18×0=0	19×0=0	20×0=0	21×0=0	22×0=0	23×0=0	24×0=0
18×1=18	19×1=19	20×1=20	21×1=21	22×1=22	23×1=23	24×1=24
18×2=36	19×2=38	20×2=40	21×2=42	22×2=44	23×2=46	24×2=48
18×3=54	19×3=57	20×3=60	21×3=63	22×3=66	23×3=69	24×3=72
18×4=72	19×4=76	20×4=80	21×4=84	22×4=88	23×4=92	24×4=96
18×5=90	19×5=95	20×5=100	21×5=105	22×5=110	23×5=115	24×5=120
18×6=108	19×6=114	20×6=120	21×6=126	22×6=132	23×6=138	24×6=144
18×7=126	19×7=133	20×7=140	21×7=147	22×7=154	23×7=161	24×7=168
18×8=144	19×8=152	20×8=160	21×8=168	22×8=176	23×8=184	24×8=192
18×9=162	19×9=171	20×9=180	21×9=189	22×9=198	23×9=207	24×9=216
18×10=180	19×10=190	20×10=200	21×10=210	22×10=220	23×10=230	24×10=240

25×0=0	26×0=0	27×0=0	28×0=0	29×0=0	30×0=0
25×1=25	26×1=26	27×1=27	28×1=28	29×1=29	30×1=30
25×2=50	26×2=52	27×2=54	28×2=56	29×2=58	30×2=60
25×3=75	26×3=78	27×3=81	28×3=84	29×3=87	30×3=90
25×4=100	26×4-104	27×4=108	28×4=112	29×4=116	30×4=120
25×5=125	26×5=130	27×5=135	28×5=140	29×5=145	30×5=150
25×6=150	26×6=156	27×6=162	28×6=168	29×6=174	30×6=180
25×7=175	26×7=182	27×7=189	28×7=196	29×7=203	30×7=210
25×8=200	26×8=208	27×8=216	28×8=224	29×8=232	30×8=240
25×9=225	26×9=234	27×9=243	28×9=252	29×9=261	30×9=270
25×10=250	26×10=260	27×10=270	28×10=280	29×10=290	30×10=300

2×0=0	3×0=0	4×0=0	5×0=0	6×0=0	7×0=0	8×0=0	9×0=0
2×1=2	3×1=3	4×1=4	5×1=5	6×1=6	7×1=7	8×1=8	9×1=9
2×2=4	3×2=6	4×2=8	5×2=10	6×2=12	7×2=14	8×2=16	9×2=18
2×3=6	3×3=9	4×3=12	5×3=15	6×3=18	7×3=21	8×3=24	9×3=27
2×4=8	3×4=12	4×4=16	5×4=20	6×4=24	7×4=28	8×4=32	9×4=36
2×5=10	3×5=15	4×5=20	5×5=25	6×5=30	7×5=35	8×5=40	9×5=45
2×6=12	3×6=18	4×6=24	5×6=30	6×6=36	7×6=42	8×6=48	9×6=54
2×7=14	3×7=21	4×7=28	5×7=35	6×7=42	7×7=49	8×7=56	9×7=63
2×8=16	3×8=24	4×8=32	5×8=40	6×8=48	7×8=56	8×8=64	9×8=72
2×9=18	3×9=27	4×9=36	5×9=45	6×9=54	7×9=63	8×9=72	9×9=81
2×10=20	3×10=30	4×10=40	5×10=50	6×10=60	7×10=70	8×10=80	9×10=90

10×0=0	11×0=0	12×0=0	13×0=0	14×0=0.	15×0=0	16×0=0	17×0=0
10×1=10	11×1=11	12×1=12	13×1=13	14×1=14	15×1=15	16×1=16	17×1=17
10×2=20	11×2=22	12×2=24	13×2=26	14×2=28	15×2=30	16×2=32	17×2=34
10×3=30	11×3=33	12×3=36	13×3=39	14×3=42	15×3=45	16×3=48	17×3=51
10×4=40	11×4=44	12×4=48	13×4=52	14×4=56	15×4=60	16×4=64	17×4=68
10×5=50	11×5=55	12×5=60	13×5=65	14×5=70	15×5=75	16×5=80	17×5=85
10×6=60	11×6=66	12×6=72	13×6=78	14×6=84	15×6=90	16×6=96	17×6=102
10×7=70	11×7=77	12×7=84	13×7=91	14×7=98	15×7=105	16×7=112	17×7=119
10×8=80	11×8=88	12×8=96	13×8=104	14×8=112	15×8=120	16×8=128	17×8=136
10×9=90	11×9=99	12×9=108	13×9=117	14×9=126	15×9=135	16×9=144	17×9=153
10×10=100	11×10=110	12×10=120	13×10=130	14×10=140	15×10=150	16×10=160	17×10=170

