SI = 1500$ ,  $T = 3$  years.

$$R = \frac{SI \times 100}{P \times T} = \frac{1500 \times 100}{5000 \times 3} = 10\%$$

3. Rs. 2100 is lent at compound interest of 5% per annum for 2 years. Find the amount after two years.

- (a) Rs. 2300      (b) Rs. 2315.25  
 (c) Rs. 2310      (d) None of these

**Ans. (b)**

Here  $P = 2100$ ,  $R = 5\%$ ,  $T = 2$  years

$$A = P \left[ 1 + \frac{R}{100} \right]^T = 2100 \left[ 1 + \frac{5}{100} \right]^2$$

$$= 2100 \times \frac{21}{20} \times \frac{21}{20} = 2315.25 \text{ Rs.}$$

4. Find the difference between the simple and the compound interest at 5% per annum for 2 years on a principal of Rs. 2000.

- (a) 5      (b) 105  
 (c) 4.5      (d) None of these

**Ans. (a)**

Here  $P = 2000$  Rs.,  $R = 5\%$ ,  $T = 2$  years

$$CI - SI = \left[ P \left[ 1 + \frac{R}{100} \right]^T - P \right] - \frac{PRT}{100}$$

$$= \left[ \left[ 2000 \times \frac{105}{100} \times \frac{105}{100} \right] - 2000 \right]$$

$$= \frac{2000 \times 5 \times 2}{100}$$

$$= 205 - 200 = \text{Rs.} 5$$

5. After how many years will a sum of Rs. 12,500 become Rs. 17,500 at the rate of 10% per annum?

- (a) 2 years      (b) 3 years  
 (c) 4 years      (d) 5 years

**Ans. (c)**

Here  $A = 17500$ ,  $P = 12500$ ,  $R = 10\%$

$$SI = A - P$$

$$= 17500 - 12500 = 5000$$

$$T = \frac{SI \times 100}{P \times R} = \frac{5000 \times 100}{12500 \times 10} = 4 \text{ years.}$$

6. What is the difference between the simple interest on a principal of Rs. 500 being



$$80 = \frac{360 \times R \times 4}{100} + \frac{360 \times 5 \times 5}{100}$$

$$72 = \frac{360 \times R \times 4}{100} \quad R = 5\%$$

12. Vinod makes a deposit of Rs. 100,000 in the HDFC Bank for a period of 2 years. If the rate of interest be 12% per annum compounded half-yearly, what amount will he get after 2 years.

- (a) 122,247.89      (b) 125,436.79  
 (c) 126,247.69      (d) None of these  
 Ans. (c)

$$P = 100000, R = 12\%, T = 2 \text{ years}$$

$$A = P \left[ 1 + \frac{R/2}{100} \right]^T$$

$$A = 100000 \left[ 1 + \frac{6}{100} \right]^2 = \text{Rs. } 126247.69$$

13. What will be the simple interest on Rs. 700 at 2% per annum for the period from February 5, 1994 to April 18, 1994?  
 (a) Rs. 12.60      (b) Rs. 11.30  
 (c) Rs. 15      (d) Rs. 13  
 Ans. (a)

$$\begin{aligned} & \text{Feb 5 to April 18, 1994} \\ & = 24 + 31 + 18 = 73 \text{ days} = 0.2 \text{ years} \end{aligned}$$

$$S = \frac{PRT}{100} = \frac{700 \times 2 \times 0.2}{100} = \text{Rs. } 12.6$$

14. Alay borrows Rs. 1500 from two money-lenders. He pays interest at the rate of 12% per annum for one loan and at the rate of 14% per annum for the other. The total interest he pays for the entire year is Rs. 136. How much does he borrow at the rate of 12%?  
 (a) Rs. 1200      (b) Rs. 1300  
 (c) Rs. 1400      (d) Rs. 300

Ans. (a)

$$P = 1500, R_1 = 12\%, R_2 = 14\%, T = 1 \text{ year}$$

$$S_I = 136$$

Let x Rs. be amount invested at 12% S.I.

$$= \frac{x \times 12 \times 1}{100} + \frac{(1500 - x) \times 14}{100} = 136$$

$$\frac{21000}{100} - \frac{2x}{100} = 136 \quad x = 1200$$

15. A sum was invested at simple interest at a certain interest for 2 years. It would have fetched Rs. 60 more had it been invested at 2% higher rate. What was the sum?  
 (a) Rs. 1500      (b) Rs. 1200  
 (c) Rs. 2500      (d) Rs. 1000  
 Ans. (a)

Since S.I. is directly proportional to Rate of Interest:

2% higher rate fetched Rs. 60 more  
 It means this sum will give S.I. of Rs. 60  
 if invested at 2% rate for 2 years.

$$P = \frac{S_I \times 100}{R \times T} = \frac{60 \times 100}{2 \times 2} = 1500$$

16. The difference between simple and compound interest on a sum of money at 5% per annum is Rs. 25. What is the sum?  
 (a) Rs. 5000      (b) Rs. 17,000  
 (c) Rs. 4000      (d) Data insufficient  
 Ans. (d)

It cannot be determined.

17. Two equal sums were borrowed at 8% simple interest per annum for 2 years and 3 years respectively. The difference of the interest was Rs. 56. The sum borrowed were  
 (a) Rs. 600      (b) Rs. 700  
 (c) Rs. 740      (d) Rs. 750  
 Ans. (b)

$$\frac{PRT_1}{100} - \frac{PRT_2}{100}$$

$$\frac{P [5 \times 3 - 5 \times 2]}{100} = 56 \quad P = ?$$

18. If the difference between the simple interest and compound interest on some principal amount at 20% per annum for 3 years is Rs. 48, then the principle amount must be  
 (a) Rs. 550      (b) Rs. 500  
 (c) Rs. 375      (d) Rs. 400

Ans. (c)

Here  $P = ?$ ,  $R = 20\%$ ,  $T = 3$  year

Difference Rs. 48

$$48 = P \left[ \left(1 + \frac{R}{100}\right)^T - 1 \right] - P - \frac{PRT}{100}$$

$$48 = P \left[ \left(1 + \frac{20}{100}\right)^3 - 1 - \frac{20 \times 3}{100} \right]$$

On solving we get  $P = 375$ .

19. Raju lent Rs. 400 to Ajay for 2 years, and Rs. 100 to Manoj for 4 years and received together from both Rs. 60 as interest. Find the rate of interest, if simple interest is being calculated.

- (a) 5%      (b) 6%  
 (c) 8%      (d) 9%

Ans. (a)

$$\frac{P_1 R_1 T_1}{100} + \frac{P_2 R_2 T_2}{100} = 60$$

$$\frac{400 \times 2 \times R}{100} + \frac{100 \times 4 \times R}{100} = 60$$

$$12R = 60, R = 5\%$$

20. In what time will Rs. 8000 amount to 40,000 at 4% per annum? (Simple interest being reckoned)

- (a) 100 years      (b) 50 years  
 (c) 110 years      (d) 160 years

Ans. (a)

$$P = 8000, A = 40000$$

$$R = 4\%, SI = 32000, T = ?$$

$$T = \frac{SI \times 100}{R \times P}$$

$$= \frac{32000 \times 100}{8000 \times 4} = 100 \text{ years}$$

21. A sum of money becomes 4 times after interest in 10 years. What is the rate of interest?

- (a) 10%      (b) 20%  
 (c) 30%      (d) 40%

Ans. (c)

Let sum be  $x$

then  $A = 4x, SI = 3x$

$$SI = \frac{PRT}{100}$$

$$3x = \frac{x \times 10 \times R}{100}$$

$$So, R = 30\%$$

22. A sum of money doubles itself in 5 years. In how many years will it become four fold (if interest is compounded)?

- (a) 15      (b) 10  
 (c) 20      (d) 12

Ans. (b)

Let sum =  $x$

$$\text{Then, } 2x = x \left[1 + \frac{R}{100}\right]^5$$

$$\Rightarrow \left[1 + \frac{R}{100}\right] = 2^{1/5}$$

$$4x = x \left[1 + \frac{R}{100}\right]^T$$

$$\Rightarrow 4 = [2^{1/5}]^T$$

$$\Rightarrow 2^2 = 2^{T/5}$$

$$\Rightarrow \frac{T}{5} = 2$$

$$\therefore T = 10 \text{ Yrs.}$$

23. A sum of money placed at compound interest doubles itself in 3 years. In how many years will it amount to 8 times itself?

- (a) 9 years      (b) 8 years  
 (c) 27 years      (d) 7 years
- Ans. (a)**

Let sum =  $x$

Then,

$$2x = x \left[ 1 + \frac{R}{100} \right]^3$$

$$\Rightarrow \left[ 1 + \frac{R}{100} \right] = 2^{1/3} \quad \dots(i)$$

$$8x = x \left[ 1 + \frac{R}{100} \right]^T$$

$$\Rightarrow 8 = [2^{1/3}]^T$$

$$\Rightarrow 2^3 = 2^{T/3}$$

$$\Rightarrow \frac{T}{3} = 3$$

$$\therefore T = 9 \text{ Yrs.}$$

24. Divide Rs. 6000 into two parts so that simple interest on the first part for 2 years at 6% p.a. may be equal to the simple interest on the second part for 3 years at 8% p.a.

- (a) Rs. 4000, Rs. 2000  
 (b) Rs. 5000, Rs. 1000  
 (c) Rs. 3000, Rs. 3000  
 (d) None of these

**Ans. (a)**

Let one part be  $x$  Rs. then

$$\frac{x \times 2 \times 6}{100} = \frac{(6000 - x) \times 3 \times 8}{100}$$

$$12x = 144000 - 24x$$

$$36x = 144000$$

$$x = 4000$$

25. A sum of money becomes  $\frac{7}{4}$  of itself in 6 years at a certain rate of simple interest. Find the rate of interest.

- (a) 12%                  (b) 12.5%  
 (c) 8%                  (d) 14%

**Ans. (b)**

Let sum be  $x$

$$A = \frac{7}{4}x, \text{ So, } SI = \frac{3}{4}x$$

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T = 6 years, R = ?

$$R = \frac{SI \times 100}{P \times T} = \frac{\frac{3}{4}x \times 100}{x \times 6} = 12.5\%$$

26. Sanjay borrowed Rs. 900 at 4% p.a. and Rs. 1100 at 5% p.a. for the same duration. He had to pay Rs. 364 in all as interest. What is the time period in years?

