1.	a)	The supervisor of a small machine shop has received three suggestions for reducing production costs. Suggestion A is to buy new jigs and fixtures; B is to rebuild an existing machine to improve its performance; and C is to purchase a new machine to replace some manual labour. Estimates have been made for the three alternative investments.	10	CO2

1a part ①

	Alternatives		
	A	B	C
First cost, $	1800	2350	4200
Economic life, years	4 → 8	4 → 8	8 (To compare, make years to 8) A, B twice
Net annual saving, S	645	840	1100
Payback period, years	2.8	2.8	3.8

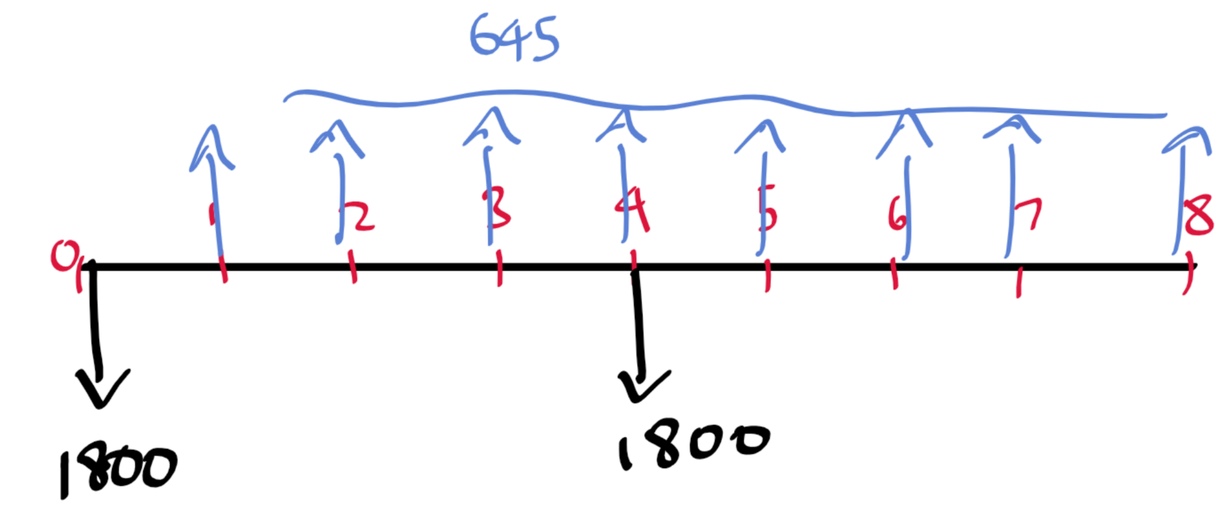
The supervisor selects alternative B saying that because of limited capital for investments, shorter payback periods are preferable. With alternatives A & B having the same payback period, B is favored because the annual savings are greater than for A. What are the flaws in this reasoning? Substantiate your argument with calculations

→ Don't apply alternatives to different time period

Sol:

Assume i = 8%

Alternative A

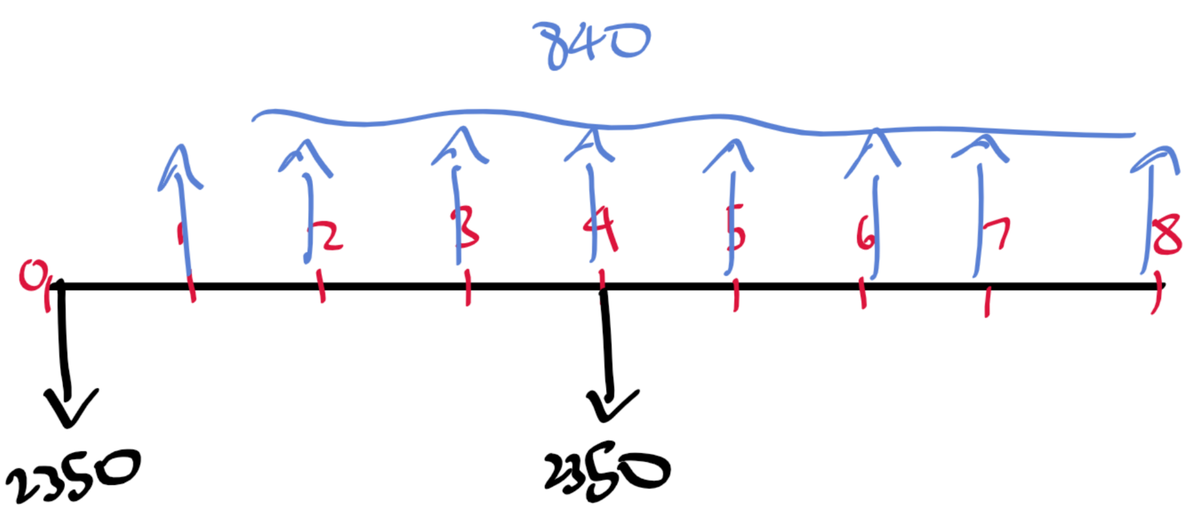


$$PW_A = -1800 + 645(P/A, 8\%, 8) - 1800(P/F, 8\%, 4)$$

$$PW_A = -1800 + 3706.582 - 1323.0537$$

$$= 583.5283$$

Alternative B

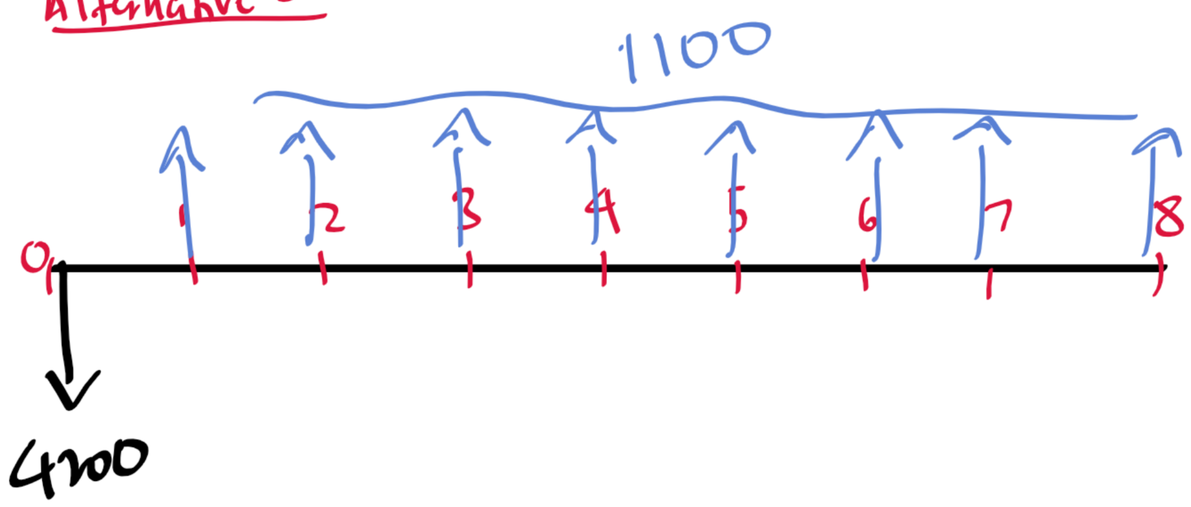


$$PW_B = -2350 + 840(P/A, 8\%, 8) - 2350(P/F, 8\%, 4)$$

$$PW_B = -2350 + 4827.1767 - 1727.32015$$

$$= 749.856$$

Alternative C



$$PW_C = -4200 + 1100(P/A, 8\%, 8)$$

$$= -4200 + 6321.3028$$

$$= 2121.3028$$

Alternative A

Year	Cash flow	Cumulative
0	-1800	-1800
1	+645	-1800(1.08) +645 = -1299
2	+645	-1299 (1.08) +645 = -757.92
3	+645	-757.92(1.08)+645 = -173.5536
4	-1800 +645	-173.5536(1.08)+645 -1800 = -1342.43
5	+645	-1342.43(1.08)+645 = ~~—
6	+645	~~—
7	+645	~~—
8	+645	

→ Payback period would 3.2 years (2.8 given)

Alternative B

Year	Cash flow	Cumulative
0	-2350	-2350
1	+840	-2350 (1.08) +840 = -1698
2	+840	-1698 (1.08) +840 = -993.84
3	+840	-993.84(1.08)+840 = -233.347
4	-2350+840	-233.34 (1.08) +840 -2350 = -1762.01
5	+840	- (1.08)+ = ~~—
6	+840	~~—
7	+840	
8	+840	

→ Payback period would 3.2 years (2.8 given)

Alternative C

Year	Cash flow	Cumulative
0	-4200	-4200
1	+1100	-4200(1.08) +1100 = -3436
2	+1100	-3436 (1.08) +1100 = -2610.88
3	+1100	-2610.88(1.08)+1100 = -1719.75
4	+1100	-1719.75(1.08)+1100 = -757.33
5	+1100	-757.33(1.08)+1100 = +282.083
6	+1100	
7	+1100	
8	+1100	

→ Payback period would 4.73 years Given (3.8)

Payback period = $4 + 1\left[\frac{-757.33 - 0}{-757.33 - 282.083}\right] = 4.73$

(Interpolation)

Hence payback periods are more than estimated values.

1.	C	What is the maximum amount you would bid for a bond with a face value of $5000 and a bond rate of 8% payable semiannually, if your minimum attractive rate of return is 10%? The bond matures in 6 years.	4	CO2

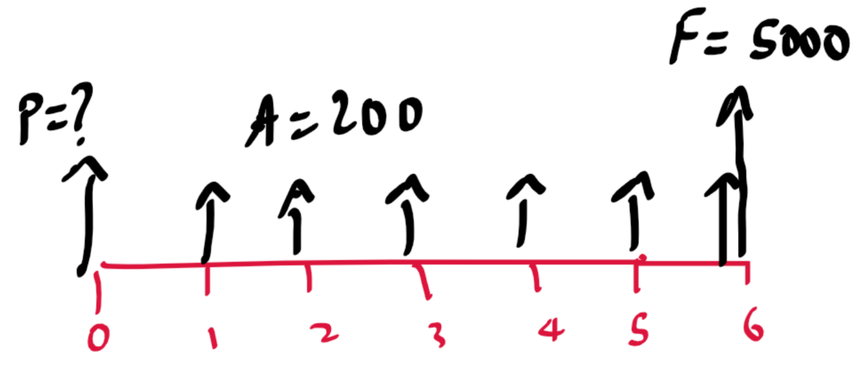
Sol: Given:

Face value = 5000

Bond rate = 8% (Semiannual)

N = 6 years

i = 10% (same)



Premium = A = (face value) × (Bond rate)

$= 5000 \times (0.08 / 2)$

$= 5000 \times 0.04$

$\boxed{A = 200}$

Present worth = PW = P (from F) + P (from A)

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

$= \frac{5000}{\left(1+\frac{10}{100}\times\frac{1}{2}\right)^{6\times2}} + 200\left[\frac{\left(1+\frac{10}{100}\times\frac{1}{2}\right)^{6\times2} - 1}{\left(\frac{10}{100}\times\frac{1}{2}\right)\left(1+\frac{10}{100}\times\frac{1}{2}\right)^{6\times2}}\right]$

