Chap-2

Enginerring economics

1-2-3-1

(2)

$SI (I) = PiN$

CI

~~For the ith interest period~~

$I_1 = P \times i$

$F_1 = P + I_1 = P + P \times i = P(1+i)$

$I_2 = F_1 \times i =$

Functionally

$F = P(F/P, i\%, N)$
$F = P(1+i)^N$

| Note: To find 'F' if 'P' is given

$P = F(P/F, i\%, N)$
$P = F(1+i)^{-N}$

| Note: To find 'P' if 'F' is given

Nominal Interest rate:

→ nominal rate is periodic interest rate times the number of periods per year.

i.e

r = interest rate per period × number of periods

r/m = interest rate compounding per period

2

A nominal interest rate may be stated for any period : 1 year semiannually, ~~month~~ monthly, weekly, daily

For example, $r = 12\%$ compounded semiannually,
$m = 2$
$r/m = 12\% / 2 = 6\%$ per 6 month

compounded quarterly $m = 4$
$r/m = 3\%$ per 3 month

$r = 18\%$ compounded monthly
$r/m = 18\% / 12 = 1.5\%$ per month

$r = 15\%$ compounded weekly, $m = 52$
$r/m = 15\% / 52 = 0.288\%$ per week

Effective interest rate
→ actual rate at interest earned during one year is known as effective rate.

Relation between effective (i) and nominal (r) interest rate

$i = (1 + r/m)^m - 1$
m = compounding period per year

For Pramod, effective interest rate for 12% compounded semi-annually

$$i_{eff} = (1+r/m)^m - 1$$

$$= (1+0.12/2)^2 - 1 = 12.36\ \%$$

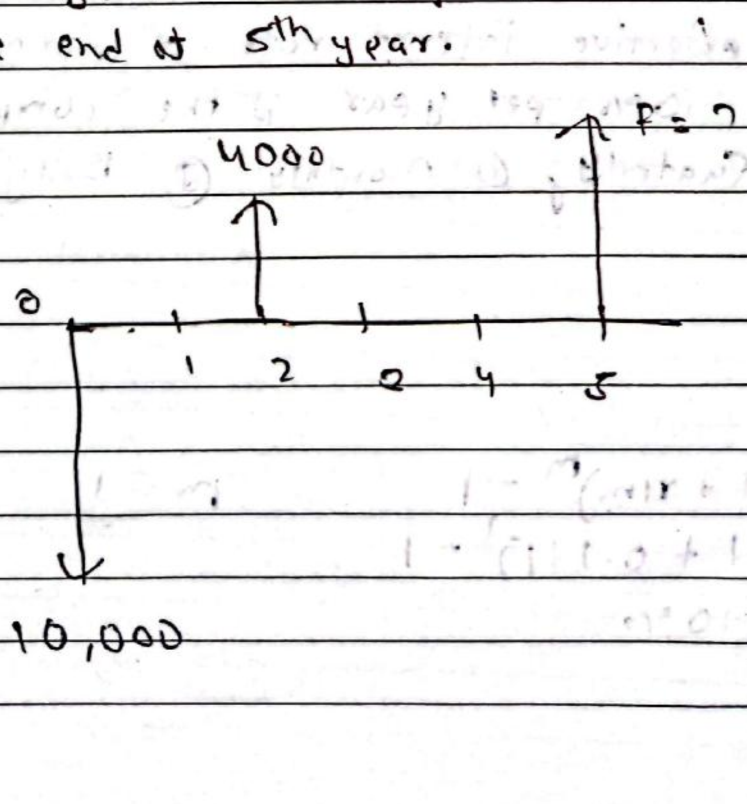
Continuous compounding

$$i = \lim_{m \to \infty} (1+r/m)^m - 1$$

$$i = e^r - 1$$

$$e^r = 1 + i$$

\# Mr X deposit 10,000 in a bank which gives 8% interest per year. He draws Rs 4000 at the end of 2nd year. What will be the remaining amount at the end of 5th year.



(a)

Amount at the end of 2^{nd} year

$$F = P(1+i)^N$$

$i = 8\%$, $N = 2$

$$F = 10{,}000\,(1 + 0.08)^2$$
$$= Rs\ 11664$$

Amount at the end of 2^{nd} year $= 11664 - 4000$
$= 7664$

Amount at the end of 5^{th} year

$$F = P(1+i)^N$$
$$F = 7664\,(1 + 0.08)^3$$
$$= Rs\ 9654.432$$

What is the effective interest rate at normal interest rate 10% per year if the compounding is (a) yearly (b) quaterly, (c) monthly (d) Daily (e) continuously

(a) yearly

$$i_{eff} = (1 + r/m)^m - 1 \qquad m = 1$$
$$= (1 + 0.1/1)^1 - 1$$
$$= 10\%$$

(5)

(b) Quarterly

$i_{eff} = (1 + r/m)^m - 1$

$m = 4$

$= ((1 + 0.1/4)^4 - 1) = 10.381\%$

(c) Monthly

$i_{eff} = (1 + r/m)^m - 1$

$m = 12$

$i_{eff} = (1 + 0.1/12)^{12} - 1 = 10.47\%$

(d) Daily

$i_{eff} = (1 + r/m)^m - 1$

$m = 365$

$= 10.51\%$

(e) Continuously

$i_{eff} = (1 + r/m)^m - 1$

$m \to \infty$

$e^r = 1 + i$

$i = e^r - 1$

$= e^{0.1} - 1$

$= 10.51\%$

⑥

\# If you deposit Rs 10,000 in a saving account now which gives 10% nominal interest rate what will be the amount after 5 years if the interest is compounded
(i) semi-annually (ii) monthly

(i) semi-annually

$i_{eff} = (1 + r/m)^m - 1$

$m = 2$

$i_{eff} = (1 + 0.1/2)^2 - 1 = 10.25\%$

$F = P (F/P, i\%, N)$

$F = P (1+i)^N$

$= 10,000 (1 + 0.1025)^5$

$= 16288.94627$

(ii) monthly

$i_{eff} = (1 + r/m)^m - 1$

$m = 12$

$i_{eff} = (1 + 0.1/12)^{12} - 1$

$= 10.47\%$

$F = 10,000 (1 + 0.1047)^{12}$

$= \cancel{33031.80050}$ 16452.116

\# Suppose you have invested Rs 1,000 at present. How long does it take for your investment to double if interest rate is 8%, compounded annually?

$$i_{eff} = (1 + r/m)^m - 1$$

$$= (1 + 0.08/1)^1 - 1$$

$$= 8\%$$

$$2\cancel{P} = \cancel{P}(1 + 0.08)^N$$

$$2 = (1.08)^N$$

$\therefore$ $N = 9$ yrs

\# Economic Equivalence

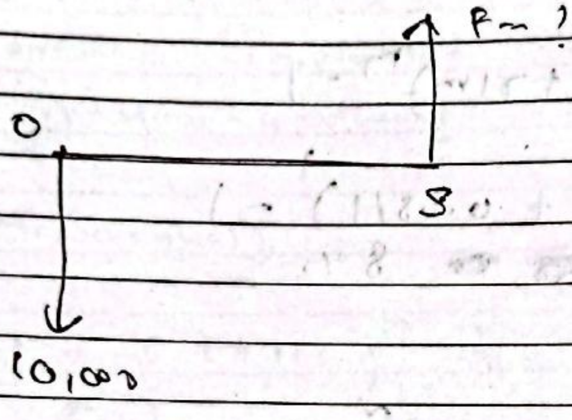
→ process of comparing two different cash amounts at different points in time is called Economic Equivalence.

General principle

→ interest rate ~~sma~~ same, time period same hunu paryo

Types of cash flow

(1) Single cash flow



(2) Formulas :

(1) To find F when A is given

$$F = A\left[\frac{(1+i)^N - 1}{i}\right]$$

(2) To find A when F is given

$$A = F\left[\frac{i}{(1+i)^N - 1}\right]$$

(3) $F = P(1+i)^N$

(4) $P = F(1+i)^{-N}$

(5) To find P when A given

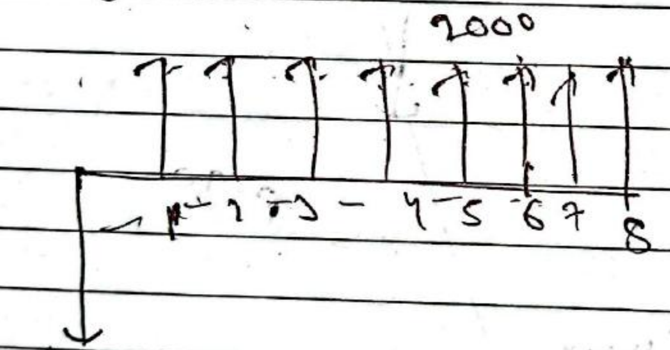
⑨

$$P = A \left[\frac{(1+i)^N - 1}{i \times (1+i)^N} \right]$$

① To find A when P is given

$$A = P \left[\frac{i \times (1+i)^N}{(1+i)^N - 1} \right]$$

⑩ Equal payment Series



P = ?

beginning

F word nang 8 years
end a ico dincha

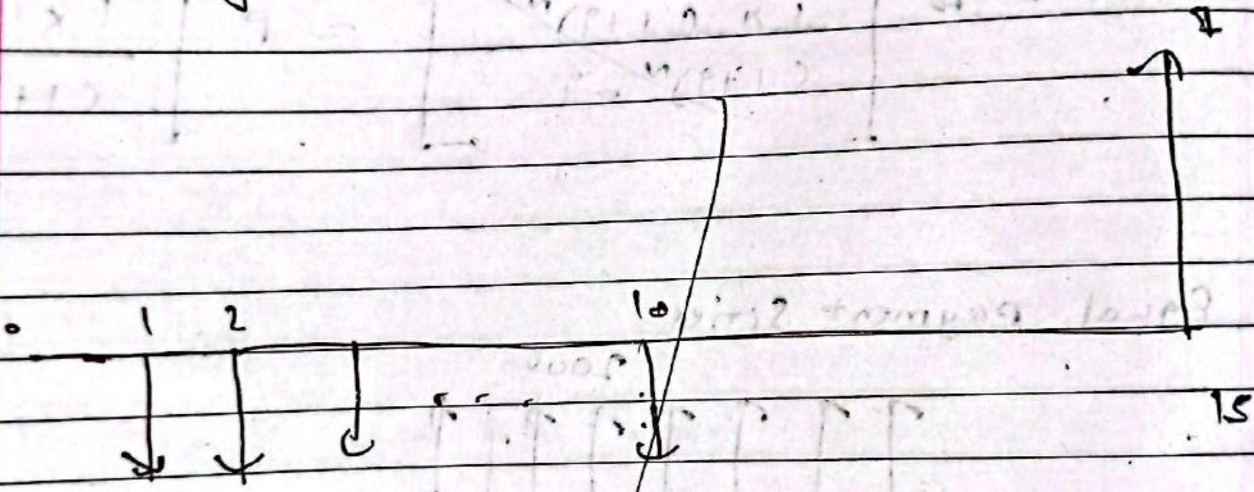
i_{eff} = 10%.

$$P = A \left[\frac{(1+i)^N - 1}{i \times (1+i)^N} \right] = 2000 \left[\frac{(1+0.1)^8 - 1}{0.1 \times (1+0.1)^8} \right]$$

$$= 10669.8524$$

(11)

Q/ Mr Jha wants to have Rs 1000000 for the studies of his daughter after period of 15 years. How much rupee does he has to deposit each year for 10 continuous years in a saving account that earns 8% interest annually.



