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3)

~~Intial cost = $30000~~

~~Annual benefit =~~

The rate of return is found from assuming the net present worth of cash floco is zero

NPW = present value of benefits − present value of costs

$PV = F*(P/F, i, n) - A*(P/A, i, n)$

net annual benefit = A = annual benefit − annual cost

= 27000 − 18000

= 9000

⇒ 0 = −30000 + 9000 * (P/A, i, 5) + 4000 * (P/F, i, 5)

Suppose

i = 10%

then NPW = −30000 + 9000 * 3.791 + 0.6209 * 4000

= 6602.6

and

if i = 15% then

NPW = −30000 + 9000 * 3.352 + 0.4972 * 4000

= 2156.8

By interpolation

$i - 0.1 = ((0.15 - 0.1) * (0 - 6602.6)) / (2156.8 - 6602.6)$

$i = 17.43$

The internal rate of return is 17.43%. — Ans

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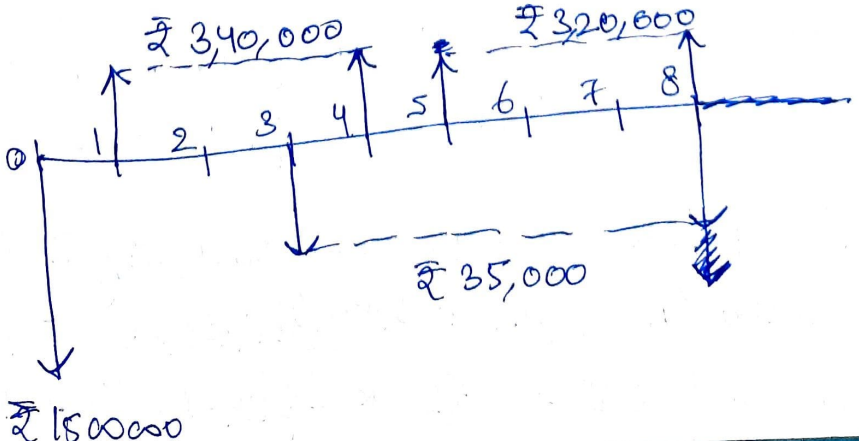
4) Tool B should not be considered further since its IRR < 8%.

- PWA = $-\$55{,}000 + (\$18{,}250 - \$6250)(P/A, 8\%, 7) + \$18000(P/F, 8\%, 7) = \$17480$
- PWC = $-\$80000 + (\$20{,}200 - \$3200)(P/A, 8\%, 7) + \$22{,}000(P/F, 8\%, 7) = \$21{,}346$

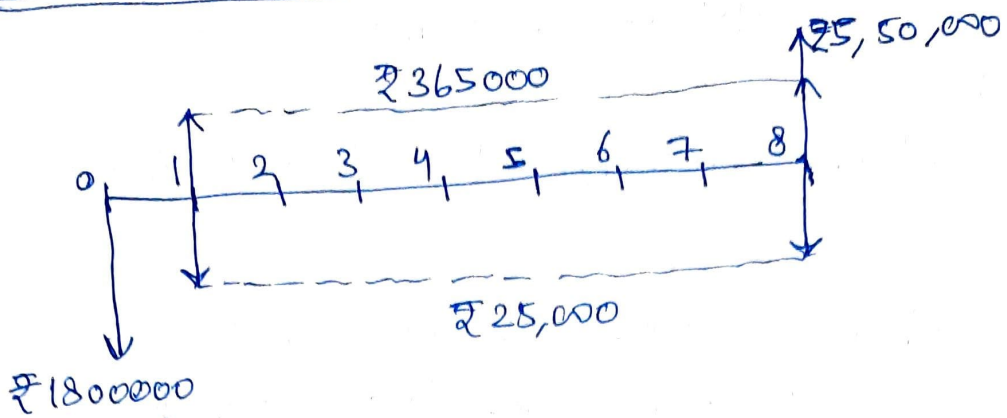
Therefore select Tool C — Ans

~~10) As per IRR method select D3. Only D3 has an IRR as there is a sign change in the cash flow. there are situations where there is no IRR, as~~

1) Alternative 1: [i = 9%]



