IEGR 350: Engineering Economy
Fall 2015
M. Salimian **Your Name:**

Test 2

100 Points (Time: 60:00 Minutes + 15 Minutes if needed)

Instruction for all problems: Show your work. No round down or up, use 2 decimals for dollar values and 4 decimals for factors.

Question 1: (10+10+10+10 +10 +10 points)
Use tables and interpolations for Problem #1. Limit the use of (P/F, i, n) as much as possible
Consider a bridge project that has an almost similar design its cash flow. Below are the information about the project:
Nominal interest rate 17.3% compounded annually except for years 10, 20, and 30 which is continuous compounding Life of the bridge: 40 years
Major capital investment: Now through year 5, $10,000,000 a year then single investments of the same amount at the end of years 10, 20, and 30
Bridge will be used from the start of year 6 generating income and savings of $2,000,000 in its first year of use increasing by $100,000 to year 10, then decreasing to year 20 to zero income level increasing again in year 21 to $2,000,000 and increasing by 14% each year to year 30, then decreasing by 25% to year 40.
Is this a profitable investment?

Solution:

See the last page

Question 2: (10 points)
A company that manufactures air-operated drain valve assemblies budgeted $74,000 per year to pay for plastic components over a 5-year period. If the company spent only $42,000 in year 1, what uniform annual amount should the company expect to spend in each of the next 4 years to expend the entire budget? Assume the company uses an interest rate of 16% per year.

Solution: (End of the chapter problems – Chapter 3 problem 29)

Using future worth analysis

F = 74000 (F/A, 16%, 5) – 42000 (F/P, 16%, 4) = 74000(6.8771) – 42000(1.8108) = $432860.2

A = 432860.2 (A/F, 16%, 4) = 432860.2 (0.19738) = $85,437.95

Using present worth analysis

P = [42000 + A (P/A, 16%, 4)](P/F, 16%, 4) = (42000 + 2.7982 A)(0.8621)= 36208.2 + 2.4123A

P = 74000 (P/A, 16%, 5) = 74000 (3.2743) = 242298.2

36208.2 + 2.4123A = 242298.2 → A = 85431.99

IEGR 350: Engineering Economy
Fall 2015
M. Salimian **Your Name:**

Question 3: (10 points)
Periodic outlays for inventory control software at Baron Chemicals are expected to be $150,000 immediately, $200,000 in 1 year, and $350,000 in 2 years. What is the present worth of the costs at an interest rate of 18% per year, compounded continuously?

Solution: (End of the chapter problems – Chapter 4 problem 53)

$i = e^{0.18} - 1 = 0.1972$ or 19.72%

P = 150,000 + 200,000(P/F, 19.72%, 1) + 350,000(P/F, 19.72%, 2)

(P/F, 19.72%, 1) = $(1.1972)^{-1}$ = 0.8353, (P/F, 19.72%, 2) = $(1.1972)^{-2}$ = 0.6977

P = 150,000 + 200,000(0.8353) + 350,000 (0.6977) = $561,255

Question 4: (20 points)
A retail shopping center developer signed a contract to build a $100 million high-end shopping center in City Center, because the city and county governments agreed to sales and tax rebates totaling $18.7 million over 10 years. The contract called for the developer to raze existing buildings 2 years from the date the contract was signed and to have the shopping center built by the end of year 3. However, due to a real estate–induced recession in the United States, the developer sought and was granted a new contract. The new contract required the developer to raze the existing buildings at the end of year 1, but the shopping center would not have to be completed for 7 years from the date the contract was signed. Assume that the cost for razing the existing buildings is $1.3 million and the developer does not build the shopping center until 7 years from now (at a cost of $100 million). Determine the difference in the future worth cost in year 7 of the two contracts at an interest rate of 16% per year.