P:10

$i = 8\%$

At end of 10 years

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

$$= A\left[\frac{(1+0.08)^{10} - 1}{0.08}\right]$$

$$= 14.48A$$

(11)

Now at : end of 15 year

$$F = P(1+i)^N$$

$$1000000 = 14.48\,A\,(1+0.08)^5$$

or $\dfrac{1000000}{(1+0.08)^5 \times 14.48} = A$ p.t.o

$\therefore A = 47001.60201$ (pachi)

Continuous compounding

(i) ~~To find F~~

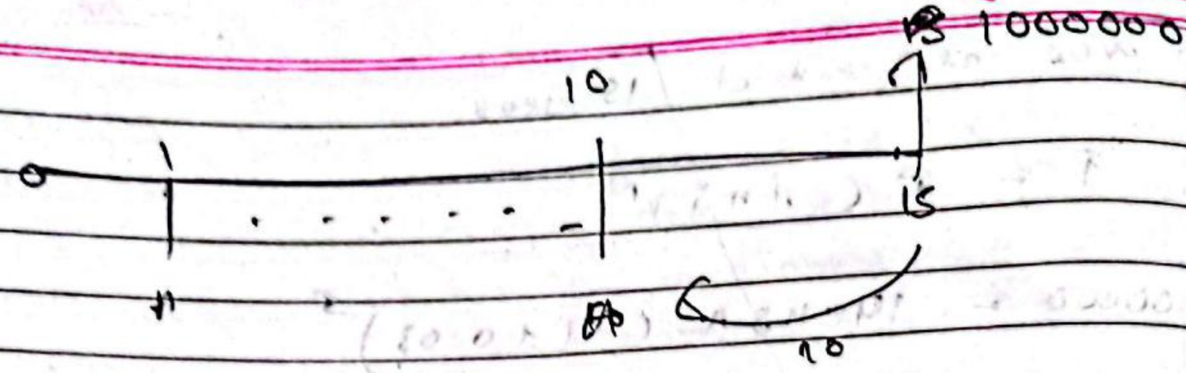
$$F = A\left[\frac{e^{rN}-1}{e^{r}-1}\right]$$

$$P = A\left[\frac{e^{rN}-1}{e^{rN}(e^{r}-1)}\right]$$

($\because 1+i = e^{r}$)

(~~change~~ remove i from previous formulas)

(12)



$$P = F(1+i)^{-N}$$

$$= 1000000\,(1+0.08)^{-5}$$

$$= 680583.197$$

Now,

$$A = F\left[\frac{i}{(1+i)^N - 1}\right]$$

$$= \cancel{1000000}\ 680583.197\left[\frac{0.08}{(1+0.08)^{10} - 1}\right]$$

$$= 46980.31011$$

(start from given data always)

(13)

\# FE of a continuous funds flow amounting \$ 10000 per year $N = 12$ yrs, $r = 20\%$.
compounding continuously.

$$F = A\left[\frac{e^{rN} - 1}{e^{r} - 1}\right]$$

$$= 10000\left[\frac{e^{0.2 \times 12} - 1}{e^{0.2} - 1}\right]$$

$$= US\ 2712.33$$

\# For compounding

(i) From higher compounding period to lower compounding period

$$i_{quater} = \frac{i_{year}}{4} \quad \text{or} \quad i_{quater} = \frac{i_{semi}}{2}$$

$$i_{sem} = \frac{i_{year}}{2}$$

(ii) from lower compounding to higher compounding

$$i_{semi} = (1 + i_{quarter})^2 - 1$$

$$i_{year} = (1 + i_{quarter})^{n} - 1$$

14

For Withdraw

If i = interest rate per year and withdraw is monthy then

$\cancel{i_{month}}$ $i_{monthly} = (1 + i_{year})^{1/12} - 1$

What will be the amount at the end of 10 yrs if you deposit Rs 5000 per month for five years continuously if nominal interest rate is 10% compounded quatrly?

$r = 10\%$ $m = 4$

$i_{eff} = \left(1 + \frac{r}{m}\right)^{m} - 1$

$= 10.38\%$

For montly rate

$i_{monthly} = (1 + i_{eff})^{1/12} - 1$

$= (1 + 0.1038)^{1/12} - 1$

$= 0.826\%$

$\cancel{F = P(1+i)^N}$

$F = A\left[\frac{(1+i)^N - 1}{i}\right]$

H.N = 5 years
$= 5 \times 12 = 60$ mon

(5)

$$P = 5000 \left[\frac{(1 + 8.26\times10^{-3})^{80} - 1}{8.26\times10^{-3}} \right]$$

$$= 386286.1904$$

Now,

$$F = P(1+i)^N$$

$$F = 386286.1904\,(1 + 0.1038)^5$$
$$= 632937.9428$$

P because already received

Mr X receives a loan of Rs 120000 from a bank at an interest rate of 12% per year. He wishes to repay the loan in monthly installment with Rs 3000 per month. How many installments are necessary to complete his payment?

$$i_{month} = (1 + i_{year})^{1/12} - 1$$
$$= (1 + 0.12)^{1/12} - 1$$
$$= 0.948\,\%$$

P ↓ A ↓

$$120000 = 3000 \left[\frac{(1 + 0.948\times10^{-2})^N - 1}{(1 + 0.948\times10^{-2})^N \times 0.00948} \right]$$

$N = 50.5$ yrs

* A person borrows Rs 5000 for 3 years to be repaid in equal monthly installments. The interest rate is 10% per year compounded continuously. How much money must be paid at the end of each month?

Soln:-

→ $i_{eff} = e^{r} - 1$

$= e^{0.1} - 1$

$= 10.52\%$

$i_{monthly} = (1 + i_{yearly})^{1/12} - 1$

$= 8.37 \times 10^{-3}$

$N = 3 \times 12 = 36$ months

$$P = A \left[\frac{e^{rN} - 1}{e^{rN}(e^{r} - 1)} \right]$$

$\cancel{P = 5000 = A \left[P \right]}$

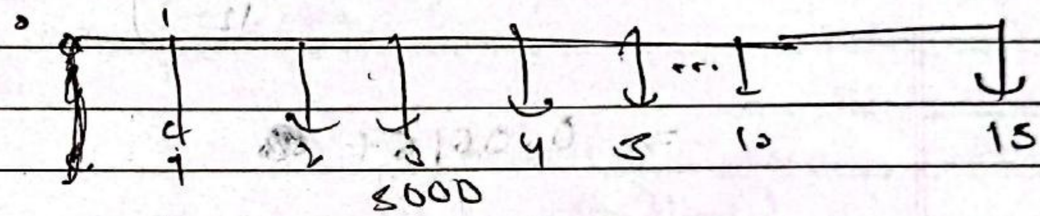
$$A = P \left[\frac{e^{rN}(e^{r} - 1)}{e^{rN} - 1} \right] = \underline{\underline{161.225}}$$

$\underline{\underline{\text{per month}}}$

(17)

If you make equal monthly deposits of Rs 5000 into bank for 10 yrs, saving accounts that pay interest rate of 6% compounded monthly, what would be the amount at the end of 15 years!

soln:



$r = 6\%$ compounded monthly

$$i_{eff} = \left(1+\frac{r}{m}\right)^m - 1$$

$$= \left(1+\frac{0.06}{12}\right)^{12} - 1$$

$$= 0.0616$$

$$F_{10} = A\left[\frac{(1+i)^N - 1}{i}\right]$$

$$= 5000\left[\frac{(1+0.0616)^{10} - 1}{0.0616}\right]$$

$$= 66425.56$$

$$F_{15} = 66425.56\,(1+0.0616)^5 = 89565.30812$$

(18)

$A = 5000$

$r = 6\%$ compounded monthly

i.e.

$$i_{eff} = \left(1 + \frac{r}{m}\right)^m - 1$$

$$= \left(1 + \frac{0.06}{12}\right)^{12} - 1$$

$$\Rightarrow 0.06167$$

$$i_{monthly} = (1 + i_{eff})^{1/12} - 1$$

$$= 5 \times 10^{-3}$$

$$= 0.5\%$$

$$F_{10} = A\left[\frac{(1+i)^n - 1}{i}\right] \quad n = 10 \times 12 = 120 \text{ months}$$

