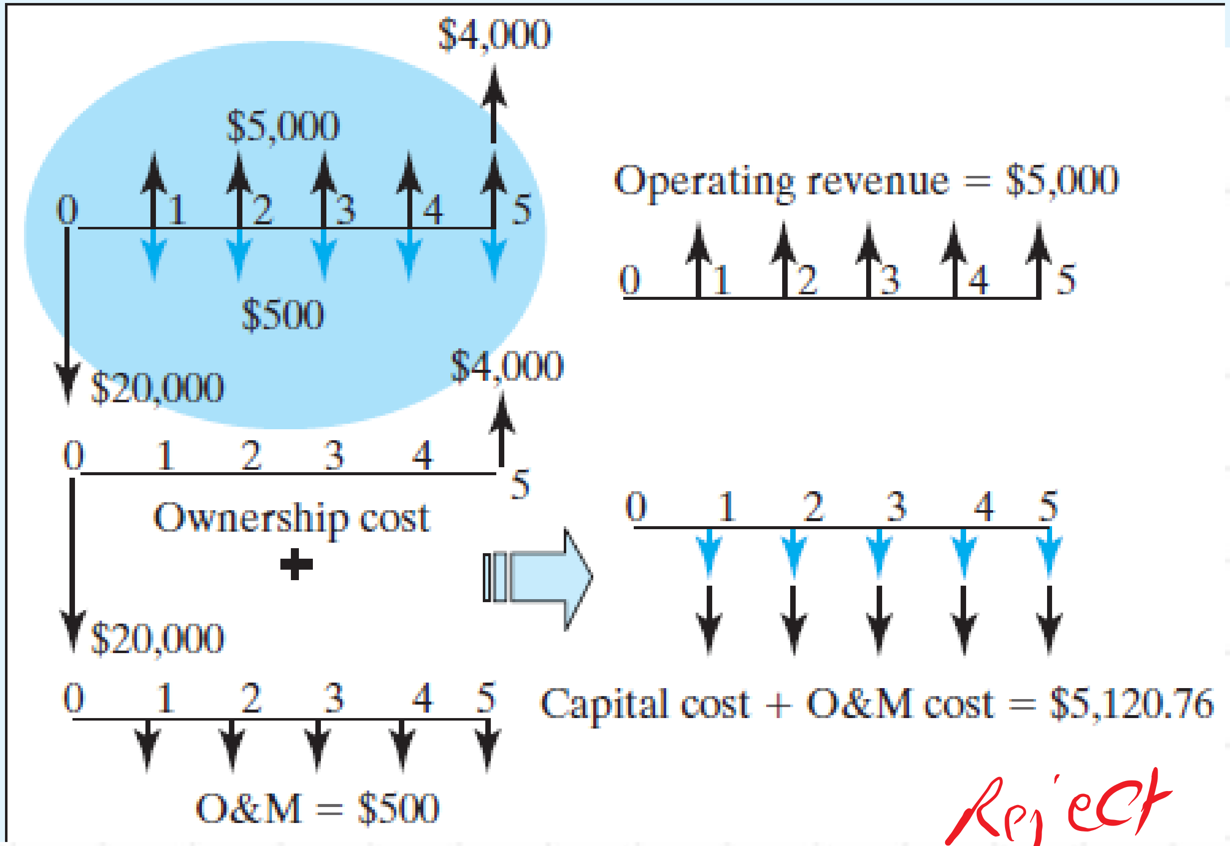
Chan PARK-chapter 6 Annual worth analysis

Consider a machine that costs $20,000 and has a five-year useful life. At the end of the five years, it can be sold for $4,000 after tax adjustment. The annual operating and maintenance (O&M) costs are about $500. If the firm could earn an after-tax revenue of $5,000 per year with this machine, should it be purchased at an interest rate of 10%? (All benefits and costs associated with the machine are accounted for in these figures.)



