## Important Formulas for Quantitative Aptitude

## APSC Prelim CSAT Paper

## Number system

- Natural Numbers: 1, 2, 3, 4.....
- Whole Numbers: $0,1,2,3,4$.....
- Integers: ....-2,-1, 0, 1, 2 .....
- Rational Numbers: Any number which can be expressed as a ratio of two integers for example a $p / q$ format where ' $p$ ' and ' $q$ ' are integers. Proper fraction will have $(p<q)$ and improper fraction will have ( $p>q$ )
- Factors: A positive integer ' $f$ ' is said to be a factor of a given positive integer ' $n$ ' if $f$ divides $n$ without leaving a remainder. e.g. 1, 2, 3, 4, 6 and 12 are the factors of 12.
- Prime Numbers: A prime number is a positive number which has no factors besides itself and unity.
- Composite Numbers: A composite number is a number which has other factors besides itself and unity.
- Factorial: For a natural number ' $n$ ', its factorial is defined as: $n$ ! $=1 \times 2 \times 3 \times 4 \times \ldots \times n$ (Note: $0!=1$ )
- Absolute value: Absolute value of $x$ (written as $|x|$ ) is the distance of ' $x$ ' from 0 on the number line. $|x|$ is always positive. $|x|=x$ for $x>0$ OR -x for $\mathrm{x}<0$


## Sum of n numbers

- Sum of first $n$ natural numbers $=n(n+1) / 2$
- Sum of the squares of first $n$ natural numbers $=n(n+1)(2 n+1) / 6$
- Sum of the cubes of first $n$ natural numbers $=[n(n+1) / 2] 2$
- Sum of first $n$ natural odd numbers $=n^{2}$
- Average $=($ Sum of Observation $/$ Number of Observations )
$>$ If a car cover a certain Distance at $X \mathrm{kmph}$ and an equal distance at Y kmph . Then , the average speed during the whole journey is [ $2 \mathrm{XY} /(\mathrm{X}+\mathrm{Y})$ ]


## BODMAS Rule

- This Rule depicts the correct sequence in which the operations are to be executed, so as to find out the value of a given expression.

Calculation should be done the following order:
B - Bracket
O-Of
D - Division
M - Multiplications
A - Addition
S - Subtractions

## Arithmetic Progression (A.P.)

An A.P. is of the form $a, a+d, a+2 d, a+3 d, \ldots$ where $a$ is called the 'first term' and $d$ is called the 'common difference'

- nth term of an A.P. $\mathrm{tn}=\mathrm{a}+(\mathrm{n}-1) \mathrm{d}$
- Sum of the first $n$ terms of an A.P. $S n=n / 2[2 a+(n-1) d]$ or $\mathrm{Sn}=\mathrm{n} / 2$ (first term + last term)


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## Geometrical Progression (G.P.)

- A G.P. is of the form $a, a r, a r^{2}, a r^{3}, \ldots$ where a is called the 'first term' and $r$ is called the 'common ratio'.
- 1.nth term of a G.P. $\mathrm{tn}=\mathrm{ar}^{\mathrm{n}-1}$
- 2.Sum of the first $n$ terms in a G.P. $S n=S_{n}=a\left(r^{n}-1\right) /(r-1)$
- $\quad[O R] S n=a\left(1-r^{n}\right) /(1-r)$, if $r \neq 1$.
- The sum of GP (of $n$ terms) is: $S_{n}=n a$, when $r=1$.
- The sum of GP (of infinite terms) is: $S_{\infty}=a /(1-r)$, when $|r|<1$.


## Divisibility Rules

A number is divisible by:

- $2,4 \& 8$ when the number formed by the last, last two, last three digits are divisible by $2,4 \& 8$ respectively.
- $3 \& 9$ when the sum of the digits of the number is divisible by 3 \& 9 respectively.
- 6,12 \& 15 when it is divisible by 2 and 3,3 and 4 \& 3and 5 respectively.
- 7, if the number of tens added to five times the number of units is divisible by 7.
- A number is divisible by 10 if the units digit is 0 .
- 11 when the difference between the sum of the digits in the odd places and of those in even places is 0 or a multiple of 11 .
- 13 , if the number of tens added to four times the number of units is divisible by 13.
- 19 , if the number of tens added to twice the number of units is divisible by 19.