- (a) 5 years                  (b) 3 years  
 (c) 2 years                  (d) 4 years

**Ans. (d)**

$$\frac{P_1 R_1 T_1}{100} + \frac{P_2 R_2 T_2}{100} = 364$$

$$\left[ \frac{900 \times 4T}{100} + \frac{1100 \times 5T}{100} \right] = 364$$

$$36T + 55T = 364$$

$$T = 4 \text{ Years}$$

27. If a certain sum of money becomes double at simple interest in 12 years, what would be the rate of interest per annum?

- (a)  $8\frac{1}{3}$                   (b) 10  
 (c) 12                  (d) 14

**Ans. (a)**

Here P =  $x$ , A =  $2x$  so  $SI = x$  then,

$$x = \frac{x \times 12 \times R}{100}$$

$$\Rightarrow R = \frac{100}{12} = 8\frac{1}{3}$$

28. A sum of Rs. 600 amounts to Rs. 720 in 4 years at simple interest. What will it amount to if the rate of interest is increased by 2%?

- (a) Rs. 648                  (b) Rs. 768  
 (c) Rs. 726                  (d) Rs. 792

**Ans. (b)**

$$P = \text{Rs. } 600, \quad A = \text{Rs. } 720  
 T = 4 \text{ years}, \quad R = ?$$

$$R = \frac{SI \times 100}{P \times T} = \frac{120 \times 100}{600 \times 4} = 5\%$$

at 7% Rate

$$SI = \frac{600 \times 7 \times 4}{100} = 168$$

$$A = 600 + 168 = 768$$



## Simple Interest



### Practice Exercise: I

- At the rate of 6% p.a. simple interest, a sum of Rs. 2500 will earn how much interest by the end of 5 years?  
 (a) Rs. 150      (b) Rs. 700  
 (c) Rs. 750      (d) Rs. 3250
- If A lends Rs. 3500 to B at 10% p.a. and B lends the same sum to C at 11.5% p.a., then the gain of B (in Rs.) in a period of 3 years is:  
 (a) 107.50      (b) 115.50  
 (c) 157.50      (d) 177.50
- Avinash borrowed Rs. 5000 from Sanjay at simple interest. After 3 years, Sanjay got Rs. 300 more than what he had given to Avinash. What was the rate of interest per annum?  
 (a) 2%      (b) 5%  
 (c) 8%      (d) 10%
- Rakesh took a loan for 6 years at the rate of 5% p.a. S.I. If the total interest paid was Rs. 1230, the principal was:  
 (a) Rs. 4100      (b) Rs. 4920  
 (c) Rs. 5000      (d) Rs. 5300
- Rs. 800 amounts to Rs. 920 in 3 years at simple interest. If the interest rate is increased by 3%, it would amount to how much?  
 (a) Rs. 992      (b) Rs. 1056  
 (c) Rs. 1112      (d) Rs. 1182

- The simple interest on a sum of money at 5% is Rs. 48 for 4 years. The simple interest on the same sum for 5 years at 4% will be.

- (a) Rs. 40      (b) Rs. 48  
 (c) Rs. 50      (d) Rs. 60

- A sum of money at simple interest amounts to Rs. 2240 in 2 years and to Rs. 2600 in 5 years. What is the principal amount?

- (a) Rs. 1520      (b) Rs. 1880  
 (c) Rs. 2120      (d) None

- The simple interest on a certain sum of money at the rate of 5% p.a. for 8 years is Rs. 840. At what rate of interest the same amount of interest can be received on the same sum after 5 years?

- (a) 6%      (b) 8%  
 (c) 9%      (d) 10%

- A sum of money was lent at simple

interest at 11% p.a. for  $3\frac{1}{2}$  years and  $4\frac{1}{2}$  years respectively. If the difference in interests for two periods was Rs. 412.50, the sum is.

- (a) Rs. 3250      (b) Rs. 3500  
 (c) Rs. 3750      (d) Rs. 4250

- Prabhat took a certain amount as a loan from a bank at the rate of 8% p.a. S.I. and gave the same amount to Ashish as a loan at the rate of 12% p.a. If at the end of 12 years, he made a profit of Rs. 320 in the deal, what was the original amount.

- (a) Rs. 2000      (b) Rs. 3000  
 (c) Rs. 4000      (d) None of these

- Rahul borrowed Rs. 830 from Mr. Lal at 12% p.a. S.I. for 3 years. He then added some more money to the borrowed sum and lent it to Shobha for the same period at 14% p.a.

*voursmahboob*  
rate of interest. If Rahul gains Rs. 93.90 in  
the whole transaction, how much money did  
he add from his side?



12. The simple interest on Rs. 1820 from March 9,

1994 to May 21, 1994 at  $7\frac{1}{2}\%$  rate will be

- (a) Rs. 29                          (b) Rs. 28.80  
 (c) Rs. 27.30                      (d) Rs. 22.50

13. Mr. Roopchand finds that an increase in the

rate of interest from  $4\frac{7}{8}\%$  to  $5\frac{1}{8}\%$  per annum increases his yearly income by Rs. 25. His investment is:

- (a) Rs. 10,000      (b) Rs. 12,000  
 (c) Rs. 15,000      (d) Rs. 20,000

14. The rate at which a sum becomes four times of itself in 15 years at S.I. will be:



15. The simple interest accrued on a sum of money at the end of four years is  $\frac{1}{5}$ th of its principal. What is the rate of interest per annum?



16. A sum of money triples itself in 15 years 6 months. In how many years would it double itself?

- (a) 6 years 3 months
  - (b) 7 years 9 months
  - (c) 8 years 3 months
  - (d) 9 years 6 months

(d) 9 years 6 months

17. The simple interest on a sum of money is  $\frac{1}{9}$  of the sum. The number of years is numerically

equal to the rate percent per annum. The rate percent per annum is:

- (a)  $3\frac{1}{3}$       (b) 5

- (c)  $6\frac{2}{3}$       (d) 10

18. A sum of Rs. 10 is lent to be returned in 11 monthly installments of Re. 1 each, interest being simple. The rate of interest is:

- (a)  $9\frac{1}{11}\%$       (b) 10%



19. The rate of simple interest on a sum of money is 6% p.a. for the first 3 years, 8% p.a. for the next 5 years and 10% p.a. for the period beyond 8 years. If the simple interest accrued by the sum for a total period of 10 years is Rs. 1560, what is the sum?

- (a) Rs. 1500      (b) Rs. 2000  
 (c) Rs. 3000      (d) Data inadequate

20. A monthly installment of Rs. 180 is required to be paid for repayment of an interest free loan in 40 months. If it is decided to pay it in 30 months, how much will be the monthly installment in rupees?



21. A sum of Rs. 1550 is lent out into two parts, one at 8% and another one at 6%. If the total annual income is Rs. 106, the money lent at 8% is:



(C) 15.

22. A sum of Rs. 1550 was lent partly at 5% and partly at 8% p.a. simple interest. The total interest received after 3 years was Rs. 300. The ratio of the money lent at 5% to that lent at 8%.

- (a) 8 : 5  
(c) 31 : 6

- (b) 5 : 8  
(d) 16 : 15

23. What should be the least number of years in which the simple interest on Rs. 2600 at  $6\frac{2}{3}\%$  will be an exact number of rupees?

- (a) 2  
(c) 4

- (b) 3  
(d) 5

24. A man invests an amount of Rs. 15860 in the names of his three sons A, B and C in such a way that they get the same amount after 2, 3 and 4 years respectively. If the rate of simple interest is 5%, then the ratio of amounts invested among A, B and C will be:

- (a) 10 : 15 : 20  
(c) 6 : 4 : 3

- (b) 22 : 23 : 24  
(d) 2 : 3 : 4

25. Rs. 2189 are divided into three parts such that their amounts after 1, 2 and 3 years respectively may be equal, the rate of simple interest being 4% p.a. in all cases. The smallest part is:

- (a) Rs. 702  
(c) Rs. 756

- (b) Rs. 597  
(d) Rs. 1093

**5. Ans. (a)**

Principal = Rs. 800, S.I. = Rs. 120,  
Time = 3 years

$$\therefore \text{Rate} = \left( \frac{100 \times 120}{800 \times 3} \right)\% = 5\%$$

New rate = 8%, Principal = Rs. 800  
Time 3 years.

$$S.I. = \text{Rs.} \left( \frac{800 \times 8 \times 3}{100} \right) = \text{Rs.} 192$$

$$\therefore \text{New amount} = \text{Rs.} (800 + 192) = \text{Rs.} 992$$

**6. Ans. (b)**

$$\text{Principal} = \text{Rs.} \left( \frac{100 \times 48}{5 \times 4} \right) = \text{Rs.} 240$$

$$S.I. = \text{Rs.} \left( \frac{240 \times 5 \times 4}{100} \right) = \text{Rs.} 48$$

**7. Ans. (d)**

$$\begin{aligned} \text{S.I. for 3 years} &= \text{Rs.} (2600 - 2240) \\ &= \text{Rs.} 360. \end{aligned}$$

$$\text{S.I. for 2 years} = \text{Rs.} \left( \frac{360}{3} \times 2 \right) = \text{Rs.} 240$$

$$\therefore \text{Principal} = \text{Rs.} (2240 - 240) = \text{Rs.} 2000$$

**8. Ans. (b)**

$$\text{Sum} = \left( \frac{100 \times 840}{5 \times 8} \right) = \text{Rs.} 2100.$$

$$\text{Rate required} = \left( \frac{100 \times 840}{2100 \times 5} \right)\% = 8\%$$

**9. Ans. (c)**

Let the sum be Rs.  $x$ . Then,

$$\begin{aligned} &\left( x \times 11 \times \frac{9}{2} \times \frac{1}{100} - x \times 11 \times \frac{7}{2} \times \frac{1}{100} \right) \\ &= 412.50 \end{aligned}$$

$$\text{or } \frac{22x}{200} = 412.50$$

**Solutions**

**1. Ans. (c)**

$$S.I. = \text{Rs.} \left( 2500 \times 6 \times \frac{5}{100} \right) = \text{Rs.} 750.$$

**2. Ans. (c)**

$$\begin{aligned} \text{Gain} &= \text{Rs.} \left( \frac{3500 \times 11.5 \times 3}{100} - \frac{3500 \times 10 \times 3}{100} \right) \\ &= \text{Rs.} (1207.5 - 1050) = \text{Rs.} 157.50. \end{aligned}$$

**3. Ans. (a)**

$$\text{Rate} = \left( \frac{100 \times 300}{5000 \times 3} \right)\% = 2\%.$$

**4. Ans. (a)**

$$\text{Principal} = \text{Rs.} \left( \frac{1230 \times 100}{6 \times 5} \right) = \text{Rs.} 4100.$$

$$\Rightarrow 11x = 41250$$

$$\Rightarrow x = 3750$$

10. Ans. (d)

Let the original amounts be Rs.  $x$ , then,

$$\frac{x \times 12 \times 12}{100} - \frac{x \times 8 \times 12}{100} = 320$$

$$\Rightarrow x = \frac{2000}{3} = \text{Rs. } 666.67$$

11. Ans. (d)

$$\frac{(830+x) \times 14 \times 3}{100} - \frac{830 \times 12 \times 3}{100} = 93.90$$

$$\text{or } 830 \times 42 + 42x - 830 \times 36 = 9390$$

$$42x = 9390 - 4980$$

$$\Rightarrow x = \frac{4410}{42} = 105.$$

∴ Money added = Rs. 105.