$= \frac{5000}{1.7958} + 200\left[\frac{1.7958 - 1}{0.05(1.7958)}\right]$

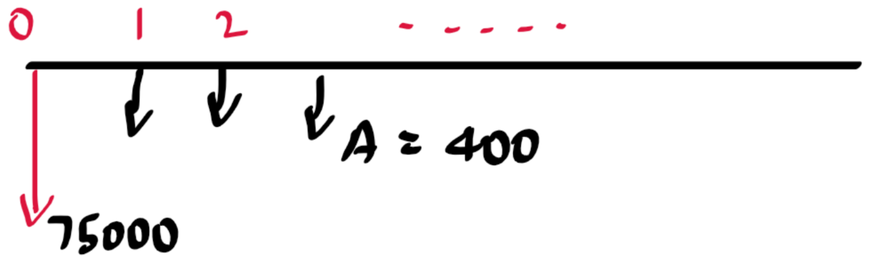
$= 2784.27 + 1772.58$

$= \boxed{4556.85}$

2	c	A short concrete canal can be constructed as part of a flood control project; the placement of a large galvanized culvert will serve the same function. The cost of the canal, which will last indefinitely, is $75,000; and its maintenance costs will average $400 per year. Culverts, which will have to be replace every 30 years, will cost $40,000 and have an annual maintenance cost of $700. Salvage values are negligible or both alternatives, and the government interest rate is 6%. Which alternative has the lower equivalent annual cost?	10	CO2

Sol:

Alternative A



$P = 75000$

$i = 6\%$

$N = \infty$

A_1 (from P) = ?

EAC = ? $(A_1 + A)$

For ∞ time period $(A/P, i, \infty) = i$

$\therefore A_1 = 75000\ (A/P, 6\%, \infty)$

$= 75000 \times 0.06$

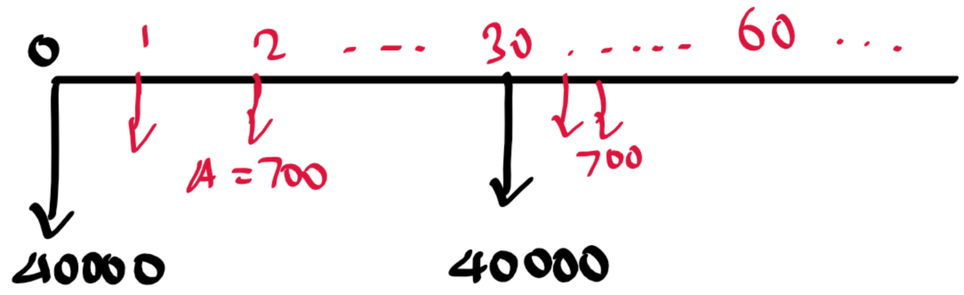
$= 4500$

$EAC = A_1 + A$

$= 4500 + 400$

$= 4900$

Alternative B



$P = 40000$

$N = 30$

$i = 6\%$

EAC = ? $(A_2 + A)$

$$A_2 = P\left[\frac{i(1+i)^n}{(1+i)^n - 1}\right]$$

$$= 40000\left[\frac{0.06\ (1.06)^{30}}{(1.06)^{30} - 1}\right]$$

$$A_2 = \frac{13784.3788}{4.74349} = 2905.957$$

$EAC = A_2 + A$

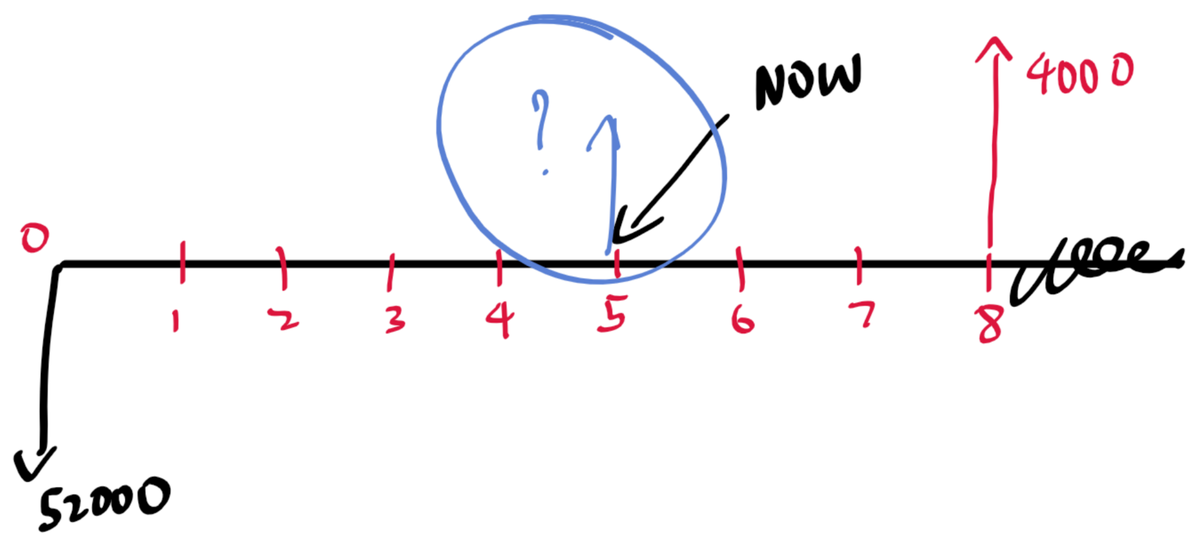
$= 2905.957 + 700$

$= 3605.95$

Alternative B has lower EAC.

