Tikrit University

The College of Petroleum Processes Engineering

Petroleum and Gas Refining Engineering Department

Management and economics of petroleum projects

Fourth Class

Lecture (4)

By

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Present, Future and Annual Worth Analysis

The present worth P is renamed PW of the alternative.

The following guidelines are applied to justify a single project or to select one from several alternatives

One alternative: If PW ≥ 0, the requested MARR is met or exceeded and the alternative is economically justified.

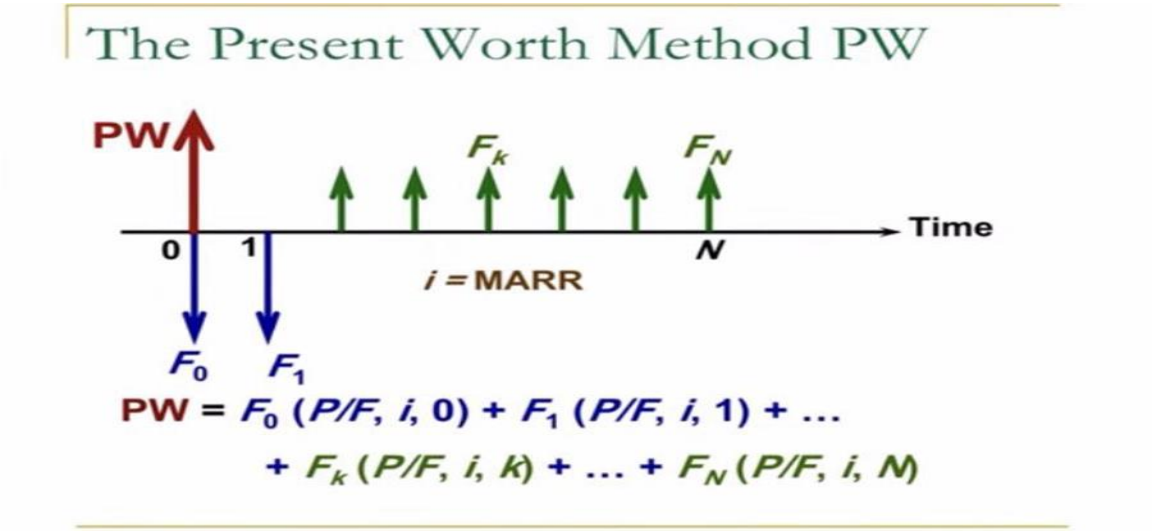
Two or more alternatives: Select the alternative with the PW that is numerically largest, This is not the absolute value of the PW amount, because the sign matters.