12. Ans. (c)

March, April, May

$$22 + 30 + 21 = 73 \text{ days}$$

$$= \frac{73}{365} \text{ years} = \frac{1}{5} \text{ years.}$$

∴ Interest

$$= \text{Rs.} \left( 1820 \times \frac{1}{5} \times \frac{15}{2 \times 100} \right) = \text{Rs. } 27.30$$

13. Ans. (a)

Let the investment be Rs.  $x$ , Then,

$$x \times \frac{41}{8} \times \frac{1}{100} - x \times \frac{39}{8} \times \frac{1}{100} = 25$$

$$\Rightarrow 2x = 20000 \Rightarrow x = 10000.$$

14. Ans. (c)

Let sum =  $x$ , Then, S.I. =  $3x$

$$\therefore \text{Rate} = \left( \frac{100 \times 3x}{x \times 15} \right) \% = 20\%$$

15. Ans. (b)

Let sum =  $x$ , Then, S.I. =  $\frac{x}{5}$ , Time = 4 years.

$$\therefore \text{Rate} = \left( 100 \times \frac{x}{5} \times \frac{1}{x \times 4} \right) \% = 5\%.$$

16. Ans. (b)

Let sum =  $x$ ,

Then, S.I. =  $2x$  and Time =  $\frac{31}{2}$  years.

$$\text{Rate} = \left( \frac{100 \times 2x}{x} \times \frac{2}{31} \right) \% = \left( \frac{400}{31} \right) \%$$

Now, sum =  $x$ , S.I. =  $x$  & Rate  $\left( \frac{400}{31} \right) \%$ .

$$\therefore \text{Time} = \left( \frac{100 \times x}{x} \times \frac{31}{400} \right) \text{years}$$

= 7 years 9 months

17. Ans. (a)

Let sum =  $x$ , Then, S.I. =  $\frac{x}{9}$ .

Let time =  $n$  years and rate =  $n\%$

$$\text{Then, } \therefore n = 100 \times \frac{x}{9} \times \frac{1}{x} \times \frac{1}{n}$$

$$\text{or } n^2 = \frac{100}{9} \text{ or } n = \frac{10}{3} = 3\frac{1}{3}\%.$$

18. Ans. (d)

Rs. 10 + S.I. on Rs. 10 for 11 months

= Rs. 11 + S.I. on Re 1 for  $(1 + 2 + 3 + 4 + \dots + 10)$  months

Rs. 10 + S.I. on Re 1 for 110 months

= Rs. 11 + S.I. on Re 1 for 55 months

S.I. on Re 1 for 55 months = Re 1.

$$\therefore \text{Rate} = \left( \frac{100 \times 12}{1 \times 55} \right) \% = 21\frac{9}{11}\%.$$

19. Ans. (b)

Let the sum be Rs.  $x$ . Then

$$\frac{x \times 6 \times 3}{100} + \frac{x \times 8 \times 5}{100} + \frac{x \times 10 \times 2}{100} = 1560$$

$$\text{or } 78x = 156000$$

$$\text{or } x = 2000$$

**20. Ans. (c)**

$$180 \times 40 = x \times 30 \text{ or } x = 240$$

**21. Ans. (a)**

Let the money lent at 8% be Rs.  $x$ . Then,

$$\frac{x \times 8 \times 1}{100} + \frac{(1550 - x) \times 6 \times 1}{100} = 106$$

$$\text{or } 2x + 9300 = 10600 \text{ or } x = 650.$$

**22. Ans. (d)**

Let the sum at 5% be Rs.  $x$ . Then,

$$\frac{x \times 5 \times 3}{100} + \frac{(1550 - x) \times 8 \times 3}{100} = 300$$

$$\text{or } x = 800$$

$$\frac{\text{Money at } 5\%}{\text{Money at } 8\%} = \frac{800}{(1550 - 800)}$$

$$= \frac{800}{750} = \frac{16}{15}$$

**23. Ans. (b)**

$$\text{SI} = \text{Rs.} \left( 2600 \times \frac{20}{3} \times \frac{1}{100} \times T \right)$$

$= \text{Rs.} \left( \frac{520}{3} \times T \right)$ , which is an exact number  
of rupees So  $T=3$

**24. Ans. (c)**

Let the amounts invested be  $x, y, z$  respectively

$$\text{Then, } \frac{x \times 2 \times 5}{100} = \frac{y \times 3 \times 5}{100} = \frac{z \times 4 \times 5}{100} = k.$$

$$\therefore x = 10k, y = \frac{20}{3}k \text{ & } z = 5k.$$

$$\text{So, } x : y : z = 10k : \frac{20}{3}k : 5k$$

$$= 30 : 20 : 15 = 6 : 4 : 3$$

**25. Ans. (b)**

Let these parts i.e.  $x, y$  and  $[2189 - (x+y)]$  be

Then,

$$\therefore \frac{x \times 1 \times 4}{100} = \frac{y \times 2 \times 4}{100}$$

$$= \frac{[2189 - (x+y)] \times 3 \times 4}{100}$$

$$\therefore \frac{x}{y} = 2 \quad \text{or} \quad x = 2y.$$

$$\therefore \frac{2y \times 1 \times 4}{100} = \frac{(2189 - 3y) \times 3 \times 4}{100}$$

$$\text{or } 44y = 2189 \times 12.$$

$$\therefore y = \left( \frac{2189 \times 12}{44} \right) = 597.$$

$\therefore$  Smallest part = Rs. 597.



## Compound Interest



### Practice Exercise: I

- The amount of Rs. 7500 at compound interest at 4% per annum for 2 years, is
  - Rs. 7800
  - Rs. 8100
  - Rs. 8112
  - Rs. 8082
- The difference between the compound interest and the simple interest on a sum of Rs. 12000 for 2 years at 12.5% per annum is
   
The sum is.

- (a) Rs. 9000      (b) Rs. 9200  
 (c) Rs. 9500      (d) Rs. 9600
3. The difference in compound interest, and simple interest on a certain amount at 10% per annum at the end of the third year is Rs. 620. What is the principal amount?  
 (a) Rs. 40000      (b) Rs. 12000  
 (c) Rs. 10000      (d) Rs. 20000
4. If the compound interest on a certain sum at  $16\frac{2}{3}\%$  for 3 years is Rs. 1270, the simple interest on the same sum at the same rate and for the same period is:  
 (a) Rs. 1200      (b) Rs. 1165  
 (c) Rs. 1080      (d) Rs. 1220
5. The compound interest on a certain sum at 5% per annum for 2 years is Rs. 328. The simple interest for that sum at the same rate and for the same period will be:  
 (a) Rs. 320      (b) Rs. 322  
 (c) Rs. 325      (d) Rs. 326
6. What is principal amount which earns Rs. 132 as compound interest for the second year at 10% per annum?  
 (a) Rs. 1000      (b) Rs. 1200  
 (c) Rs. 1320      (d) Rs. 1188
7. A sum of money at compound interest amounts to Rs. 578.40 in 2 years and to Rs. 614.55 in 3 years. The rate of interest per annum is:  
 (a) 4%      (b) 5%  
 (c)  $6\frac{1}{4}\%$       (d)  $8\frac{1}{3}\%$
8. A sum of money amounts to Rs. 4624 in 2 years and to Rs. 4913 in 3 years at compound interest. The sum is:  
 (a) Rs. 4096      (b) Rs. 4260  
 (c) Rs. 4335      (d) Rs. 4360
9. A sum of money at compound interest amounts to thrice itself in 3 years. In how many years will it be 9 times itself?  
 (a) 12      (b) 9  
 (c) 6      (d) 8
10. In how many years will a sum of Rs. 800 at 10% per annum compounded semiannually become Rs. 926.10?  
 (a)  $2\frac{1}{2}$       (b)  $1\frac{1}{2}$   
 (c)  $2\frac{1}{3}$       (d)  $1\frac{1}{3}$
11. To find out the total compound interest accrued on a sum of money after 5 years, which of the following informations given in the statements P and Q will be sufficient?  
 P : The sum was Rs. 20000.  
 Q : The total amount of simple interest on the sum after 5 years was Rs. 4000.  
 (a) Only P is sufficient  
 (b) Only Q is sufficient  
 (c) Either P or Q is sufficient  
 (d) Both P & Q are needed  
 (e) Both P and Q are not sufficient.
12. The least number of complete years in which a sum of money put out at 20% compound interest will be more than doubled is:  
 (a) 3      (b) 4  
 (c) 5      (d) 6
13. A tree increase annually by  $\frac{1}{8}$  th of its height. By how much will it increase after 2 years, if it stands today 64 cm high?  
 (a) 72 cm      (b) 74 cm  
 (c) 75 cm      (d) 81 cm
14. The compound interest on a sum for 2 years is Rs. 832 and the simple interest on the same sum for the same period is Rs. 800. The difference between the compound interest and the simple interest for 3 years will be:

## Solutions

MATH

- (a) Rs. 48      (b) 66.56  
 (c) Rs. 98.56    (d) None of these

15. A sum of money becomes Rs. 13380 after 3 years and Rs. 20070 after 6 years on compound interest. The sum is:

- (a) Rs. 8800      (b) Rs. 8890  
 (c) Rs. 8920      (d) Rs. 9040

16. A sum of Rs. 1100 was taken as a loan. This is to be repaid in two equal installments. If the rate of interest be 20% compounded annually, then the value of each installments is:

- (a) Rs. 842      (b) Rs. 792  
 (c) Rs. 720      (d) Rs. 700

17. The compound interest on Rs. 8000 at 15% per annum for 2 years 4 months, compounded annually is:

- (a) Rs. 2980      (b) Rs. 3091  
 (c) Rs. 3109      (d) Rs. 3100

18. What annual payment will discharge a debt of Rs. 7620 due in 3 years at  $16\frac{2}{3}\%$  per

annum compound interest?