Solution: (End of the chapter problems – Chapter 5 problem 30)

FW_{old} = -1,300,000(F/P, 16%, 5) – 100,000,000(F/P, 16%, 4) = -1,300,000(2.1003) – 100,000,000(1.8106)

FW_{old} = - $183,790,390

FW_{new} = -1,300,000(F/P, 16%, 6) – 100,000,000 = -1,300,000(2.4364) – 100,000,000 = - $103,167,320

Difference = 183,790,390 - 103,167,320 = 80,623,070 (higher cost for old contract)

IEGR 350: Engineering Economy
Fall 2015
M. Salimian
Test 2 - Problem 1 Solution Key

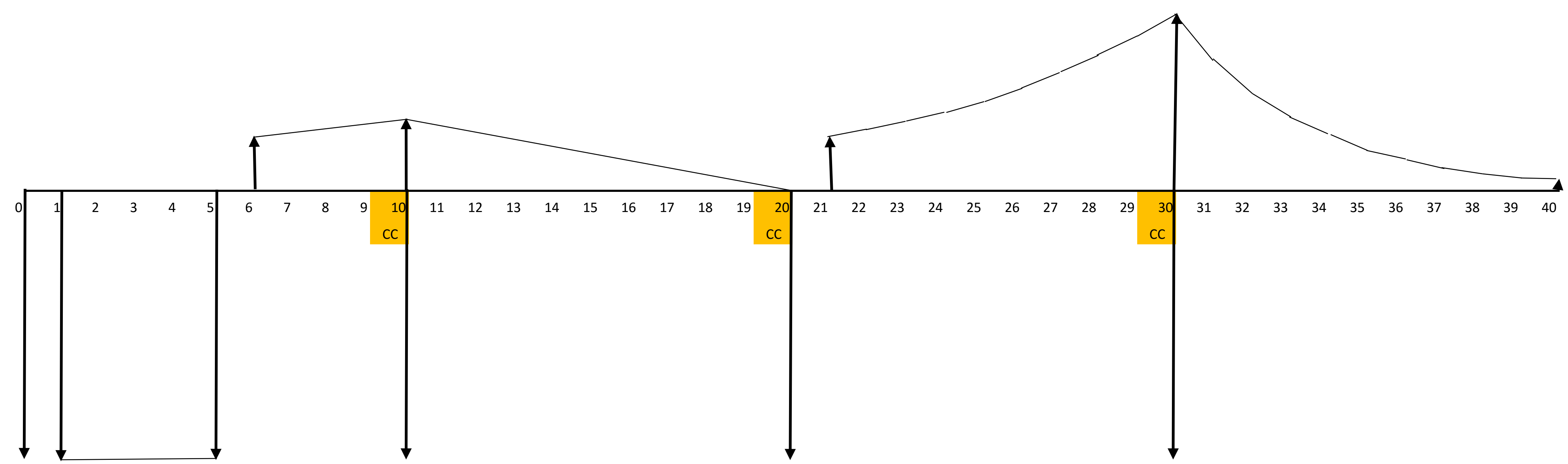
Consider a bridge project that has an almost similar design its cash flow. Below are the information about the project:

Nominal interest rate 17.3% compounded annually except for years 10, 20, and 30 which is continuous compounding Life of the bridge: 40 years

Major capital investment: Now through year 5, $10,000,000 a year then single investments of the same amount at the end of years 10, 20, and 30

Bridge will be used from the start of year 6 generating income and savings of $2,000,000 in its first year of use increasing by $100,000 to year 10, then decreasing to year 20 to zero income level increasing again in year 21 to $2,000,000 and increasing by 14% each year to year 30, then decreasing by 25% to year 40

Is this a profitable investment?



						2.00	2.10	2.20	2.30	2.40	2.16	1.92	1.68	1.44	1.20	0.96	0.72	0.48	0.24	0.00
-10	-10	-10	-10	-10	-10					-10										-10

2.00	2.28	2.60	2.96	3.38	3.85	4.39	5.00	5.71	6.50	4.88	3.66	2.74	2.06	1.54	1.16	0.87	0.65	0.49	0.37	78.88750942
									-10											-90