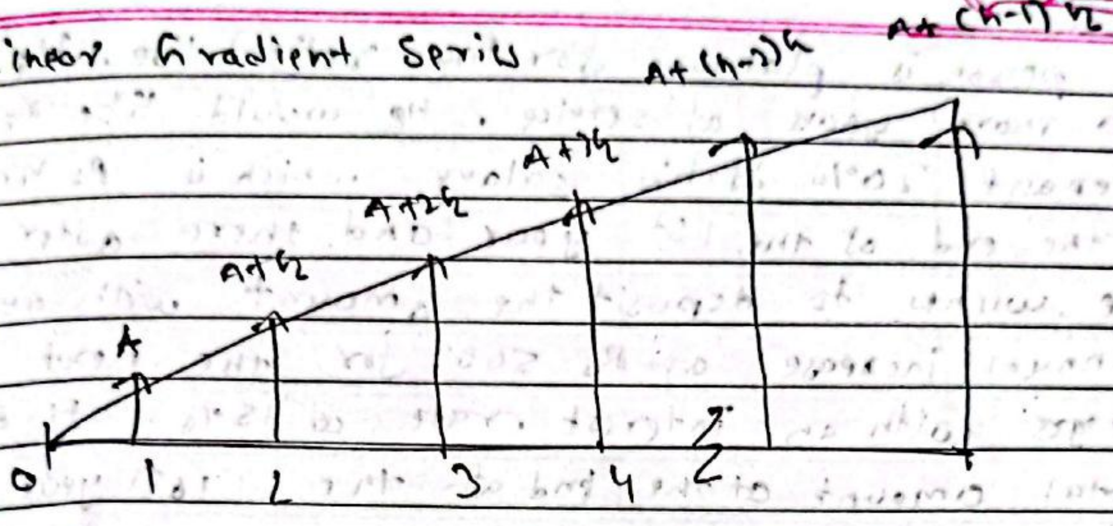
$$= 5000\left[\frac{(1 + 0.5 \times 10^{-2})^{120} - 1}{0.5 \times 10^{-2}}\right]$$

$$= 81939.6734$$

$$F_{15} = 81939.6734\,(1 + 0.06167)^5$$

$$= 110520.7948$$

Linear Gradient Series



Increasing linear Gradient

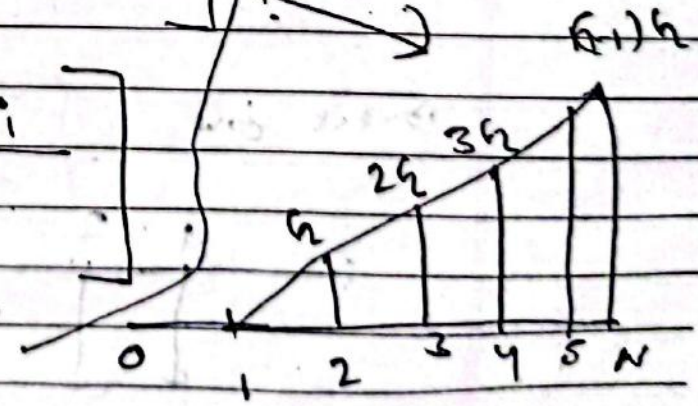
(amount increase or decrease in gradient)

(1) Find F when G is given

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

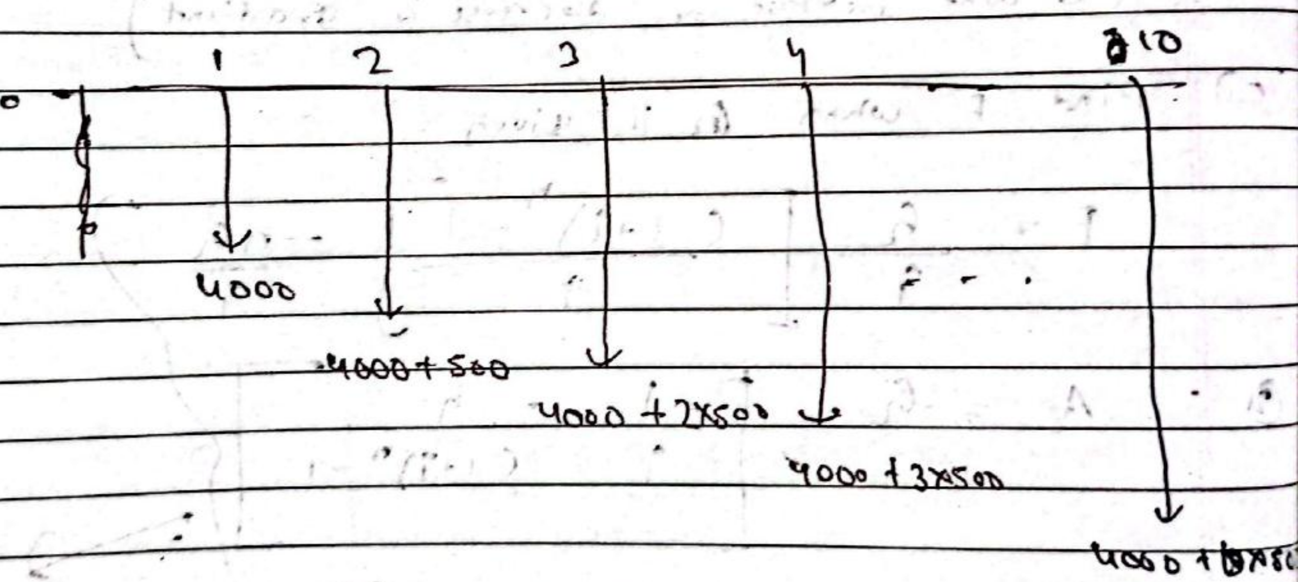
(2)
$$A = G\left[\frac{1}{i} - \frac{n}{(1+i)^n - 1}\right]$$

(3)
$$P = \frac{G}{i^2}\left[\frac{(1+i)^n - 1 - ni}{(1+i)^n}\right]$$

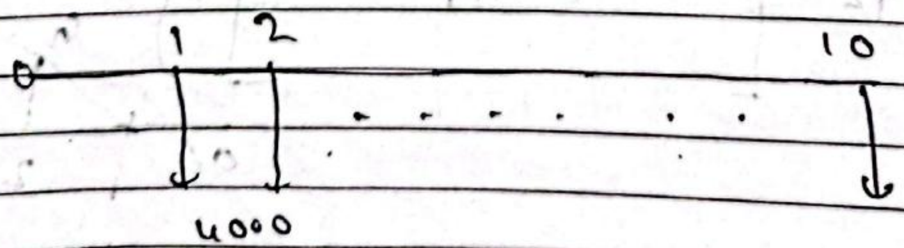


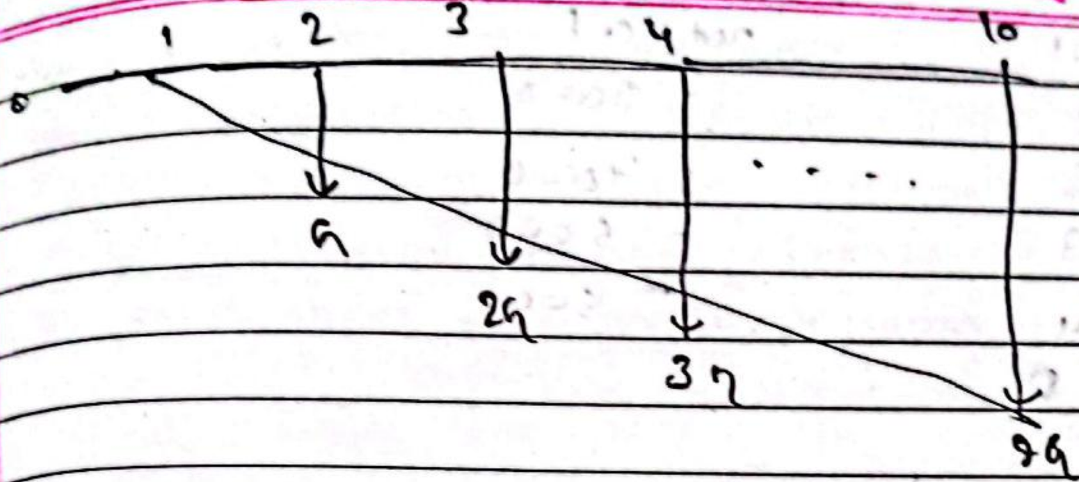
(G is zero at year 1)

A person is planning for his retired life. He has 10 more years of service. He would like to deposit 20% of his salary which is Rs 4000 at the end of the 1st year and there after he wishes to deposit the amount with an annual increase of Rs 500 for the next 9 yrs with an interest rate of 15%. Find total amount at the end of the 18th year of the above service.



Break dow





$G = 500$

$F = F_A + F_G$

$$F_G = \frac{G}{i}\left[\frac{(1+i)^n - 1}{i}\right] - \frac{nG}{i}$$

$$= \frac{500}{0.15}\left[\frac{(1+0.15)^{10} - 1}{0.15}\right] - \frac{10 \times 500}{0.15}$$

$= 34345.77741$

$$F_A = A\left[\frac{(1+i)^N - 1}{i}\right]$$

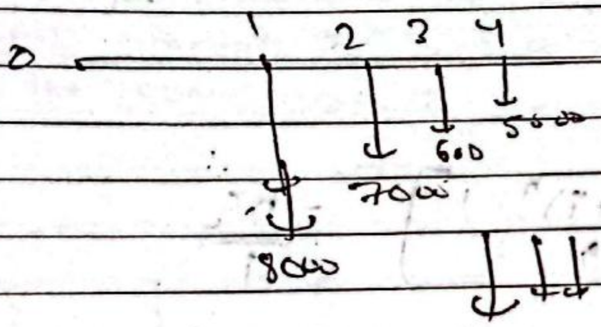
$$= 4000\left[\frac{(1+0.15)^{10} - 1}{0.15}\right]$$

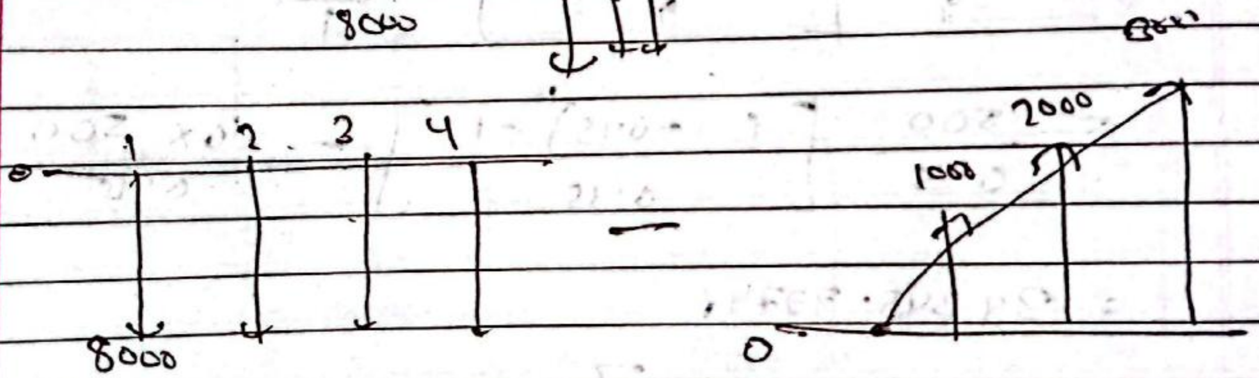
$= 81214.87295$

$= 115560.6504$ #

(22)