The Present Worth Method PW

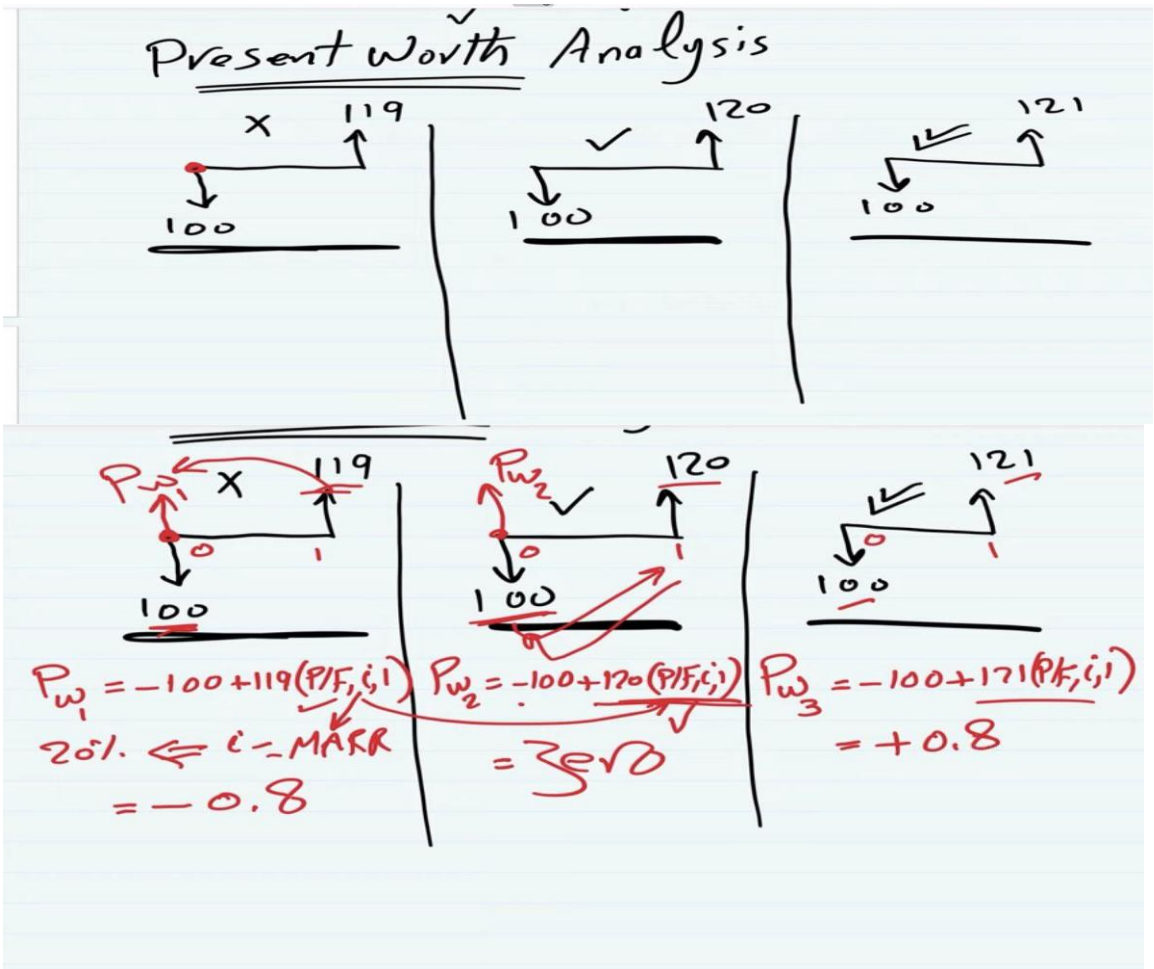
- The project (Alternative) is acceptable for investment when:

$$PW \geq 0$$

- The better alternative is that of higher **PW**


The Present Worth Method PW
PW
F_k
F_N
Time
0
1
N
i = MARR
F_0
F_1
PW = F_0 (P/F, i, 0) + F_1 (P/F, i, 1) + ...
+ F_k (P/F, i, k) + ... + F_N (P/F, i, N)

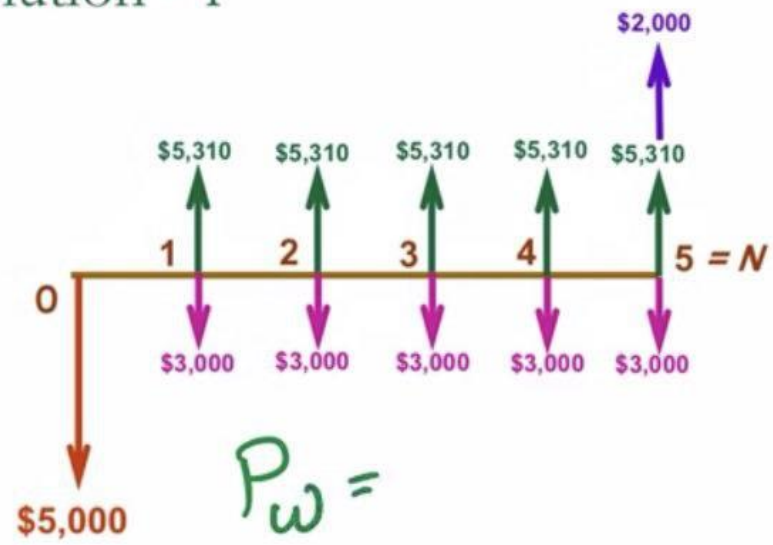
Ex:

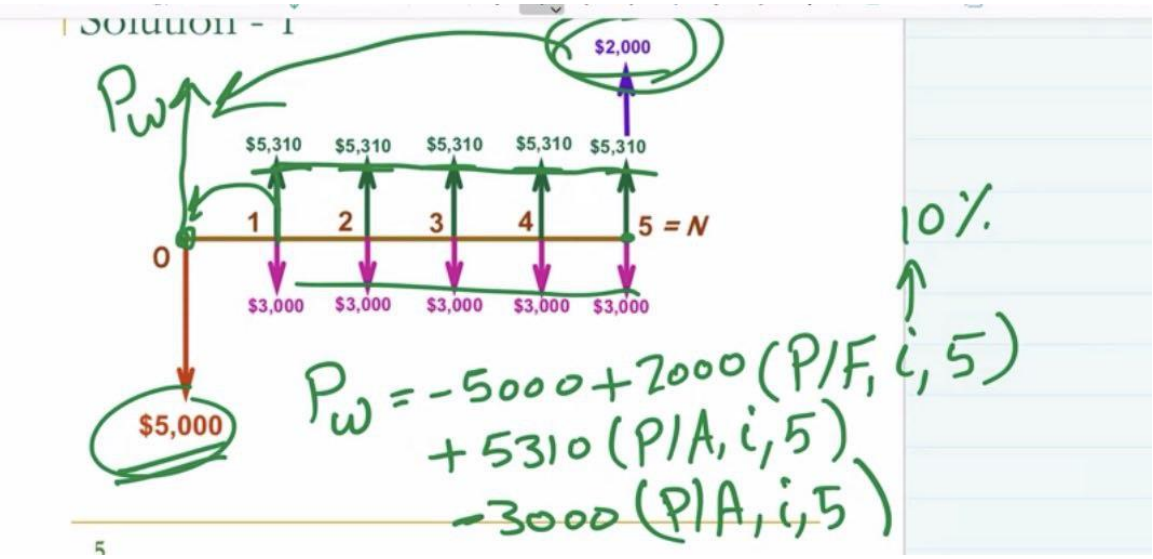

Present Worth Analysis
X
119
100
120
100
121
100
P_{W_1}
P_{W_2}
$P_{W_1} = -100 + 119(P/F, i, 1)$
$P_{W_2} = -100 + 120(P/F, i, 1)$
$P_{W_3} = -100 + 121(P/F, i, 1)$
20% ⇐ i = MARR
= −0.8
= zero
= +0.8

Example - 1

- An investment of $5,000 can be made in a project that will produce a uniform annual revenue of $5,310 for *five years* and then have a market (salvage) value of $2,000.
- Annual expenses will be $3,000 each year.
- The company is willing to accept any project that will earn 10% per year or more, on all invested capital.
- Show whether this is desirable investment by using the PW method.

Solution - 1





Example - 2

- A piece of new equipment has been proposed by engineers to increase the productivity of certain manual welding operation.
- The investment cost is $25,000 and the equipment will have the market value of $5,000 at the end of a study period of five years.
- Increased productivity attributable to the equipment will amount to $8,000 per year after extra operating costs have been subtracted from the revenue generated by the additional production.
- If the firm's MARR is 20% per year, is this proposal a sound one?
- Use the **PW** method.

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Solution - 2

PW = – $25,000 + $8,000 (*P/A*, 20%, 5) + $5,000 (*P/F*, 20%, 5)

PW = – $25,000 + $8,000 (2.9906) + $5,000 (0.4019)

PW = $934.3 > 0

The project is acceptable

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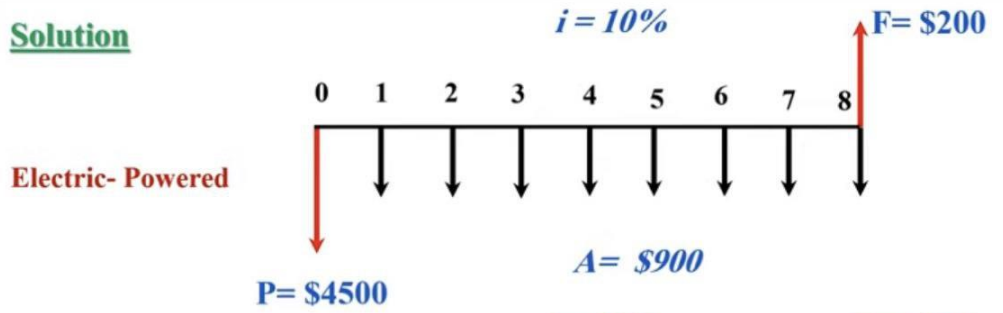
1- Present Worth Analysis of Equal-Life Alternatives

