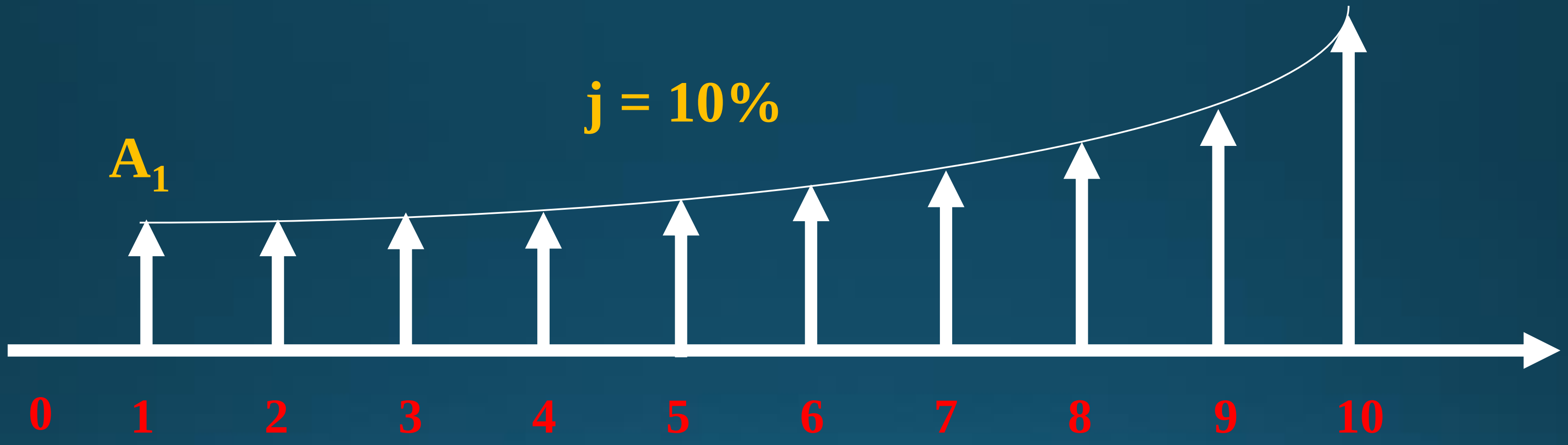
GE 403
Engineering Economy

Eng. Howaidi Alotaibi
Civil Engineering Department
E-mail halshaibani@ksu.edu.sa

Geometric Series

The geometric cash flow series occurs when the size of a cash flow increases or decreases by a fixed percent from one time period to the next.