$CR = I(A/P, i\%, n) - S(A/F, i\%, n)$

$i = 10\%$

$n = 5$

$A/P = 0.2638$

$A/F = 0.1638$

$CR = -(0.2638(20{,}00$

$+(0.1638(40$

$= -5276 + 655.2$

$= -4620.8$

ADD O.M

$= -5120.8$

Rev < CR+Mai

Reject

EUAB

EAB = equivalent annual benefit →

EUAC

EAC = equivalent annual cost ⟨ O, M / C R

EUAW

EAW = equivalent annual worth = EAB - EAC

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Annual Cash Flow Analysis

Annual Cash Flow Analysis

Annual Cash Flow Analysis

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The total equivalent uniform annual worth (EUAW) of an asset is given by:

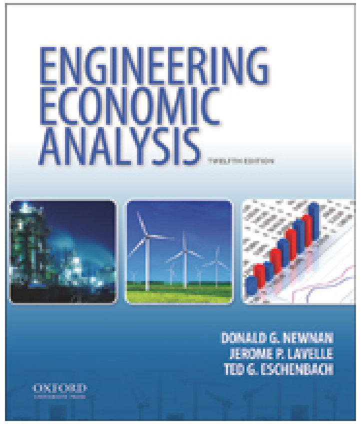
EUAW = EUAB (benefits) - EUAC (costs)

Example: An asset has an initial cost of $100,000 and an estimated salvage value of $40,000 after its 6-year service life. Estimated O&M costs are $50,000 in year one, increasing by $6,000 per year thereafter. Calculate the total EUAC of this asset at 20% interest. We can calculate it in parts by first looking at the one-time cash flows and then the annual flows. We treat them from the cost point of view:

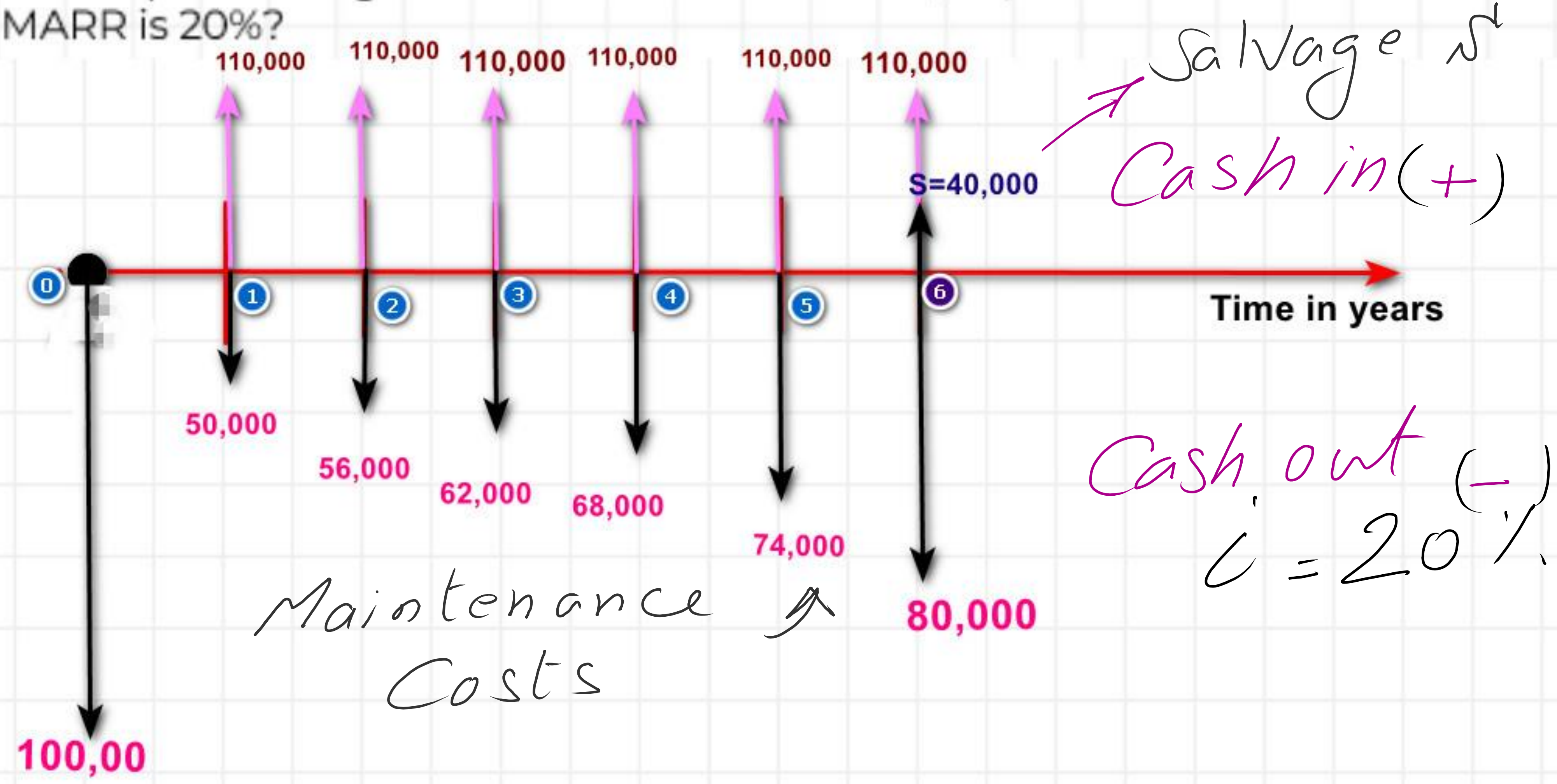
EUA (one-time cash flows) = P (A/P,20%,6) – S (A/F,20%,6)
(This has an alternative form: (P - S)(A/P,20%,6) + Si)