# EOY	net CF
1	− 8000
2	− 7000
3	− 6000
4	− 5000





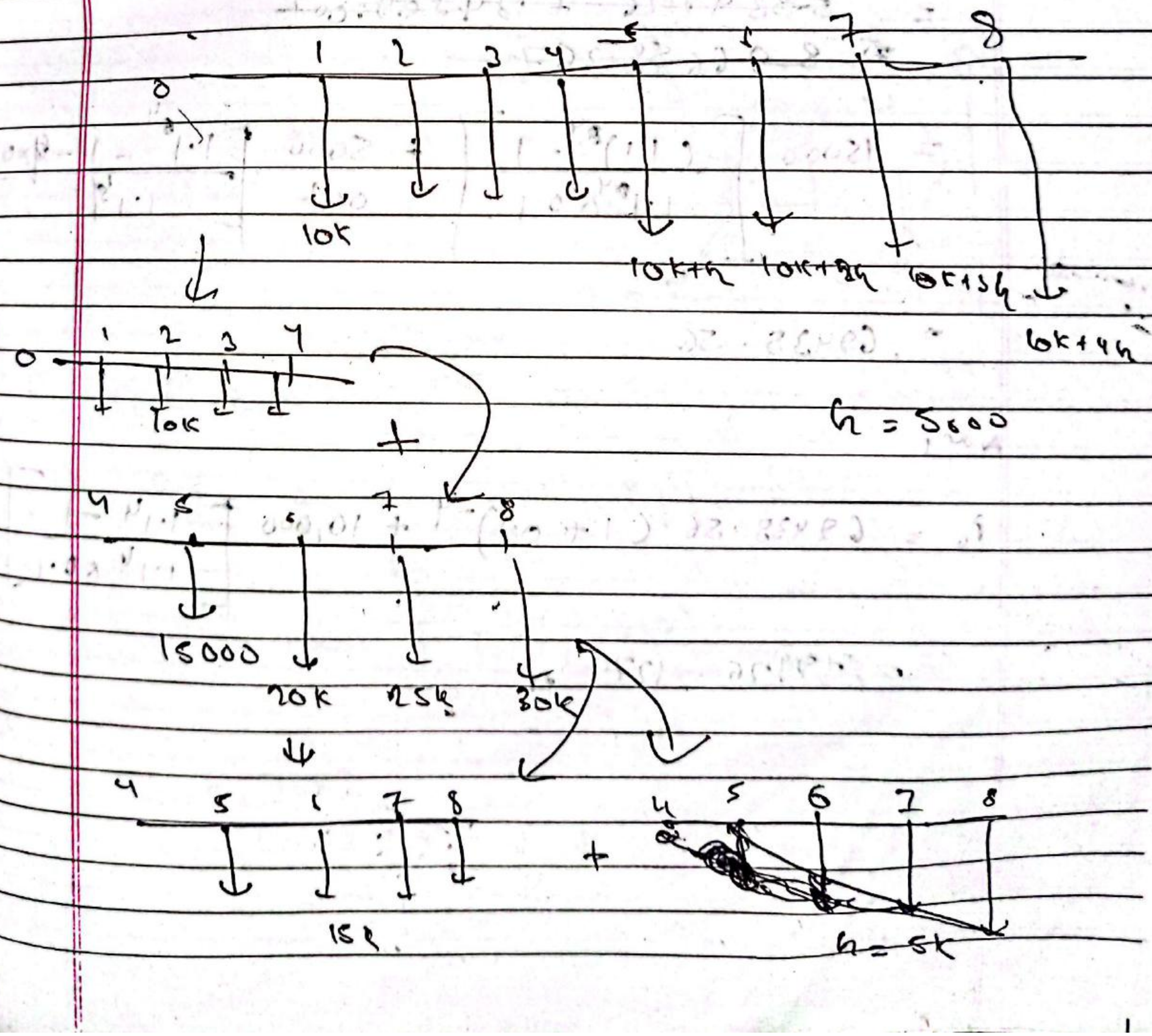
$i = 15\%$

$P = P_A + P_G$

$$= A\left[\frac{(1+i)^N - 1}{i\,(1+i)^N}\right] + \frac{G}{i^2}\left[\frac{(1+i)^n - 1 - ni}{(1+i)^n}\right]$$

$= 19053.38$

Q. An engineer has inspected the average cost on a cement production for 8 years. cost average were steady at Rs 10,000 per year for the 1st year. 4 years but have increased consistently by Rs 5000 per year for last 4 year. PW if i=10%.



(24)

$P_4 = P_A + P_G$

$= A\left[\frac{(1+i)^n - 1}{(1+i)^n \times i}\right] + \frac{G}{i^2}\left[\frac{(1+i)^n - 1 - ni}{(1+i)^n}\right]$

$= \cancel{53348.26 + 34308.007}$

$= \cancel{89658.267}$

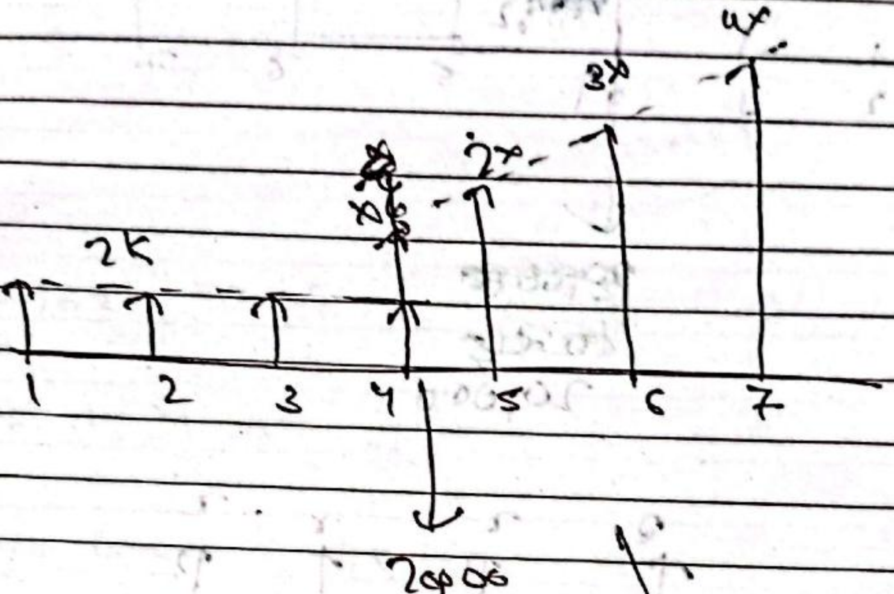
$= 15000\left[\frac{(1.1)^4 - 1}{1.1^4 \times 0.1}\right] + \frac{5000}{0.1^2}\left[\frac{1.1^4 - 1 - 4\times 0.1}{1.1^4}\right]$

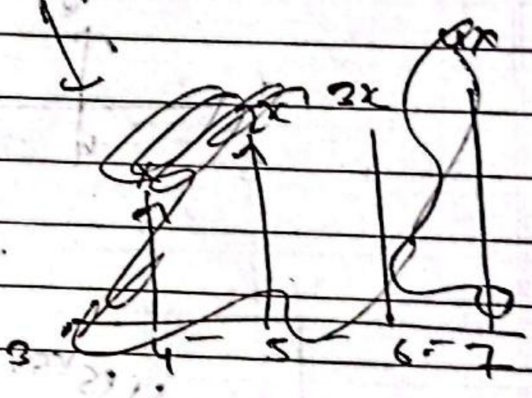
$= 69438.56$

Now,

$P_0 = 69438.56\,(1+0.1)^{-4} + 10,000\left[\frac{1.1^4 - 1}{1.1^4 \times 0.1}\right]$

$= 79126.127$ #





find x if $i = 10\%$

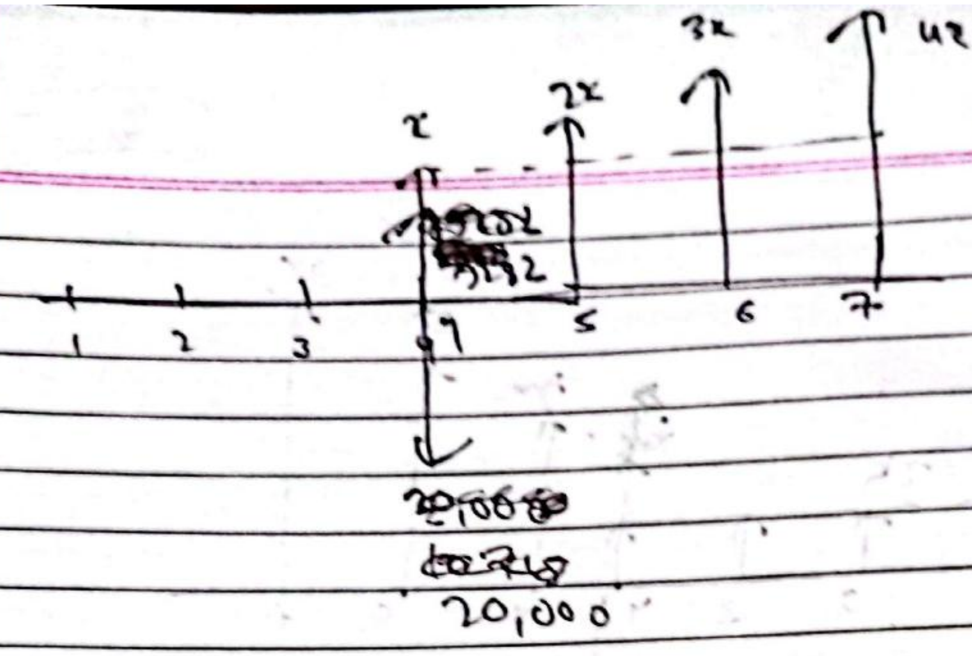
At 4th year

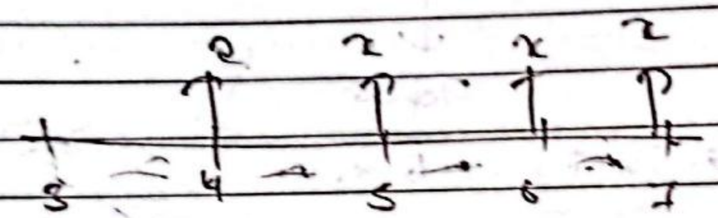
$$F_4 = A\left[\frac{(1+i)^n - 1}{i}\right]$$