→ Prime Numbers 0-100

0	1	2	3	4	5	6	7	8	9	
10	11	12	13	14	15	16	17	18	19	
20	21	22	23	24	25	26	27	28	29	
30	31	32	33	34	35	36	37	38	39	
40	41	42	43	44	45	46	47	48	49	
50	51	52	53	54	55	56	57	58	59	
60	61	62	63	64	65	66	67	68	69	
70	71	72	73	74	75	76	77	78	79	
80	81	82	83	84	85	86	87	88	89	
90	91	92	93	94	95	96	97	98	99	100

→ Squares & Cubes 1-30

n	n^2	n^3	n	n^2	n^3	n	n^2	n^3
0	0	0	10	100	1000	20	400	8,000
1	1	1	11	121	1331	21	441	9,261
2	4	8	12	144	1,728	22	484	10,648
3	9	27	13	169	2197	23	529	12,167
4	16	64	14	196	2,744	24	576	13,824
5	25	125	15	225	3,375	25	625	15,625
6	36	216	16	256	4,096	26	676	17,576
7	49	343	17	289	4,913	27	729	19,683
8	64	512	18	324	5,832	28	784	21,952
9	81	729	19	361	6,859	29	841	24,389
						30	900	27,000

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→ Prime Numbers 100-200

100	101	102	103	104	105	106	107	108	109
110	111	112	113	114	115	116	117	118	119
120	121	122	123	124	125	126	127	128	129
130	131	132	133	134	135	136	137	138	139
140	141	142	143	144	145	146	147	148	149
150	151	152	153	154	155	156	157	158	159
160	161	162	163	164	165	166	167	168	169
170	171	172	173	174	175	176	177	178	179
180	181	182	183	184	185	186	187	188	189
190	191	192	193	194	195	196	197	198	199

→ Percentage

Fraction	%	Fraction	%	Fraction	%	Fraction	%	Fraction	%
3/4	75%	5/4	125%	1/1	100%	1/6	16.66%	1/11	9.09%
4/5	80%	3/2	150%	1/2	50%	1/7	14.28%	1/12	8.33%
2/3	66.66%	1/16	6.25%	1/3	33.33%	1/8	12.5%	1/13	7.69%
5/6	83.33%			1/4	25%	1/9	11.11%	1/14	7.14%
6/5	120%			1/5	20%	1/10	10%	1/15	6.66%

~~[illegible]~~

0! = 1	4! = 4×3×2×1 = 24
1! = 1	5! = 5×4! = 120
2! = 2	6! = 6×5×4! = 720
3! = 3×2×1 = 6	7! = 7×6! = 5040

g) divisible by 7 → difference between two alternate groups taking 3-digits at a time should either be zero or multiple of 7.

eg − $\overset{odd}{550}, \overset{even}{500}, \overset{odd}{006} \rightarrow (\overset{odd}{550+006}) - (\overset{even}{500}) = 556 - 500 = 56 \% 7 = 0$

divisible by 13 → difference between two alternate groups taking 3-digits at a time should either be zero or multiple of 13.

eg − $\overset{even}{200}, \overset{odd}{174} \rightarrow \overset{even}{200} - \overset{odd}{174} = 26 \% 13 = 0.$

h) divisible by 17 → multiply last digit by '5' & subtract that from the rest. If result % 17 = 0, then n % 17 = 0 too.

eg − $986 \rightarrow [98][6] \rightarrow 98 - 6\times5 = 98 - 30 = 68 \% 17 = 0 \Rightarrow 986 \% 17 = 0$

$876 \rightarrow [87][6] \rightarrow 87 - 6\times5 = 87 - 30 = 57 \% 17 \neq 0 \Rightarrow 876 \% 17 \neq 0$

divisible by 19 → multiply last digit by '2' & add it to the rest. If sum % 19 = 0 then n % 19 = 0 too.

