Q:Two APs have the same common difference.The difference between their 100th terms is 100,what is the difference between their 1000th terms?
Solution:

$$x(n) = \{x(0) + nd\}u(n) \tag{1}$$

$$x(99) - y(99) = 100 \tag{2}$$

$$\implies (x(0) + 99d) - (y(0) + 99d) = 100 \tag{3}$$

$$\implies x(0) - y(0) = 100 \tag{4}$$

Now to find the difference between the 1000th terms of APs;

$$x(999) - y(999) = (x(0) + 999d) - (y(0) + 999d) \tag{5}$$

$$= x(0) - y(0) \tag{6}$$

$$= 100 \tag{7}$$

Therefore,the difference between the 1000th terms of two given APs is 100.

We know that,
The Z-transform of a discrete signal $x(n)$ is given by:

$$X(z) = \mathcal{Z}\{x(n)\} = \sum_{n=-\infty}^{\infty} x(n)z^{-n}$$

Considering x(n-1) and y(n-1) as n^{th} terms of the APs(Arithmetic Progressions), Z-transform for x(n-1) and y(n-1) can be given by

$$X(z) = \mathcal{Z}\{x(n)\} = \sum_{n=-\infty}^{\infty} x(n)z^{-n} \tag{8}$$

$$= x(0)U(z) + d[-z\frac{d(U(z))}{dz}] \tag{9}$$

$$X(z) = x(0)U(z) + d(-z)\frac{d(U(z))}{dz} \tag{10}$$

$$Y(z) = y(0)U(z) + d(-z)\frac{d(U(z))}{dz} \tag{11}$$

Variable	Description	Value
$x(n)$	n^{th} term of X	none
$y(n)$	n^{th} term of Y	none
d	common difference between the terms of AP	none
$X(z)$	z-transform of x(n)	none
$Y(z)$	z-transform of y(n)	none
$U(z)$	z-transform of u(n)	$\frac{1}{1-z^{-1}}, |z| > 1$
$x(n) - y(n)$	difference of nth terms of X and Y	$x(99) - y(99) = 100$

TABLE 0

INPUT PARAMETERS

$$X = \{101, 106, 111, ..., 596\} \tag{12}$$
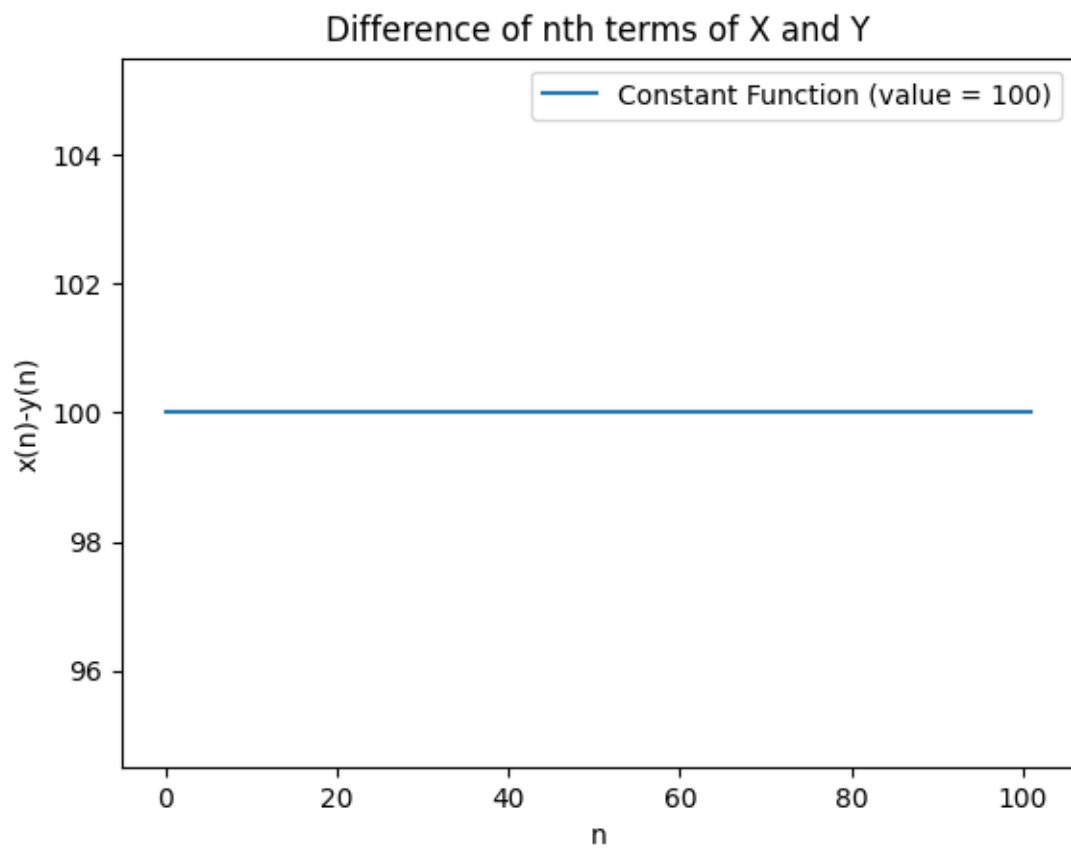
$$Y = \{1, 6, 11, ..., 496\} \tag{13}$$

Fig. 0.