

# Number System

Natural No. 1, 2, 3, 4

Whole No. 0, 1, 2, 3, 4

Integers पूरा अंक -5, -4, -3, -2, -1, 0, 1, 2, 3, 4

Fraction or decimal  $\frac{1}{2}$ ,  $-\frac{1}{2}$ ,  $\frac{2}{3}$ , 0.5

Rational No. (logical No.) = Integers + Fraction

Irrational No.  $\pi$  (approx value  $\frac{22}{7}$ ),  $e$  (approx value 2.71828),  $\sqrt{2}, \sqrt{3}, \sqrt{5}$

Real No. = Rational No. + Irrational No. (Non-terminating & Non Repeating)

Imaginary No.  $\sqrt{-2}, \sqrt{-1} = i$   
 $= \sqrt{-2} = \sqrt{-1 \times 2} = \sqrt{-1} \times \sqrt{2} = \sqrt{2}i$

## Number System

14/6/23

Real No.

Imaginary No.

Rational

Irrational

$\sqrt{2}, \sqrt{3}$

Integer

Fraction

$\pi, e, \sqrt{2}, \sqrt{3}$

Negative No. -5, -2

whole No.

Terminating  
 $\frac{1}{2} = 0.5$

Non-terminating & Non-Repeating

zero

Natural No.

Non-terminating

$\frac{1}{3} = 0.3333$

$\frac{2}{7} = 0.28571428$

# Ratio

Ratio is a comparison of the sizes of 2 or more quantities by division. Eg: Profit Ratio X:Y:Z 5:3:2

Current Ratio CA:CL 4:3

Eg 1: Given that Current Ratio of a Company is 3:2

$$CA:CL::3:2$$

Case 1: If CA are 600000; find CL.

$$CL = \frac{2}{3} \times 600000 = 400000$$

Case 2: If CL are ₹ 600000; find CA.

$$CA = \frac{3}{2} \times 600000 = 900000$$

Case 3: If Working Cap is ₹ 600000. find CA & CL.

$$\frac{CA}{CL} = \frac{3}{2} \text{ let's } \frac{3x}{2x}$$

$$CA - CL = WC, \quad 3x - 2x = 600000$$
$$x = 600000$$

$$CA = 3 \times 600000 = 1800000$$

$$CL = 2 \times 600000 = 1200000$$

Ratio of 3 term can be expressed as

a:b:c or a to b to c.

Ratio of 4 term can be expressed as

a:b:c:d or a to b to c to d.

However, ratio of 2 terms can be expressed as

a:b or a to b or  $\frac{a}{b}$

Ratio of 4 term can be expressed

a) a:b:c:d

b) a/b : c/d

c) a/b x d/c

d) None of these

If the Ratio is  $a:b:c:d$  <sup>Consequent</sup>  
 'a' called 1<sup>st</sup> term or Antecedent  
 'b' " 2<sup>nd</sup> " or Consequent

If the Ratio of the quantities can be expressed in terms of Integers, then quantities are said to be Commensurable. Cannot expressed Integers said Incommensurable.

Eg:- 2 Check whether quantities are Commensurable or Incommen---

Case 1:  $x=10, y=5$   $\frac{x}{y} = \frac{10}{5} = 2:1$  are Common---

Case 2:  $x=10/3, y=5/3$   $\frac{x}{y} = \frac{10/3}{5/3} = \frac{10}{5} = 2:1$  are Comm---

Case 3:  $x=10\sqrt{3}, y=5\sqrt{3}$   $\frac{x}{y} = \frac{10\sqrt{3}}{5\sqrt{3}} = 2:1$  are Common---

Case 4:  $x=10.3, y=5.3$   $\frac{x}{y} = \frac{10.3}{5.3} = \frac{103}{53}$  are Comm.