- (a) Rs. 2540      (b) Rs. 3430  
 (c) Rs. 3260      (d) Rs. 3380

19. A sum of money invested at compound interest amounts to Rs. 800 in 3 years and Rs. 840 in 4 years. What is the rate of interest per annum?

- (a) 2%      (b) 4%  
 (c) 5%      (d) 10%

20. A sum of money becomes 8 times of itself in 3 years at compound interest. The rate of interest is:

- (a) 100%      (b) 8%  
 (c) 1%      (d) Data inadequate



## 1. Ans. (c)

$$\text{Amount} = \text{Rs.} \left[ 7500 \times \left( 1 + \frac{4}{100} \right)^2 \right]$$

$$= \text{Rs.} \left( 7500 \times \frac{26}{25} \times \frac{26}{25} \right) = \text{Rs.} 8112$$

## 2. Ans. (d)

Let the sum be Rs.  $x$ . Then,

$$\text{C.I.} = x \left( 1 + \frac{25}{2 \times 100} \right)^2 - x$$

$$= \left( \frac{9}{8} \times \frac{9}{8} \right) x - x = \frac{17x}{64}$$

$$\text{S.I.} = \left( x \times \frac{25}{2} \times 2 \times \frac{1}{100} \right) = \frac{x}{4}$$

$$(\text{C.I.}) - (\text{S.I.}) = \left( \frac{17x}{64} - \frac{x}{4} \right) = \frac{x}{64}$$

$$\therefore \frac{x}{64} = 150 \quad \text{or} \quad x = 9600.$$

## 3. Ans. (d)

Let the sum be Rs.  $x$ . Then,

$$\text{C.I.} = x \left( 1 + \frac{10}{100} \right)^3 - x$$

$$= \left( \frac{1331}{1000} - x \right) = \frac{331x}{1000}$$

$$\text{S.I.} = \frac{x \times 10 \times 3}{100} = \frac{3x}{10}$$

$$\therefore (\text{C.I.}) - (\text{S.I.}) = \left( \frac{331x}{1000} - \frac{3x}{10} \right) = \frac{31x}{1000}$$

$$\therefore \frac{31x}{1000} = 620$$

$$\text{or } x = 20000.$$

Hence, the principal amount is Rs. 20000.

MADE EASY

**4. Ans. (c)**

Let the sum be Rs.  $x$ . Then,

$$C.I. = \left[ x \times \left( 1 + \frac{50}{3 \times 100} \right)^3 \right] - x$$

$$= \left( \frac{343x}{216} - x \right) = \frac{127x}{216}$$

$$\therefore \frac{127x}{216} = 1270$$

$$\text{or } x = \frac{1270 \times 216}{127} = 2160.$$

Thus, the sum is Rs. 2160.

$$\therefore S.I. = \text{Rs.} \left( 2160 \times \frac{50}{3} \times 3 \times \frac{1}{100} \right) \\ = \text{Rs.} 1080.$$

**5. Ans. (a)**

Let the sum be Rs.  $x$ . Then,

$$C.I. = x \left( 1 + \frac{5}{100} \right)^2 - x$$

$$= \left( \frac{441x}{400} - x \right) = \frac{41x}{400}$$

$$\therefore \frac{41x}{400} = 328 \text{ or } x = \frac{328 \times 400}{41} = 3200.$$

$$\therefore S.I. = \text{Rs.} \left( \frac{3200 \times 5 \times 2}{100} \right) = \text{Rs.} 320.$$

**6. Ans. (b)**

Let the principal at the end of first year be  
Rs.  $x$ .

$$\text{Then, } \frac{x \times 10 \times 1}{100} = 132 \text{ or } x = 1320.$$

Now, let the original principal be Rs. P.

Then, amount after 1 year

$$= P + \frac{P \times 10 \times 1}{100} = \frac{11P}{10}.$$

$$\therefore \frac{11P}{10} = 1320$$

$$\text{or } P = \frac{1320 \times 10}{11} = \text{Rs.} 1200.$$

**7. Ans. (d)**

Interest on Rs. 578.40 for 1 year  
= Rs. (614.55 - 578.40) = Rs. 36.15.

$$\therefore \text{Rate} = \left( \frac{100 \times 36.15}{578.40} \right)\% = 6\frac{1}{4}\%.$$

**8. Ans. (a)**

Interest on Rs. 4624 for 1 year  
= Rs. (6083.50 - 5290) = Rs. 793.50

$$\therefore \text{Rate} = \left( \frac{100 \times 793.50}{4624 \times 1} \right)\% = 6\frac{1}{4}\%$$

$$\text{Now, } x \left( 1 + \frac{25}{4 \times 100} \right)^2 = 4624$$

$$\text{or } x \times \frac{17}{16} \times \frac{17}{16} = 4624$$

$$\therefore x = \left( 4624 \times \frac{16}{17} \times \frac{16}{17} \right) = \text{Rs.} 4096.$$

**9. Ans. (c)**

$$P \left( 1 + \frac{R}{100} \right)^3 = 3P \Rightarrow \left( 1 + \frac{R}{100} \right)^3 = 3 \quad \dots(i)$$

$$\text{Let } P \left( 1 + \frac{R}{100} \right)^n = 9P \Rightarrow \left( 1 + \frac{R}{100} \right)^n = 9.$$

$$\therefore \left( 1 + \frac{R}{100} \right)^n = 3^2$$

$$= \left[ \left( 1 + \frac{R}{100} \right)^3 \right]^2 = \left( 1 + \frac{R}{100} \right)^6 \quad (\text{using (i)})$$

Hence,  $n = 6$  years.

**10. Ans. (b)**

Rate = 5% per half year.

Let time =  $2n$  half years =  $n$  years.

$$\text{Then, } 800 \left(1 + \frac{5}{100}\right)^2 = 926.10$$

$$\Rightarrow \left(\frac{21}{20}\right)^2 = \frac{926.10}{800} = \frac{9261}{8000} = \left(\frac{21}{20}\right)^3$$

$$\therefore 2n = 3 \text{ or } n = \frac{3}{2} \text{ years.}$$

11. Ans. (d)

Clearly both P and Q together are needed.  
Using P and Q rate of interest R can be calculated as

$$R = \left(\frac{100 \times 4000}{5 \times 20000}\right) = 4\%$$

Now, C.I. can be calculated.

12. Ans. (b)

$$P = \left(1 + \frac{20}{100}\right)^n > 2P \text{ or } \left(\frac{6}{5}\right)^n > 2$$

$$\text{Now } \left(\frac{6}{5} \times \frac{6}{5} \times \frac{6}{5} \times \frac{6}{5}\right) > 2$$

So,  $n = 4$  years.

13. Ans. (d)

$$\text{Increase \%} = \left(\frac{1}{8} \times 100\right)\% = 12\frac{1}{2}\%.$$

Height after 2 years

$$= \left[64 \times \left(1 + \frac{25}{2 \times 100}\right)^2\right] \text{ cm}$$

$$= \left(64 \times \frac{9}{8} \times \frac{9}{8}\right) \text{ cm} = 81 \text{ cm.}$$

14. Ans. (c)

Diff. in C.I. & S.I. for 2 years = Rs. 32  
S.I. for 1 year = Rs. 400.

$\therefore$  S.I. on Rs. 400 for 1 year = Rs. 32.

$$\therefore \text{Rate} = \left(\frac{100 \times 32}{400 \times 1}\right)\% = 8\%.$$

Hence, diff. in C.I. and S.I. for 2 years = S.I. on Rs. 832

$$= \text{Rs.} \left(832 \times \frac{8}{100} \times 1\right) = \text{Rs.} 66.56$$

Total difference = Rs. (32 + 66.56)  
= Rs. 98.56

15. Ans. (c)

Let the sum be Rs.  $x$ , then,

$$x \left(1 + \frac{R}{100}\right)^3 = 13380$$

$$\& x \left(1 + \frac{R}{100}\right)^6 = 20070$$

On dividing, we get  $\left(1 + \frac{R}{100}\right)^3$

$$= \frac{20070}{13380} = \frac{3}{2}$$

$$\therefore x \times \frac{3}{2} = 13380$$

$$\Rightarrow x = \left(13380 \times \frac{2}{3}\right) = 8920.$$

Hence, the sum is Rs. 8920.

16. Ans. (c)

Let the value of each installment be Rs.  $x$ .  
Then,

$$= \frac{x}{\left(1 + \frac{20}{100}\right)} + \frac{x}{\left(1 + \frac{20}{100}\right)^2} = 1100$$

$$\text{or } \frac{5x}{6} + \frac{25x}{36} = 1100, 55x = 36 \times 1100$$

$$\therefore x = \left(\frac{36 \times 1100}{55}\right) = \text{Rs.} 720.$$

17. Ans. (c)

Time = 2 years 4 months

$$= 2\frac{4}{12} \text{ years} = 2\frac{1}{3} \text{ years.}$$

$$\begin{aligned}\therefore \text{C.I.} &= \text{Rs.} \left[ 8000 \times \left(1 + \frac{15}{100}\right)^2 \times \left(1 + \frac{\frac{1}{3} \times 15}{100}\right) - 8000 \right] \\ &= \text{Rs.} \left( 8000 \times \frac{23}{20} \times \frac{23}{20} \times \frac{21}{20} - 8000 \right) \\ &= \text{Rs.} 3109.\end{aligned}$$

3. Ans. (b)

Let each installment be Rs.  $x$ . Then,

$$\frac{x}{\left(1 + \frac{50}{3 \times 100}\right)} + \frac{x}{\left(1 + \frac{50}{3 \times 100}\right)^2}$$

$$+ \frac{x}{\left(1 + \frac{50}{3 \times 100}\right)^3} = 7620.$$

$$\text{or } \frac{6x}{7} + \frac{36x}{49} + \frac{216x}{343} = 7620.$$

$$294x + 252x + 216x = 7620 \times 343$$

$$\text{or } x = \frac{7620 \times 343}{762} = 3430.$$

∴ Amount of each installment = Rs. 3430.

19. Ans. (c)

Interest on Rs. 800 for 1 year

$$= \text{Rs.} (840 - 800) = \text{Rs.} 40.$$

$$\therefore \text{Rate} = \left( \frac{100 \times 40}{800 \times 1} \right)\% = 5\%.$$

20. Ans. (a)

$$P \left(1 + \frac{R}{100}\right)^3 = 8P$$

$$\text{or } \left(1 + \frac{R}{100}\right)^3 = 8 = 2^3$$

$$\therefore 1 + \frac{R}{100} = 2$$

$$\text{or } \frac{R}{100} = 1$$

$$\text{or } R = 100.$$





In real life situations we come across practical problems of accomplishing the given project in prescribed time limit. Since efficiency of different person is different, the management has to take proper note of it before distributing the task to subordinates or executives. We discussed all such problems under the heading 'Time and work'.