IF $A_1=500$ $A_2=1.1\times A_1= 550$ $A_3=1.1\times A_2= 1.1\times 550=605$

$A_t=A_1(1\pm j)^{n-t}$ ⇨ $A_{10}= A_1(1+0.1)^{10-1} = 500(1.1)^9= 1179$

$A_{10}= A_3(1+0.1)^{10-3} = 605(1.1)^7 = 1179$

Geometric Series

$$P = A_1\left[\frac{1-(1+j)^n(1+i)^{-n}}{i-j}\right]$$

geometric series, present worth factor
$i \neq j$

$$P = nA_1/(1+i)$$

$i = j$

$$P = A_1(P|A_1\ i\%, j\%, n)$$

$$F = A_1\left[\frac{(1+i)^n-(1+j)^n}{i-j}\right]$$

geometric series, future worth factor
$i \neq j$

$$F = nA_1(1+i)^{n-1}$$

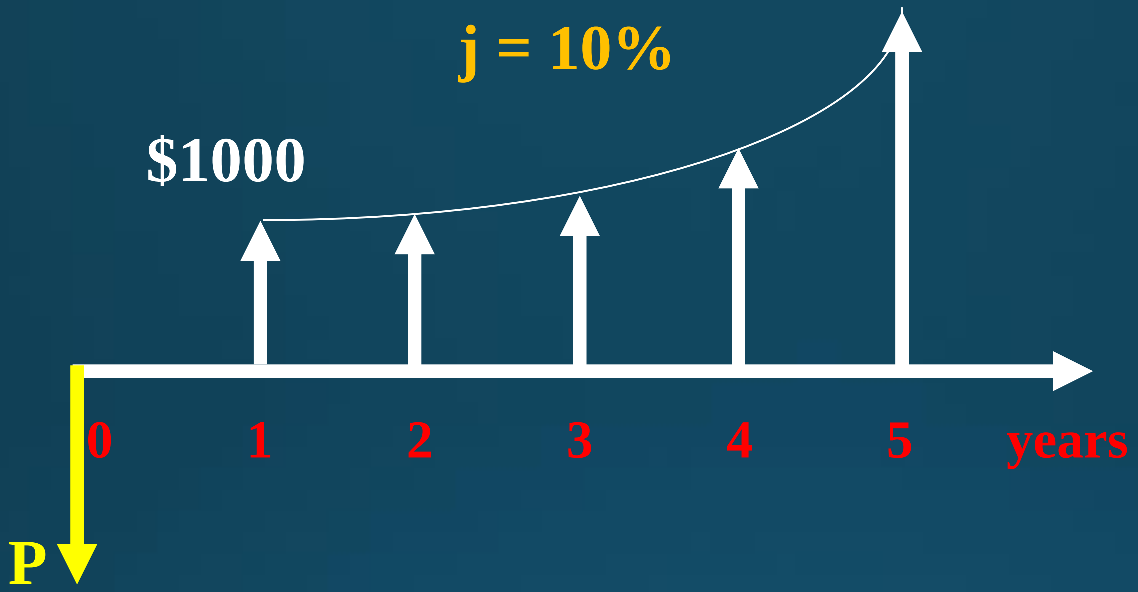
$i = j$

$$F = A_1(F|A_1\ i\%, j\%, n)$$

Ex.1

You want to be able to withdraw $1,000 from a savings account at the end of year 1, with withdrawals increasing by 10 percent each year thereafter over a total of 5 years. How much money must be on deposit right now, at the end of year 0, to just deplete the account after the five withdrawals if interest is 5 percent compounded annually?

