10.5.4-5

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Question:
A small terrace at a football ground comprises of 15 steps each of which is 50 m long and built of solid concrete.Each step has a rise of 1/4 m and a tread of 1/2 m. Calculate the total volume of concrete required to build the terrace. [Hint: Volume of concrete required to build the first step=

$$\text{V} = \frac{1}{4} \cdot \frac{1}{2} \cdot 50 \tag{1}$$

solution

parameter	description	value
l	length	$50m$
b	breadth	$0.25m$
h	height	$0.5m$
$y(n)$	sum of volume	$6.25m^3$

TABLE 0: input parameters

$$x(n+1) - x(n) = 6.25m^3 \tag{2}$$

$$y(n) = \frac{n+1}{2}[2x(0) + (n)d] \tag{3}$$

$$n = 0, 1, 2, 3, ... \tag{4}$$

here

parameter	description	value
$x(0)$	first term	6.25
d	common difference	6.25
n	no of terms -1	14
$x(n)$	volume of (n+1)th step	$x(0) + nd$

TABLE 0: formula parameters

$$y(14) = \frac{14+1}{2}[12.5 + (14)6.25] \tag{5}$$

$$= \frac{15}{2}[12.5(14)6.25] \tag{6}$$

$$= \frac{15}{2}[12.5 + 87.5] \tag{7}$$

$$= (7.5) \cdot 100 = 750m^3 \tag{8}$$

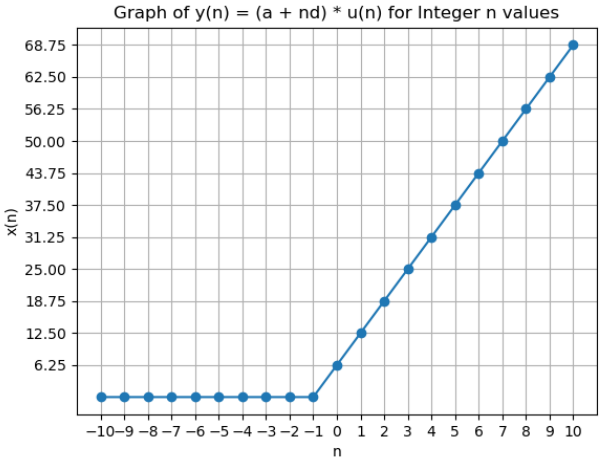

Fig. 1

plot of x(n) and n

$$\text{x(n)} = (x(0) + n \cdot d) \cdot u(n) \tag{9}$$

$$x(n) \overset{Z}{\longleftrightarrow} X(Z) \tag{10}$$

$$x(n) = (x(0) + nd)u(n) \tag{11}$$

$$X(Z) = \sum_{-\infty}^{\infty} x(n)Z^{-n} \tag{12}$$

$$= \frac{x(0)}{1 - z^{-1}} + \frac{dz^{-1}}{(1 - z^{-1})^2} \quad , |z| > |r| \tag{13}$$

$$= \frac{6.25}{1 - z^{-1}} + \frac{6.25z^{-1}}{(1 - z^{-1})^2} \quad , |z| > |r| \tag{14}$$

convolution for y(n)

$$(f * g)(t) = \sum_{-\infty}^{\infty} f(\tau)g(t - \tau)d\tau \tag{15}$$

$$f(t) = u(n) \tag{16}$$

$$g(t) = x(n) = x(0) + 6.25n \tag{17}$$

$$y(n) = \sum_{-\infty}^{\infty} u(\tau)(x(0) + (n - \tau)6.25)d\tau \tag{18}$$