Alternative 2:



$$NPW_1 = -1500000 + 340000(P/A, 9\%, 4) + 320000(P/A, 9\%, 4)(P/F, 9\%, 4) - 35000(P/A, 9\%, 6)(P/F, 9\%, 2)$$

$$= 203786.74$$

$$NPW_2 = -1800000 - 25000(P/A, 9\%, 8) + 365000(P/A, 9\%, 8) + 550000(P/F, 9\%, 8)$$

$$= 357864.95$$

$\therefore NPW_2 > NPW_1$

$\therefore$ alternative 2 is more economical — Ans

4) PW of Tool A $= -55000 - 6250(P/A, 8\%, 7) + 18250(P/A, 8\%, 7) + 18000(P/F, 8\%, 7)$

$= \$17979.27$

AW of Tool A $= 8\% * \$17979.27 / (1-(1+8\%)^{-7}) = \$3453.32$

PW of Tool B $= -45000 - 8550(P/A, 8\%, 7) + 16750(P/A, 8\%, 7) + 3750(P/F, 8\%, 7) = -\$119.87$

AW of Tool B $= 8\% * -\$119.68 / (1-(1+8\%)^{-7})$

$= -\$22.99$

PW of Tool C $= -80000 - 3200(P/A, 8\%, 7) + 20200(P/A, 8\%, 7) + 22000(P/F, 8\%, 7)$

$= \$21,345.07$

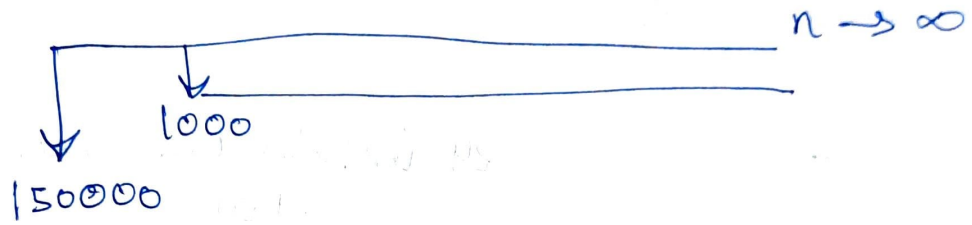
AW of Tool C $= 8\% * \$21,345.07 / (1-(1+8\%)^{-7})$

$= \$4099.80$

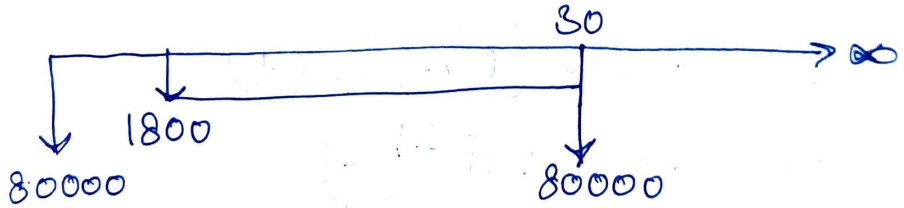
Since PW and AW of Tool C is the highest, therefore Tool C should be chosen.

~~# 9) Present value~~

5) A:



B:



$i = 10\%$

A:

Recurring	Non Recurring
1000	150000

Capitalized cost $= \frac{1000}{i} + 150000$
A

$= \frac{1000}{0.1} + 150000$

$= 160000$

B:-

$$80000 + \frac{80000(A/F, 10\%, 30)}{i} + \frac{1800}{i}$$

$$= 80000 + \frac{80000(0.00608)}{0.1} + \frac{1800}{0.1}$$

$$= 102864 = CC$$

$$CC = \frac{A}{i}$$

∴ - this is cost dominated

Ans:- Canal B will be built as it has the capitalized cost of B is lower than that of A.