eg → $475 \rightarrow [47][5] \rightarrow 47 + 5\times2 = 47 + 10 = 57 \% 19 = 0 \Rightarrow 475 \% 19 = 0$

→ $575 \rightarrow [57][5] \rightarrow 57 + 5\times2 = 57 + 10 = 67 \% 19 \neq 0 \Rightarrow 575 \% 19 \neq 0$

Divisibility Rules

→ Division by ZERO is not possible

→ If two numbers are divisible by a number, then their sum & difference is also divisible by the number.

eg. $n_1 = 63 \% 9 = 0$ sum $= 63 + 27 = 90 \% 9 = 0$

$n_2 = 27 \% 9 = 0$ diff $= 63 - 27 = 36 \% 9 = 0$

$n_3 = 9$

a) division by 2 → unit place is even or zero. eg → 324

b) division by 3 → sum of digits is divisible by 3. eg − $324 \rightarrow 3+2+4 = 9 \% 3 = 0$

division by 9 → sum of digits is divisible by 9. eg − $324 \rightarrow 3+2+4 = 9 \% 3 = 0$

c) divisible by 4 → Last 2 digits divisible by 4 or be '00'. eg − $324 \rightarrow 24 \% 4 = 0$

divisible by 8 → Last 3 digits divisible by 8 or be '000'. eg − $1088 \rightarrow 088 \% 8 = 0$

d) divisible by 5 → unit digit is '5' or '0'. eg − $15 \rightarrow 5 \% 5 = 0$

divisible by 10 → unit digit is '0'. eg − 100 →

~~divisible by 15 →~~

e) divisible by 6 → divisible by co-primes 2 & 3 → eg $\left.\begin{array}{l} 324 \rightarrow 4 \% 2 = 0 \\ 324 \rightarrow 3+2+4 = 9 \% 3 = 0 \end{array}\right\} \% 6 = 0$

f) divisible by 11 → difference between sum of ~~each~~ digits in odd & even places should either be zero or divisible by 11.

eg $8283 \rightarrow \underbrace{(2+3)}_{odd} - \underbrace{(8+8)}_{even} = 5 - 16 = 11 \% 11 = 0$

Properties of divisibility

a) dividend = divisor × quotient + remainder

$D = [d \times q] + r$

d)D(q
r

b) Greatest 'n' digit number exactly divisible by a number

→ subtract the remainder

eg- Greatest 3 digit number divisible by 13

Greatest 3 digit num = 999. 999/13 ⇒ r = 11

999 − 11 = 988 → Greatest 3 digit number divisible by 13

c) Least 'n' digit number exactly divisible by a number

→ Add (divisor − remainder) [d − r]

eg- Least 3 digit number divisible by 13

Least 3 digit num = 100. 100/13 → q = 7, r = 9

100 + [13 − 9] = 100 + 4 = 104 → least 3 digit number divisible by 13

→ Sieve of Eratosthenes: let 'p' be a number & 'n' be the smallest counting number such that $n^2 \geq p$.

e.g. - to check 811 is prime or not → $29^2 = 841 > 811$

- now check if 811 is divisible by any of prime nos. below 29.
- none of prime nos below 29 divide 811 ⇒ 811 is prime number.

a) divisible by 2 → unit place is even or '0'. eg - 324

b) divisible by 3 → sum of digits is divisible by 3. eg → 324 → 3+2+4 = 9 % 3 = 0

divisible by 9 → sum of digits is divisible by 9. eg → 324 → 3+2+4 = 9 % 9 = 0

c) divisible by 4 → last 2 digits divisible by '4' or be '00'. eg - 324 → 24 % 4 = 0

divisible by 8 → last 3 digits divisible by '8' or be '000' eg - ~~324~~ 1088 → 088 % 8 = 0

divisible by 16 → last 4 digits divisible by '16' or be '0000' eg - 4096 → 4096 % 16 = 0

d) divisible by 5 → unit digit is '5' or '0' eg - 15

divisible by 10 → unit digit is '0'. eg 100

divisible by 20 → unit digit is '0' & tens digit is even. eg - 460 → 6 % 2 = 0;

e) divisible by 6 → divisible by coprimes '2' & '3'. eg 324 → 4 % 2 = 0

324 → 3+2+4 = 9 % 3 = 0 } % 6 = 0

divisible by 12 → divisible by coprimes '3' & '4'

divisible by 14 → divisible by coprimes '2' & '7'

divisible by 15 → divisible by coprimes '3' & '5'

divisible by 18 → divisible by coprimes '2' & '9'