= (100,000)(0.3007) – (40,000)(0.1007)

= $30,070 – $4,028 = $26,042 per year



Example: An asset has an initial cost of $100,000 and an estimated salvage value of $40,000 after its 6-year service life. Estimated O&M costs are $50,000 in year one, increasing by $6,000 per year thereafter. Calculate the operations and maintenance. Costs are $50,000 in the first year, increasing by $6000 every year per thereafter. The assets expected to generate annual benefits of $110,000. Is this desirable investment if MARR is 20%?



ENGINEERING ECONOMICS

Factor Name	Converts	Symbol	Formula
Single Payment Compound Amount	to F given P	$(F/P, i\%, n)$	$(1+i)^n$
Single Payment Present Worth	to P given F	$(P/F, i\%, n)$	$(1+i)^{-n}$
Uniform Series Sinking Fund	to A given F	$(A/F, i\%, n)$	$\frac{i}{(1+i)^n-1}$
Capital Recovery	to A given P	$(A/P, i\%, n)$	$\frac{i(1+i)^n}{(1+i)^n-1}$
Uniform Series Compound Amount	to F given A	$(F/A, i\%, n)$	$\frac{(1+i)^n-1}{i}$
Uniform Series Present Worth	to P given A	$(P/A, i\%, n)$	$\frac{(1+i)^n-1}{i(1+i)^n}$
Uniform Gradient Present Worth	to P given G	$(P/G, i\%, n)$	$\frac{(1+i)^n-1}{i^2(1+i)^n}-\frac{n}{i(1+i)^n}$
Uniform Gradient † Future Worth	to F given G	$(F/G, i\%, n)$	$\frac{(1+i)^n-1}{i^2}-\frac{n}{i}$
Uniform Gradient Uniform Series	to A given G	$(A/G, i\%, n)$	$\frac{1}{i}-\frac{n}{(1+i)^n-1}$