2) $P = \$3000$ 24 installments monthly $= \$150$

$\Rightarrow 24 \times 150 = 3600$

$$3000 = 150 (P/A, i, 24)$$

$$\Rightarrow 20 = \frac{(1+i)^{24} - 1}{i(1+i)^{24}}$$

$$\Rightarrow 20 = \frac{(1+i)^{24} - 1}{i(1+i)^{24}}$$

$$\Rightarrow i = 0.0151308$$

$$= 1.51308\% \text{ per month}$$

i_{eff} per quarter $= (1+i)^3 - 1$

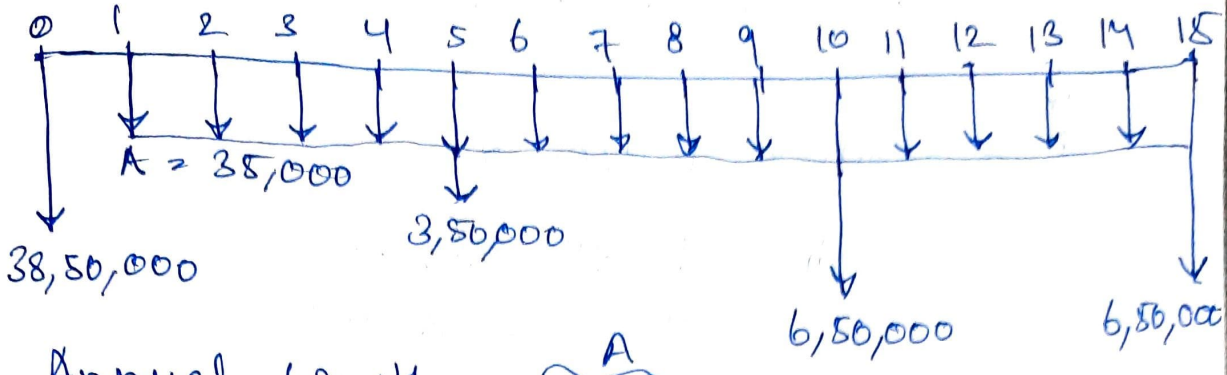
$= (1.0151308)^3 - 1$

$= 0.04608$

$= 4.608\%$

7) $n = 15$ years, $i = 10\%$

Alternative 1:



Annual Worth = $\underbrace{35000}_{A} + CR$

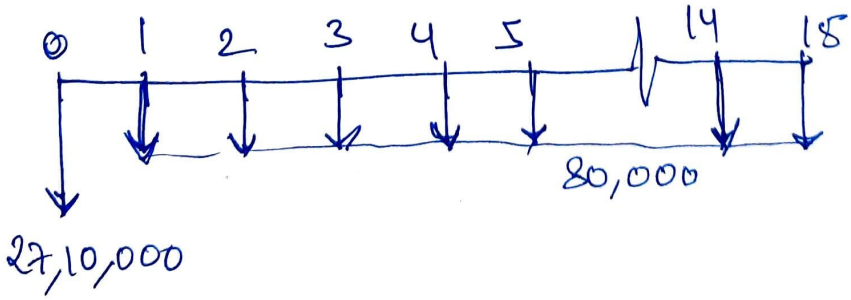
$CR = [38,50,000 + 350000 * (P/F, 10\%, 5) + 6,50,000 * (P/F, 10\%, 10)] \times (A/P, 10\%, 15) + 6,50,000 \times (A/F, 10\%, 15)$

$= [38,50,000 + 3,50,000 \times 0.6209 + 6,50,000 \times 0.3855] \times (0.1315) + 6,50,000 (0.0315)$

$= ₹\ 5,88,277.53$

∴ Annual worth = ₹ 62,3277.53

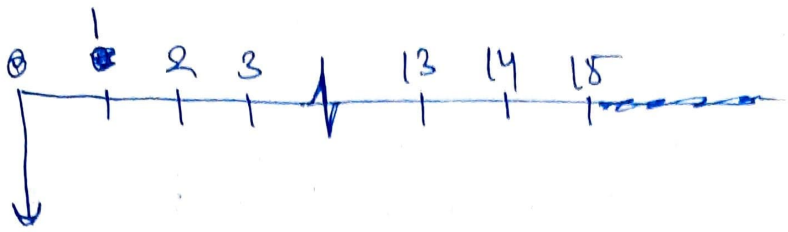
Alternative 2:



Annual worth = $80,000 + 2710000 \underbrace{(A/P, 10\%, 15)}_{0.1315}$

$= ₹\ 4,36,365$

Alternative 3:



P = 3800000 + 430000

Annual worth = P(A/P, 10%, 15)

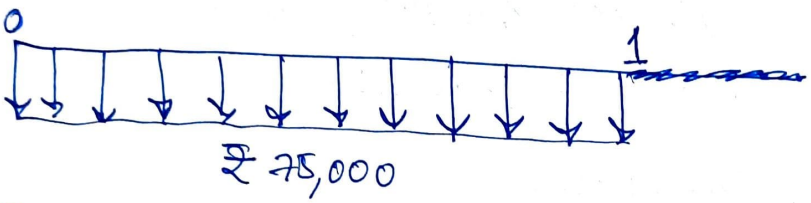
= 4230000 × 0.1315

= ₹ 5,56,245

Ans:- Alternative 2 is the best alternative.