→ AP : Arithmetic Progression GP: Geometric Progression

→ AP: quantities increase/decrease by a common difference

a = first term ; d = common difference ; l = last term

→ General form = $a, a+d, a+2d, a+3d, \dots, a+(n-1)d$

→ Last term, $l = a+(n-1)d$

→ Sum of 'n' terms $(S_n) = \frac{n}{2}[2a+(n-1)d] = \frac{n}{2}[a+a+(n-1)d] = \frac{n}{2}[a+l]$

→ $n = \frac{l-a}{d} + 1$

→ GP: quantities increase/decrease by a constant factor

→ a = first term ; r = common ratio ; l = last term

→ General form = $a, ar, ar^2, ar^3, \dots, ar^{n-1}$

$= ar^0, ar^1, ar^2, ar^3, \dots, ar^{n-1}$

→ last term, $l = ar^{(n-1)}$

→ Sum of 'n' terms, $S_n = \frac{a(r^n-1)}{r-1}$

→ $x^a \cdot x^b = x^{a+b}$; $\frac{x^a}{x^b} = x^{a-b}$; $(x^a)^b = x^{a \cdot b}$

→ HCF (i) Factorization Method (ii) Difference Method

(*) HCF ≤ the smallest of given numbers

→ LCM (i) Factorization Method (ii) LCM-HCF multiplication property

(*) LCM ≥ the greatest of given numbers

→ (a) Product of two given numbers is equal to the product of their HCF & LCM ⇒ $A \times B = HCF(A,B) \times LCM(A,B)$

(b) If a, b, c are three numbers that divide a number 'n' to leave the same remainder 'r', the smallest value of 'n' is

$n = (LCM \text{ of } a,b,c) + r$

→ HCF → ① Apply Rule/property/Method ② Find HCF

LCM → ① Find LCM ② Apply Rule/property/Method

→ In LCM problem, if difference is common/constant, then

Result = LCM − Common Difference.

→ LCM = LCM of ratio units × HCF ⇒ $HCF = \frac{LCM}{LCM \text{ of Ratio Units}}$

→ In fractions, $LCM = \frac{LCM \text{ of Numerators}}{HCF \text{ of Denominators}}$

& $HCF = \frac{HCF \text{ of Numerators}}{LCM \text{ of Denominators}}$

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→ **Ages**

Past	Present	Future
$(x-15)$	(x)	$(x+15)$
[ago, before]		[after, hence, later]

[of/times]

$\Rightarrow n \times$ age

→ **Ratio & Proportion**

$a:b = a/b = a \div b$

→ If $a:b = c:d$ OR $\frac{a}{b} = \frac{c}{d}$ OR $a:b :: c:d$

1) $a \times d = b \times c$ $\Rightarrow \frac{a \times d}{b \times d} = \frac{b \times c}{b \times d} \Rightarrow \frac{a}{b} = \frac{c}{d}$

2) $\frac{b}{a} = \frac{d}{c}$ (investendo) $\Rightarrow b \times c = a \times d \Rightarrow a \times d = b \times c$

3) $\frac{a}{c} = \frac{b}{d}$ (Alternendo) $\Rightarrow a \times d = b \times c$

4) $\frac{a+b}{b} = \frac{c+d}{d}$ (componendo) $\Rightarrow ad + \cancel{bd} = bc + \cancel{bd} \Rightarrow a \times d = b \times c$

5) $\frac{a-b}{b} = \frac{c-d}{d}$ (dividendo) $\Rightarrow ad - \cancel{bd} = bc - \cancel{bd} \Rightarrow a \times d = b \times c$

6) $\frac{a+b}{a-b} = \frac{c+d}{c-d}$ (componendo & dividendo) $\Rightarrow \frac{\frac{a+b}{b}}{\frac{a-b}{b}} = \frac{\frac{c+d}{d}}{\frac{c-d}{d}} = \frac{a+b}{a-b} = \frac{c+d}{c-d}$

