INDICES

The first rule: $a^n \times a^m = a^{m+n}$

The second rule: $(a^n)^m = a^{mn}$

The third rule: $a^m \div a^n = a^{m-n}$

The fourth rule: $a^o = 1$

The fifth rule: $a^{-1} = \frac{1}{a}$ $a^{-m} = \frac{1}{a^m}$

$$a^{\frac{n}{m}} = (a^{\frac{1}{m}})^n = (\sqrt[m]{a})^n$$

- If $a^m = a^n$, then m = n
- If $a^m = b^m$ and m;
- Then a = b if m is odd
- Or a = b if m is Even

AVERAGES

$$\Rightarrow \text{Simple Average} = \frac{\text{Sum of elements}}{\text{Number of elements}}$$

$$\Rightarrow Weighted\ \ Average = \frac{w_1x_1 + w_2x_2 + \ldots + w_nx_n}{w_1 + w_2 + \ldots + w_n}$$

$$\Rightarrow Arithmetic\ \ Mean = (a_1 + a_2 + a_3 \ldots a_n) / n$$

FRACTIONS AND PERCENTAGES

FRACTIONS	%AGE	FRACTION	%AGE	FRACTION	%AGE
1/2	50	1/8	12.5	1/14	7.14
1/3	33.33	1/9	11.11	1/15	6.67
1/4	25	1/10	10	1/16	6.25
1/5	20	1/11	9.09	1/17	5.88
1/6	16.67	1/12	8.33	1/18	5.55
1/7	14.28	1/13	7.69	1/19	5.26

PERCENTAGES

- r% change can be nullified by $\frac{100r}{100+r}$ % change in another direction.
  E.g.: An increase of 25% in prices can be nullified by a reduction of [100x25/(100+25)] = 20% reduction in consumption.

- If a number 'x' is successively changed by a%, b%, c%...
- Final value = $x\left(1+\frac{a}{100}\right)\left(1+\frac{b}{100}\right)\left(1+\frac{c}{100}\right)...$

The net change after two successive changes of a% and b% is

$$\left(a+b+\frac{ab}{100}\right)\%$$

PARTNERSHIP

- If two partners A and B are investing their money to run a business then
  (Simple Partnership)

$$\frac{\text{Capital of A}}{\text{Capital of B}} = \frac{\text{Profit of A}}{\text{Profit of B}}$$

- If two partners A and B are **INVESTING** their **MONEY** for different period of time to run a business then
  (Compound Partnership)

$$\frac{\text{Capital of A x Time period of A}}{\text{Capital of B x Time period of B}} = \frac{\text{Profit of A}}{\text{Profit of B}}$$

INTEREST

- Amount = Principal + Interest
- Simple Interest = PNR/100
- Compound Interest = $P\left(1+\frac{r}{100}\right)^n - P$
- Population formula P' = $P\left(1\pm\frac{r}{100}\right)^n$
- SI and CI are same for a certain sum of money (P) at a certain rate (r) per annum for the first year. The difference after a period of two years is given by
- Depreciation formula = Initial Value x $\left(1-\frac{r}{100}\right)^n$
- SI and CI are same for a certain sum of money (P) at a certain rate (r) per annum for the first year. The difference after a period of two years is given by, $\Delta = \frac{PR^2}{100^2}$

PROFIT AND LOSS

- **% Profit =** $\left(\frac{\text{Claimed Weight} - \text{Actual Weight}}{\text{Actual Weight}} - 1\right) x100$

- **Discount % =** $\frac{\text{Marked Price} - \text{Selling Price}}{\text{Marked Price}} x100$

Effective Discount after successive discount of a% and b% is (a + b – ab/100). Effective Discount

when you buy x goods and get y goods free is $\left(\frac{y}{x+y}\right) x100$

ALLIGATION

SUCCESSIVE REPLACEMENT-
Where a is the original quantity, b is the quantity that is replaced and n is the number of times the operation is carried out,