Solution



$$P = A_1(P/A_1\ i\%, j\%, n)$$

$$P = 1000(P/A_1\ 5\%, 10\%, 5)$$

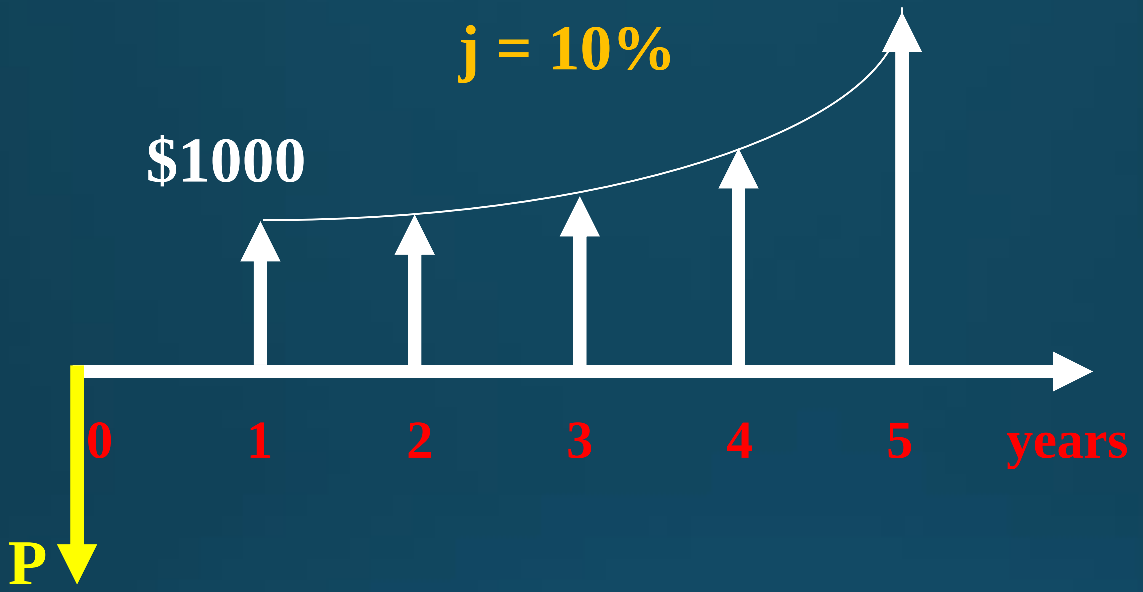
$$P = 1000(5.23753) = \$5237.53$$

TABLE A-b-2

j	4%	5%	6%	10%	15%
n	To Find P Given A_1 $(P\|A_1\ i\%,j\%,n)$	To Find P Given A_1 $(P\|A_1\ i\%,j\%,n)$	To Find P Given A_1 $(P\|A_1\ i\%,j\%,n)$	To Find P Given A_1 $(P\|A_1\ i\%,j\%,n)$	To Find P Given A_1 $(P\|A_1\ i\%,j\%,n)$
1	0.95238	0.95238	0.95238	0.95238	0.95238
2	1.89569	1.90476	1.91383	1.95011	1.99546
3	2.83002	2.85714	2.88444	2.99536	3.13789
4	3.75545	3.80952	3.86429	4.09037	4.38912
5	4.67206	4.76190	4.85348	5.23753	5.75951
6	5.57995	5.71429	5.85208	6.43932	7.26042

5.00% Time Value of M

Solution



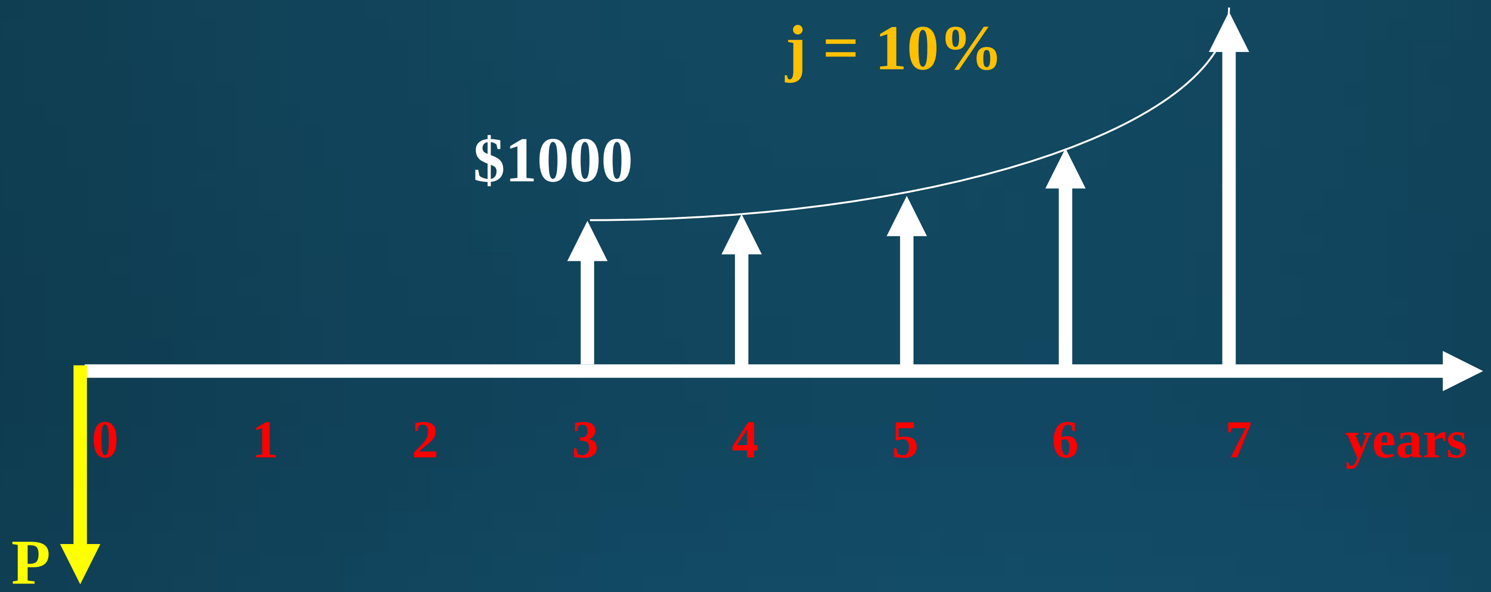
$$P = A_1\left[\frac{1-(1+j)^n(1+i)^{-n}}{i-j}\right]$$

