NCERT Discrete 10.5.2.19

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Subba Rao started work in 1995 at an annual salary of Rs. 5000 and received an increment of Rs. 200 each year. In which year did his income reach Rs. 7000?

Table

Parameter	Value	Description
$x(0)$	5000	Initial Income
d	200	Annual Increment (Common Difference)
$x(n)$	$(x(0) + nd)u(n)$	n^{th} term of the AP

Table: Input Parameters

From the values given in Table 1:

$$7000 = 5000 + 200n \tag{1}$$

$$\implies 2000 = 200n \tag{2}$$

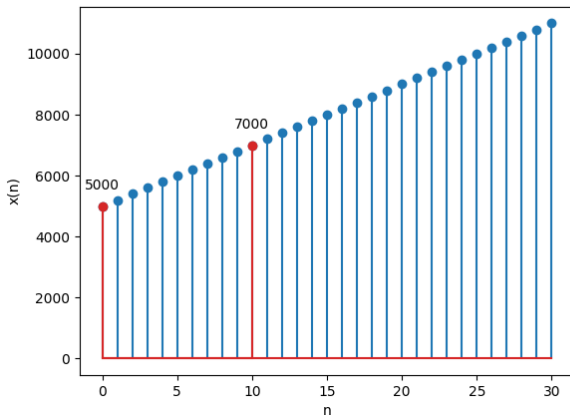$$\therefore n = 10 \tag{3}$$

Plot

Figure: Plot of $x(n)$ vs n. See Table 1 for details.

Code

```
import numpy
import matplotlib.pyplot as plt
# X−axis
n = numpy.arange(0, 31, 1)
# Y−axis
x = 5000 + 200 * n
# Plot graph
plt.stem(n, x)
# Mark (0,5000) and (10, 7000) in red
plt.stem([0, 10], [5000, 7000], linefmt="C3")
# Label axes
plt.xlabel("n")
plt.ylabel("x(n)")
# Label (0, 5000) and (10, 7000)
plt.annotate("5000", (0, 5000), ha="center", va="bottom", xytext=(0, 10), textcoords="offset-points")
plt.annotate("7000", (10, 7000), ha="center", va="bottom", xytext=(0, 10), textcoords="offset-points")
# Save x(n) vs n graph
plt.savefig("../figs/10_5_2_19.png")
```

Z-transform

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

$$X(z) = \frac{x(0)}{1 - z^{-1}} + \frac{dz^{-1}}{(1 - z^{-1})^2} \quad |z| > 1 \tag{4}$$

Using the values from Table 1:

$$X(z) = \frac{5000}{1 - z^{-1}} + \frac{200z^{-1}}{(1 - z^{-1})^2} \quad |z| > 1 \tag{5}$$