→ If $\overbrace{a:\underbrace{b = c}_{\text{mean terms}}:d}^{\text{extreme term}}$, then Product of means = Product of extremes
$\Rightarrow b \times c = a \times d$

→ If $a:b = b:c$ OR $a/b = b/c$ OR $a:b :: b:c$
then $b \times b = a \times c \Rightarrow b^2 = ac$

→ If $x:y_1$ & $y_2:z$, then $x:y:z = xy_2 : y_1y_2 : y_1z$

$$\begin{bmatrix} x : y_1 \\ y_2 : z \end{bmatrix}$$

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Simple Average (Arithmetic Mean)

→ Average(A) = $\frac{\text{Sum}(S)}{\text{Number}(n)}$ $\Rightarrow$ Avg = $\frac{\text{Sum}}{n}$

→ Sum(S) = Average(A) × Number(n) $\Rightarrow S = A \times n$

Weighted Average

→ If values $y^1, y^2, y^3, \dots$ occur $w1, w2, w3, \dots$ times then
Weighted Average = $\frac{w1y1 + w2y2 + w3y3 + \dots}{w1 + w2 + w3 + \dots}$

→ **Average for Consecutive Numbers**

In case of consecutive numbers OR consecutive odd numbers OR consecutive even numbers, average is always the middle number

eg – 5, 6, 7, 8, 9 → 7 | 5, 6, 7, 8 → 6.5 |

→ New value = old value + $(n \pm 1)$ (difference)
(+) → member Added ; (−) → member removed ; diff = | old avg − new avg |

→ Δ Increase/decrease in avg = n × change
Total ~~age~~ value of replacement = value of removed member + Δ
eg : Δ Increase in age = 16 × 3y = 48y
Total age of person replacing = 27y + 48y = 75y

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→ By Rule of Alligation,

$$\frac{Q_L}{Q_H} = \frac{\text{Quantity of cheaper ingredient}}{\text{Quantity of dearer ingredient}} = \frac{d-m}{m-c}$$

Low Rate High Rate

Mean

High Rate - Mean Mean - Low Rate

→ In Profit, (SP > CP)

$SP = CP + Profit \Rightarrow SP = \frac{CP(100 + \%age\,Profit)}{100}$

$Profit = SP - CP \Rightarrow Profit\ \%age = \frac{SP-CP}{CP} \times 100$

$CP = SP - Profit \Rightarrow CP = \frac{SP \times 100}{100 + \%age\,Profit}$

In Loss, (CP > SP)

$SP = CP - Loss \Rightarrow SP = \frac{CP(100 - \%age\,Loss)}{100}$

$CP = SP + Loss \Rightarrow CP = \frac{SP(100 + \%age\,Loss)}{100}$

$Loss = CP - SP \Rightarrow Loss\ \%age = \frac{CP-SP}{SP} \times 100$

→ $\text{Final concentration} = \text{Initial}\left(1 - \frac{R}{\text{Initial}}\right)^n$

where

Final concentration = amount of concentration remaining after the process

'n' = no. of times process is done

'R' = replaced quantity

'Initial' = Initial concentration.

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→ If $X:Y_1$ & $Y_2:Z$

then $X:Y:Z = XY_2 : Y_2Y_1 : Y_1Z$

$X : Y_1$
$Y_2 : Z$

→ ~~If~~

→ If $A:B_1$, $B_2:C_1$, $C_2:D$

then $A:B:C:D = AB_2C_2 : B_1B_2C_2 : B_1C_1C_2 : B_1C_1D$

A B_1
B_2 C_1
C_2 D

→ Share of 'a' = Total Amount × $\frac{a}{a+b+c}$; Total Amount = $ax + bx + cx$

Any Share = Total Amount × $\frac{\text{Related Ratio Term}}{\text{Sum of Ratio terms}}$

Mixtures & Alligation

→ Alligation - Rule which enables us to find the ratio of ingredients at given price must be mixed to produce a mixture of desired price (mixing/linking)

→ Mean Price - Cost Price (C.P.) of a unit quantity of mixture

→ Dearer - most expensive ingredient.