## HCF and LCM

- H.C.F stands for Highest Common Factor. The H.C.F. of two or more numbers is the greatest number that divides each one of them exactly.
- The least number which is exactly divisible by each one of the given numbers is called their L.C.M.
- Two numbers are said to be co-prime if their HCF is 1.
- HCF of fractions = (HCF of numerators)/(LCM of denominators)
- LCM of fractions = (LCM of numerators)/(HCF of denominators )
- Product of two numbers = Product of their HCF and LCM


## PERCENTAGES

- To express $x \%$ as a fraction: We have, $x \%=x / 100$
- To express $a / b$ as a percentage: We have, $a / b \%=(a / b \times 100)$
- If $A$ is $R \%$ more than $B$, then $B$ is less than $A$ by $R /(100+R) * 100$
- If $A$ is $R \%$ less than $B$, then $B$ is more than $A$ by $R /(100-R)$ * 100
- If the price of a commodity increases by $\mathrm{R} \%$, then reduction in consumption, not to increase the expenditure is : $R /(100+R) * 100$
- If the price of a commodity decreases by $R \%$, then the increase in consumption, not to decrease the expenditure is: $R /(100-R)^{*} 100$


## PROFIT \& LOSS

- Gain = Selling Price(S.P.) - Cost Price(C.P)
- Loss = C.P. - S.P.
- Gain \% = Gain * 100 / C.P.
- Loss \% = Loss * 100 / C.P.
- S.P. $=(100+$ Gain\% $) / 100^{*}$ C.P.
- S.P. $=(100-$ Loss\% $) / 100^{*} \mathrm{C} . \mathrm{P}$.
- C.P. $=[100 /(100+$ Gain\%) ] x S.P
- C.P. $=[100 /(100-$ Loss\%) $] \times$ S.P
> When a shopkeeper sell two similar items, one at a gain of say $\mathrm{x} \%$, and other at a loss of $\mathrm{x} \%$ then the seller always incure a loss given by - Loss \% = ( Common loss \& gain \% / $10)^{2}$
$>$ If a trader sell his goods at cost price, but uses false weight , then Gain\% = [ Error / (True value-Error )]x $100 \%$


## SIMPLE \& COMPOUND INTERESTS

Let P be the principal, R be the interest rate percent per annum, and N be the time period.

- 1.Simple Interest $=\left(P^{*} N^{*} R\right) / 100$
- 2.Compound Interest $=\mathrm{P}(1+\mathrm{R} / 100) \mathrm{N}-\mathrm{P}$
- 3.Amount = Principal + Interest
$\Rightarrow$ When interest is compound Annually, Amount $=P(1+R / 100)^{n}$
$>$ When interest is compounded Half-yearly: Amount $=P[1+(R / 2) / 100]^{2 n}$
> Population after n years: $\mathrm{P}(1+\mathrm{R} / 100)^{\mathrm{n}}, \mathrm{R}$ is the population growth rate
> Population before n years: $\mathrm{P}(1-\mathrm{R} / 100)^{\mathrm{n}}, \mathrm{R}$ is the population growth rate


## RATIO \& PROPORTIONS:

- The ratio $\mathrm{a}: \mathrm{b}$ represents a fraction $\mathrm{a} / \mathrm{b}$. a is called antecedent and b is called consequent.
- The equality of two different ratios is called proportion.
- If $a: b=c: d$ then $a, b, c, d$ are in proportion. This is represented by $a: b:: c: d$.
- In $a: b=c: d$, then we have $a^{*} d=b^{*} c$.
- If $a / b=c / d$ then $(a+b) /(a-b)=(d+c) /(d-c)$.