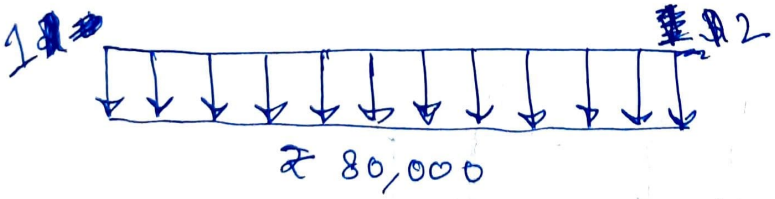
8) i = 18% compounded monthly.

year 1:



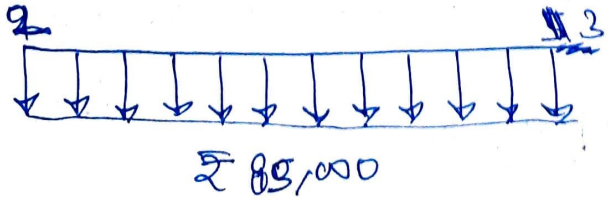
$PW_1 = 75000 + 75000(P/A, i_1, 11)$

Year 2:-



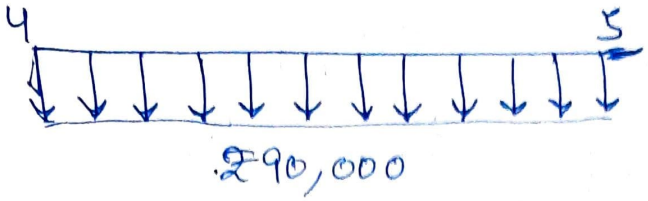
$PW_2 = (80,000 + 80,000(P/A, i_1, 11))(P/F, i_2, 1)$

Year 3:



$PW_3 = (85000 + 85000(P/A, i_1, 11))(P/F, i_2, 2)$

Year 4:



$PW_4 = (90,000 + 90000(P/A, i_1, 11))(P/F, i_2, 3)$

$i_1 = \left(1+\frac{r}{n}\right)^n - 1 = \left(1+\frac{.18}{12}\right)^1 - 1 = 1.5\%$

$i_2 = \left(1+\frac{.18}{12}\right)^{12} - 1 = 19.56\%$

$\therefore P/A, i_1, 11) = 10.071$

$\Rightarrow PW_1 = 75000 + 755,333.83 = 830,333.83$

$\Rightarrow PW_2 = 885680(P/F, 19.56, 1)$
$= 740,782.87$

$\Rightarrow PW_3 = 941,035(P/F, 19.56, 2)$
$= 658,315.32$

$\Rightarrow PW_4 = 996,390(P/F, 19.56, 3)$
$= 583,004.14$

$PW = PW_1 + PW_2 + PW_3 + PW_4$
$= 2,812,436.16$

$\Rightarrow 2812436.16 = 3200000 - S(P/F, i_2, 4)$

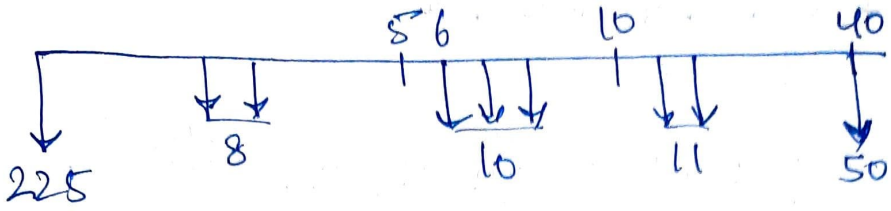
$\frac{S}{(1.1956)^4} = 387563.84$

$\boxed{S = 791,930.14}$

Minimum salvage value required for making warehouse.

b) $i = 10\%$ Infinite lives

(All costs in million $)



a)

Non-recurring cost = 225

Recurring cost = $\frac{A}{i}$

$$\Rightarrow \frac{8}{i} + \frac{2}{i}\left(\frac{1}{1+i}\right)^5 + \frac{1}{i}\left(\frac{1}{1+i}\right)^{10} + \frac{50\left(\frac{i}{(1+i)^{40}-1}\right)}{i}$$

$$\Rightarrow 80 + 12.42 + 3.86 + 1.13$$

$$\Rightarrow 97.41$$

C.C = 225 + 97.41 = 322.41 (million $)

b) Non-recurring cost = 350

Recurring cost = $\frac{A}{i}$

$$\frac{0.8}{i} + \frac{0.1}{i}\left(\frac{1}{(1+i)}\right)^9 = 8 + 0.92 = 8.92$$