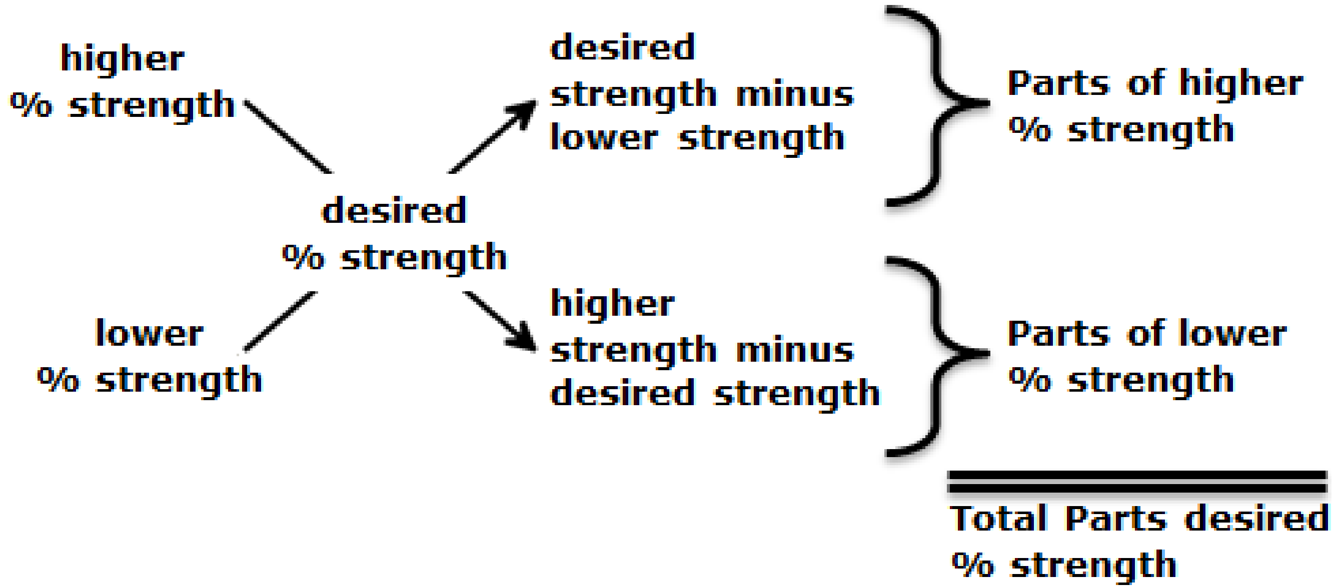
$$\frac{\text{Quantity of original entity after n operation}}{\text{Quantity of mixture}} = \left(\frac{a-b}{a}\right)^n$$

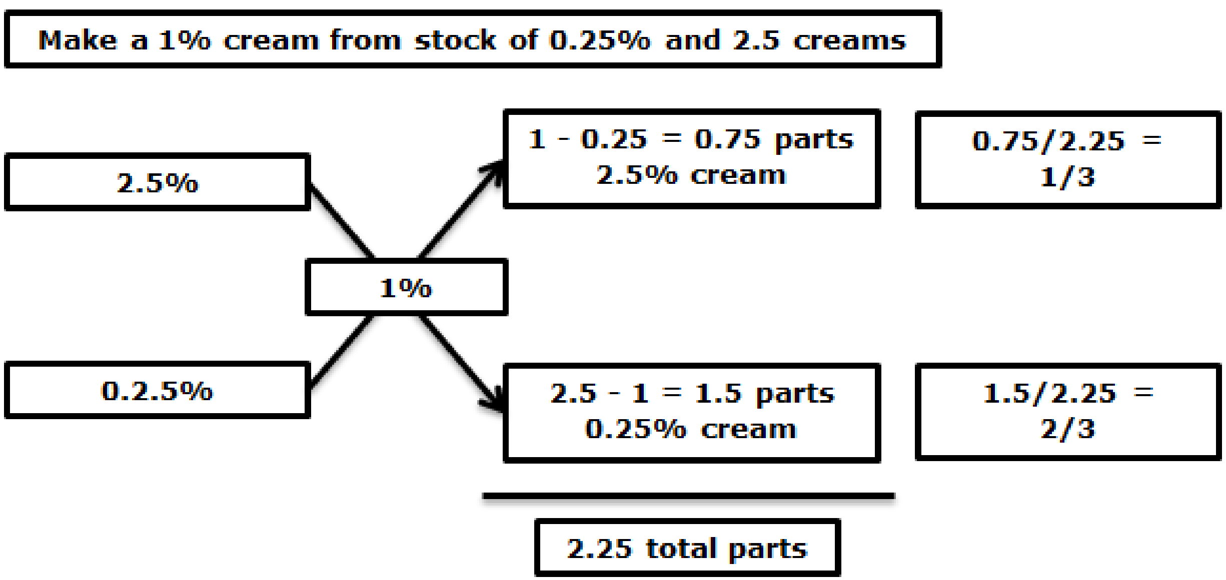
ALLIGATION- The ratio of weights of the two items mixed will be inversely proportional to the deviation of attributes of these two items from the average attribute of the resultant mixture.