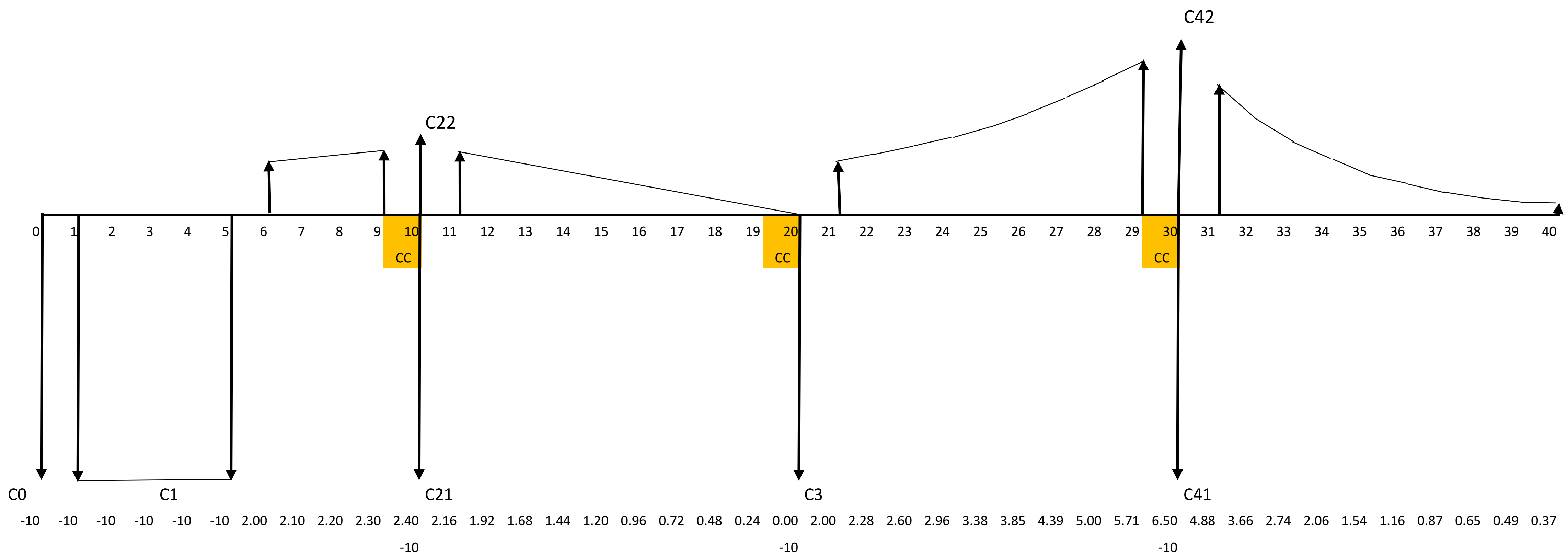
Effective Interest rate calculation:
Nominal: 17.3%, continuous compounding (CC)
$r = e^{i} - 1 = (2.718)^{0.173} - 1 = 1.1888 - 1 = 0.1888$

Based on the given information the cash flow is plotted and the needed values have been calculated.
Please note that you do not need to calculate all values, only certain number of them.
Due to presence of continuous compounding in years 10, 20, and 30 which impacts the series present worth