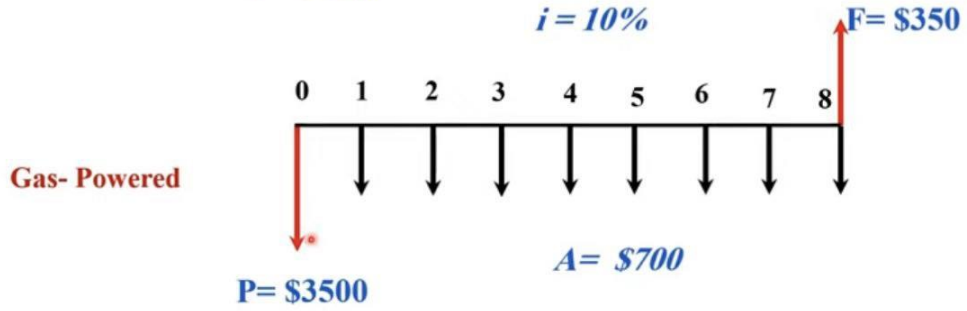
Example 1

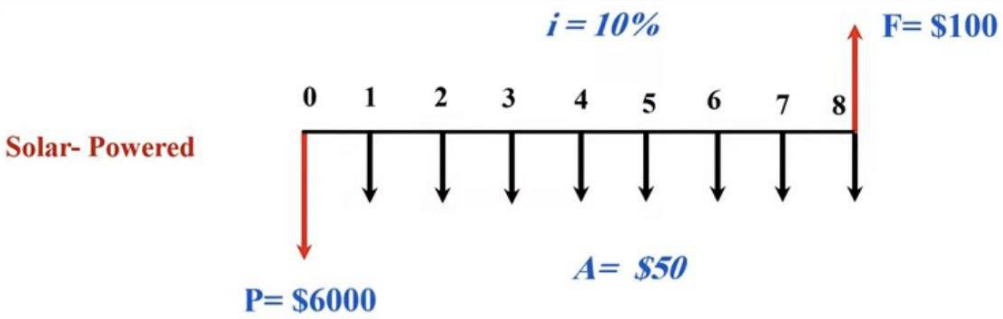
A space agency wants to contract a system to ship fuel cells. There are three equal service machines that need an economic evaluation to be chosen between them. Perform the present worth analysis with the costs shown below. The MARR is 10% per year.

	Electric- Powered	Gas- Powered	Solar- Powered
First cos, $	-4500	-3500	-6000
Annual operating cost (AOC), $/year	-900	-700	-50
Salvage value S, $	200	350	100
Life, years	8	8	8

Solution







$PW_E = -4500 - 900(P/A, 10\%, 8) + 200(P/F, 10\%, 8) = \$-9208$

$PW_G = -3500 - 700(P/A, 10\%, 8) + 350(P/F, 10\%, 8) = \$-7071$

$PW_S = -6000 - 50(P/A, 10\%, 8) + 100(P/F, 10\%, 8) = \$-6220$

$PW_E = -4500 - 900(P/A, 10\%, 8) + 200(P/F, 10\%, 8) = \$-9208$

$PW_G = -3500 - 700(P/A, 10\%, 8) + 350(P/F, 10\%, 8) = \$-7071$

$PW_S = -6000 - 50(P/A, 10\%, 8) + 100(P/F, 10\%, 8) = \$-6220$

The solar-powered machine is selected since the PW of its costs is t lowest; it has the numerically largest PW value.

2- Present Worth Analysis of Different-Life Alternatives

Example 2

Real estate development company plans to purchase new machine for finishing work. Two manufacturers offered the estimates below.

(a) Determine which supplier should be selected on the basis of a present worth comparison, if the MARR is 15% per year.

(b) Real estate development company has a standard practice of evaluating all options over a 5-year period. If a study period of 5 years is used and the salvage values are not expected to change, which vendor should be selected?