→ Rule of Alligation - Always maintain the order in which problem is given, else answer gets changed

→ CP of cheaper ingredient (c) (d) CP of dearer ingredient

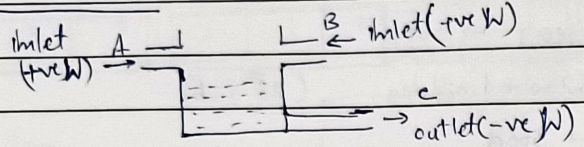
(−) (−)

Mean Price (m)

(d − m) : (m − c)

CP of dearer ingredient − Mean Price   Mean Price − CP of cheaper ingredient

Pipes & Cisterns



→ Net Work done = Sum of Work done by Inlets − Sum of work done by outlets

Chain Rule

→ Work Done = No. of Men × Days × Hrs/day

$$W = M \times D \times H$$

→ $W_1 = M_1 \times D_1 \times H_1$; $W_2 = M_2 \times D_2 \times H_2$

$$\frac{W_1}{W_2} = \frac{M_1 \times D_1 \times H_1}{M_2 \times D_2 \times H_2}$$

Probability

→ How likely an event is supposed to happen

→ Probability = $\dfrac{\text{Favourable Outcome}}{\text{Total Number of Outcomes}}$

→ AND → Multiply eg → 1 Green AND 1 blue ball in a box

→ OR → Add eg → 1 red OR 1 blue ball in a box

→ $^{\boxed{3}}C_{\boxed{2}}$ ← Total No. of things (3) ; ← selected / drawn / picked up (2)

$$^{3}C_{2} = \cancel{3\times(3-2)!} \;\; \frac{\overset{1st}{3} \times \overset{2nd}{2}}{2 \times 1} = 3$$

→ 0 < probability < 1

→ atleast : min to max ; atmost : max to min

→ $$^{n}C_{r} = \frac{n!}{r!(n-r)!} = \frac{(n)\times(n-1)\times \ldots \cancel{(n-r)!}}{r!\,\cancel{(n-r)!}}$$

Profit & Loss

→ (SP > CP) | (CP > SP)

→ (i) Profit = SP − CP | (iii) Loss = CP − SP

→ (ii) % Profit = $\dfrac{\text{Profit}}{CP} \times 100 = \dfrac{SP - CP}{CP} \times 100$ | (iv) % Loss = $\dfrac{\text{Loss}}{CP} \times 100 = \dfrac{CP - SP}{CP} \times 100$

→ Multipliers to find SP

for Profit, $SP = \dfrac{CP \times (100 + \%\,\text{profit})}{100}$

for Loss, $SP = \dfrac{CP \times (100 - \%\,\text{Loss})}{100}$

Time & Work

→ Work (Effort) = Manpower × time

Total Work = Efficiency × Total time

→ Total Work = LCM ⇒ If A, B, C, total work = LCM(A, B, C)

→ Efficiency = $\dfrac{\text{Total Work}}{\text{Total time}}$ ⇒ $A = \dfrac{TW}{d}$

→ OR, Total Work = Efficiency × Total time ⇒ $TW = A \times d$

→ Efficiency = capacity to work

→ Efficiency ∝ 1/time ; Efficiency ∝ Work

For Months

J	F	M	A	M	J	J	A	S	O	N	D
0	3	3	6	1	4	6	2	5	0	3	5

→ For Years

1600 - 1699	6
1700 - 1799	4
1800 - 1899	2
1900 - 1999	0
2000 - 2099	6

← 26 Jan 1947

Last 2 digit of YYYY = 47

YY/4 - 47/4 (Q) = 11

odd day for MM = 0

Date as it is = 26

odd day for YY00(1900) = 0

total 84 % 7 = 0

If YYYY is leap then (-1) -0

0 → Sun

→ For calendar re-use

(any Yr) % 4, then only possible remainders are 0, 1, 2, 3

If rem = 0, Yr + 28

rem = 1, yr + 6

rem = 2/3, yr + 11

Time & Distance

→ Speed = $\frac{\text{Distance}}{\text{time}}$ ⇒ $s = \frac{D}{t}$ ⇒ $\uparrow D \propto t \uparrow$