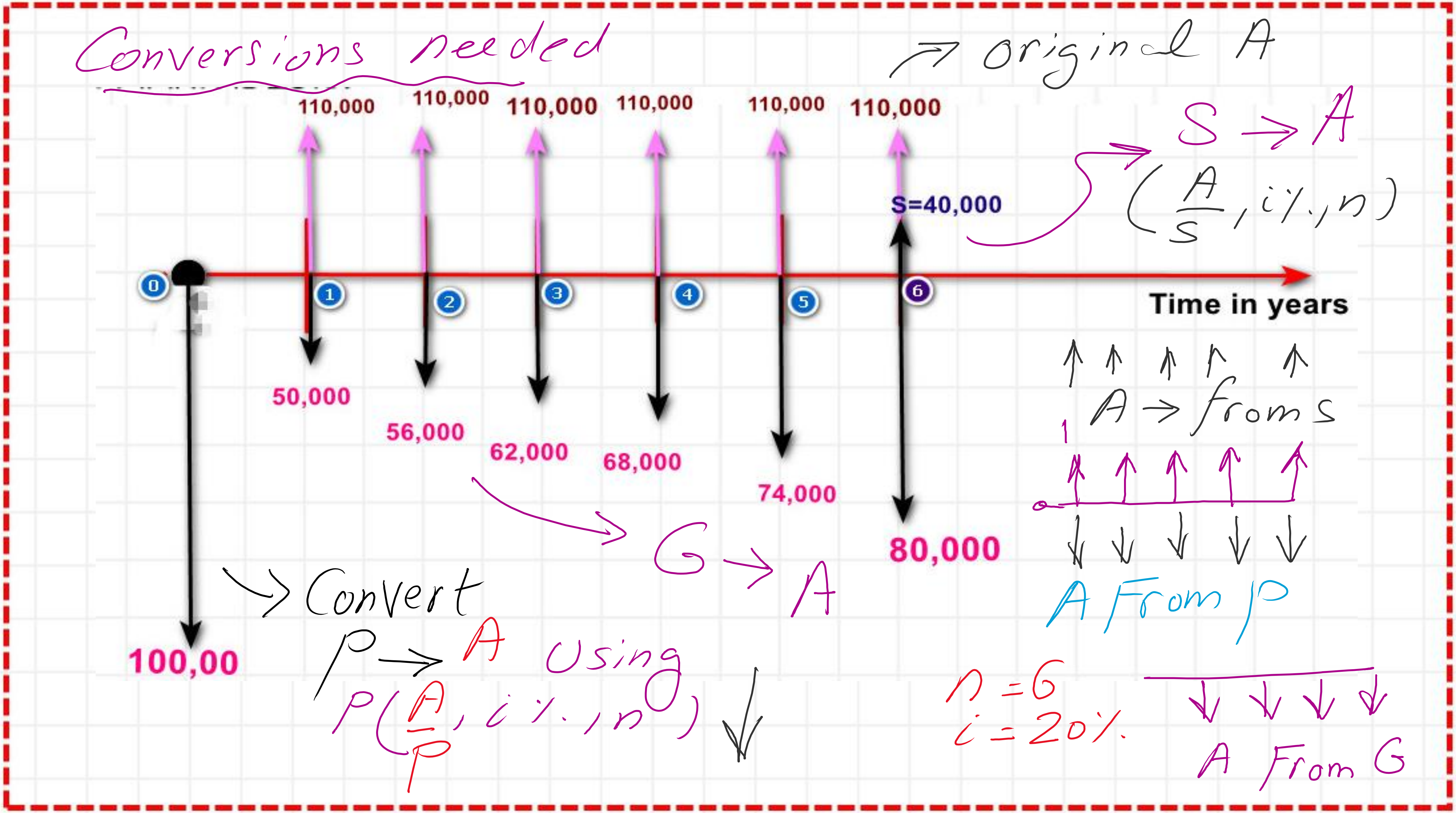
for Salvage to A

A/F

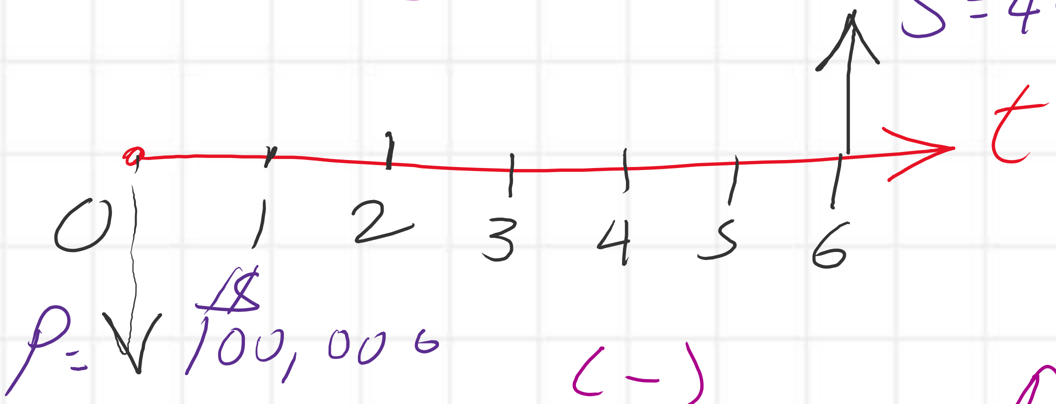
P to A

Convert G to A

to A


Conversions needed
→ original A
110,000
110,000
110,000
110,000
110,000
110,000
S=40,000
S → A
(A/S, i%, n)
0
1
2
3
4
5
6
Time in years
A → from S
50,000
56,000
62,000
68,000
74,000
80,000
100,00
G → A
Convert
P → A using
