* If $\frac{1}{\Delta^2} n^{(1)} = \frac{1}{\Delta}\left(\frac{1}{\Delta} n^{(1)}\right) = \frac{1}{\Delta}\frac{(n^{(2)})}{2}$ $\left\{ \because \frac{1}{\Delta} \text{ as integration i.e } \frac{1}{\Delta}(n^{(m)}) = \frac{n^{m+1}}{m+1} \right.$

$$= \frac{n^{(3)}}{6} = \frac{n(n-1)(n-2)}{6} = \frac{(n^2-n)(n-2)}{6} = \frac{n^3-2n^2-n^2+2n}{6} = \frac{n^3-3n^2+2n}{6}$$

* $\frac{1}{\Delta} n^{(1)} = \frac{n^{(2)}}{2} = \frac{n(n-1)}{2} = \frac{n^2-n}{2}$

* $\Delta(n^{(1)}) = 1$, $\Delta(n^{(2)}) = 2n^{(1)}$ (as differentiation i.e $\Delta(n^{(m)}) = m n^{(m-1)}$)

Generating function.

If $G(x) = \frac{1}{(1-2x)(1-3x)}$, the sequence, will be evaluated by partial fraction

i.e $\frac{1}{(1-2x)(1-3x)} = \frac{A}{1-2x} + \frac{B}{1-3x}$ —(*)

$$= \frac{(1-3x)A + B(1-2x)}{(1-2x)(1-3x)}$$

$$\frac{1}{\cancel{(1-2x)(1-3x)}} = \frac{A - 3xA + B - 2Bx}{\cancel{(1-2x)(1-3x)}}$$

$$\Rightarrow 1 = (A+B) - 3Ax - 2Bx$$

Equating Coeff. of x) $-3A-2B = 0 \Rightarrow 3A+2B = 0$ —(1)

Const.) $A+B = 1 \Rightarrow B = 1-A$ —(2)

using in (1)

$3A + 2(1-A) = 0 \Rightarrow 3A + 2 - 2A = 0$

$\Rightarrow A + 2 = 0 \Rightarrow A = -2$

$\therefore$ from (2) $B = 1-(-2) = 1+2 = 3$

$\therefore$ $G(x) = -\frac{1}{2}\left(\frac{1}{1-2x}\right) + \frac{1}{3}\left(\frac{1}{1-3x}\right)$ {Using (*)}

$\Rightarrow \cancel{G(x)}\ a_n = -\frac{1}{2}(2)^n + \frac{1}{3}(3)^n$ $\left\{\because \cancel{\text{for}}\ \cancel{\frac{1}{1-kx}}\ G(x) = \frac{1}{1-kx};\ a_n = k^n\right\}$

$\Rightarrow a_n = \frac{1}{3}(3)^n - \frac{1}{2}(2)^n$

$\boxed{a_n = 3^{n-1} - 2^{n-1}}$

* If $G(x) = \frac{1}{x^2-5x+6}$ (factorise the term)

$= \frac{1}{(x-3)(x-2)}$, then same as above

* If in numerator some term is there, then also same procedure.