C.C = 350 + 8.92 = 358.92 (million $)

∴ A cost is less

Ans:- Steel Conduit (a) is better

10) 1500 hours / yr.

study period of useful life = 5 yrs

MARR = 20%

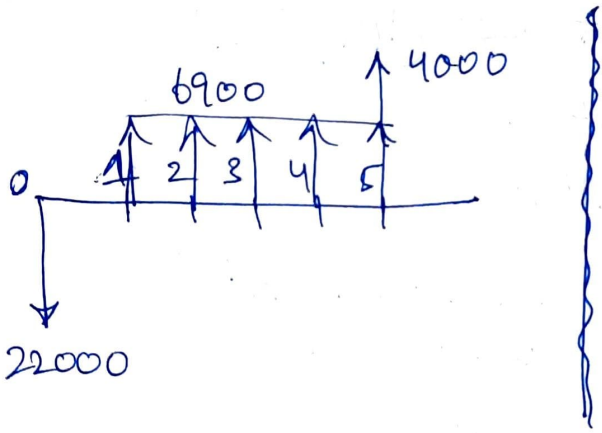
- Arranging in ascending order of investment:

D1, D4, D2, D3

Company D1 & D4

	D1	D4	D4 − D1
Invest	100000	122000	22,000
Annual exp.	29000	22100	−6900
Market val.	10000	14000	4000

⇒ CFD — Cost dominated



$\therefore -PW = -22000 + 6900(P/A, i, 5) + 4000(P/F, i, 5)$

NPW = 0

PW(5%) = +11004.1

PW(30%) = −4114.4

PW(20%) = 245.5

$\text{Req } i = 20\% + \frac{245.5 + 0}{245.5 - (-4114.4)} \times (10\%)$

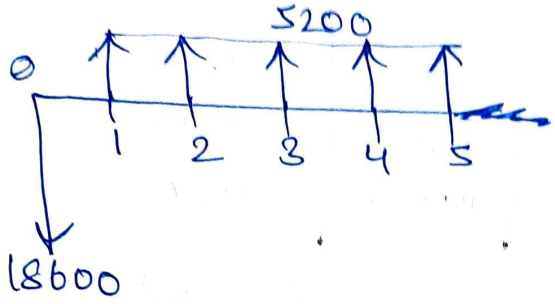
⇒ $i = 20.56\% > \text{MARR}$

∴ D4 accepted

Comparing D4 & D2

	D4	D2	D2 − D4
invest	122000	140600	18600
exp.	22100	16900	−5200
market val.	14000	14000	0

⇒



∴ PW = −18600 + 5200 (P/A, i, 5)

PW(10%) = 1113.2

PW(15%) = −1169.6

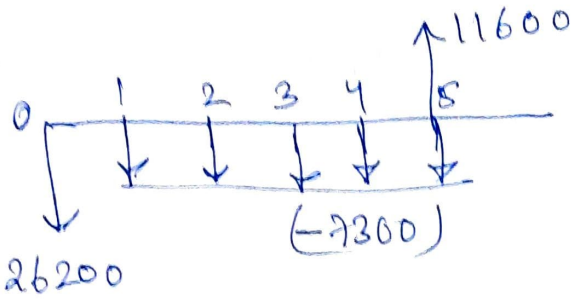
∴ reqd i = 10% + $\frac{1113.2 + 0 \times (5\%)}{1113.2 + 1169.6}$