3	b)	An asset was purchased 5 years ago for $52,000/-. It was expected to have an economic life of 8 years, at which time its salvage value would be $ 4000. If the function that the asset was serving is no longer needed, for what price must be sold now to recover the invested capital when i=12%	8	CO2

Sol:

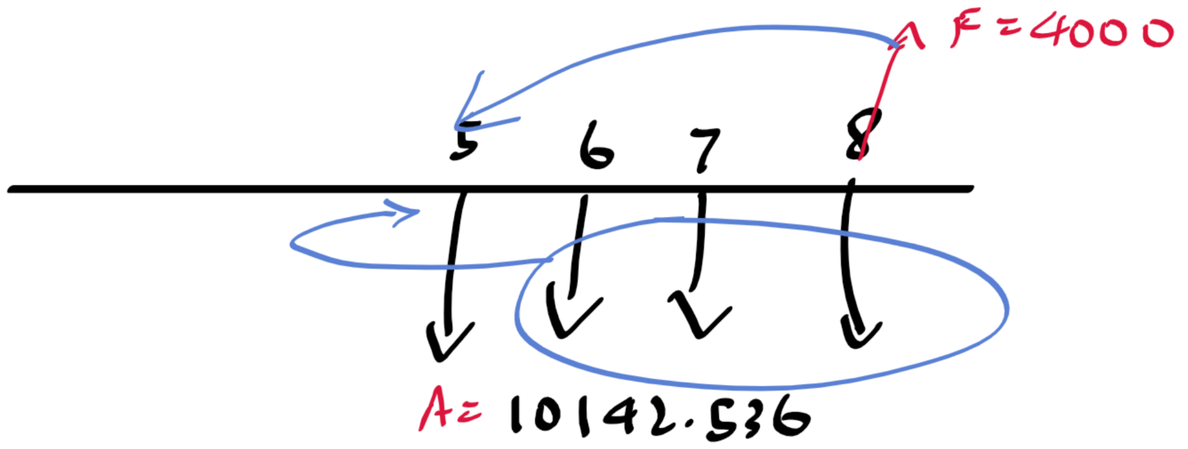


Formula: $EAC = (P-S)(A/P,i,N) + Si$

$$= (52000 - 4000)\left[\frac{(1.12)^8 0.12}{(1.12)^8 - 1}\right] + 4000 \times 0.12$$

$$= 9662.536 + 480$$

$$= 10142.536$$



∴ Selling price (year 5) = $10142.536(P/A, 12\%, 3) + 4000(P/F, 12\%, 3)$

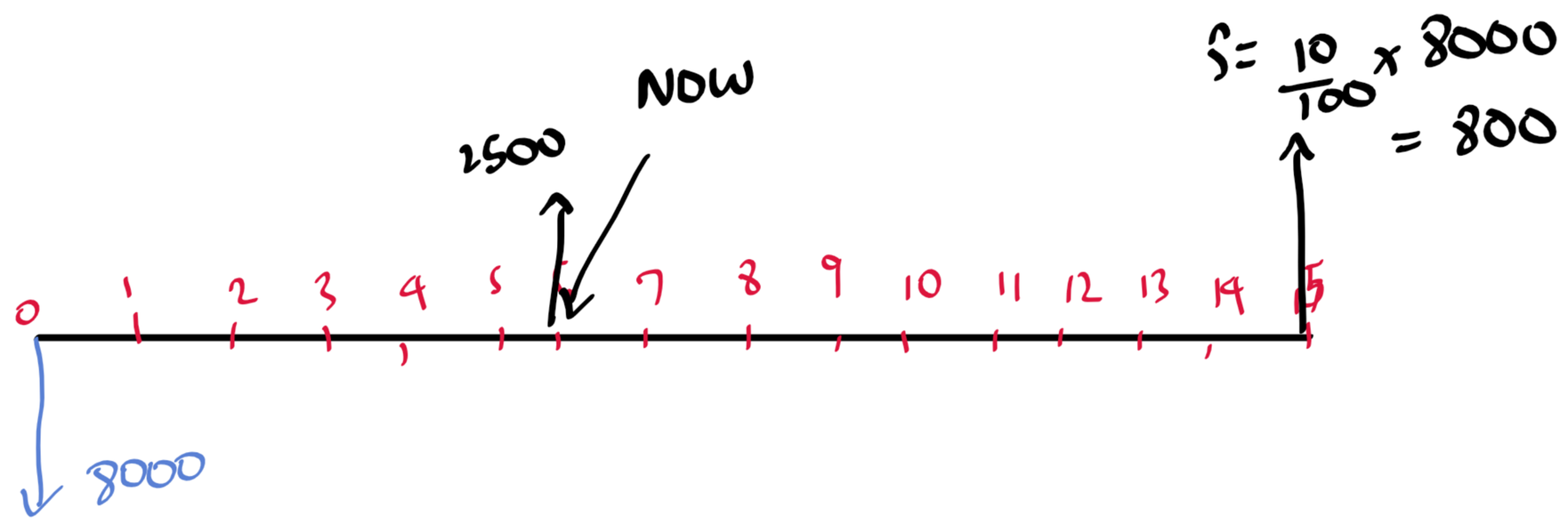
$$= 10142.536\left[\frac{(1.12)^3 - 1}{(0.12)(1.12)^3}\right] + \frac{4000}{(1.12)^3}$$

$$= 24360.6601 + 2847.12099$$

$$= 27207.7811$$ → Asset must be sold for 27.207 k

3	c	A standby electric generator was purchased 6 years ago for $ 8000. At the time it expected that the equipment would be used for 15 years and would have salvage value of 10% of the first cost. The generator is no longer needed and is to be sold for $ 2500 using an interest rate of 15%. Determine the difference between the anticipated and actual equivalent annual capital costs	6	CO2