$$= 2000\left[\frac{(1+0.1)^4 - 1}{0.1}\right]$$

$$= 9282$$

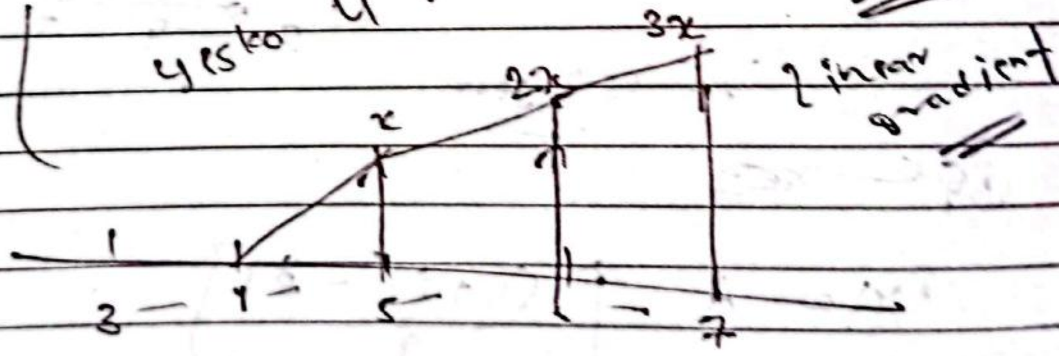
5b





+

(yesko 4 ratcha 3 ma nisleincha ka)



$$P_3 = x\left[\frac{(1+0.1)^4-1}{(1.1)^4\times 0.1}\right] + \frac{x}{0.1^2}\left[\frac{1.1^4-1-4\times 0.1}{1.1^4}\right]$$

$$= 3.169x + 4.378x = 7.547x$$

$P_4 = 7.547x \quad (1+0.1)^1$

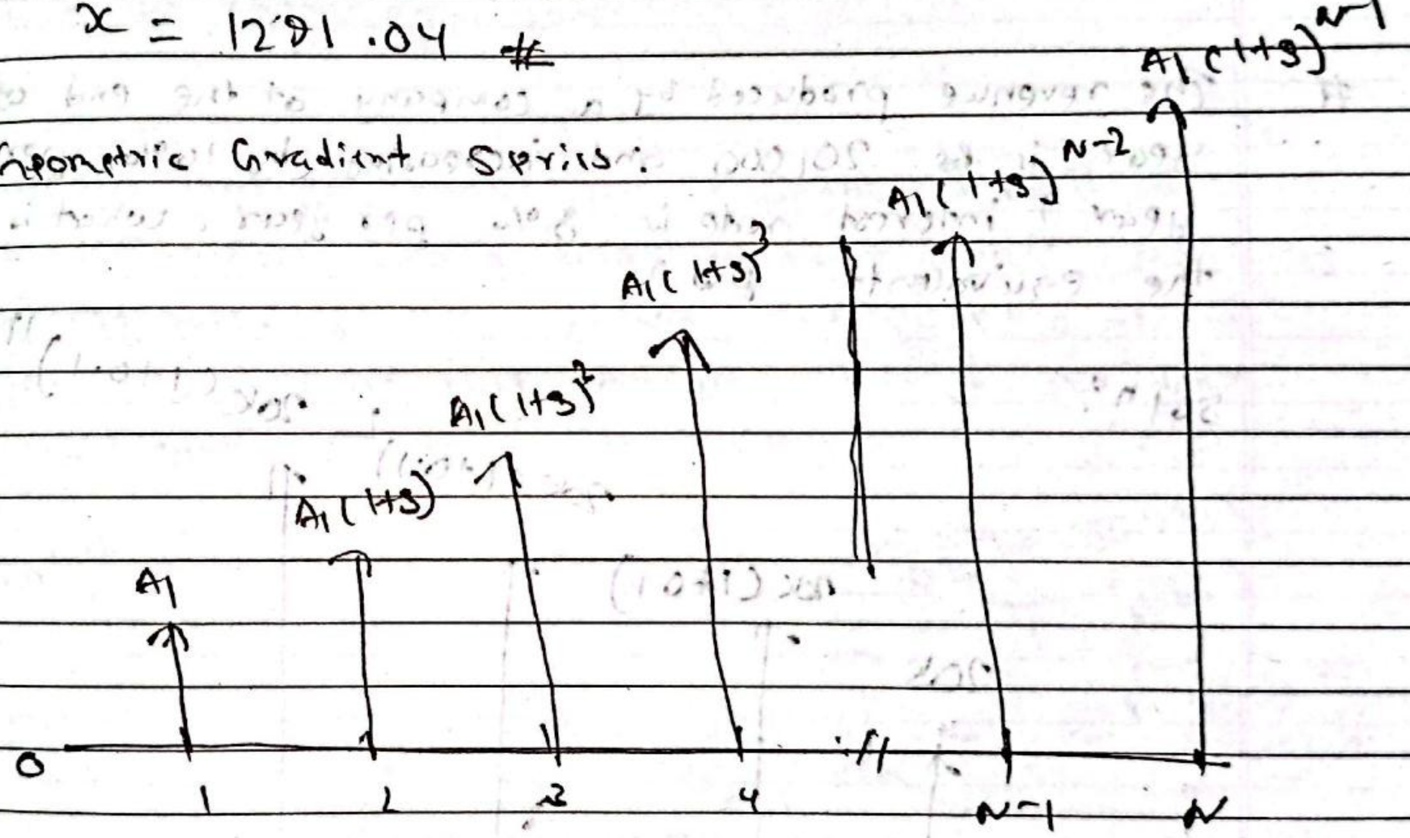
$= 8.3018x$

Now, at year 4 (equate)

$8.3018x + 9282 - 20{,}000 = 0$

$x = 1291.04$ #

Geometric Gradient Series:



P.W

if $i \neq g$

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

$i = g$, $\quad P = \dfrac{NA_1}{(1+i)}$

(28)

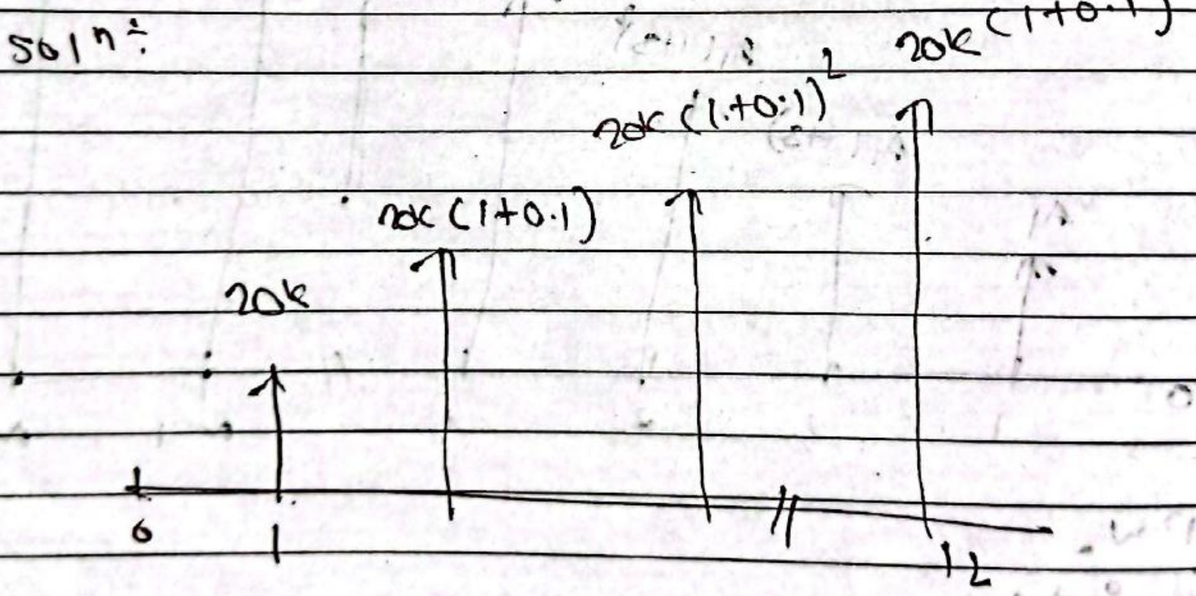
F.W

if $i \neq g$ $\quad F = A_1 \left\{ \dfrac{(1+i)^n - (1+g)^n}{i-g} \right\}$

$i = g$, $\quad F = NA_1 (1+i)^{n-1}$

The revenue produced by a company at the end of 1st year is Rs 20,000 and increasing by 10% per year ; interest rate is 8% per year. What is the equivalent PW ?

Soln:



$A = 20,000$
$g = 10\%$
$i = 8\%$
$n = 12$

$i \neq g$

$$P = A\left(\frac{1 - (1+g)^n (1+i)^{-n}}{i-g}\right)$$

$$= 2000\left(\frac{1 - (1+0.1)^{12}(1+0.08)^{-12}}{0.08-0.1}\right)$$

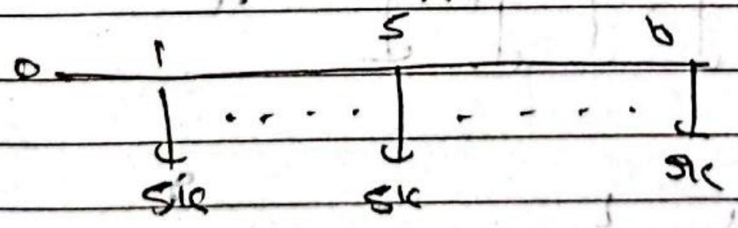
P = Rs 246313.08

Suppose that you make the monthly deposit of Rs 5000 each into a bank account that pays an interest rate of 8% compounded weekly for 5 years, interest rate charges to 6% per year. How much money after 8 yrs?

soln:

$F_{10} = \cancel{89606.99}\,(1+0.06)^5$

$= 11\cancel{9914}3786$



$$i_{eff} = \left(1+\frac{r}{m}\right)^m - 1 = \left(1+\frac{0.08}{48}\right)^{48} - 1$$