## TIME \& DISTANCE

Distance $=$ Speed $*$ Time
$1 \mathrm{~km} / \mathrm{hr}=5 / 18 \mathrm{~m} / \mathrm{sec}$
$1 \mathrm{~m} / \mathrm{sec}=18 / 5 \mathrm{~km} / \mathrm{hr}$
> Suppose a man covers a certain distance at $x \mathrm{kmph}$ and an equal distance at y kmph . Then, the average speed during the whole journey is $2 x y /(x+y) k m p h$

## Upstream \& Downstream

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 $u \mathrm{~km} / \mathrm{hr}$ and the speed of the stream is $v \mathrm{~km} / \mathrm{hr}$ : Speed downstream $=(u+v) \mathrm{km} / \mathrm{hr}$ Speed upstream $=(u-v) \mathrm{km} / \mathrm{hr}$
> If the speed downstream is a km/hr and the speed upstream is $b \mathrm{~km} / \mathrm{hr}$ :
Speed in strill water $=1 / 2(a+b) \mathrm{km} / \mathrm{hr}$ Rate of stream $=1 / 2(a-b) k m / h r$

## TIME \& WORK

- If $A$ can do a piece of work in $n$ days, then A's 1 day's work $=1 / n$
- If $A$ and $B$ work together for $n$ days, then ( $A+B$ )'s 1 days's work $=1 / n$
- If $A$ is twice as good workman as $B$, then ratio of work done by $A$ and $B=2: 1$


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## Area \& Volume

- Sum of the angle of a triangle is $=180$ degree
- The sum of any two side of a triangle is greater than the third side.
- Pythagorous Theorem $=$ Hypotenuse $^{2}=(\text { Base })^{2}+(\text { Height })^{2}$
- Area of a rectangle $=($ Length $\times$ Breadth $)$
- Perimeter of a rectangle $=2$ (Length + Breadth $)$
- Area of a square $=(\text { side })^{2}=1 / 2(\text { diagonal })^{2}$
- Area of an equilateral triangle $=\sqrt{ } 3 / 4(\text { Side })^{2}$
- Area of 4 walls of a room $=2$ (Length + Breadth) $\times$ Height
- Area of a triangle $=1 / 2 \times$ Base $\times$ Height
- Area of a circle $=\pi R^{2}$, where $R$ is the radius
- Circumference of a circle $=2 \pi R$, thus, Circumference of a semi-circle $=\pi R$.


## CUBE

Let each edge of a cube be of length $a$. Then, Volume $=a 3$ cubic units.

## CUBOID

Let length $=I$, breadth $=b$ and height $=h$ units. Then Volume $=(l \times b \times h)$ cubic units

## Types of Angle

- Acute angle $=0^{\circ}-90^{\circ}$
- Right Angle $=90^{\circ}$
- Obtuse angle $=90^{\circ}-180^{\circ}$
- Straight Angle $=180^{\circ}$
- Reflex Angle $=180^{\circ}-360^{\circ}$
- Complete angle $=360^{\circ}$
- Complementary Angle $=$ sum of two angles $=90^{\circ}$
- Supplementary angle $=$ sum of two angles $=180^{\circ}$


## Triangle Properties

Based on sides
A. Equilateral Triangle : All three sides equal
B. Isosceles Triangle : Two sides equal
C. Scalene Triangle : all three sides different

## Based on Angles

- Right Angle Triangle : One angle $90^{\circ}$
- Obtuse Angle Triangle : One angle more than $90^{\circ}$
- Acute Angle Triangle : All angles less than $90^{\circ}$
- When $A C 2<A B 2+B C 2$ (Acute angle triangle )
- When $A C 2>A B 2+B C 2$ (Obtuse angle triangle )
- When $A C 2=A B 2+B C 2$ (Right angle triangle )


## Some Basic Formulae

- $(a+b)(a-b)=\left(a^{2}-b^{2}\right)$
- $(a+b)^{2}=\left(a^{2}+b^{2}+2 a b\right)$
- $(a-b)^{2}=\left(a^{2}+b^{2}-2 a b\right)$
- $(a+b+c)^{2}=a^{2}+b^{2}+c^{2}+2(a b+b c+c a)$
- $\left(a^{3}+b^{3}\right)=(a+b)\left(a^{2}-a b+b^{2}\right)$
- $\left(a^{3}-b^{3}\right)=(a-b)\left(a^{2}+a b+b^{2}\right)$
- $\left(a^{3}+b^{3}+c^{3}-3 a b c\right)=(a+b+c)\left(a^{2}+b^{2}+c^{2}-a b-b c-a c\right)$
- When $a+b+c=0$, then $a^{3}+b^{3}+c^{3}=3 a b c$.


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