→ Distance = Speed × time ⇒ $D = s \times t$ ⇒ $\uparrow D \propto s \uparrow$

→ Time = $\frac{\text{Distance}}{\text{Speed}}$ ⇒ $t = \frac{D}{s}$ ⇒ $\uparrow s \propto \frac{1}{t} \downarrow$

→ $1\ km/hr = \frac{5}{18}\ m/s \left[\frac{1000\ m}{3600\ s}\right]$; $1\ m/s = 18/5\ km/hr \left[\frac{3600\ m}{1000\ s}\right]$

Calendar

→ Non-Leap Year → 365d

1y = 52W + 1 odd day (28th Feb)

→ Leap Year → 366d

1y = 52W + 2 odd days (29th Feb)

→ Century Leap year → exactly divisible by 400 (4 & 100)

eg - 1600 & 2000 ~~are~~ were century Leap year

→ years 1700, 1800, 1900 ~~are~~ were not century leap years

→ 01/Jan/0001 A.D. (Anno Domini) was a Monday

→ In a century → 100 y

24 Leap years — 76 non-leap years

24 × (2 odd days) — 76 × (1 odd day)

$\frac{48}{7}$ + $\frac{76}{7}$

rem = 6 + 6

12 % 7 = 5 ← remainder

→ 100 y = 5 odd/extra days.

200 y = 10 % 7 = 3 odd days

300 y = 15 % 7 = 1 odd day

400 y = 0 odd day (Century leap Year)

Years	No of odd
Normal Year	1
Leap	2
100 y	5
200 y	3
300 y	1
400 y	0

Month		Remainder
Jan, Mar, May, Jul, Aug, Oct, Dec	31 % 7	3
Feb	(28 % 7) or (29 % 7)	0 (Non-Leap) 1 (Leap)
Apr, Jun, Sep, Nov	30 % 7	2

Day of week	No. of odd
Sun	0
Mon	1
Tue	2
Wed	3
Thu	4
Fri	5
Sat	6

Boats & Streams

If, speed of boat in still water = 'x' kmph & speed of the stream = y kmph

→ Speed of boat going downstream, $S_{DN} = (x+y)$ kmph

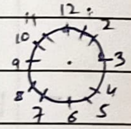
→ Speed of boat going upstream, $S_{UP} = (x-y)$ kmph

$S_{DN} + S_{UP} = 2x$; $S_{DN} - S_{UP} = 2y$

→ ⇒ boat, $x = \frac{S_{DN} + S_{UP}}{2}$; ⇒ stream, $y = \frac{S_{DN} - S_{UP}}{2}$

→ $\frac{x}{y} = \frac{n+1}{n-1}$; n = factor, 5 times the time to row up than to row down ⇒ n = 5

Clocks



→ 1 clock = 360° ; 60 min = 6° each; 12 hrs = 30° each

→ In 60 min, minute hand gains 55 min on the hour hand.

→ In 1 hr (65 min), both hands coincide once & make right angle twice

→ Hands are in straight line while coincident or opposite

→ Two hands at right angle, they are 15 min spaces apart

→ two hands at 180° or opposite, they are 30 min spaces apart.

→ Every hour, hands coincide once after 65 min (11-12 o'clock, [it coincides at 12 o' so it's 11 times only]

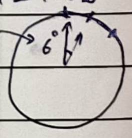
11 times in 12 hrs ⇒ 22 times in 24 hrs

→ Two hands coincide, 11 times in 12 hrs ⇒ 22 times in 24 hrs

→ in opposite, 11 times in 12 hrs ⇒ 22 times in 24 hrs

→ Every hour, hands make right angle two times in 65 min.

right angle, 22 times in 12 hrs ⇒ 44 times in 24 hrs



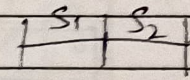
→ Speed of min hand = 60 min sp./hr = $1 \frac{\text{min spaces}}{\text{min}}$ 5 min = 5 min. sp. spaces

→ Speed of hr hand = 5 $\frac{\text{min sp.}}{\text{hr}}$ = $\frac{1}{12} \frac{\text{min spaces}}{\text{min}}$

→ Relative speed of min hand & hr hand = $\frac{1}{1} - \frac{1}{12} \frac{\text{min sp.}}{\text{min}} = \frac{11}{12} \frac{\text{min spaces}}{\text{min}}$.