### Theory

Let a person A can finish a task in  $x$  days and person B can finish it in  $y$  days. Then

A can finish  $\frac{1}{x}$  Part of work in a day and

B can finish  $\frac{1}{y}$  part of work in a day.

If both will be working together to finish the task then in a day they can finish

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

part of the work so to finish the work it require

$$\frac{xy}{x+y} \text{ days.}$$

**Ex. 1:** A can finish the task in 8 day and B can finish the same task in 12 days. How many days are required to finish the task if both are working together?

**Sol.** A can finish the task in 8 days

So in a day A can finish  $\frac{1}{8}$  part of work

B can finish the task in 12 days

So in a day B can finish  $\frac{1}{12}$  part of work.

If both are working simultaneously, then in a day they can finish

$$\frac{1}{8} + \frac{1}{12} = \frac{20}{8 \times 12} = \frac{5}{24} \text{ Part of work}$$

so the whole task will be finished in  $\frac{24}{5}$  days i.e. 4.8 days.

**Ex. 2:** A can complete a work in 8 days, B can do the same work in 24 days. If both are working together then the task will be finished in how many days?

**Sol.** Here  $x = 8, y = 24$

$$\text{Total number of days required} = \frac{xy}{x+y}$$

$$= \frac{8 \times 24}{8+24} = 6 \text{ days.}$$

When A and B work in alternate days.

**Case I** starting from A.

Let A can finish the task in 8 days and B can finish the same task in 10 days. How many days

are required to finish the task if both are working in alternate days?

**Solution:**

A can finish the task in 8 days

$$\text{So A's work in a day} = \frac{1}{8} \text{ part}$$

B can finish the task in 10 days

$$\text{So B's work in a day} = \frac{1}{10} \text{ part}$$

Both are working alternately starting from A.

$$\text{then in first two days they can finish } \frac{1}{8} + \frac{1}{10}$$

part i.e. In first day A will finish  $\frac{1}{8}$  part

In second day B will finish  $\frac{1}{10}$  part

$$\Rightarrow \frac{8+10}{80} = \frac{18}{80}$$

If they continue in such a manner together in

8 days they can finish  $\frac{72}{80}$  part of work. Still

$\frac{8}{80}$  or  $\frac{1}{10}$  part is remaining, which is to be

finished by A in 9th day so, to finish  $\frac{1}{10}$  part

A needs

$$\frac{1/10}{1/8} = \frac{4}{5} \text{ days}$$

So, together they can finish the task in  $8\frac{4}{5}$  days

**Case II:**

In the above question calculate number of days required to finish the task by A and B if both are working alternately starting from B.

**Solution:**

The explanation remains the same from 1st

day to 8th day. In 9th day  $\frac{1}{10}$  part of the

work still remains which has to be done by B.

(If they start working alternately starting from B, then on 9th day it will be B's turn)

B can finish  $\frac{1}{10}$  part of work in  $\frac{1/10}{1/8} = \frac{8}{10}$  days

So, together they can complete the task in 9 days.

## Concept of Negative Work

Supposing A and B are working to build a wall while C is working to break the wall. In such case the wall is being built by A and B while it is being destroyed by C. Here if we consider the work as building the wall, we can say that C is doing negative work.

**Ex. 1:** A can build a wall in 8 days and B can build it in 12 days while C can completely destroy it in 24 days. If they start working at the same time, in how many days will the work be completed.

**Sol.:** The net combined work per day here is  
A's work + B's work - C's work

$$\Rightarrow \frac{1}{8} + \frac{1}{12} - \frac{1}{24} = \frac{3+2-1}{24} = \frac{4}{24} = \frac{1}{6}$$

Hence the work will be completed in 6 days

**Note:** The concept of negative work commonly appears as a problem based on pipes and cisterns, where the inlet pipes and outlet pipes/leaks work against each other.

**Ex. 2:** A tortoise can climb upto 5 m in first hour. Next hour it climbs down to 4 m. It is trying to reach a platform of 15 m. Find number of hours required to the tortoise to climb up the platform.

**Sol.:** It is very clear that tortoise can climb upto 5 m per hour

Effective climbing in the last hour will be 5 m. Remaining time in which tortoise will climb up to platform can be calculated by simple logic.

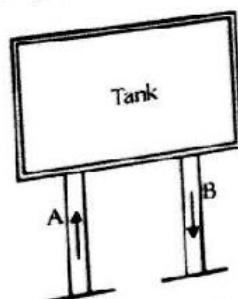
- ∴ In first hour tortoise can climb up 5 m
- next hour tortoise can climb down by 4 m
- ∴ Effective work within 2 hours = 1 m.
- ∴ 1m climbing requires 2 hours.
- ∴ 10 m Climbing will require 20 hours.
- Total time required by tortoise to climb up to 15 m is  $20 + 1 = 21$  hours.

**Ex. 3:** A snail is trying to reach at the top level of wooden stick which is 95 cm of height. Snail can climb up to 5 cm in first hour but climb down to 3 cm in next hour. Find the time required by snail to reach the top of wooden stick.

- Sol.:** Snail can climb 5 cm in last hour. Remaining time in which snail will climb stick can be calculated by simple method.
- 5 cm climbing up in first hour &
  - 3 cm climbing down in next hour
  - ∴ Effective work done by snail will be 2 cm in 2 hour.
  - ∴ 90 cm can be climbed in 90 hours.
  - ∴ Total time required by snail will be  $90 + 1 = 91$  hours.

### Pipes and Cisterns

Pipes are connected to a tank or cistern and are used to fill or empty the tank



Inlet: is a pipe which is used to fill the tank.  
In the given figure pipe A is inlet

MADE EASY

Outlet: is a pipe connected to a tank and is used for emptying the tank.

In the figure pipe B is outlet.

1. If an inlet can completely fill the empty tank in  $x$  hours,

$$\text{the part of the tank filled in 1 hour} = \frac{1}{x}$$

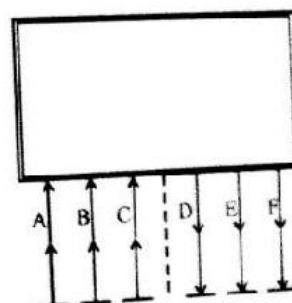
2. If an outlet can empty the tank in  $y$  hours then

$$\text{the part of tank emptied in 1 hour} = \frac{1}{y}$$

3. If both inlet and outlet are open, net part of

$$\text{the tank filled in 1 hours} = \frac{1}{x} - \frac{1}{y}$$

A tank can have large number of inlet and outlet..



Here in the figure A, B and C are inlets while D E and F are outlets.

Let A, B and C can fill the tank in  $X_1$ ,  $X_2$  and  $X_3$  hours respectively and D, E and F can empty the full tank in  $Y_1$ ,  $Y_2$  and  $Y_3$  hours respectively then the net part of the tank filled in 1 hour

$$= \left[ \frac{1}{X_1} + \frac{1}{X_2} + \frac{1}{X_3} \right] - \left[ \frac{1}{Y_1} + \frac{1}{Y_2} + \frac{1}{Y_3} \right]$$

**Ex. 1:** A pipe can fill the tank in 5 hours and pipe B can empty the full tank in 10 hours. Calculate the time required to fill the tank if both are running simultaneously

Sol. Here  $x = 5, y = 10$

so, net part of the tank filled in 1 hours

$$= \frac{1}{5} - \frac{1}{10} = \frac{1}{10}$$

so the tank will be filled in 10 hours.

**Ex. 2 :** Two inlet pipes can fill the tank in 10 and 20 hours respectively while two outlet pipes can empty the full tank in 30 and 25 hours respectively. Find the time required to fill the tank if all pipes are running simultaneously?

Sol.

$$\begin{array}{lll} \text{Here} & X_1 = 10, & X_2 = 20 \\ & Y_1 = 30 & Y_2 = 25 \end{array}$$

so the net part of the tank filled in 1 hour

$$\left[ \frac{1}{10} + \frac{1}{20} \right] - \left[ \frac{1}{30} + \frac{1}{25} \right]$$

$$= \frac{3}{20} - \frac{11}{150} = \frac{23}{300}$$

So the tank will be filled in  $\frac{300}{23} = 13.04$  hours

### Concept of Man.Day

If 100 workers can finish the task in 50 days, then 1 worker can finish the task in  $100 \times 50 = 5000$  day.

This is represented in form of Man.Day

So, man day is nothing but the time required to finish the task by 1 person.

Task given above is equal to 5000 Man.Day.

### Three Cases:

#### Case-I.

Let 100 workers can finish the task in 50 days, then how many days are required to finish the task by 25 workers?

**Solution:**

$$\text{Here Man.Day} = 100 \times 50 = 5000$$

now according to question only 25 workers are available so

Day =  $\frac{5000}{25} = 200$  days are required.  
finished the task by 25 workers

#### Case-II.

Let 100 worker can finish the task in 50 days, 100 worker started completing the task working for 10 days. To finish the task as soon as possible 100 more workers are employed. Now calculate the number of days required to complete the task.

**Solution:**

$$\text{Here Man . Day} = \text{constant}$$

$$100 \times 50 = 5000$$

initially 100 workers are working for 10 days so they can finish

$$100 \times 10 = 1000 \text{ (Man.Day)}$$

Now 4000 Man.Day is still remaining which has to be finished by 200 workers

$$\text{So, } 200 \times \text{Day} = 4000$$

$$\text{Day} = \frac{4000}{200} = 20 \text{ days}$$

So total it requires  $10 + 20 = 30$  days to complete the task.

#### Case-III.

Let 100 workers can finish the task in 50 days 100 workers started the task and working for 20 days. Now because of some unforeseen situations 80 workers have to leave the work. Then find number of days required to complete the task.

**Solution:**

$$\text{Here Man . Day} = \text{constant}$$

$$100 \times 50 = 5000$$

initially 100 workers are working for 20 days so, they can finish

$$100 \times 20 = 2000 \text{ (Man . Day)}$$

Now, 3000 (Man . Day) is still remaining which has to be finished by 20 workers

$$\text{Man} \times \text{Day} = 3000$$

$$20 \times \text{Day} = 3000$$

$$\text{Day} = \frac{3000}{20} = 150 \text{ days}$$

so total it requires  $20 + 150 = 170$  days to complete the task.