Sol:



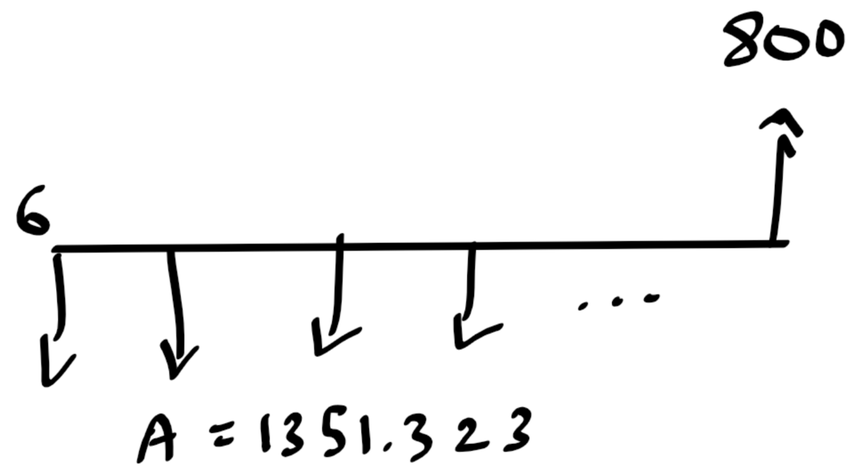
$$EAC = (P-S)(A/P,i,N) + Si$$

$$= (8000-800)\left[\frac{(1.15)^{15} \times 0.15}{(1.15)^{15}-1}\right] + 800 \times 0.15$$

$$= 1231.32277 + 120$$

$$= 1351.323$$

Selling price (year 6) =



$$= 1351.323\,(P/A, 15\%, 9) + 800\,(P/F, 15\%, 9)$$

$$= 1351.323\left[\frac{(1.15)^9-1}{0.15(1.15)^9}\right] + \frac{800}{(1.15)^9}$$

$$= 6447.95108 + 227.4099$$

$$= 6675.36 \rightarrow \text{selling price expected}$$

$$\therefore \text{Difference} = 2500 - 6675.36$$

$$= -4175.36101$$

4	a	A machine needed for 3 years can be purchased for $ 77,662 and sold at the end of the period for about $ 25,000. A comparable machine can be leased for $ 30,000 per year. If the firm expects a return of 20% on investments should it buy or lease the machine when end of year payments expected	10	CO2

Sol:

BUY

$P = 77662$

$N = 3$

$S = 25000$

$i = 20\%$

LEASE

$A = 30000$

↓

Given

$$EAC = (P-S)(A/P, i, N) + Si$$

$$= (77662 - 25000)\left[\frac{0.2(1.2)^3}{(1.2)^3 - 1}\right] + 25000(0.2)$$

$$= 52662 \times 0.47474 + 5000$$

$$= 24999.8 + 5000$$

$$\approx 30000$$

Both annual costs are equal to 30k. Hence both methods can be preffered.

But since return is expected, instead of leasing 30k per year, buying and selling for salvage of 25k is expected to give a return.

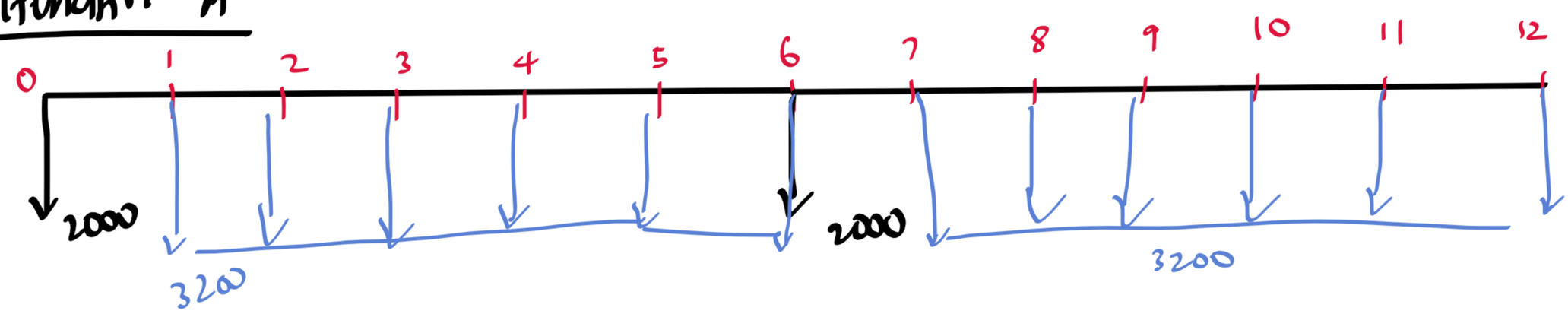
5	a	The following alternatives are available to accomplish an objective of 12 year duration. Compare the present worth of the alternatives. Use an interest rate of 7% Draw Conclusions	10	CO2

highest PW after calculation

	Plan A	Plan B	Plan C
Life cycle in years	6	3	5
First cost (Rs)	2000	8000	10000
Annual cost (Rs)	3200	700	500

Sol:

Alternative A



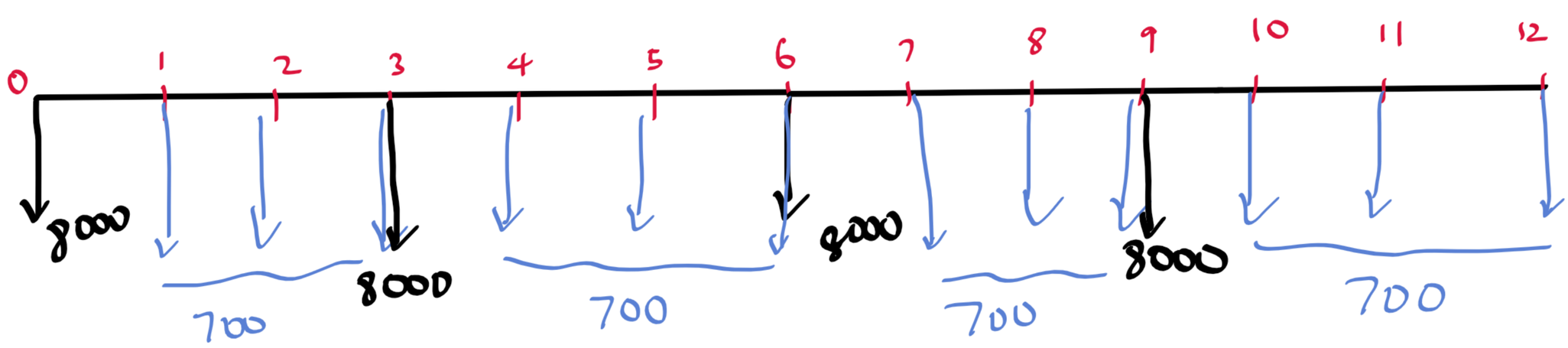
$$PW = 2000 + 2000\,(P/F, 7\%, 6) + 3200\,(P/A, 7\%, 12)$$

$$= 2000 + \frac{2000}{(1.07)^6} + 3200\left[\frac{(1.07)^{12}-1}{(0.07)\ (1.07)^{12}}\right]$$

$$= 2000 + 1332.6844 + 25416.5961$$

$$= 28749.28 \rightarrow \text{For A}$$

Alternative B



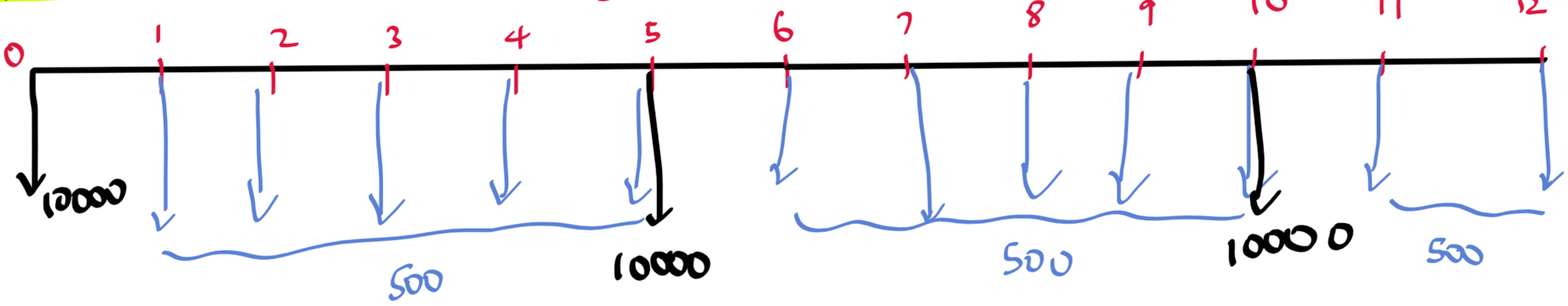
$$PW = 8000 + 8000(P/F, 7\%, 3) + 8000(P/F, 7\%, 6) + 8000(P/F, 7\%, 9)$$

$$+ 700(P/A, 7\%, 12)$$

$$= 8000 + 6530.38 + 5330.7377 + 4351.47 + 5559.88$$

$$= 29772.4677 \rightarrow \text{For B}$$

Alternative C



$$PW = 10000 + 10000\,(P/F, 7\%, 5) + 10000(P/F, 7\%, 10) + 500(P/A, 7\%, 12)$$

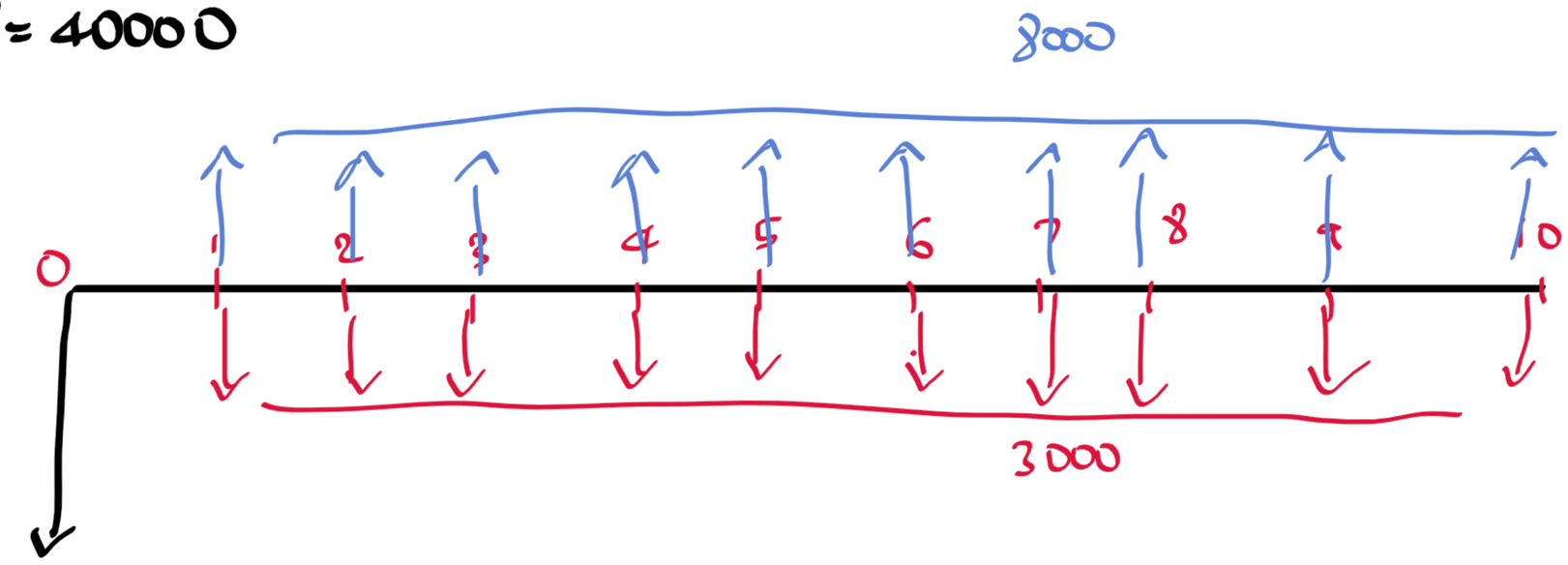
$$= 10000 + 7129.86179 + 5083.4929 + 222.0059 = 22435.3605$$