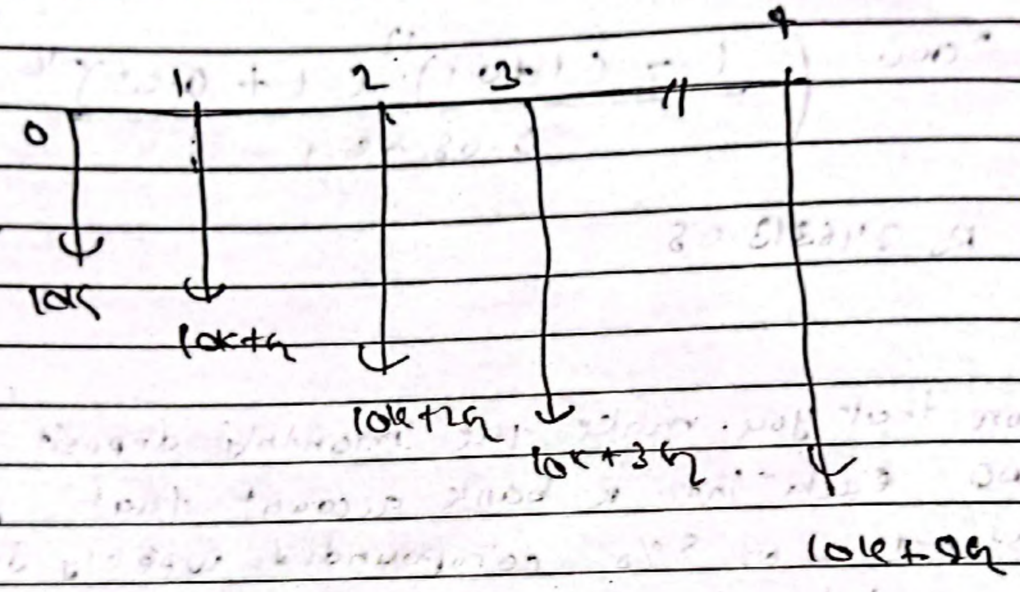
$= 0.0832$

$$F_5 = 5000\left(\frac{(1+0.0832)^5 - 1}{0.0832}\right) = 89606.989$$

$= (1 + i_{year})^{1/12} - 1$

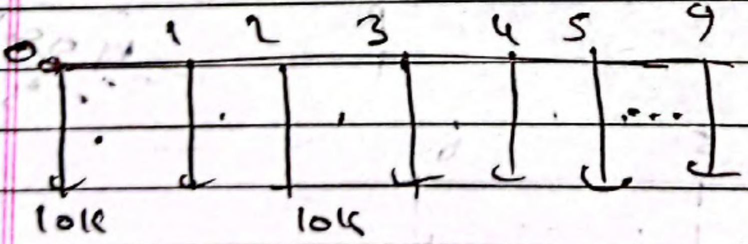
5 years to monthly and rest use $i_{monthly}$ 6% =

(30) #



$$i_{eff} = \left(1 + \frac{0.12}{12}\right)^{12} - 1$$

$$= 0.1268$$



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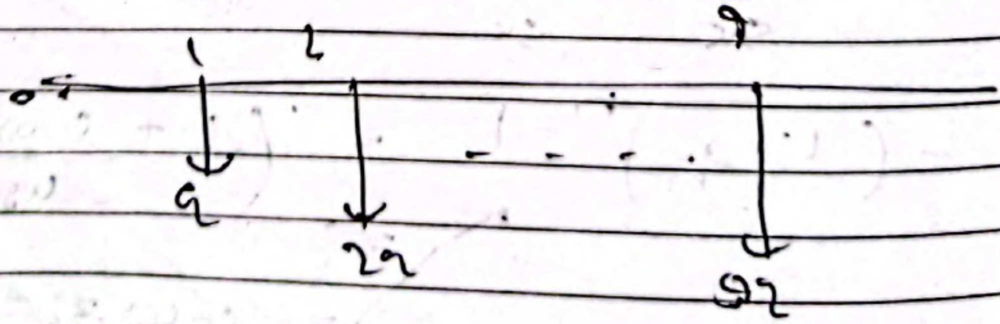


$$F_{10} = A\left[\frac{(1+i)^n - 1}{i}\right] + \frac{G}{i}\left[\frac{(1+i)^n - 1}{i}\right] - \frac{nG}{i}$$

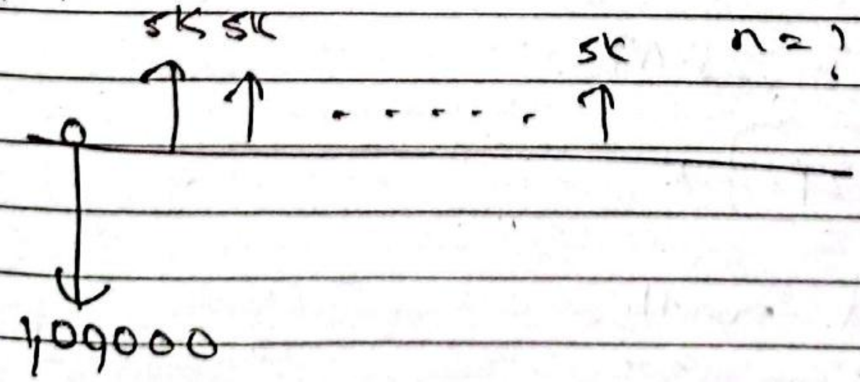
$$10{,}000\left[\frac{(1.1268)^{10} - 1}{0.1268}\right] + \frac{2000}{0.1268}\left[\frac{(1.1268)^{10} - 1}{0.1268}\right]$$

$$- \frac{10 \times 2000}{0.1268}$$

309689.916

If you ~~deposit~~ deposit Rs 1 lakh now in a bank account that gives 6% interest per yer. How many times could you draw Rs 5000 per mont with that money.

Soln:



$$i_{monthly} = (1 + i_{yr})^{1/12} - 1$$

$$= 0.4867\ \%$$

(30)

$$P = A\left[\cancel{}\ \frac{(1+i)^n - 1}{i \times (1+i)^n}\right]$$

$$1{,}00{,}000 = \overset{5000}{A}\left[\frac{(1.0048)^n - 1}{0.0048 \times (1.0084)^n}\right]$$

$$20 = \left[\frac{(1.0048)^n - 1}{0.0048 \times (1.0048)^n}\right]$$

$$0.096 \times (1.0048)^n = (1.0048)^n - 1$$

$$\cancel{-}\,0.904 \times (1.0048)^n = \cancel{-}1$$

$$(1.0048)^n = 1.1061$$

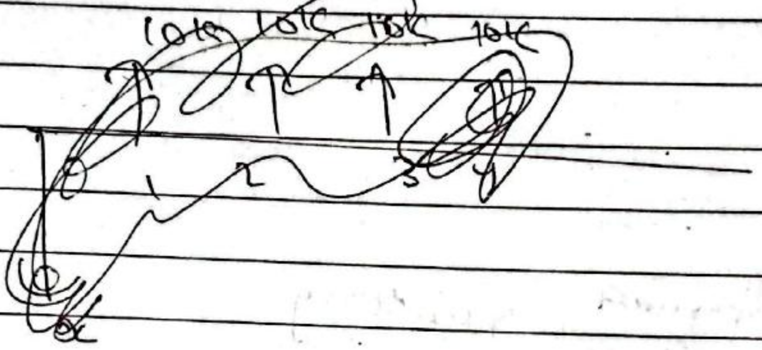
$$n = 21.07$$

$$\boxed{n = 21}$$

for 21 months

If you wish to draw Rs 10,000 per month for 4 years. How much should you deposit at present for that when rate of interest is 7% per year.

soln:-



$i = 7\%$ $\qquad i_{monthly} = (1 + 0.07)^{1/12} - 1$

$$P = A\left[\frac{(1+i)^n - 1}{(1+i)^n \times i}\right] \qquad = 0.56\%$$

$n = 4 \times 12$

= $\frac{(1.07)^4 - 1}{(1.07)^4 \times 0.07}$

= ~~33872.1125~~ = 419876.0433

In CFD

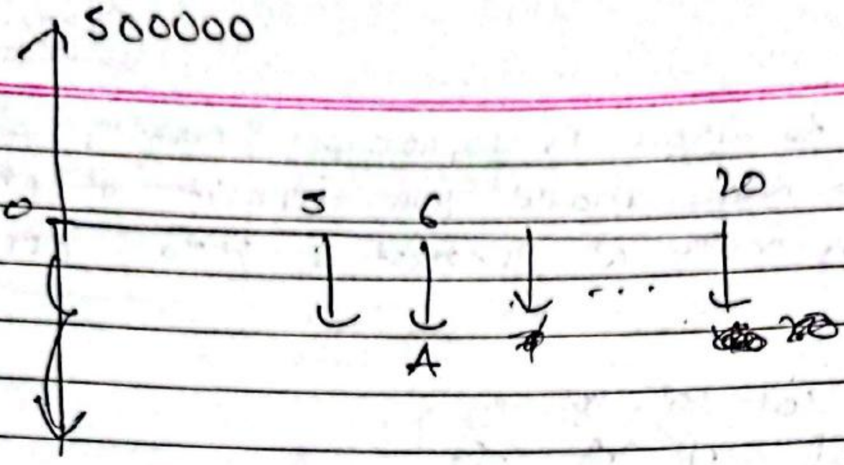
- → borrowed money
- → Revenues
- → Investment returns

(Inflows)

- → expenses
- → Repayment of loans
- → taxes
- → buying
- → Dividends
- → Investment

34

H



$A = ?$

$i = 11\%$ compounded quatorly

loan payment in semiannual installment.

$i = 11\%$ com quatory

$i_q = \frac{11}{4} = 2.75\%$ quatorly

$i_{sem} = (1 + i_q)^2 - 1$

$= (1 + 0.0275)^2 - 1 = 5.57\%$

20 yrs

semi annually

Now,

$F = P(1+i)^N = 500000\,(1+0.057)^{40}$ — (1)

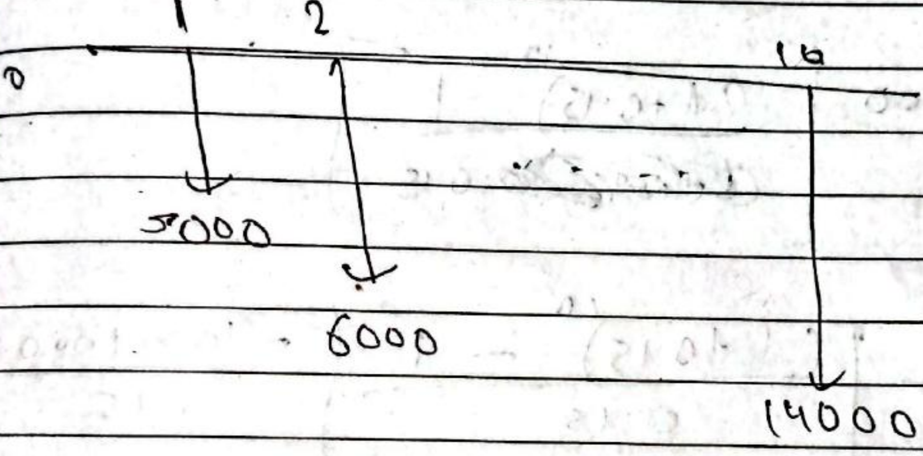
$F = A\left[\frac{(1+i)^N - 1}{i}\right] = A\left[\frac{(1+0.057)^{30} - 1}{0.057}\right]$

— (2)

Equating (i) and (ii) $\left(\uparrow - \downarrow = 0\right)$.