Case 5:  $x=10\sqrt{3}, y=5\sqrt{7}$   $\frac{x}{y} = \frac{10\sqrt{3}}{5\sqrt{7}}$  - Incommen---

### Types of Ratios

15/June/23

If the Ratio is  $a:b$   $GP = a=1, b=2, c=4$

1. Inverse Ratio  $b:a$   $AP = 1, 2, 3$

2. Duplicate Ratio  $a^2:b^2$   $HP = 1, \frac{1}{2}, \frac{1}{3}$

3. Triplicate Ratio  $a^3:b^3$

4. Sub-duplicate "  $a^{1/2}:b^{1/2} :: \sqrt{a}:\sqrt{b}$

5. Sub-triplicate  $a^{1/3}:b^{1/3} :: \sqrt[3]{a}:\sqrt[3]{b}$

6. Compound Ratio

If Ratios are  $a/b, c/d, e/f$

Compound Ratio  $a/b \times c/d \times e/f = ace/bdf$

Eg:- 3 If Ratios are  $2/3, 9/15, 7/5, 2/35$  find Compound

$$\frac{2}{3} \times \frac{9}{15} \times \frac{7}{5} \times \frac{2}{35} = \frac{2}{75}$$

Eg 4:- find the Compound Ratio of  $6/81$ , Inverse ratio of  $2/3$  and duplicate Ratio of  $3/4$ .

$$\frac{6}{81} \times \frac{3}{2} \times \frac{9}{16} = \frac{432}{2592} = 0.1666$$

### 7. Continued Ratio

If the Ratios are  $a, b$  and  $c$ , then Continued Ratio can be expressed as  $b : a : b : c : d$

Eg:- 5 find Continued Ratio follows Cases.

Case 1:-  $\frac{a}{b} = \frac{2 \times 4}{3 \times 4} = \frac{8}{12}$        $\frac{b}{c} = \frac{4 \times 3}{5 \times 3} = \frac{12}{15}$

$a : b : c = 8 : 12 : 15$

Case 2:-  $\frac{a}{b} = \frac{2 \times 5}{3 \times 5}$

$\frac{b}{c} = \frac{4 \times 3}{5 \times 3}$

$a : b : c = 10 : 15 : 12$

Case 3:-  $\frac{a}{b} = \frac{2 \times 4}{3 \times 4}$

$\frac{b}{c} = \frac{4 \times 2}{5 \times 2}$

$a : b : c = 8 : 12 : 10 = 4 : 6 : 5$

Case 4:-  $\frac{a}{b} = \frac{2 \times 2}{3 \times 2} = \frac{4}{6}$

$\frac{b}{c} = \frac{2 \times 3 \times 2}{5 \times 3 \times 2} = \frac{6}{30}$        $\frac{c}{d} = \frac{2 \times 15}{7 \times 15} = \frac{30}{105}$

$a : b : c : d = 8 : 12 : 30 : 105$

Case 5:-  $\frac{a}{b} = \frac{3}{5}$

$\frac{b}{c} = \frac{2}{3}$

$\frac{c}{d} = \frac{2}{1}$

$12 : 20 : 30 : 15$

Case 6:-  $\frac{a}{c} = \frac{2}{3}$

$\frac{b}{d} = \frac{2}{5}$

$\frac{a}{d} = \frac{3}{2}$

$30 : 8 : 45 : 20$

## Units of Measurements

"Kilo" Means 1000 times higher

$$\text{Eg } 1 \text{ Kilogram} = 1 \text{ gram} \times 1000 = 1000 \text{g}$$

$$2.5 \text{ Kilogram} = 2.5 \text{ m} \times 1000 = 2500 \text{ m}$$

"Mills" Means 1000 times Lower

$$\text{Eg } 1 \text{ Milligram} = \frac{1 \text{ gram}}{1000} = 1 \text{g} = 1000 \text{ milligram}$$

"Centi" Means 100 times Lower

$$\text{Eg } 1 \text{ Centimeter} = \frac{1 \text{ m}}{100} = 1 \text{ m} = 100 \text{ Centimeters}$$

K B C Mode

Killo) 1000

Base) 100

Centi) 10

Milli) 10

Meter, Gram, Litre

$$1 \text{ km} = 1000 \text{ m} = 100000 \text{ cm} = 1000000 \text{ mm}$$

$$\text{a) } 50 \text{ m} = 5000 \text{ cm} \quad \text{b) } 1.25 = 12.5 \text{ mm}$$

$$\text{c) } 6250 \text{ mm} = 625 \text{ cm} \quad \text{d) } 7000 \text{ cm} = 70 \text{ m}$$

$$\text{e) } 6 \text{ m} = 6000 \text{ mm} \quad \text{f) } 1.25 \text{ Kg} = 1250000 \text{ mg}$$

Eg 1 :- find the Ratio of following

Case 1 :- 4 Kg and 20 gram.

$$4000 \text{ gm} : 20 \text{ gm} = 200 : 1$$

Case 2 :- 2.5 km and 5000 mm

$$2500000 : 5000$$

$$500 : 1$$

Case 3 :- 3.5 cm and 25 mm

$$3.50 \text{ mm} : 25 \text{ mm}$$

$$14 : 1$$

## Proportion

If  $a/b = c/d$ , then  $a, b, c$  and  $d$  are said to be in proportion.  
An Equality of 2 Ratios is known as proportion.

