Arithmetic Progression Problem

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Which term of the arithmetic progression (AP): $3, 8, 13, 18, \ldots$ is 78?
Find the term (k) when the term $x(k)$ is equal to 78.

1   Input Table:

Here is the input table with common difference, initial term, and a description:

n	Parameters	Description
1	$x(0)$	Initial Term
2	d	Common Difference
3	$x(k) \times u(k)$	Target Term

2   Solution:

Let's solve the problem:

$$\text{Let } x(n) = [3 + (n-1)5] \times u(n)$$
$$\text{Given: } x(k) = 78$$

Substitute values into the formula:

$$78 = 3 + (k-1) \times 5$$
$$78 = 3 + (k-1) \times 5$$
$$78 - 3 = 5(k-1)$$
$$75 = 5(k-1)$$
$$15 = k - 1$$
$$k = 16$$

Therefore, the correct term number (k) when $x(k) = 78$ in the given arithmetic progression is $k = 16$.

3 Z-Transform:

Let the Z-transform of $x(n)$ be $X(z)$. Let $U(z)$ be the Z-transform of $u(n)$.

$$X(z) = x(0)U(z) + dz^{-1}Z\{nu(n)\} \tag{1}$$

$$= \frac{3}{1 - z^{-1}} + \frac{5z^{-1}}{(1 - z^{-1})^2} \tag{2}$$

$$= \frac{3(1 - z^{-1}) + 5z^{-1}}{(1 - z^{-1})^2} \tag{3}$$

$$= \frac{3 - 3z^{-1} + 5z^{-1}}{(1 - z^{-1})^2} \tag{4}$$

$$= \frac{3 + (5 - 3)z^{-1}}{(1 - z^{-1})^2} \quad \text{for } |z| > 1 \tag{5}$$