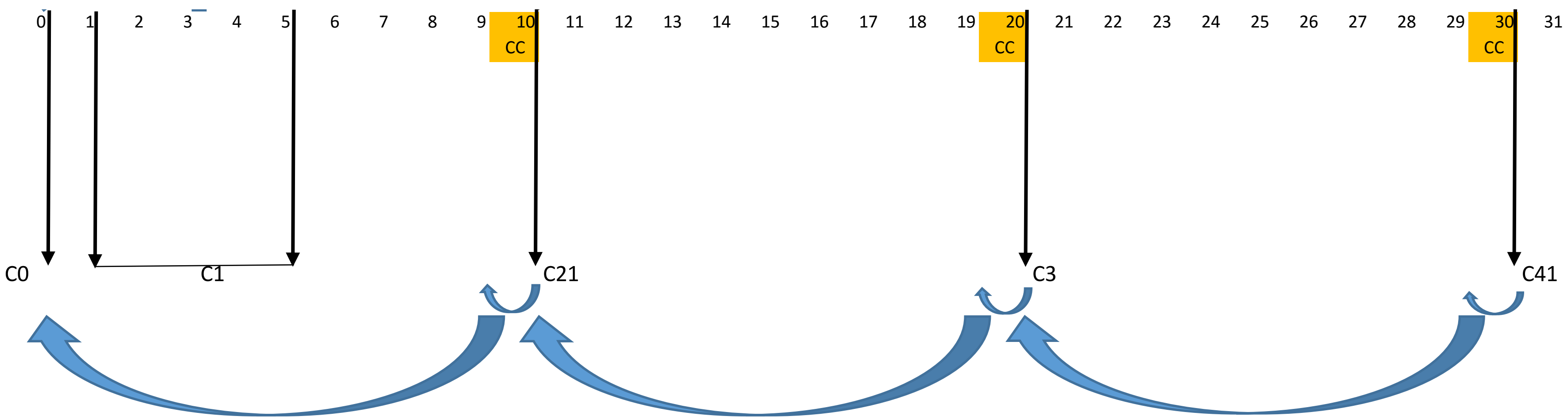
1.188866105

or 18.88%

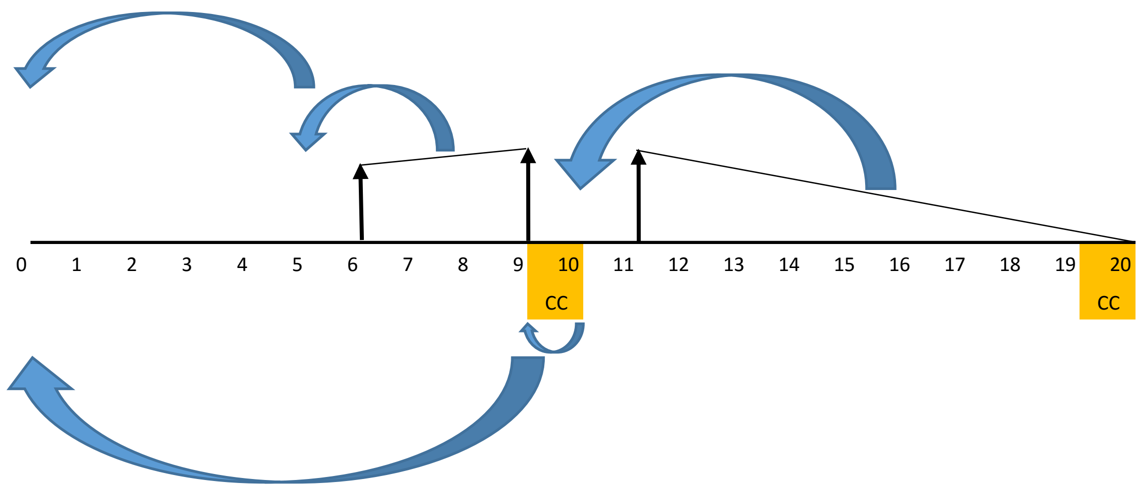
calculations and some items being shared between two series, we need to separate some transactions from the series shown. The replotted cash flow for the problem is drawn below.



We will begin by single values during the years with continuous compounding and the payments in years 1 through 5.
Here, I have shown them separately but you can do the at them same time.
PW4 = (-C41+C42)(P/F, 18.88%, 1)(P/F, 17.3%, 9)(P/F, 18.88%, 1)(P/F, 17.3%, 9)(P/F, 18.88%, 1)(P/F, 17.3%, 9)
PW3 = -C3(P/F, 18.88%, 1)(P/F, 17.3%, 9)(P/F, 18.88%, 1)(P/F, 17.3%, 9)
PW2 = (-C21+C22)(P/F, 18.88%, 1)(P/F, 17.3%, 9)
PW1 = -C1(P/A, 17.3%, 5)



Next we will look at two arithmetic gradient series. Again, I have shown them separately but you can do them at the same time.
The G value of 0.24 is calculated as (2.4-0)/10=0.24 for the second series.
PW5 = [2(P/A, 17.3%, 4)+0.1(P/G, 17.3%, 4)](P/F, 17.3%, 5)
PW6 = [(2.16)(P/A, 17.3, 10)-0.24(P/G, 17.3%, 10)](P/F, 18.88%, 1)(P/F, 17.3%, 9)