If it is expressed as  $a:b::c:d$   
'a' is called as 1<sup>st</sup> term / 1<sup>st</sup> proportional term.  
'b' is " " 2<sup>nd</sup> " / 2<sup>nd</sup> " " " " "

'a' and 'd' are also known as Extreme terms  
'b' and 'c' " " " " Middle term / Mean t.

$$\frac{a}{b} = \frac{c}{d} \quad [ad = bc]$$

Eg 1:- find the Value of  $x$  if the following terms are in proportion

Case 1:- 2, 3, 5,  $x$

$$ad = bc \quad \Rightarrow \quad 2x = 15 \quad \Rightarrow \quad x = \frac{15}{2} = 7.5$$

Case 2:- 2, 3,  $x$ , 5  $x = \frac{10}{3}$

Case 3:- 225, 150, 75,  $x$   $x = 50$

Case 4:- 252, 132,  $x$ , 66  $x = 26$

Case 5:-  $x$ , 105, 17, 21  $x = 8.5$

Case 6:-  $\frac{16}{25}, \frac{4}{9}, \frac{3}{125}, x$   $\frac{4}{9} \times \frac{3}{125} \times \frac{25}{16}$

$$x = 0.0166, \quad x = \frac{1}{6}$$

Case 7:-  $\frac{2}{5}, \frac{3}{8}, x, \frac{25}{4}$   $\frac{2}{5} \times \frac{25}{4} \times \frac{8}{3} = \frac{400}{60}$

$$x = 6.666, \quad \frac{20}{3}$$

$$\frac{25}{4} = 6.25$$
$$\frac{25}{40} = 0.625$$

Similarly If  $\frac{a}{b} = \frac{b}{c}$ , then a, b and c are said to be in continuous proportion. It is expressed as  $a:b::b:c$

a is known as 1<sup>st</sup> proportional term  
 b is " " 2<sup>nd</sup> " " "  
 a and c are known as extreme term  
 b is known as Middle term / Mean term

If  $\frac{a}{b} = \frac{b}{c} = \frac{b^2}{ac}$

Eg 2:- find value of x. If following term in prop--

Case 1:- 2, 3, x  $x = 9/2$

Case 2:- 2, x, 3  $x = \pm \sqrt{6}$

Case 3 - x, 2, 3  $x = 4/3$

" 4 28, 42, x  $x = 63$

" 5 x, 168, 882  $x = 32$

" 6 1176, x, 6 a) 84 b) -84 c) both d) None  
 $x \pm 84$

Case 7:- 28, x, 25 a)  $2\sqrt{7}$  b)  $7\sqrt{5}$  c)  $10\sqrt{7}$  d)  $10\sqrt{11}$

Case 8:- 12, x, 98  
 $x = + 34.29$

a)  $14\sqrt{3}$  b)  $14\sqrt{5}$  c)  $14\sqrt{6}$  d)  $14\sqrt{17}$

### Laws of proportions

if  $\frac{a}{b} = \frac{c}{d}$   $\frac{a}{b} = \frac{c}{d}$   $\frac{1}{2} = \frac{3}{6} = 0.5$

1. Invertendo  $\frac{b}{a} = \frac{d}{c}$   $\frac{2}{1} = \frac{6}{3} = 2$

2. Alternendo  $\frac{a}{c} = \frac{b}{d}$   $\frac{1}{3} = \frac{2}{6} = 0.33$

or

$\frac{d}{b} = \frac{c}{a}$   $\frac{6}{2} = \frac{3}{1} = 3$

3. Componendo  $\frac{a+b}{b} = \frac{c+d}{d} \quad \frac{1+2}{2} = \frac{3+6}{6} = 1.5$

4. Dividendo  $\frac{a-b}{b} = \frac{c-d}{d} \quad \frac{1-2}{2} = \frac{3-6}{6} = 0.5$

5. Componendo and Dividendo  $\frac{a+b}{a-b} = \frac{c+d}{c-d} \quad \frac{1+2}{1-2} = \frac{3+6}{3-6} = -3$

6. Addendo

If  $\frac{a}{b} = \frac{c}{d}$ , then  $\frac{a}{b} = \frac{c}{d} = \frac{a+c}{b+d}$