## Man . Day . Hour

$$M_1 \cdot D_1 \cdot H_1 = \text{work, also}$$

$$M_2 \cdot D_2 \cdot H_2 = \text{work}$$

Work may be anything like construction of a wall of different size.

$$\frac{M_1 D_1 H_1}{W_1} = \frac{M_2 D_2 H_2}{W_2}$$

Also if  $W_1 = l_1 b_1 h_1$  where

length is  $l_1$ ,

breadth  $b_1$ , and

height  $h_1$ , and

if  $W_2 = l_2 b_2 h_2$  where

$l_2$ ,  $b_2$  and  $h_2$  are length, and height respectively of second wall then

$$\frac{M_1 D_1 H_1}{l_1 b_1 h_1} = \frac{M_2 D_2 H_2}{l_2 b_2 h_2}$$

$$\Rightarrow \frac{l_1 b_1 h_1}{l_2 b_2 h_2} = \frac{M_1 D_1 H_1}{M_2 D_2 H_2}$$

## Concept of Efficiency

Efficiency of persons performing same task may not be same. It may be different for different persons. If efficiency is high a person can complete the work much faster than the stipulated time period. Similarly if efficiency is low, it requires more time to finish the same task than that of stipulated time.

We will observe following examples to have a grasp of problems based on concept of efficiency.

**Ex. 1:** A is twice as efficient as B and finishes the task 20 days earlier than B. Find the number of days required to finish the task if A and B can complete the work in  $x$  days.

Sol.: Let A can complete the work in  $x$  days then B requires  $2x$  days to finish the same work.

According to given condition A finish the task 20 days earlier than B.  $\Rightarrow 2x - x = 20$

So, A can finish the task in 20 days and B can finish the same task in 40 days.

**Ex. 2:** A is three times as efficient as B and finishes the task 32 days ahead of B. Find the number of days required to finish the task if both are working simultaneously.

Sol.: Let A requires  $x$  days then

B requires  $3x$  days

$$3x - x = 32 \Rightarrow 2x = 32$$

$$x = 16 \text{ days}$$

$$x = 16 \quad 3x = 48 \text{ days}$$

Together they can finish

$$\frac{1}{16} + \frac{1}{48} = \frac{4}{48} \text{ part} = \frac{1}{12} \text{ part}$$

Thus 12 days are required by them to finish the task.

**Ex. 3:** A is four times as efficient as B and can finish a task 45 days ahead of B. Find the total number of days required to finish the task if both are working simultaneously.

Sol.: Let A requires  $x$  days then

B requires  $4x$  days

According to given condition

$$4x - x = 45 \Rightarrow 3x = 45 \Rightarrow x = 15$$

Together they can finish

$$\frac{1}{15} + \frac{1}{60} = \frac{5}{60} = \frac{1}{12} \text{ part in a day}$$

So, it requires 12 days to finish the task together.

**Ex. 4:** A is three times as efficient as B and together they finish a task in 30 days. Find

number of days required by B to finish the same task individually.

Sol.: Let A requires  $x$  days then  
B requires  $3x$  days  
According to given condition

$$\frac{1}{x} + \frac{1}{3x} = \frac{1}{30}$$

$$\Rightarrow \frac{4}{3x} = \frac{1}{30}$$

$$\Rightarrow \frac{4 \times 30}{3} = x$$

$$\Rightarrow x = 40 \\ \therefore 3x = 120 \text{ Ans.}$$

**Ex.5** A is thrice as efficient as B and can finish the task 16 days ahead of B. Find number of days required to finish the same task, if both are working alternately starting from A.

Sol.: Let A requires  $x$  days then  
B requires  $3x$  days

According to given condition

$$3x - x = 16 \Rightarrow 2x = 16$$

$$\Rightarrow x = 8$$

$$3x = 24$$

If they are working alternately then in two days they can finish

$$\frac{1}{8} + \frac{1}{24} \Rightarrow \frac{1}{6} \text{ part}$$

So it requires 12 days to finish the task.



### SOLVED EXAMPLES

1. Vinod can do 25% of a piece of work in 5 days. How many days will he take to complete the work ten times?  
(a) 150 days      (b) 250 days  
(c) 200 days      (d) 180 days

Ans. (c)

25% part or  $\frac{1}{4}$  part  $\therefore 5$  days

then 1 part in  $\frac{5}{\frac{1}{4}} = 20$  days.

days required to complete 10 times  
 $= 20 \times 10 = 200$  days

2. 6 men can do a piece of work in 12 days. How many men are needed to do the work in 18 days?

- (a) 3 men      (b) 6 men  
(c) 4 men      (d) 2 men

Ans. (c)

Here Man . Day =  $6 \times 12 = 72$

$$m \times 18 = 72, m = \frac{72}{18} = 4$$

3. A can do a piece of work in 20 days and B can do it in 15 days. How long will the job be if both work together?

- (a)  $8\left(\frac{6}{7}\right)$  days      (b)  $8\left(\frac{4}{7}\right)$  days

- (c)  $9\left(\frac{3}{7}\right)$  days      (d) None of these

Ans. (b)

Here  $x = 20$  and  $y = 15$  days required

$$\frac{xy}{x+y} = \frac{20 \times 15}{20+15} = \frac{300}{35} = 8\frac{4}{7} \text{ days}$$

4. Nisha and Archana can do a piece of work in 10 days and Nisha alone can do it in 15 days. How many days can Archana do it?

- (a) 60 days      (b) 30 days  
(c) 50 days      (d) 45 days

Ans. (a)

One day work of both =  $\frac{1}{10}$

and Nishu's day work =  $\frac{1}{12}$

So, Archana's one day work

$$= \frac{1}{10} - \frac{1}{12} = \frac{2}{120} = \frac{1}{60}$$

So, 60 days required to finish the work by Archana

5. 4 men and 3 women finish a job in 6 days. And 5 men and 7 women can do the same job in 4 days. How long will 1 man and 1 woman take to do the work?

- (a)  $22\left(\frac{2}{7}\right)$  days    (b)  $25\left(\frac{1}{2}\right)$  days  
 (c)  $5\left(\frac{1}{7}\right)$  days    (d)  $12\left(\frac{7}{22}\right)$  days.

Ans. (a)

Let man completes m part in a day and woman completes w part in a day then

$$4m + 3w = \frac{1}{6} \text{ also} \quad (1)$$

$$5m + 7w = \frac{1}{4} \quad (2)$$

after simplifying we get

$$20m + 15w = \frac{5}{6}$$

$$20m + 28w = 1$$

$$\text{So } 13w = \frac{1}{6}$$

$$w = \frac{1}{78} \quad (3)$$

from (1) and (3) we get

$$m = \frac{5}{156}$$

$$m + w = \frac{5}{156} + \frac{1}{78} = \frac{7}{156}$$

$$\text{So it require } \frac{156}{7} \text{ days} = 22\frac{2}{7}$$

6. If 8 boys and 12 women can do a piece of work in 25 days. In how many days can the work be done by 6 boys and 11 women working together?

- (a) 15 days  
 (b) 10 days  
 (c) 12 days  
 (d) Cannot be determined  
 Ans. (d)

$$8B + 12W = \frac{1}{25} \quad (1)$$

now to calculate

$$6B + 11W = ?$$

It can not be determined because we have 1 equation but two variables.

7. A can do a piece of work in 10 days and B can do the same work in 20 days. With the help of C, they finish the work in 5 days. How long will it take for C alone to finish the work?

- (a) 20 days    (b) 10 days  
 (c) 35 days    (d) 15 days  
 Ans. (a)

$$\frac{1}{5} - \frac{1}{10} - \frac{1}{20} = \frac{1}{20}$$

This is C's one day work so 20 days are required for C alone to finish task

8. A can do a piece of work in 20 days. He work at it for 5 days and then B finishes it in 10 more days. In how many days will A and B together finish the work?

- (a) 8 days    (b) 10 days  
 (c) 12 days    (d) 6 days  
 Ans. (a)

$$A's \text{ one day work} = \frac{1}{20}$$

in 5 day a can complete  $\frac{1}{20} \times 5 = \frac{1}{4}$  part

remaining work =  $\frac{3}{4}$  part

∴ B finish  $\frac{3}{4}$  part in 10 days

∴ B finish 1 part in  $\frac{10}{\frac{3}{4}} = \frac{40}{3}$  days

together they can finish it in

$$\frac{\frac{1}{20} + \frac{3}{40}}{\frac{1}{8}} = 8 \text{ days}$$

9. Twenty workers can finish a piece of work in 30 days. After how many days should 5 workers leave the job so that the work is completed in 35 days?

- (a) 5 days      (b) 10 days  
 (c) 15 days      (d) 20 days

Ans. (c)

$$\text{Man} \times \text{Day} = \text{Man} \cdot \text{Day}$$

$$20 \times 30 = 600$$

Let 5 workers leave after  $x$  days then

$$20x + 15(35 - x) = 600$$

$$5x + 525 = 600$$

$$5x = 75, x = 15$$

10. Subhash can copy 50 page in 10 hours; subhash and Prakash together can copy 300 pages in 40 hours. In how much time can Prakash copy 30 pages?

- (a) 13 h      (b) 12 h  
 (c) 11 h      (d) 9 h

Ans. (b)

∴ Subhash in 10 hours can copy 50 pages

$$\therefore \text{in 1 hour } \frac{50}{10} = 5 \text{ pages}$$

Both can copy 300 pages in 40 hours

$$\text{So, in 1h } \frac{300}{40} = 7.5$$

Clearly prakash can copy 2.5 pages in 1 hour

$$\text{so 30 pages in } \frac{1}{2.5} \times 30 = 12 \text{ hours}$$

11. Sashi can do a piece of work in 25 days. Rishi can do it in 20 days. They work 5 days and then Sashi goes away. How many more days will Rishi finish the work?  
 (a) 10 days      (b) 12 days  
 (c) 14 days      (d) None of these

Ans. (d)

$$\text{Shashi's days work} = \frac{1}{25}$$

$$\text{Rishi's days work} = \frac{1}{20}$$

$$\text{together they can finish } \frac{1}{25} + \frac{1}{20}$$

$$= \frac{9}{100} \text{ part in a day}$$

$$\therefore \text{Work in 5 days } \frac{9}{100} \times 5 = \frac{45}{100} \text{ part}$$

$\frac{55}{100}$  part is remaining. Rishi can finish it.

$$\left( \frac{\frac{55}{100}}{\frac{1}{20}} \right) = 11 \text{ days}$$

12. Priya can do  $\frac{1}{2}$  of the work in 8 days. Preeti can do  $\frac{1}{3}$  of the work in 6 days. How long will it take for both of them to finish the work?