$\therefore$ For C

5	b	A Rs.40000 cost of extrusion machine is expected to be obsolete after 10 years with no salvage value. If it generates Rs.8000 per year, of which Rs.3000 must be paid as taxes what is the pay off period	10	CO2

Definitely not 10, maybe 5

Sol: P = 40000



40000

If 40k was invested elsewhere, it would get certain interest. So we need to get 40k plus as return if i is given.

with 0% interest:

Get back 40000

A = 8000 − 3000 = 5000

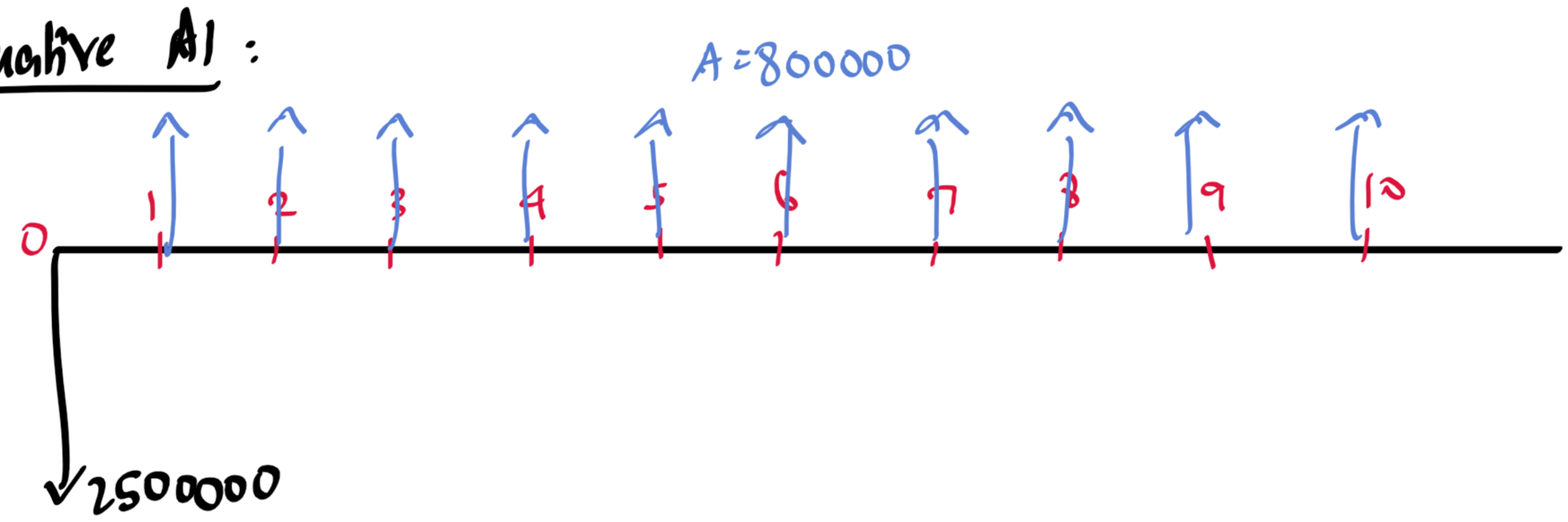
∴ Payoff period = $\frac{40000}{5000}$ = 8 years

$$T = \frac{I}{(D - Tax)}$$

6	a	(a) A company has three proposals for expanding its business operations. The details are given below. Each alternative has significant salvage value at the end of its life. Assuming an interest rate of 15% compounded annually, find the best alternative for expanding the business operations of the company using the annual equivalent method Draw cash flow diagram --	10	CO2

Alternative	Intial cost in Rs.	Annual revenue in Rs.	Life in years
A1	2500000	800000	10
A2	2000000	600000	10
A3	3000000	1000000	10