$$P = 1000\left[\frac{1-(1+0.1)^5(1+0.05)^{-5}}{0.05-0.1}\right] = \$5237.53$$

Ex.2

You want to be able to withdraw $1,000 from a savings account at the end of **year 3**, with withdrawals increasing by 10 percent each year thereafter over a total of 5 years. How much money must be on deposit right now, at the end of year 0, to just deplete the account after the five withdrawals if interest is 5 percent compounded annually?

Solution



$$P = A_1(P/A_1\ i\%,\ j\%,\ n)(P/F\ i\%,n)$$

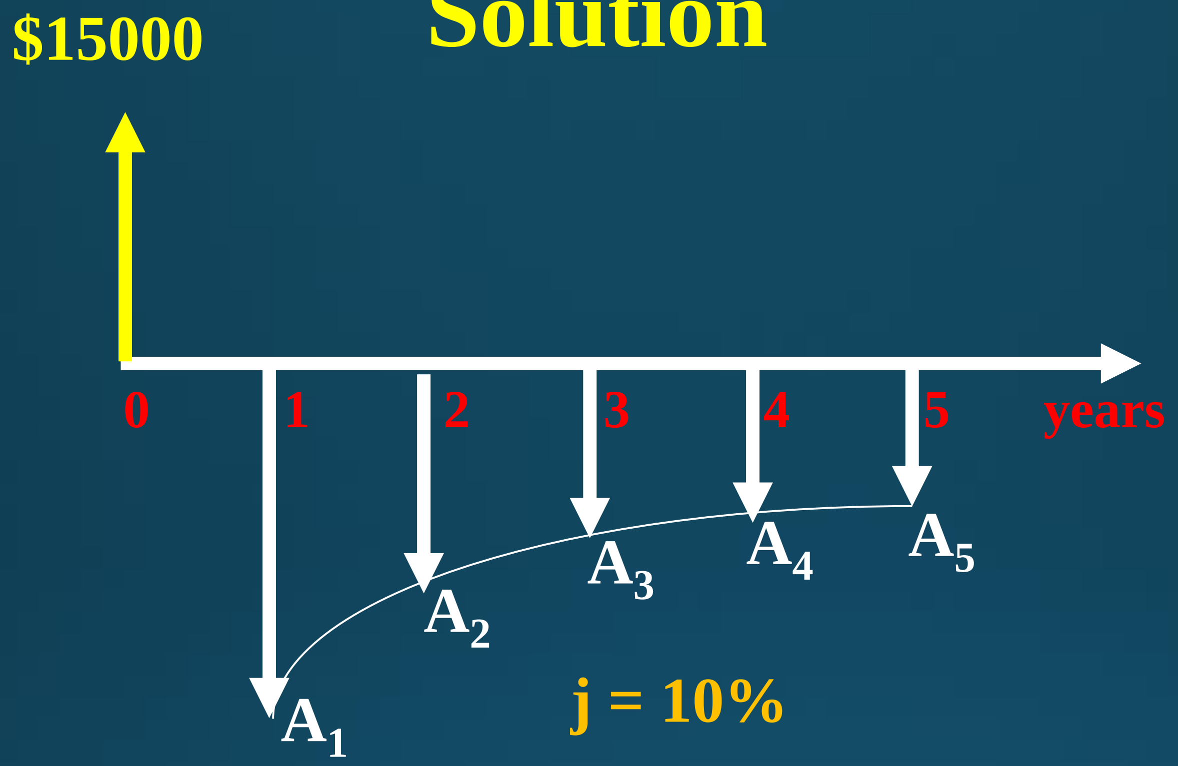
$$P = 1000(P/A_1\ 5\%,\ 10\%,\ 5)(P/F\ 5\%,2)$$

$$P = 1000(5.23753)(0.90703) = \$4750.6$$

Ex.3

Ali borrowed $15,000 at 18% per year compounded annually, he paid off the loan over a 5-year period with annual payments. Each successive payment was 10% less than the preceding payment. How much was the fifth payment.

