

# Progressions and Series Tips and Formulas

By

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## Cracku Tip 1 – Progressions and Series

- Progressions and Series is one of the important topics for CAT and significant number of questions appear in the examination from this section every year.
- Some of the questions from this section can be very tough and time consuming while the others can be very easy.
- The trick to ace this section is to quickly figure out whether a question is solvable or not and not waste time on very difficult questions.

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## Cracku Tip 2 – Progressions and Series

- Some of the questions in this section can be answered by ruling out wrong choices among the options available. This method will both save time and improve accuracy.
- There are many shortcuts which will be of vital importance in answering this section.
- This formula sheet contains an exhaustive list of various formulas and shortcuts.

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## Cracku Tip 3 – Progressions and Series

There are 3 standard types of progressions

- Arithmetic Progression
- Geometric Progression
- Harmonic Progression

## Cracku Tip 4 – Progressions and Series

### Arithmetic progression (A.P)

- If the sum or difference between any two consecutive terms is constant then the terms are said to be in A.P
- Ex. 2,5,8,11 or  $a, a+d, a+2d, a+3d...$
- If 'a' is the first term and 'd' is the common difference then the general 'n' term is  $T_n = a + (n-1)d$
- Sum of first 'n' terms in A.P  $= \frac{n}{2} [2a+(n-1)d]$
- Number of terms in A.P  $= \frac{\text{Last term} - \text{First term}}{\text{Common difference}} + 1$

## Cracku Tip 5 – Progressions and Series

### Properties of A.P

If  $a, b, c, d, \dots$  are in A.P and 'k' is a constant then

- $a-k, b-k, c-k, \dots$  will also be in A.P
- $ak, bk, ck, \dots$  will also be in A.P
- $a/k, b/k, c/k$  will also be in A.P

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## Cracku Tip 6 – Progressions and Series

### Geometric Progression

- If in a succession of numbers the ratio of any term and the previous term is constant then that numbers are said to be in Geometric Progression.
- Ex :1, 3, 9, 27 or  $a, ar, ar^2, ar^3$
- The general expression of an G.P,  $T_n = ar^{n-1}$  (where  $a$  is the first terms and ' $r$ ' is the common ratio)
- Sum of ' $n$ ' terms in G.P,  $S_n = \frac{a(1-rn)}{1-r}$  (If  $r < 1$ ) or  $\frac{a(rn-1)}{r-1}$  (If  $r > 1$ )

## Cracku Tip 7 – Progressions and Series

### Properties of G.P

If  $a, b, c, d, \dots$  are in G.P and 'k' is a constant then

1.  $ak, bk, ck, \dots$  will also be in G.P
2.  $a/k, b/k, c/k$  will also be in G.P

Sum of term of infinite series in G.P,  $S_{\infty} = \frac{a}{1-r}$  ( $-1 < r < 1$ )

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## Cracku Tip 8 – Progressions and Series

### Harmonic Progression

- If  $a, b, c, d, \dots$  are unequal numbers then they are said to be in H.P if  $1/a, 1/b, 1/c, \dots$  are in A.P
- The 'n' term in H.P is  $1/(\text{nth term in A.P})$

#### Properties of H.P :

If  $a, b, c, d, \dots$  are in H.P, then

$$a+d > b+c$$

$$ad > bc$$

## Cracku Tip 9 – Progressions and Series

### Arithmetic Geometric Series

- A series will be in arithmetic geometric series if each of its term is formed by product of the corresponding terms of an A.P and G.P.
- The general form of A.G.P series is  $a, (a+d)r, (a+2d)r^2, \dots$
- Sum of 'n' terms of A.G.P series

$$S_n = \frac{a}{1-r} + rd \frac{(1-r^{n-1})}{1-r} + rn \frac{[a+(n-1)d]}{1-r} \quad (r \neq 1)$$

$$S_n = \frac{n}{2} [2a + (n-d)]$$

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# Cracku Tip 10 – Progressions and Series

## Arithmetic Geometric Series

- Sum of infinite terms of A.G.P series

$$S_{\infty} = \frac{a}{1-r} + rd \frac{1}{(1-r)^2} \quad (r < 1)$$

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# Cracku Tip 11 – Progressions and Series

## Standard Series

- The sum of first 'n' natural number =  $\frac{n(n+1)}{2}$
- The sum of squares of first 'n' natural numbers =  $\frac{n(n+1)(2n+1)}{6}$
- The sum of cubes of first 'n' natural numbers =  $\left(\frac{n(n+1)}{2}\right)^2$
- The sum of first 'n' odd natural numbers =  $n^2$
- The sum of first 'n' even natural numbers =  $n(n+1)$
- In any series  $T_n = S_n - S_{n-1}$

## Cracku Tip 12 – Progressions and Series

### Arithmetic mean

- The arithmetic mean =  $\frac{\text{Sum of all the terms}}{\text{Number of Terms}}$
- If two number A and B are in A.P then arithmetic mean =  $\frac{a+b}{2}$

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## Cracku Tip 13 – Progressions and Series

### Arithmetic mean

- Inserting 'n' means between two numbers a and b
- The total terms will become  $n+2$ , a is the first term and b is the last term
- Then the common difference  $d = \frac{b-a}{n+1}$
- The last term  $b = a+(n+1)d$
- The final series is a,  $a+d$ ,  $a+2d$ , ....

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## Cracku Tip 14 – Progressions and Series

### Geometric Mean

- If  $a, b, c, \dots$   $n$  terms are in G.P then  $G.M = \sqrt[n]{a \times b \times c \times \dots n \text{ terms}}$
- If two numbers  $a, b$  are in G.P then their  $G.M = \sqrt{a \times b}$

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## Cracku Tip 15 – Progressions and Series

### Geometric Mean

- Inserting 'n' means between two quantities a and b with common ratio 'r'
- Then the number of terms are n+2 and a, b are the first and last terms
- $r^{n+1} = \frac{b}{a}$  or  $r = \frac{\sqrt[n+1]{b}}{a}$
- The final series is a, ar, ar<sup>2</sup>,...



## Cracku Tip 16 – Progressions and Series

### Harmonic Mean

- If a, b, c, d,.. are the given numbers in H.P then the Harmonic mean of 'n' terms = 
$$\frac{\text{Number of terms}}{\frac{1}{a} + \frac{1}{b} + \frac{1}{c} + \dots..}$$
- If two numbers a and b are in H.P then the Harmonic mean = 
$$\frac{2ab}{a+b}$$

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## Cracku Tip 17 – Progressions and Series

Relationship between AM, GM and HM for two numbers a and b,

- $AM = \frac{a+b}{2}$
- $G.M = \sqrt{a \times b}$
- $H.M = \frac{2ab}{a+b}$
- $G.M = \sqrt{AM \times HM}$
- $A.M \geq G.M \geq H.M$

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