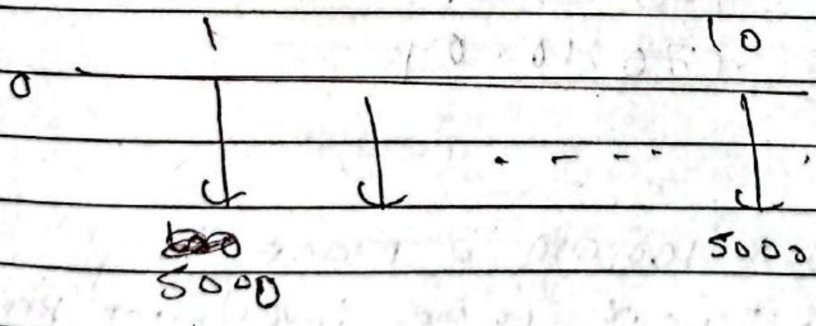
$$500000\,(1.057)^{40} = A\left[\frac{(1.057)^{10}-1}{0.057}\right]$$

$A = 61217.32$



$\Downarrow$

$i = 15\%$



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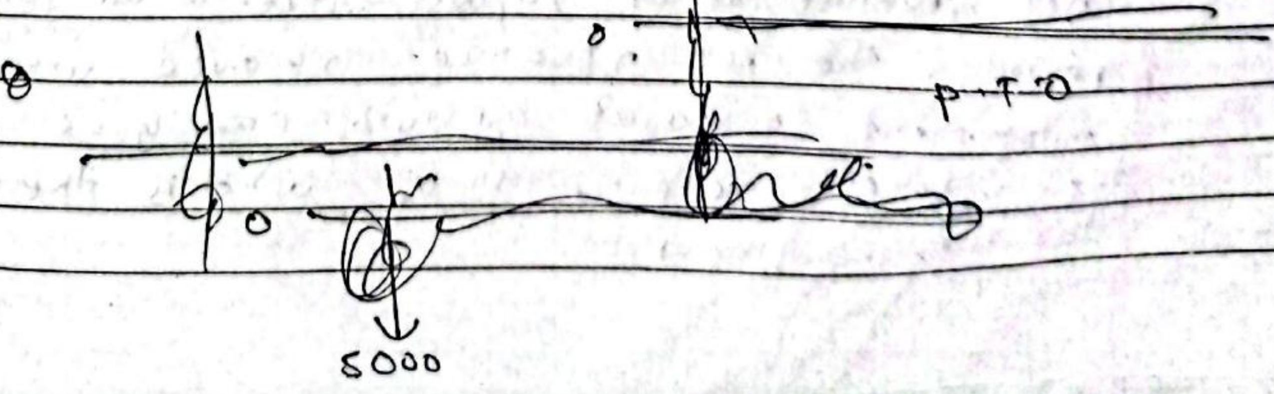
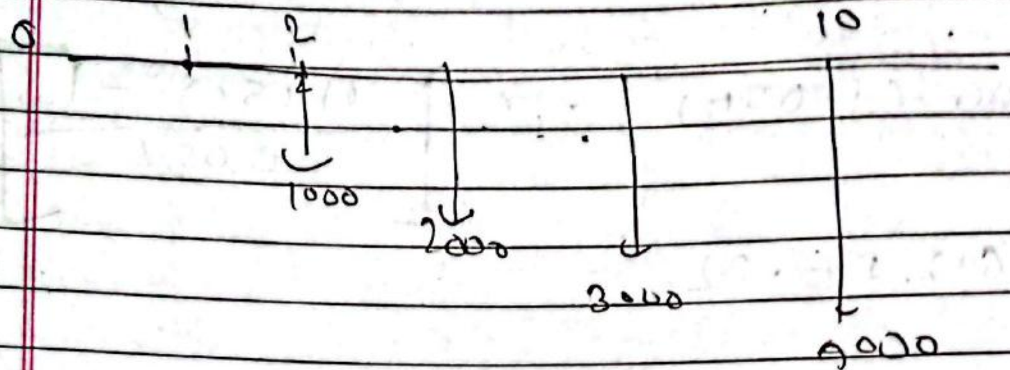


p.T.O



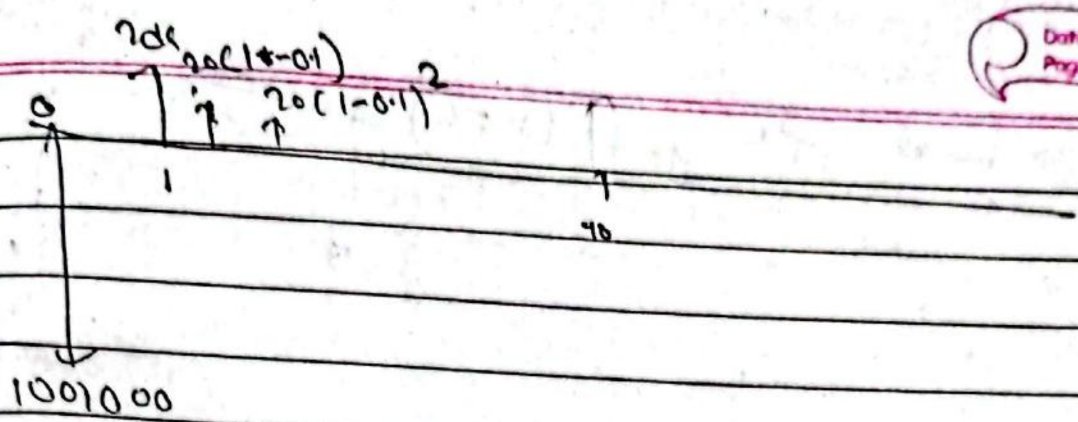
Now,

$$F_{10} = 5000 \left[\frac{(1+0.15)^{10} - 1}{0.15} \right]$$

$$+ \frac{1000}{0.15} \left[\frac{(1+0.15)^{10} - 1}{0.15} \right] - \frac{10 \times 1000}{0.15}$$

$\doteq$ ~~93785.70805~~ ~~170209.33~~
170210.04

An investment of Rs 100,000 is made in a company. The first year of the investment product net revenue of Rs 20,000. Over a 40 year period, the net revenue received from the investment decreased by 20% each year. If the interest rate is 12%, what is the PW for the investment?

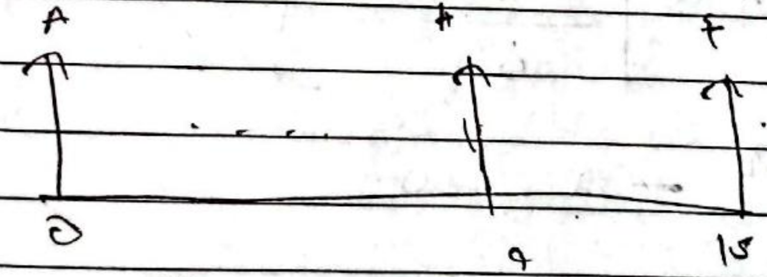


Q.(12) $g = -0.1$, $i = 0.112$ $A = 20{,}000$, $N = 40$

$$P.W = -100{,}000 + 20{,}000\left[\frac{1-(1+g)^n(1+i)^{-n}}{i-g}\right]$$

$$= -100{,}000 + 20{,}000\left[\frac{1-(1-0.1)^{40}(1+0.12)^{-40}}{0.12+0.1}\right]$$

= Rs 13,618.3



amount wal cash flow ma jati wata ra cha n is that

$A = 50{,}000$ $r = 10\%$ comp monthly

$$i = \left(1+\frac{r}{m}\right)^m - 1 = 10.47\%$$

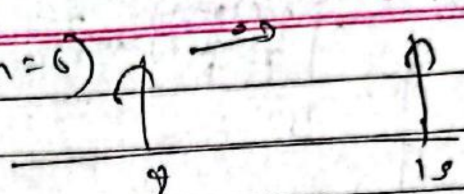
At end of 9th year

$$RW = A\left[\frac{(1+i)^n-1}{i}\right] = 50{,}000\left[\frac{(1+0.1047)^{10}-1}{0.1}\right]$$

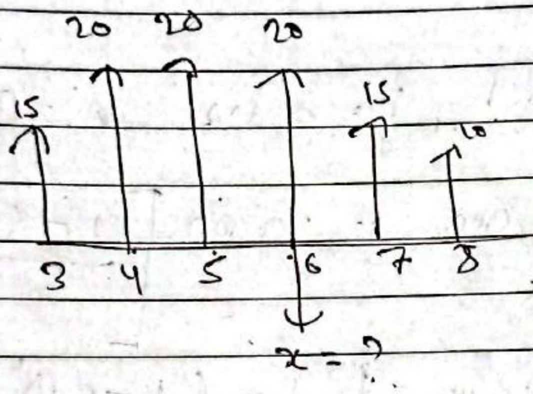
= Rs 853360.65

(38)

FW at end of 15^{th} year $(n=6)$



#



$i = 10\%$

$x = ?$

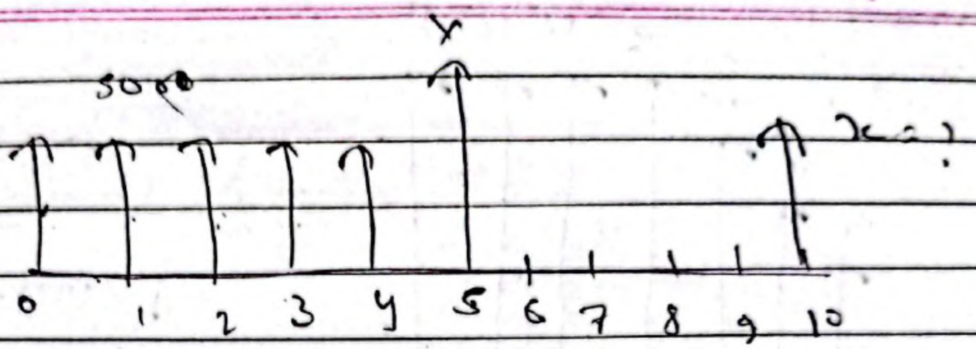
Compounding 15, 20, 20, 20 to year 6 and discount 15 and 10 to year 6

$$15(1+0.1)^3 + 20\left[\frac{(1+0.1)^3 - 1}{0.1}\right] + 15(1+0.1)^{-1}$$

$$+ 10(1+0.1)^{-2} - x = 0$$

$\therefore \quad x = 108.065$

FW at end of 10 yrs with 8% intrest rate compounded continuously with Rs 500 at begining of each year for 1st five years.