⇒ i = 12.43% < MARR

∴ D2 not chosen, D4 chosen

Comparing D4 & D3

	D3 − D4
invest	26200
exp.	−7300
market val.	11600



$$\therefore -PW = -26200 + 7300(P/A, i, 5) + 11600(P/F, i, 5)$$

PW (20%) = 296.34

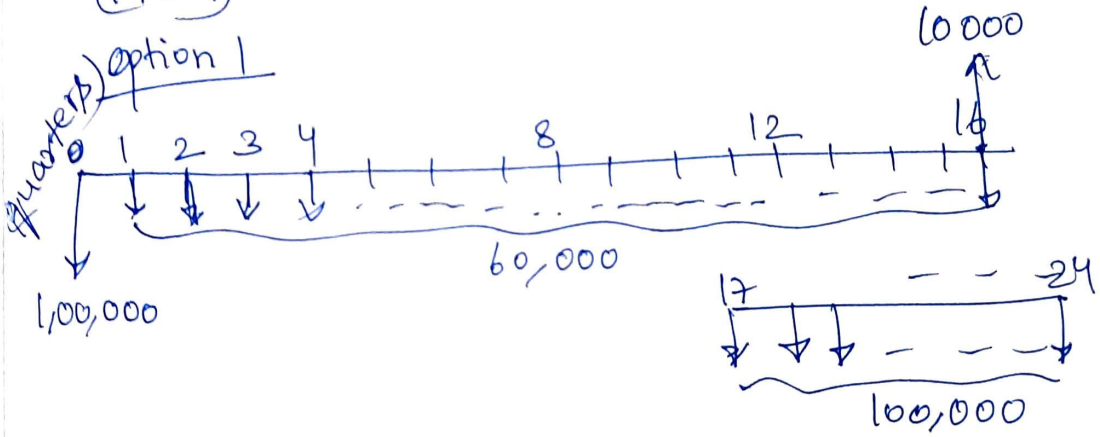
PW (25%) = -2768.98

By interpolation, we get $i = 20.4\%$ > MARR

$\therefore$ - D3 chosen ⇒ **D3 is best choice**

9) $i_{eff\ (PP=4)} = \left(1 + \frac{0.12}{4}\right)^{4/4} - 1 = 3\%$

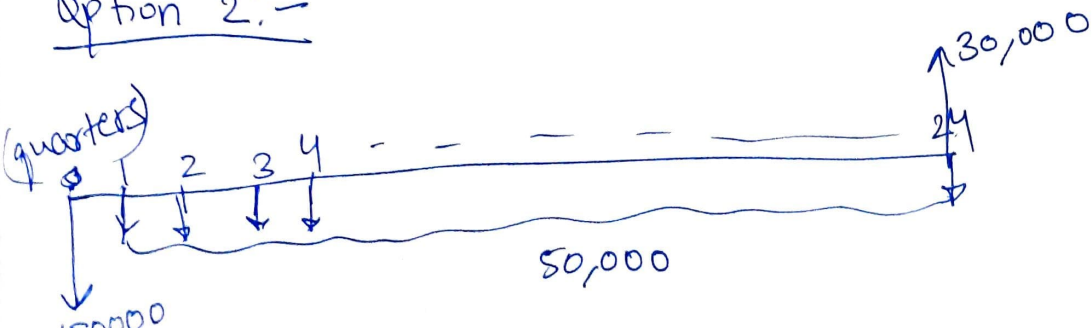
Option 1



$$PW = 100000 + 60000(P/A, 3, 16) - 10000(P/F, 3, 16) + 100000(P/A, 3, 8)(P/F, 3, 16)$$

$$= 1284901.704$$

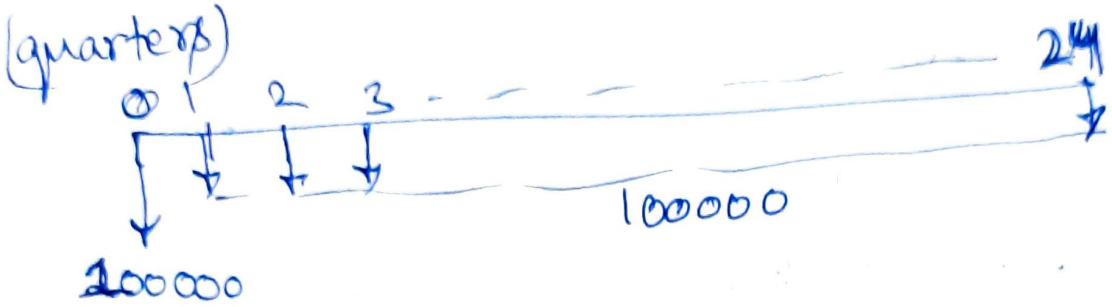
Option 2:-



$PW = 150000 + 30000 (P/A, 3, 24) - 30000 (P/F, 3, 24)$

$= \$ 98,20,18$

Option 3



$PW = 100000 (P/A, 3, 24) + 100000$

$= \$ 1793550$

Conclusion:- Based on cost dominated CFD approach:- Option2 has min value of PW and hence must be chosen