$$\frac{\text{Quantity of first item}}{\text{Quantity of second item}} = \frac{x_2 - x}{x - x_1}$$

ALLIGATION

Alligation:





RATIO AND PROPOTION

$$\text{If } \frac{a}{b} = \frac{c}{d} \;\&\; a \neq b \text{ then } \frac{a+b}{a-b} = \frac{c+d}{c-d}$$

$$\text{If } a/b = c/d = e/f = k$$

$$\frac{a+c+e}{b+d+f} = k$$

$$\frac{pa+qc+re}{pb+qd+rf} = k$$

$$\frac{pa^n+qc^n+re^n}{pb^n+qd^n+rf^n} = k\text{^}n$$

TIME SPEED AND DISTANCE

- Speed = Distance/Time
- 1 kmph = 5/18 m/sec; 1 m/sec = 18/5 kmph
- $$Speed_{Avg} = \frac{Total Distance Covered}{Total Time Taken} = \frac{d_1 + d_2 + d_3 \ldots d_n}{t_1 + t_2 + t_3 \ldots t_n}$$
- If the distance covered is constant then the average speed is Harmonic Mean of the values ($s_1, s_2, s_3 \ldots s_n$)
- $$Speed_{Avg} = \frac{n}{1/s_1 + 1/s_2 + 1/s_3 \ldots 1/s_n}$$
- $$Speed_{Avg} = \frac{2s_1 s_2}{s_1 + s_2} \text{(for two speeds)}$$
- If the time taken is constant then the average speed is Arithmetic Mean of the values ($s_1, s_2, s_3 \ldots s_n$)
- $$Speed_{Avg} = \frac{s_1 + s_2 + s_3 + \ldots s_n}{n}$$
- $$Speed_{Avg} = \frac{s_1 + s_2}{2} \text{(for two speeds)}$$

TIME SPEED AND DISTANCE

$$\text{For Trains, time taken} = \frac{\text{Total length to be covered}}{\text{Relative Speed}}$$

- Downstream/Upstream: In water, the direction along the stream is called downstream. And, the direction against the stream is called upstream

- If the speed of a boat in still water is u km/hr and the speed of the stream is v km/hr, then:
  Speed downstream = (u + v) km/hr
  Speed upstream = (u - v) km/hr

- If the speed downstream is a km/hr and the speed upstream is b km/hr, then:

$$\text{Speed in still water} = \frac{1}{2}(a+b)\ km/hr$$

$$\text{Rate of stream} = \frac{1}{2}(a-b)\ km/hr$$

TIME AND WORK

- If a person can do a certain task in t hours, then in 1 hour he would do 1/t portion of the task.

- A does a particular job in 'a' hours and B does the same job in 'b' hours, together they will take $\frac{ab}{a+b}$ hours

- A does a particular job in 'a' hours more than A and B combined whereas B does the same job in 'b' hours more than A and B combined, then together they will take $\sqrt{ab}$ hours to finish the job.

- A does a particular job in 'a' hours, B does the same job in 'b' hours and C does the same job in 'c' hours, then together they will take hours. $\frac{abc}{ab+bc+ca}$

- If A does a particular job in 'a' hours and A&B together do the job in 't' hours, the B alone will take $\frac{at}{a-t}$ hours.

TIME AND WORK

- If A does a particular job in ‘a’ hours, B does the same job in ‘b’ hours and ABC together do the job in ‘t’ hours, then
- C alone can do it in $\frac{abt}{ab-at-bt}$ hours
- A and C together can do it in $\frac{bt}{b-t}$ hours
- B and C together can do it in $\frac{at}{a-t}$ hours

If the objective is to fill the tank, then the *Inlet pipes* do **positive work** whereas the *Outlet pipes* do **negative work**. If the objective is to empty the tank, then the *Outlet pipes* do **positive work** whereas the *Inlet Pipes* do **negative work.**

PIPES AND CISTERN

A pipe connected with a tank or a cistern or a reservoir, that fits it is known as a inlet.