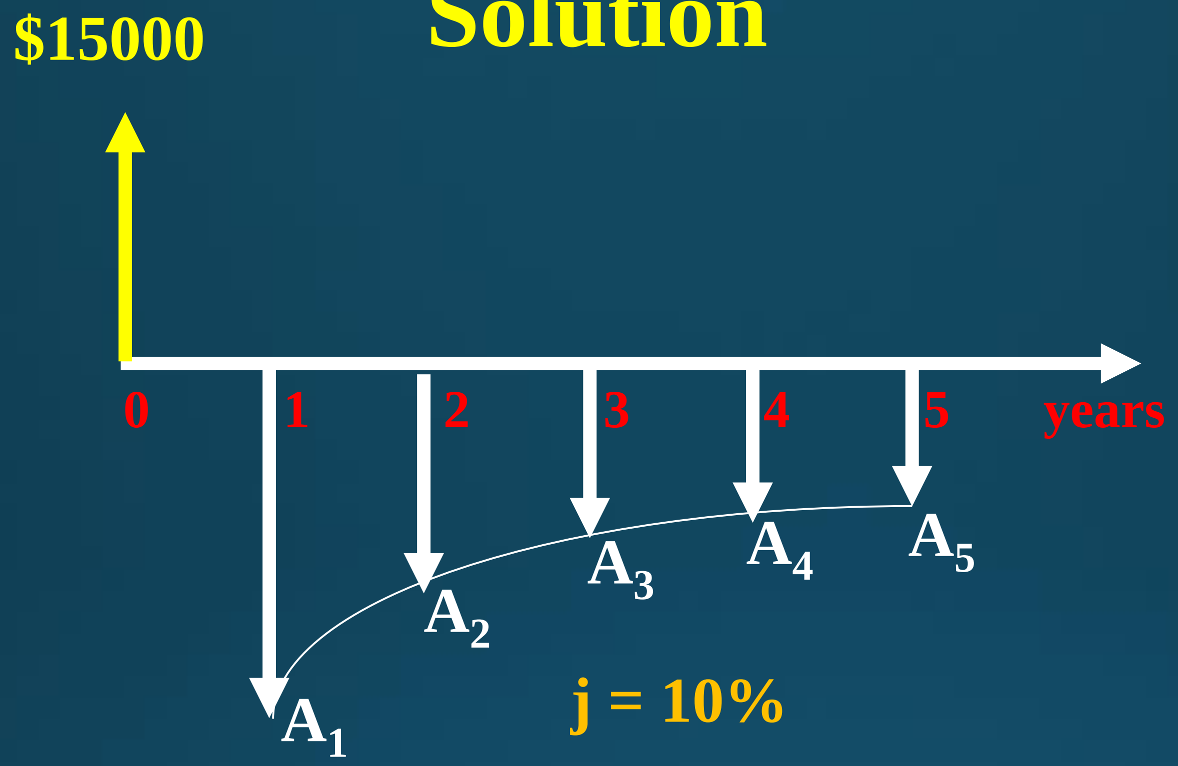
Solution



$$P = A_1\left[\frac{1-(1+j)^n(1+i)^{-n}}{i-j}\right]$$

$$15000 = A_1\left[\frac{1-\left(1+(-0.1)\right)^5(1+0.18)^{-5}}{0.18-(-0.1)}\right] \Rightarrow A_1 = \$5661.2$$

Solution



$$A_t = A_1(1-j)^{t-1}$$

$$A_5 = A_1(1-0.1)^{5-1}$$

$$A_5 = 5661.2(1-0.1)^4 \Longrightarrow A_5 = \$3714.4$$