Sol: **Alternative A1 :**



$A_1 = P(A/P, i, N)$

$= 2500000\,(A/P, 15\%, 10)$

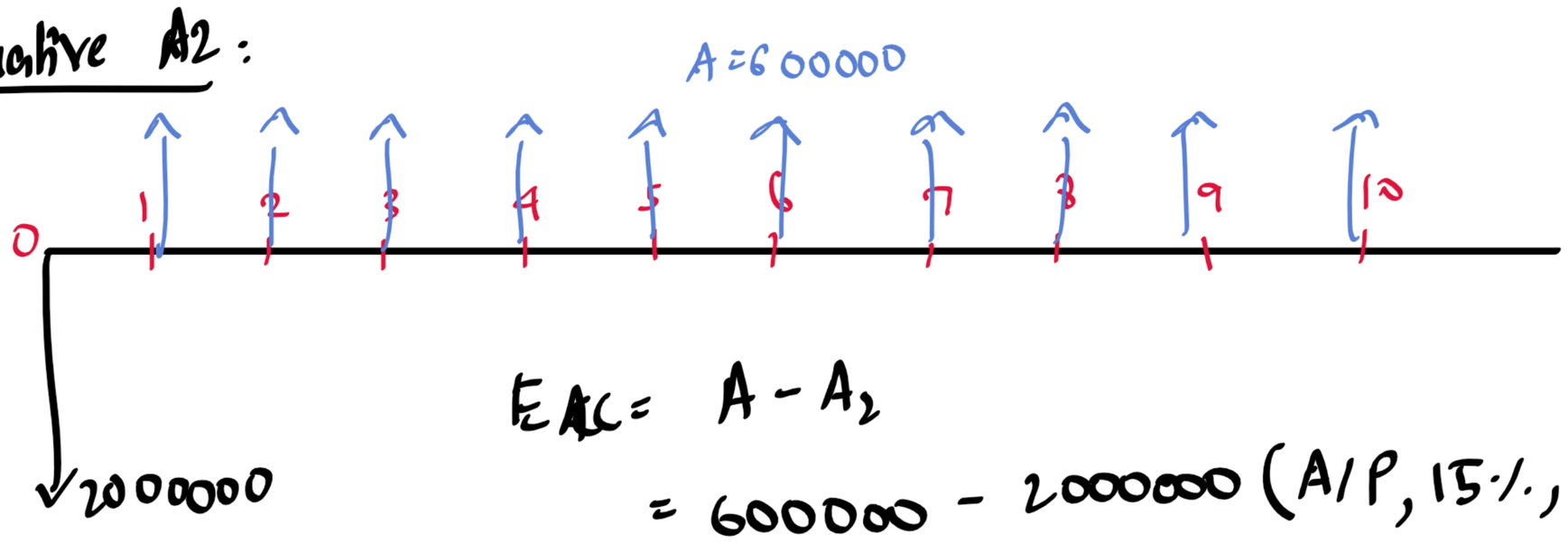
$= 2500000\left[\dfrac{0.15\,(1.15)^{10}}{(1.15)^{10}-1}\right]$

$= 498130.155$

$EAC = A - A1 = 800000 - 498130.155$

$EAC = 301869.845$

Alternative A2 :

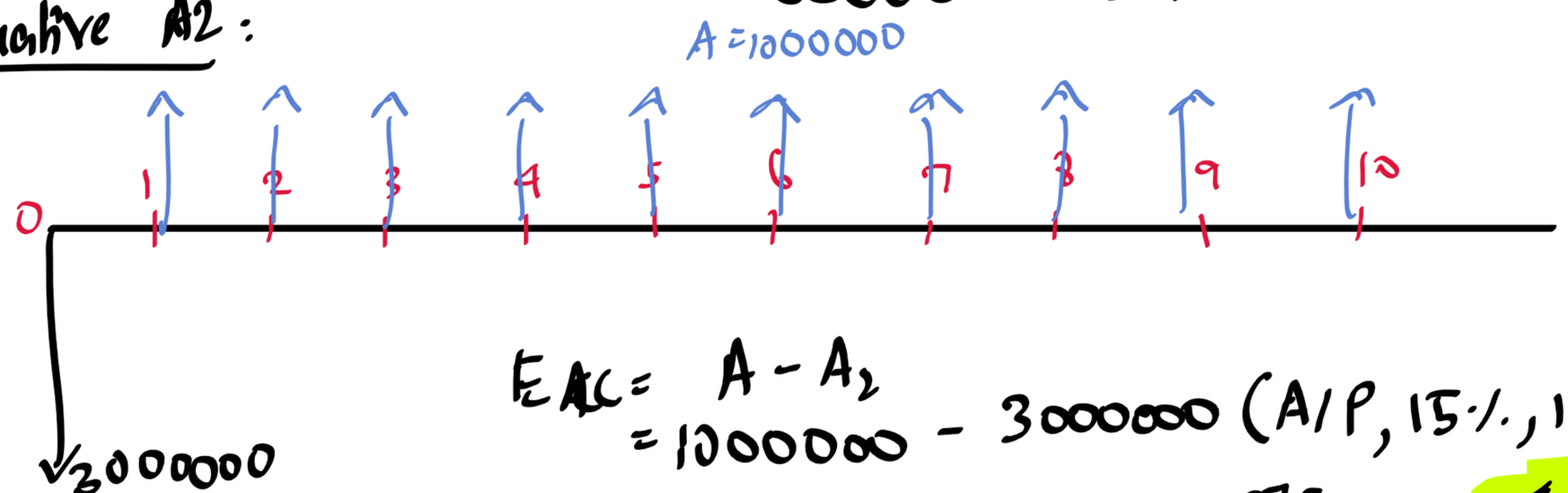


$EAC = A - A_2$

$= 600000 - 2000000\,(A/P, 15\%, 10)$

$= 600000 - 398504.125 = 201495.875$

Alternative A2 :



$EAC = A - A_2$

$= 1000000 - 3000000\,(A/P, 15\%, 10)$

$= 1000000 - 597756.1875 = 402243.813$