Outlet- A pipe connected with a tank or cistern or reservoir, emptying it is known as a outlet

If a pipe can fill a tank in y hours then part filled in 1 hour = 1/y
If a pipe can empty a tank in y hours, then part emptied in 1 hour = 1/y

If a pipe can fill a tank in x hours and another pipe can empty the full tank in y hours where(x>y) then on opening both the pipes the net part filled in one hour is = (1/x - 1/y)

if a pipe can fill a tank in x hours and another pipe can empty the full tank in y hours(y>x) then on opening both the pipes, the net part emptied in 1 hour = (1/y – 1/x)

PERMUTATIONS AND COMBINATIONS

- When two tasks are performed in succession, i.e., they are connected by an **'AND'**, to find the total number of ways of performing the two tasks, you have to **MULTIPLY** the individual number of ways. When only one of the two tasks is performed, i.e. the tasks are connected by an '**OR**', to find the total number of ways of performing the two tasks you have to **ADD** the individual number of ways.

- **Linear arrangement of ‘r’ out of 'n' distinct items (^nP_r):**

- The first item in the line can be selected in 'n' ways AND the second in (n — 1) ways AND the third in (n — 2) ways AND so on. So, the total number of ways of arranging 'r' items out of 'n' is

- $(n)(n - 1)(n — 2)...(n - r + 1) = \frac{n!}{(n-r)!}$

PERMUTATIONS AND COMBINATIONS

- **Circular arrangement of 'n' distinct items:** Fix the first item and then arrange all the other items linearly with respect to the first item. This can be done in **(n — 1)!** ways.
- In a necklace, it can be done in $\frac{(n-1)}{2}$ ways
- **Selection of r items out of 'n' distinct items (^nCr):** Arrange of r items out of n = $\frac{n!}{r!(n-r)!}$ Select r items out of n and then arrange

  those r items on r linear positions.
- $^nP_r = {}^nC_r \times r!$
- Number of ways of arranging 'n' items out of which `p' are alike, 'q' are alike, 'r' are alike in a line is given by = $\frac{n!}{p!q!r!}$

PROBABILITY

CONDITIONAL PROBABILITY FORMULA

conditional probability that A occurs given that B has occurred is written as P(A|B) and defined by

$$P(A|B) = P(A \cap B) / P(B)$$

$$\text{THEORITICAL PROBABILITY} = \frac{\text{FAVOURABLE OUTCOMES}}{\text{TOTAL OUTCOMES}}$$

- If the probability of an event occurring is P, then the probability of that event occurring ‘r’ times in ‘n’ trials is = ${}^{n}C_{r} \times P^{r} \times (1-P)^{n-r}$

PROBABILITY

Odds

$$\Rightarrow \text{Odds in factor} = \frac{\text{Number of favorable outcomes}}{\text{number of not favorable outcomes}}$$

$$\Rightarrow \text{Odds against} = \frac{\text{not favourable outcome}}{\text{Number of the favorable outcomes}}$$

- If A and B are two independent events, then,
  $P(A \cap B) = P(A)\,P(B)$ or
  $P(AB) = P(A)\,P(B)$

- If the probabilities of happening of n independent events be p_1, p_2 p_n respectively, then
  (i) Probability of happening none of them
  $= (1 - p_1)(1 - p_2) \ldots (1 - p_n)$
  (ii) Probability of happening atleast one of them
  $= 1 - (1 - p_1)(1 - p_2) \ldots (1 - p_n)$
  (iii) Probability of happening of first event and not happening of the remaining
  $= p_1 (1 - p_2)(1 - p_3) \ldots (1 - p_n)$

MENSURATION

NAME OF PLANE FIGURE	AREA IN SQUARE UNIT	PERIMETER IN UNITS
CIRCLE	πr^2	$2\pi r$
RECTANGLE	LENGTH* WIDTH	2(LENGTH+WIDTH)
SQUARE	SIDE*SIDE	4*SIDE
TRIANGLE	0.5*BASE*HEIGHT	SUM OF ALL SIDES
RHOMBUS	LENGTH*HEIGHT	4*LENGTH OF A SIDE