- (a)  $\frac{88}{17}$  day      (b)  $\frac{144}{17}$  days  
 (c)  $\frac{72}{17}$  days      (d) 8 days

Ans. (b)

$$\text{Priya's days work} = \left( \frac{1}{2} \right) = \frac{1}{16}$$

Preeti's days work

$$\Rightarrow \left( \frac{1}{3} \right) = \frac{1}{18} \text{ days}$$

Together they can finish in

$$\frac{1}{\frac{1}{16} + \frac{1}{18}} = \frac{144}{17} \text{ days}$$

13. Manoj takes twice as much time as Ajay and thrice as much as Vijay to finish a piece of work. Together they finish the work in 1 day. What is the time taken by Manoj to finish the work?

- (a) 6 days      (b) 3 days  
 (c) 2 days      (d) None of these

**Ans. (a)**

M : A : V

2 : 1 : 2/3 or 6 : 3 : 2

Let Manoj takes  $6x$  days Ajay takes  $3x$  days

and vijay  $2x$  days then  $\frac{1}{6x} + \frac{1}{3x} + \frac{1}{2x} = 1$

$$\frac{1}{x} \left[ \frac{1}{6} + \frac{1}{3} + \frac{1}{2} \right] = 1$$

$$\frac{1}{x} = 1, \quad \text{So } x = 1$$

Manoj will take 6days

14. Apurva can do a piece of work in 12 days. Apurva and Amit complete the work together and were paid Rs. 54 and Rs. 81 respectively. How many days must they have taken to complete the work together?

- (a) 4 days      (b) 4.5 days  
 (c) 4.8 days      (d) 5 days

**Ans. (c)**

Payment ratio = 54 : 81

$$\text{days work} = \frac{1}{12} : \frac{1}{x}$$

$$54 : 81 :: \frac{1}{12} : \frac{1}{x}$$

$$81 \times \frac{1}{12} = 54 \times \frac{1}{x}$$

$$x = \frac{54 \times 12}{81}, x = 8 \text{ days}$$

together they will take  $= \frac{12 \times 8}{12+8} = 4.8 \text{ days}$

15. Raju is twice as efficient as Vijay. Together, they finish the work in 14 days. In how many days can Vijay alone do the same work?

- (a) 16 days      (b) 21 days  
 (c) 32 days      (d) 42 days

**Ans. (d)**

Let Raju can do the work in  $x$  days then vijay in  $2x$  days

together they can complete in

$$\frac{2x+x}{3x} = 14 \text{ days}$$

$$x = 21 \text{ days}, 2x = 42 \text{ days}$$

16. If 12 men and 16 boys can do a piece of work in 5 days and 13 men and 24 boys can do it in 4 days, compare the daily work done by a man with that done by a boy?

- (a) 1 : 2      (b) 1 : 3  
 (c) 2 : 1      (d) 3 : 1

**Ans. (c)**

$$12M + 16B = \frac{1}{5} \quad (1)$$

$$13M + 24B = \frac{1}{4} \quad (2) \text{ also}$$

$$36M + 48B = \frac{3}{5}$$

$$26M + 48B = \frac{2}{4}$$

$$10M = \frac{1}{10}, M = \frac{1}{100}$$

$$\text{from eq (1)} B = \frac{1}{200}, M : B = 1 : 2 : 1$$

17. A can do a work in 10 days and B can do the same work in 20 days. They work together

for 5 days and then A goes away. In how many more days will B finish the work?

- (a) 5 days      (b) 6.5 days  
 (c) 10 days      (d)  $8\frac{1}{3}$  days

**Ans. (a)**

In 5 days the can complete

$$\left[ \frac{1}{10} + \frac{1}{20} \right] \times 5 = \frac{3}{4} \text{ part}$$

Remaining is  $\frac{1}{4}$  part

$$\text{B will finish it in } \frac{\frac{1}{4}}{\frac{1}{20}} = 5 \text{ days}$$

18. 15 men could finish a piece of work in 210 days. But at the end of 100 days, 15 additional men are employed. In how many more days will the work be complete?

- (a) 80 days      (b) 60 days  
 (c) 55 days      (d) 50 days

**Ans. (c)**

Man  $\times$  Day = Man . Day

$$15 \cdot 210 = 3150 \text{ So after 100 days}$$

$$15 \cdot 100 = 1500 \text{ will be completed}$$

$$\text{remaining work} = 1650 \text{ Man . Day}$$

$$\text{Man . Day} = 1650$$

$$30 \cdot \text{Day} = 1650$$

$$\text{Day} = 55$$

19. In a fort there was sufficient food for 200 soldiers for 31 day. After 27 days 120 soldiers left the fort. For how many extra days will the rest of the food last for the remaining soldiers?

- (a) 12 days      (b) 10 days  
 (c) 8 days      (d) 6 days

**Ans. (b)**

Man  $\times$  Day = Man . Day

$$200 \cdot 31 = 6200$$

After 27 days

$$200 \times 27 = 5400 \text{ Man}$$

Day is finished

$$\text{remaining} = 800$$

$$\text{Man . Day} = 800$$

$$80 \cdot \text{Day} = 800$$

$$\text{Day} = 10$$

20. A cistern is normally filled in 5 hours. It takes 6 hours when there is leak at the bottom. If the cistern is full, in what time will the leak empty it?

- (a) 6 h      (b) 5 h  
 (c) 30 h      (d) 15 h

**Ans. (c)**

In one hour  $\frac{1}{5}$  part is filled now let it be empty in x hour then

$$\frac{1}{5} - \frac{1}{x} = \frac{1}{6}$$

$$\Rightarrow \frac{1}{5} - \frac{1}{6} = \frac{1}{x}$$

$$\Rightarrow \frac{1}{30} = \frac{1}{x} \Rightarrow x = 30 \text{ hours}$$

21. Pipe A and B running together can fill a cistern in 6 minutes. If B takes 5 minutes more than A to fill the cistern, then the time taken by A and B will fill the cistern separately respectively?

- (a) 15 min, 20 min      (b) 15 min, 10 min  
 (c) 10 min, 15 min      (d) 25 min, 20 min

**Ans. (c)**

Let pipe A can fill in x and pipe B in  $x+5$  minutes

$$\frac{1}{x} + \frac{1}{x+5} = \frac{1}{6}$$

$$\text{or } \frac{x(x+5)}{2x+5} = \frac{1}{6}$$

$$x = 10, x + 5 = 15$$

A cistern is normally filled in 6 h but takes 4 h longer to fill because of a leak in its bottom. If the cistern is full, the leak will empty it in how much time?

- (a) 15 h
- (b) 16 h
- (c) 20 h
- (d) None of these

**Ans. (a)**

Let leak empty in  $x$  hours Now

$$\frac{1}{6} - \frac{1}{x} = \frac{1}{10}$$

$$\frac{1}{6} - \frac{1}{10} = \frac{1}{x}$$

$$x = 15$$

3. If three taps are open together, a tank is filled in 10 h. One of the taps can fill in 5 h and another in 10 h. At what rate does the 3rd pipe work?

- (a) Waste pipe emptying the tank in 10 h
- (b) Waste pipe emptying the tank in 20 h
- (c) Waste pipe emptying the tank in 5 h
- (d) Fills the tank in 10 h

**Ans. (c)**

$$\frac{1}{5} + \frac{1}{10} + \frac{1}{x} = \frac{1}{10}$$

$$\frac{1}{x} = \frac{-1}{5}$$

i.e. pipe can empty in 5 hours

24. There are two pipe in a tank. Pipe A is for filling the tank and Pipe B is for emptying the tank. If A can fill the tank in 10 hours and B can empty the tank in 15 hours then find how many hours will it take to completely fill a half empty tank?

- (a) 30 hours
- (b) 15 hours
- (c) 20 hours
- (d) 33.33 hours

**Ans. (b)**

$$\frac{1}{10} - \frac{1}{15} = \frac{5}{150} = \frac{1}{30}$$

So it takes 30 hours to fill the tank and 15 hours to fill half the tank

25. There are three Taps A, B and C in a tank. They can fill the tank in 10 hrs, 20 hrs and 25 hrs respectively. At first, all of them are opened simultaneously. Then after 2 hours tap C is closed and A and B are kept running. After the 4th hour, tap B is also closed. The remaining work is done by Tap A alone. Find the percentage of the work done by Tap A by itself.

- (a) 32 %
- (b) 52 %
- (c) 75 %
- (d) None of these

**Ans. (d)**

	A	B	C		Total Work
I <sup>st</sup> hour	$\frac{1}{10}$	$\frac{1}{20}$	$\frac{1}{25}$	$\frac{19}{100}$ part	$\frac{19}{100}$ part
II <sup>nd</sup> hour	$\frac{1}{10}$	$\frac{1}{20}$	$\frac{1}{25}$	$\frac{19}{100}$ part	$\frac{19}{100}$ part
III <sup>rd</sup> hour	$\frac{1}{10}$	$\frac{1}{20}$	x	$\frac{3}{20}$ part	$\frac{15}{100}$ part
IV <sup>th</sup> hour	$\frac{1}{10}$	$+\frac{1}{20}$	x	$\frac{3}{20}$ part	$\frac{15}{100}$ part

So remaining part after 4 hour is

$$1 - \left( \frac{19}{100} + \frac{19}{100} + \frac{15}{100} + \frac{15}{100} \right) = \frac{32}{100}$$

Which will be filled by tap A

Total work done by A

$$= \frac{1}{10} + \frac{1}{10} + \frac{1}{10} + \frac{1}{10} + \frac{32}{100}$$

$$= \frac{(10+10+10+10+32)}{100} = \frac{72}{100}$$

So % of work done by A

$$= \frac{72}{100} \times 100 = 72\%$$



## Time & Work



### Practice Exercise: I

1. 10 men can complete a piece of work in 15 days and 15 women can complete the same work in 12 days. If all the 10 men and 15 women work together, in how many will the work get completed?

(a)  $6\frac{2}{3}$  days      (b)  $8\frac{1}{3}$  days

(c)  $7\frac{2}{3}$  days      (d) None of these

2. A can do  $\frac{1}{3}$  of a work in 5 days and B can do  $\frac{2}{5}$  of the work in 10 days. In how many days both A and B together can do the work?

(a)  $13\frac{2}{3}$  days      (b)  $9\frac{3}{8}$  days

(c)  $18\frac{5}{8}$  days      (d) None of these

3. A is thrice as good as B and is therefore able to finish a piece of work in 60 days less than B. Find the time in which they can do it, working together.