Eg If  $\frac{1}{2} = \frac{3}{6}$  then,  
 $\frac{1}{2} = \frac{3}{6} = \frac{1+3}{2+6} = 0.5$

7. Subtrahendo

If  $\frac{a}{b} = \frac{c}{d}$  then,  
 $\frac{a}{b} = \frac{c}{d} = \frac{a-c}{b-d}$

Eg If  $\frac{1}{2} = \frac{3}{6}$  then,  
 $\frac{1}{2} = \frac{3}{6} = \frac{1-3}{2-6} = \frac{-2}{-4} = 0.5$

Words problems

Eg:-3

Case 1:- If Rs 10  $\rightarrow$  20 apples  
 Rs 50  $\rightarrow$  100 "

Rs 10 : 20 apples :: 50 : x apples  
 $x = \frac{20 \times 50}{10} = 100$  apples

Case 2:- If Rs 10  $\rightarrow$  20 apples  
 Rs 25  $\rightarrow$  50 apples

Rs 10 : 20 apples :: x : 50 apples  
 $x = \frac{10 \times 50}{20} = 25$



Calc -  $3 \times 3 = 3^2$   
 $3^2 \times 3^3 = 3^5$

# Indices

$3 + 3 + 3 + 3 = 3 \times 4$   
 $3 \times 3 \times 3 \times 3 = 3^4 \rightarrow$  power, exponent, index  
 base

## Laus of Indices

1.  $a^x \times a^y = a^{x+y}$   
 $a^x + a^y = a^{x+y}$

Eg:  $(2.3)^4 \times (2.3)^8 = 2.3^{12} = 21914.62$

2.  $a^x \div a^y = a^{x-y}$   $5^4 \div 5^3 = 5^1$

Eg:  $(3.6)^{10} \div (3.6)^4 = (3.6)^6 = 2176.78$

3.  $(a^x)^y = (a^y)^x = a^{xy}$

$(5^2)^3 = (5 \times 5)^3 = 5 \times 5 \times 5 \times 5 \times 5 \times 5$   
 $\sqrt[2]{\quad} \sqrt[2]{\quad} \sqrt[2]{\quad}$   
 $\sqrt[6]{\quad}$

Eg:  $(1.37)^5 = (1.37)^{10} = 23.29$

4.  $a^x b^x = (ab)^x$

$(5 \times 2)^3 = 5 \times 2 \times 5 \times 2 \times 5 \times 2$

Eg:  $1.54^8 \times 1.12^8 = (1.54 \times 1.12)^8 = (1.7248)^8 = 78.326$

Eg:  $1.54^8 \times 1.12^9$

$1.54^8 \times 1.12^8 \times 1.12 = (1.54 \times 1.12)^8 \times 1.12$

$= 78.326 \times 1.12 = 87.7259$

5.  $\frac{a^x}{b^x} = \left(\frac{a}{b}\right)^x$

Eg:  $\frac{287.54^{17}}{129.02^{17}} = \left(\frac{287.54}{129.02}\right)^{17} = (2.22864672143)^{17}$   
 $825469.296675$

Eg:  $\frac{287.54^{15}}{129.02^{16}} = \frac{287.54^{15}}{129.02^{15} \times 129.02}$

7.  $\sqrt[n]{a} = a^{\frac{1}{n}}$

8.  $\frac{1}{a^n} = a^{-n}$

9. If  $a^x = a^y$  Same then  $x=y$  Exception  $a \neq 1, 0, -1$

10. If  $a^x = b^x$  then  $a=b$  Exception  $x \neq 0$  where is even  
 either  $a=b$  or  $a=-b$

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

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

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

14.  $(a+b)^3 = a^3 + b^3 + 3ab(a+b)$

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

16.  $(a-b)^3 = a^3 - b^3 - 3ab(a-b)$

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

19. If  $a+b+c=0$  then  $a^3 + b^3 + c^3 = 3abc$

$a+b = -c$

$(a+b)^3 = (-c)^3$

$a^3 + b^3 + 3ab$