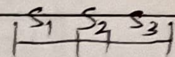
→ Same distance travelled by speeds S1 & S2,

then Average Speed, $S_{avg} = \frac{2 \times (S_1 \times S_2)}{(S_1 + S_2)}$



→ same distance travelled by speeds S1, S2 & S3

then, average speed, $S_{avg} = \frac{3 \times (S_1 \times S_2 \times S_3)}{(S_1 S_2) + (S_2 S_3) + (S_3 S_1)}$

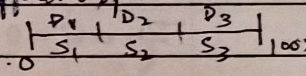


→ same direction, Relative speed = $V_1 - V_2$ $\overrightarrow{V_1}$ Ⓐ $\overrightarrow{V_2}$ Ⓑ

Relative speed = $V_2 - V_1$

→ opposite direction, relative speed = $V_1 + V_2$ Ⓐ $\xrightarrow{V_1}\xleftarrow{V_2}$ Ⓑ

→ different distance D1, D2, D3 travelled at different speeds S1, S2, S3 then



Average Speed, $S_{avg} = \frac{D_1 + D_2 + D_3}{\left(\frac{D_1}{S_1} + \frac{D_2}{S_2} + \frac{D_3}{S_3}\right)}$

Trains

S_1 = speed of train S_2 = Speed of object

L_1 = length of train L_2 = Length of object

t = time taken by train to completely pass the object

→ CASE (A): stationary object without considerable length ($L_2 = 0$) ($S_2 = 0$)

$L_1 = S_1 \times t$

→ Case B: Stationary object with considerable length ($S_2 = 0$)

$L_1 + L_2 = S_1 \times t$

→ Case C = Moving object without considerable length ($L_2 = 0$)

$L_1 = (S_1 \pm S_2)\, t$ (same dir → −ve, opp dir → +ve)

→ Case D: Moving object with considerable length [L_2 = ✓] [S_2 = ✓]

$L_1 + L_2 = (S_1 \pm S_2)\, t$

→ If the difference b/w CI & SI is of 3yrs, then

$$\text{Difference} = \frac{3 \times P(R)^2}{(100)^2} + P\left(\frac{R}{100}\right)^3$$

Partnership

→ $\frac{C_1 T_1}{C_2 T_2} = \frac{P_1}{P_2}$ $C_1, C_2 \rightarrow$ Capital ; $T_1 T_2 \rightarrow$ Investment tennure (in months)
$P_1, P_2 \rightarrow$ Profit

→ $P \propto C$; $P \propto C$; $C \propto \frac{1}{T}$

Permutation & Combination

→ Permutation – No. of ways a group of things can be arranged.
eg A, B, C → ABC, ACB, BAC, BCA, CAB, CBA → 6

→ $^nP_r = \frac{n!}{(n-r)!}$ → order / sequence matters here

→ $^nC_r = \frac{n!}{r!(n-r)!}$ → order / sequence does Not matter here

→ $^nC_r = {^nC_{n-r}}$

→ for repetition, divide by $n!$, n ⇒ no. of repetition.

→ Angle $= \left|30H - \frac{11}{2}M\right|$ ⇒ Angle $= |30H - 5.5M|$

Percentage

→ $\frac{x}{y} \times 100$

→ net % change $= -\left(\frac{x}{10}\right)^2$

→ Two step change in Percentage → If number is changed by a% and the result is again changed by b%, then net
Net % change in number $= \frac{a + b + ab}{100}$ (+ve → inc ; -ve → dec)

→ Expenditure = Price × Consumption ⇒ Price $\propto \frac{1}{\text{Consumption}}$
⇒ Price ∝ Expenditure

Interest

P = Principal, R = Rate of interest, N = time in years, I = interest, A = amount

→ $A = P + I$

→ Simple Interest, $SI = \frac{P \times R \times N}{100}$ ⇒ SI is an AP
Basic Principal is constant

→ In compounding interest, $A = \left(1 + \frac{R}{100}\right)^T$ T = periods of compounding
R = rate for compounding period
$CI = A - P$

Basic principal keeps on increasing, because of interest on interest
⇒ CI is an G.P.

→ If diff b/w CI & SI is of 2 yrs, then

$$\text{Difference} = \frac{P(R)^2}{10000} = \frac{P(R)^2}{(10)^2}$$

P = Principal
R = Rate of interest