P(A/P, i%, n)
A From P
n = 6
i = 20%
A From G

Estimate factors



$i = 20\%$

$n = 6$ years

$$EUAC_{(CR)} = \overset{(-)}{A} \text{ from } P + \overset{+}{A} \text{ from } S \Rightarrow \frac{A}{P} = \frac{i(1+i)^n}{(1+i)^n - 1}$$

→ Convert I → A

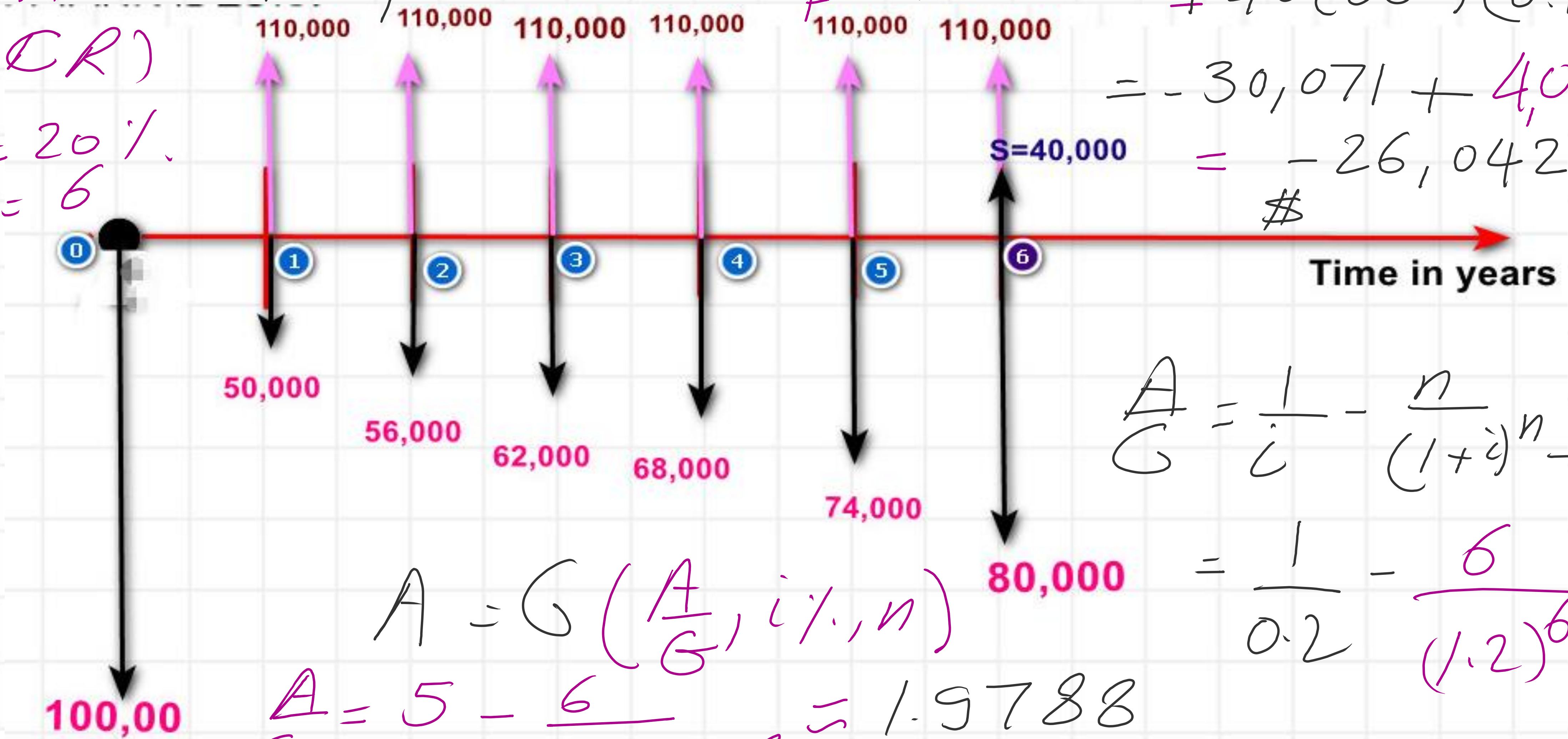
$$\frac{A}{P} = \frac{0.20(1+0.2)^6}{(1.2)^6 - 1} = 0.30071$$