(a)  $22\frac{3}{4}$  days      (b)  $22\frac{1}{2}$  days

(c) 24 days      (d) None of these

4. Ramesh takes twice as much time as Mahesh and thrice as much time as Suresh to complete a job. If working together, they can complete the job in 4 days, then the time taken by each of them separately to complete the work is  
 (a) 36, 24 and 16 days  
 (b) 20, 16 and 12 days  
 (c) 24, 42 and 18 days  
 (d) None of these

5. 5 men can complete a work in 12 days. If 5 children can complete the same work in 15 days, then 1 man and 1 child, working together, can complete the work in

(a) 6 days      (b) 4 days  
 (c) 8 days      (d) None of these

6. A and B can finish a piece of work in 12 days while B and C in 40 days while C and A in 15 days. A, B, C together can do the work in

(a)  $24\frac{3}{4}$  days      (b)  $28\frac{2}{3}$  days

(c)  $26\frac{2}{3}$  days      (d) None of these

7. Ajay and Sunil can do a piece of work in 10 days, Sunil and Sanjay in 15 days, Sanjay and Ajay in 20 days. They work at it for 6 days and then Ajay and Sunil and Sanjay go on together for more. If Sunil then leaves, how long will it take to complete the work?

(a) 12 days      (b) 10 days  
 (c) 16 days      (d) None of these

8. Amit, Raman and Sanju together can complete a work in 4 days. If Amit and Raman together can complete the work in 4 days, then Raman and Sanju together can do it in 6 days. Then Raman alone can complete the work in

(a) 16 days      (b) 12 days  
 (c) 20 days      (d) None of these

9. Bindal can finish a work in 10 days. If Bindal and Raman together are twice as efficient as Bindal. If they work together, in how many days, the work will be finished?

(a)  $3\frac{1}{3}$  days      (b)  $5\frac{2}{3}$  days

(c)  $4\frac{1}{3}$  days      (d) None of these

## Solutions

### 1. Ans. (a)

It is given that in a day

10 men can finish  $\frac{1}{15}$  part of the work, also

15 women can finish  $\frac{1}{12}$  part of work

If they work together then

$$\frac{1}{15} + \frac{1}{12} = \frac{3}{20} \text{ part}$$

So it takes  $\frac{20}{3}$  or  $6\frac{2}{3}$  days.

### 2. Ans. (b)

A can do the complete work in  $5 \times 3 = 15$  days

B can do the complete work in  $= 10 \times \frac{5}{2}$

= 25 days.

Here, A and B are working together, can complete

$$\frac{1}{15} + \frac{1}{25} = \frac{8}{75} \text{ part of work in a day}$$

$\Rightarrow \frac{75}{8}$  or  $9\frac{3}{8}$  days to finish the work.

### 3. Ans. (b)

Let A can finish the work in x days  
then B will take  $3x$  days

It is given that

$$3x - x = 60$$

$$\therefore x = 30$$

A and B working together will complete

$$\frac{1}{30} + \frac{1}{90} = \frac{2}{45} \text{ part of work}$$

$$\Rightarrow \frac{45}{2} \text{ or } 22\frac{1}{2} \text{ days}$$

Ans. (c)

Let Ramesh takes x days to finish the work.

Then, Mahesh takes  $\frac{x}{2}$  and Suresh takes  $\frac{x}{3}$  days to finish the same work.

$$x : \frac{x}{2} : \frac{x}{3} = 6 : 3 : 2$$

$$\Rightarrow 6y : 3y : 2y$$

$\therefore$  Ramesh, Mahesh and Suresh together, will complete

$$\frac{1}{6y} + \frac{1}{3y} + \frac{1}{2y} \text{ part in a day}$$

$$= \frac{1+2+3}{6y}$$

$$= \frac{1}{y} \text{ part}$$

$\Rightarrow$  together they can take y days to finish the work

It is given that  $y = 4$

Ramesh takes  $6y = 24$  days

Mahesh takes  $3y = 12$  days

Suresh takes  $2y = 8$  days

### 5. Ans. (b)

1 Man can complete the work in

$$5 \times 2 = 10 \text{ days}$$

1 woman can complete the work in  $4 \times 3 = 12$  days, and 1 child can complete the work in  $5 \times 3 = 15$  days.

$\therefore$  1 man, 1 woman and 1 child, working together, can complete

$$\frac{1}{10} + \frac{1}{12} + \frac{1}{15} = \frac{1}{4} \text{ of work in a day}$$

$\Rightarrow$  4 days to finish the work

### 6. Ans. (c)

$$(A + B)'s 1 \text{ day work} = \frac{1}{30}$$

+ A)'s 1 day work =  $\frac{1}{60}$

∴ (A + B + C)'s 1 day work

$$= \frac{4+3+2}{120} = \frac{9}{120} \text{ part}$$

(A + B + C)'s 1 day work

$$= \frac{9}{120} \times \frac{1}{2} = \frac{3}{80} \text{ part}$$

∴  $\frac{80}{3}$  or  $26\frac{2}{3}$  days

Ans. (b)

Work done by all of them together in 6 days

$$= \frac{6 \times 13}{120} \text{ i.e. } \frac{13}{20}$$

Also, work done by Sunil and Sanjay in 4

$$\text{days} = \frac{4}{15}$$

∴ Remaining work

$$= 1 - \left( \frac{13}{20} + \frac{4}{15} \right) = \frac{1}{12}$$

Which is to be done by Sanjay.

Now, Ajay, Sunil and Sanjay, can

complete the work in  $\frac{120}{13}$  days and Ajay

and Sunil can complete the work in 10 days.

∴ Sanjay alone can complete  $\frac{1}{12}$  part

∴  $\frac{1}{12}$  of the work is done by Sanjay in  $\frac{120}{12}$  days.

10 days.

It is given that Amit, Raman and Sanju together can finish the work in 4 days.

Amit and Raman together can do it in  $\frac{24}{5}$  days. Raman and Sanju together can do it in 8 days. Therefore, Amit alone can complete

$$\left( \frac{1}{4} - \frac{1}{8} \right) \text{ i.e. } \frac{1}{8} \text{ part of work in a day}$$

⇒ whole work in 8 days

So Raman alone can complete  $\frac{1}{4} - \frac{1}{8} - \frac{1}{24} =$

$$\frac{1}{12} \text{ part in a day}$$

⇒ 12 days to finish the whole work

9. Ans. (a)

It is given that Bindal can finish the work in a 10 days then Jindal in 5 days together

$$\frac{1}{5} + \frac{1}{10} = \frac{3}{10} \text{ part in a day}$$

So  $\frac{10}{3}$  days to finish the whole work

10. Ans. (a)

Let A can finish the work in x days

Then B can finish the work in 4x days

It is given that

$$4x - x = 45$$

$$\Rightarrow x = 15, 4x = 60 \text{ days}$$

Together they can finish  $\frac{1}{15} + \frac{1}{60}$  part in a day

$$\Rightarrow \frac{1}{12} \text{ part}$$

∴ 12 days to finish the whole work

1. Ans. (a)

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We have  $M_1 = 24$ ,  $D_1 = 27$ ,  $W_1 = 1$ ,  $H_1 = 7$ .

$M_2 = 14$ ,  $D_2 = ?$ ,  $W_2 = 1$ ,  $H_2 = 9$

Since they are doing the same work

So  $M_1 D_1 H_1 = M_2 D_2 H_2 = \text{Work}$

$$\Rightarrow 24 \times 27 \times 7 = 14 \times D_2 \times 9$$

$$\Rightarrow D_2 = 36 \text{ days.}$$

12. Ans. (a)

We have,  $M_1 = 45$ ,  $D_1 = 30$ ,  $H_1 = 12$

$M_2 = 60$ ,  $D_2 = ?$ ,  $H_2 = 10$

Since they are doing the same work

So  $M_1 D_1 H_1 = M_2 D_2 H_2 = \text{Work}$

$$\Rightarrow 45 \times 30 \times 12 = 60 \times D_2 \times 10$$

$$\Rightarrow D_2 = 27 \text{ days}$$

13. Ans. (b)

∴ 4 men can finish given work in 20 days

∴ 1 man in 80 days, also

∴ 6 women can finish same work in 20 days

∴ 1 women in 120 days

⇒ (6 men + 11 women)'s 1 day work

$$= \frac{6}{80} + \frac{11}{120} = \frac{18+22}{240} = \frac{1}{6} \text{ part}$$

So 6 days to finish the whole work.

14. Ans. (b)

$$(A+B)'s 5 \text{ day's work} = 5 \left( \frac{1}{10} + \frac{1}{15} \right) = \frac{5}{6}$$

$$\text{Remaining work} = 1 - \frac{5}{6} = \frac{1}{6}$$

$$\therefore C's 2 \text{ days' work} = \frac{1}{6}$$

Now A's 5 days' work : B's 5 days' work :  
C's 2 days' work

$$= \frac{5}{10} : \frac{5}{15} : \frac{1}{6} = 3 : 2 : 1$$

$$B's \text{ share} = \left( 450 \times \frac{2}{6} \right) = \text{Rs. } 150$$

$$C's \text{ share} = \text{Rs. } [450 - (225 + 150)] \\ = \text{Rs. } 75$$

15. Ans. (d)

If B does  $x$  part of work in 1 hour

then B does  $\frac{3}{4}x$  part in  $\frac{3}{4}$  hour

Now, A does half of  $\frac{3}{4}x$  i.e.  $\frac{3}{8}x$  work  
hour

It is given that  $x + \frac{3}{8}x = \frac{1}{18}$

$$\text{So } x = \frac{4}{99}$$

B complete work in  $\frac{99}{4}$  days and A in 66 days

16. Ans. (c)

$$1\text{st man's 3 days' work} = \frac{3}{6} = \frac{1}{2}$$

$$2\text{nd man's 3 days' work} = \frac{3}{8}$$

$$\text{Boy's 3 days' work} = 1 - \left( \frac{1}{2} + \frac{3}{8} \right) = \frac{1}{8}$$

∴ They should get money in the ratio

$$\frac{1}{2} : \frac{3}{8} : \frac{1}{8} \text{ i.e. } 4 : 3 : 1$$

$$\therefore \text{Boy's share} = \text{Rs. } \frac{1}{8} \times 600 = \text{Rs. } 75$$

17. Ans. (b)

It is given that

$$(5M + 2B) = 4(1M + 1B)$$

$$\Rightarrow M = 2B$$

∴ Work done by a man and boy are  
ratio 2 : 1