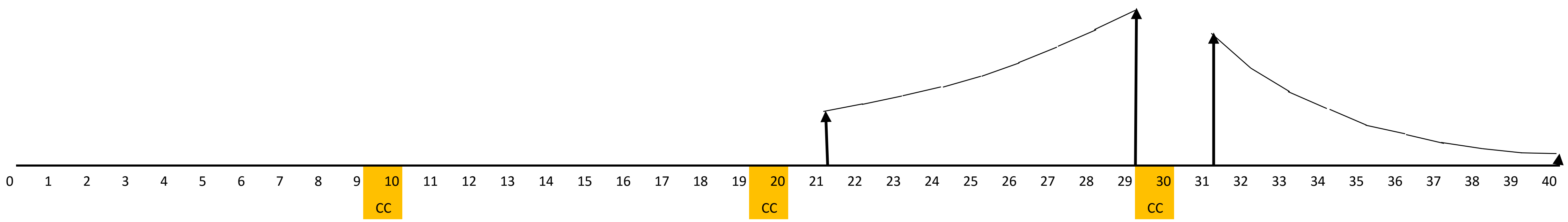


Next we will look at two geometric gradient series. Again, I have shown them separately but you can do them at the same time.
geometric series increasing by 14% (g = 0.14) with A1=2.00, i=17.3% and n=9
PW(geometric series) = A1 (P/A1, g, i, n) = A1 {[1 – ((1 + g)/(1 + i))^n] / (i – g)}
PW(geometric series at year 20) = 2 {[1- (1.14/1.173)^9]/(0.173-0.14)} = 13.727

13.72714

PW7= 13.727(P/F, 18.88%, 1)(P/F, 17.3%, 9)(P/F, 18.88%, 1)(P/F, 17.3%, 9)
geometric series decreasing by 25% (g = - 0.25) with A1=4.8779, i=17.3% and n=10
PW(geometric series) = A1 {[1 – ((1 + g)/(1 + i))^{n}] / (i – g)}
PW(geometric series at year 30) = 4.8779 {[1- (0.75/1.173)^{10}]/(0.173+0.25)} = 11.4
PW8 = 11.4(P/F, 18.88%, 1)(P/F, 17.3%, 9)(P/F, 18.88%, 1)(P/F, 17.3%, 9)(P/F, 18.88%, 1)(P/F, 17.3%, 9)

11.4



2.00 2.28 2.60 2.96 3.38 3.85 4.39 5.00 5.71 6.50 4.88 3.66 2.74 2.06 1.54 1.16 0.87 0.65 0.49 0.37

6.50390
4.877923
32.17
18.41

Therefor the Present worth of the complete cash flow is:
PW = -C1+ PW1 + PW2+ PW3 + PW4 + PW5 + PW6 + PW7 + PW8

Calculations needed using interpolation from tables of 16% and 18% provided:
(P/X, 17.3%, n) = (P/X, 16%, n) + {[(P/X, 18%, n)-(P/X, 16%, n)]/(18-16)}(17.3-16)
Using the interpolation formula:
(P/F, 17.3%, 1) = 0.8526 (real value 0.8525)
(P/F, 17.3%, 9) = 0.2386 (real value 0.2379)
(P/A, 17.3%, 4) = 2.7279 (real value 2.7271)
(P/A, 17.3%, 5) = 3.1786 (real value 3.1774)
(P/A, 17.3%, 10) = 4.6127 (real value 4.6082)
(P/G, 17.3%, 4) = 3.5523 (real value 3.5506)
(P/G, 17.3%, 10) = 14.9430 (real value 14.9159)

(P/F, 18.88%, 1) = (P/F, 18%, 1) + {[(P/F, 18%, 1)-(P/F, 16%, 1)]/(18-16)}(18.88-18)
(P/F, 18.88%, 1) = 0.8410 (real value 0.8412)

P/F, I, 1	P/F, I, 9	
0.8621	0.263	16%
0.8475	0.2255	18%
0.85261	0.238625	17.30%

P/A , I, 4	P/A , I, 5	P/A , I, 10	
2.7982	3.2743	4.8332	16%
2.6901	3.1272	4.4941	18%
2.727935	3.178685	4.612785	17.30%

P/G , I, 4	P/G , I, 10	
3.6814	16.0399	16%
3.4828	14.3525	18%
3.55231	14.94309	17.30%

P/F, I,1

0.8621	16%
0.8475	18%
0.841076	18.88%