→ Convert S → A

$$\frac{A}{F} = \frac{A}{P} \cdot \frac{P}{F} = \frac{i(1+i)^n}{(1+i)^n - 1} \cdot \frac{1}{(1+i)^n}$$

$F \rightarrow S$

$$\frac{0.20}{(1.2)^6 - 1} = 0.10071$$



$$EAC_{(CR)} = P\left(\frac{A}{P}, i\%, n\right) - S\left(\frac{A}{F}, i, n\right) = -100{,}000(0.30071) + 40(000)(0.10071)$$

$$= -30{,}071 + 4{,}028$$

$$= -26{,}042 \text{ \$}$$

$i = 20\%$

$N = 6$

$$\frac{A}{G} = \frac{1}{i} - \frac{n}{(1+i)^n - 1}$$

$$= \frac{1}{0.2} - \frac{6}{(1.2)^6 - 1}$$

$$A = G\left(\frac{A}{G}, i\%, n\right)$$

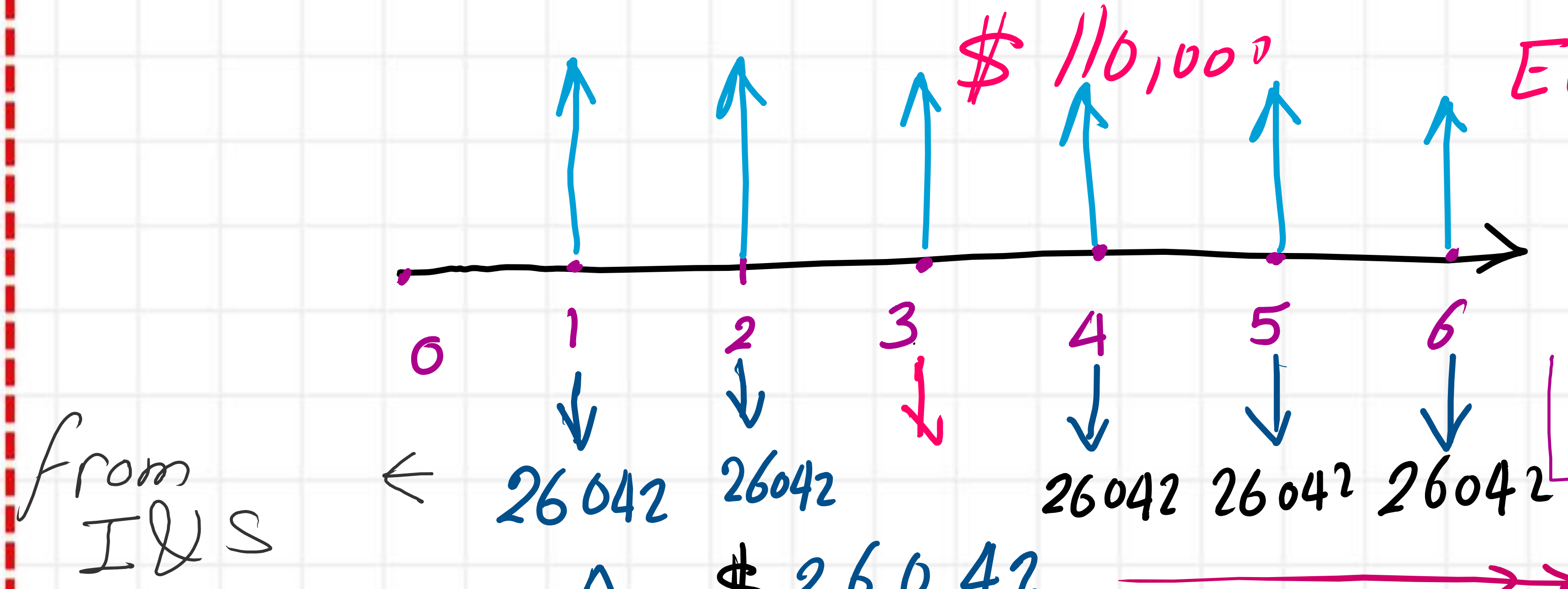
$$\frac{A}{G} = 5 - \frac{6}{1.98598} = 1.9788$$