$$F_4 = A\left[\frac{(1+i)^n - 1}{i}\right]$$

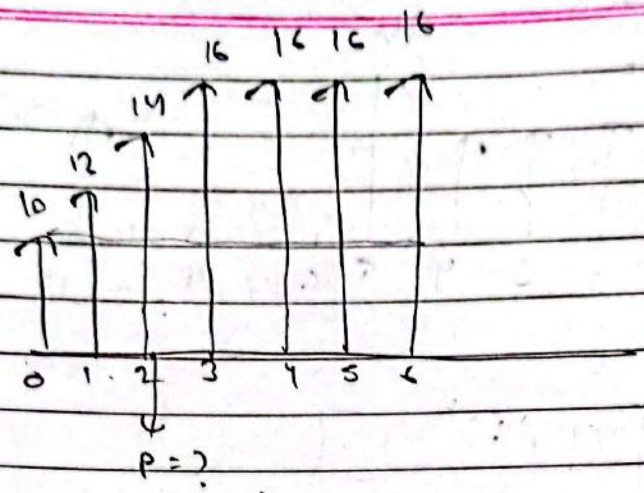
$$F_4 = A\left[\frac{e^{rN} - 1}{e^r - 1}\right] = 500\left[\frac{e^{0.08\times 5} - 1}{e^{0.08} - 1}\right]$$

$$= 2952.58$$

$$F_{10} = \cancel{(1+} \; 2952.58\, e^{rN}$$
$$= 2952.58\, e^{0.08 \times 6}$$
$$= 4771.6$$

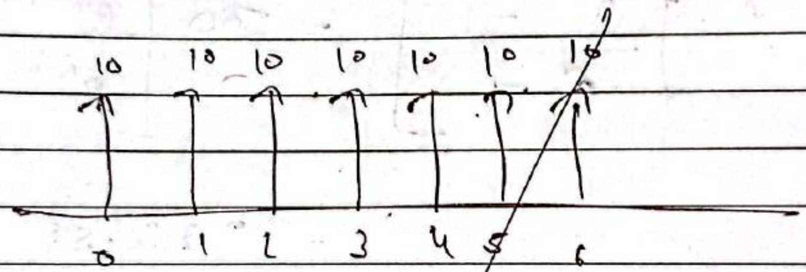
p.T.O

32

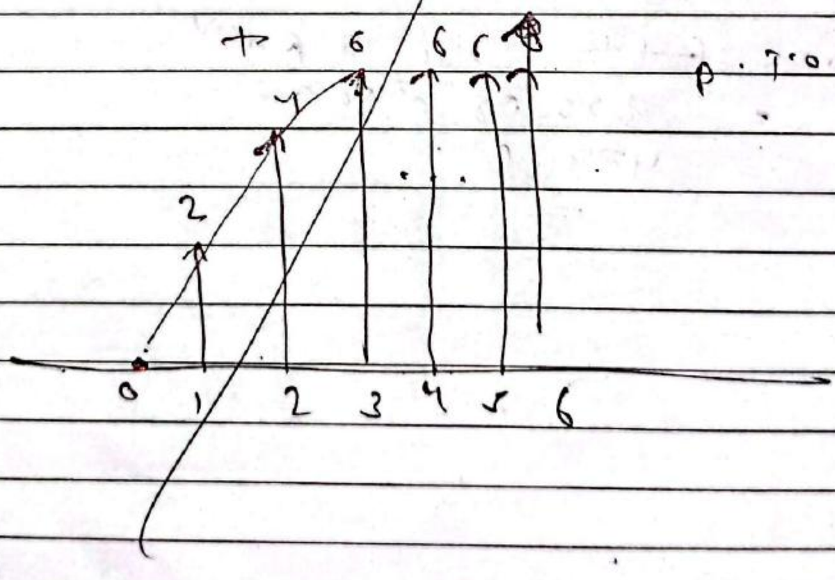


10
12
14
16 16 16 16
0 1 2 3 4 5 6
P = ?

i = 10%

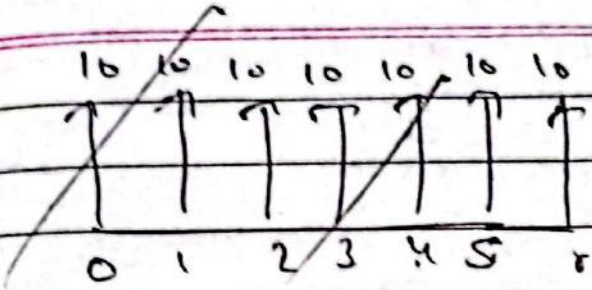


10 10 10 10 10 10 10
0 1 2 3 4 5 6



2
4
6 6 6
0 1 2 3 4 5 6

p · 7·0



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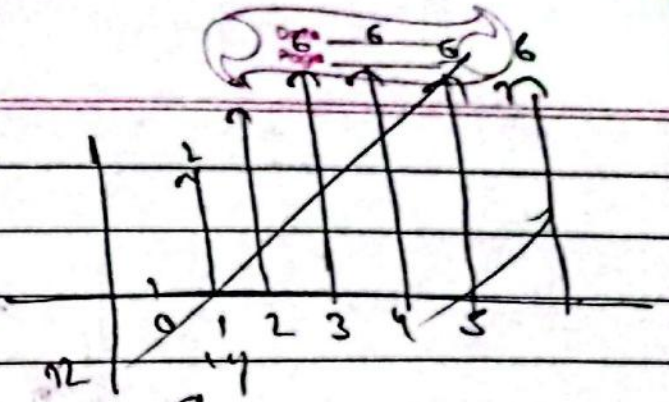
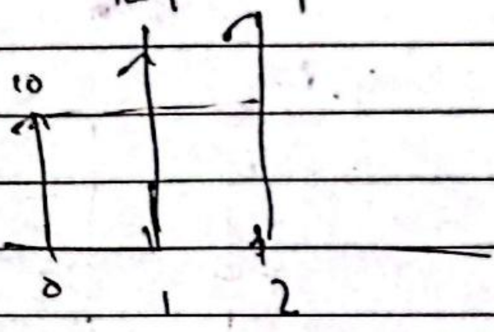
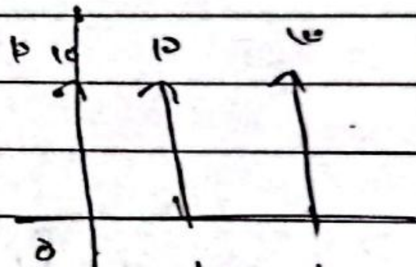


$$F_2 = 10\left[\frac{(1+i)^n - 1}{i}\right]$$

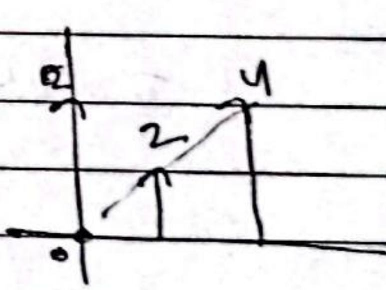


$$+\ \frac{G}{i}\left[\frac{(1+i)^n - 1}{i}\right] - \frac{nG}{i}$$



$$10\left[\frac{(1+0.1)^3 - 1}{0.1}\right] - \frac{2}{0.1}$$

$$\left[\frac{(1+0.1)^3 - 1}{0.1}\right] - \frac{3 \times 2}{0.1}$$



39.3

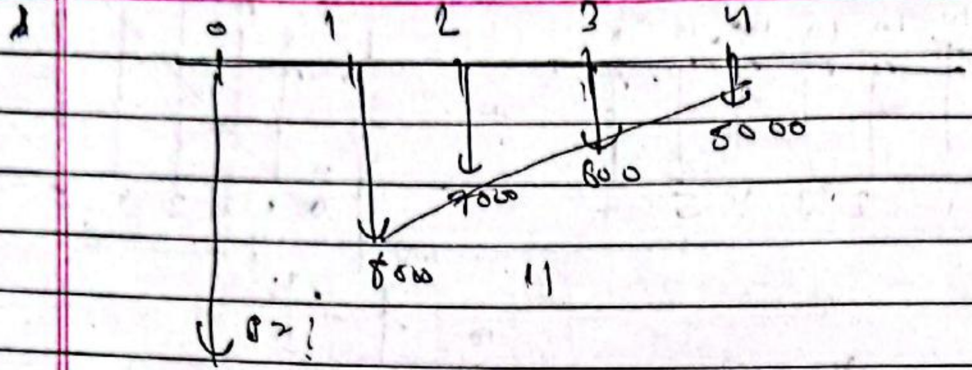
$$F_6 = 16\left[\frac{(1+0.1)^4 - 1}{0.1}\right] = 74.256$$

$$P_2 = 74.256(1+0.1)^{-4} = 50.71$$

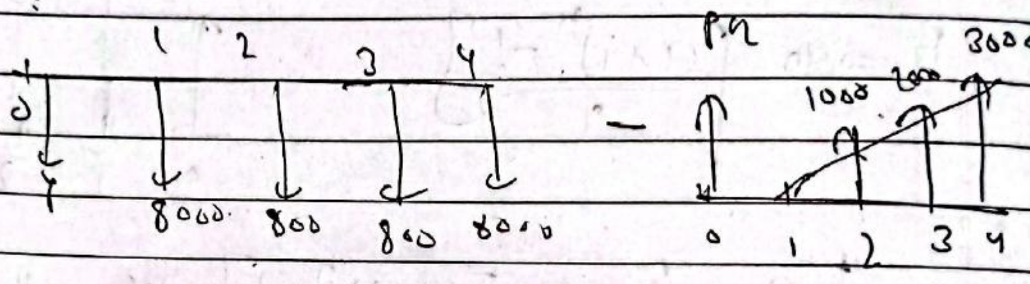
$$-P + 39.3 + 50.71 = 0$$

$$\therefore P = 90.01$$ #

$i = 15\%$



$$\begin{array}{r} 30024.5 \\ \hline 6622.5 \end{array}$$



$G = 1000$

$P = P_A - P_G$

$$= 8000\left[\frac{(1+0.15)^4 - 1}{(1+0.15)^4 \times 0.15}\right] - \frac{1000}{(0.15)^2}\left[\frac{(1+0.15)^4 - 1 - 4\times 0.15}{(1+0.15)^4}\right]$$

$= 19053.39$

If W nikalda at end of year aaucha (cost ko)

p.v nikalda baptova 1 . 0 ma aaucha

cashflow ko jadi cha teti ganda