

NCERT Question 11.9.3.9

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Question: Find the sum to indicated number of terms in the geometric progression:
 $1, -a, a^2, -a^3, \dots n$ terms (if $a \neq -1$).

Solution:

Input Parameters	Values	Description
$x(0)$	1	First term
r	$(-a)$	Common ratio
$x(n)$	$(-a)^n u(n)$	General term

TABLE 1
GIVEN INPUTS

Signal	Transform
$\frac{1}{1-z^{-1}}$	$u(n)$
$\frac{1}{1-az^{-1}}$	$(a)^n u(n)$

TABLE 2
Z TRANSFORM PAIRS

$$x(n) = (-a)^n u(n) \quad (1)$$

$$X(z) = \frac{1}{1 + az^{-1}} \quad (2)$$

The ROC is $|z| > |a|$

From Table 1,

$$y(n) = (-a)^n u(n) * u(n) \quad (3)$$

$$Y(z) = X(z) U(z) \quad (4)$$

$$= \frac{1}{1 + az^{-1}} \frac{1}{1 - z^{-1}} \quad (5)$$

Using Z transform pairs to find the inverse Z-transform:

$$Y(z) = \frac{1}{a+1} \frac{1}{z^{-1}} \left[\frac{1}{1-z^{-1}} - \frac{1}{1+az^{-1}} \right] \quad (6)$$

$$y(n) = \left[\frac{1 - (-a)^{n+1}}{1 - (-a)} \right] u(n) \quad (7)$$

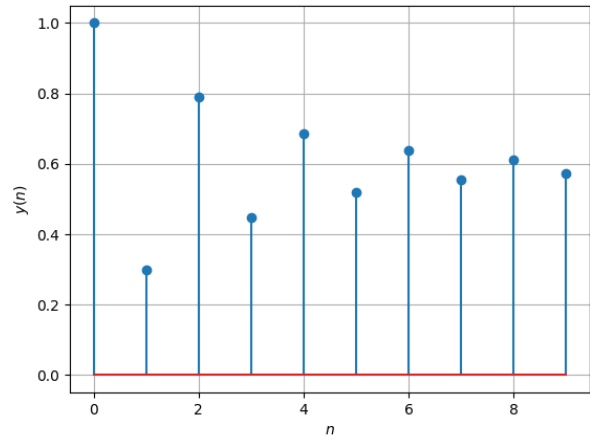


Fig. 1. Plot of $y(n)$ for $a = 0.7$