$$EAC_{O\&M} = A - G\left(\frac{A}{G}, i, n\right) = -50{,}000 - 6000(1.9788)$$

$$= -61{,}872.8$$

EUAB & EUAC

EUAB ⇒ income



CR Value

From I&S

$A_1 = \$26,042$

From O&M

$A_2 = 50,000 + 1.9788(6000) = 61872.8$

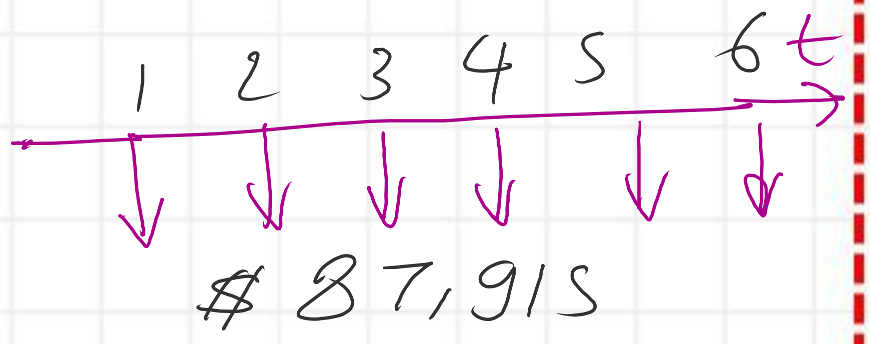
$EUAC = -(26042 + 61872.8) = -87914$ Total Cost

$(EUAC)_{O,M} = -50,000 - (6,000)(1.9788)$

$= -50,000 - 11,872.8 = -61,873$ \$

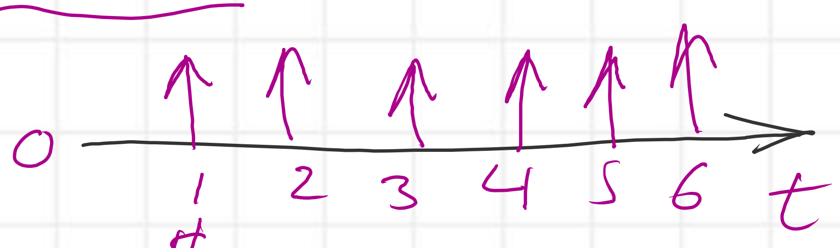
Total EUAC = $-26,042 - 61,873$

$= \$ -87,915$



while

EUAB = \$110,000 income



EUAW $= +\$110,000 - \$87,915 = \$22,085 > 0$

Investement is acceptable