	Supplier A	Supplier B
First cos, $	-15000	-18000
Annual M&O cost, $/year	-3500	-3100
Salvage value S, $	1000	2000
Life, years	6	9

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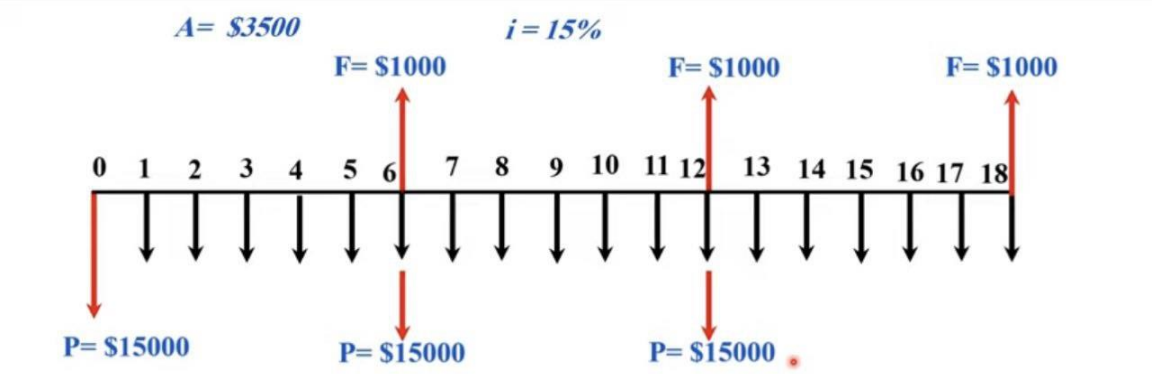
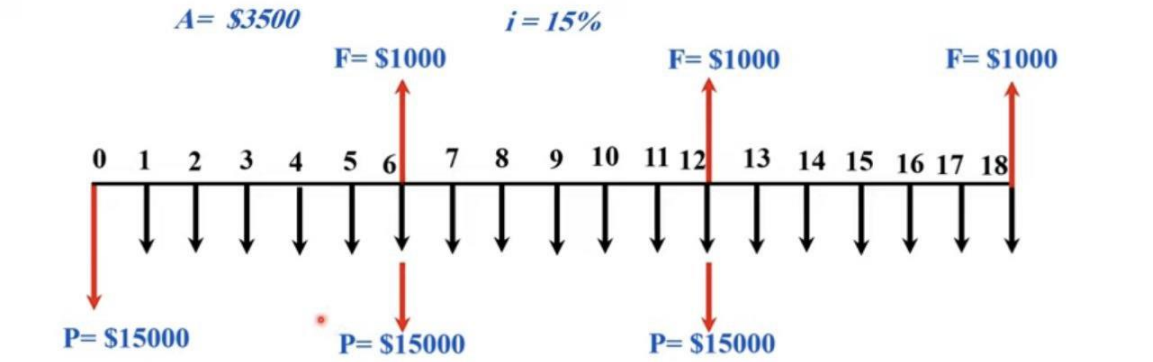
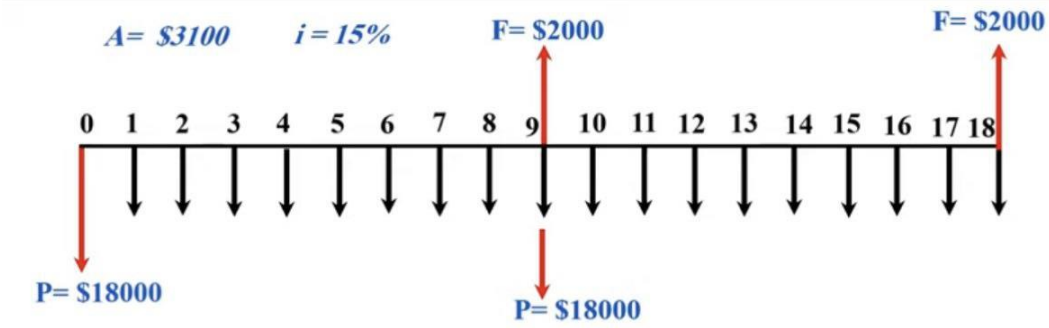




$$PW_A = -15000 - 15000(P/F, 15\%, 6) + 1000(P/F, 15\%, 6) - 15000(P/F, 15\%, 12) + 1000(P/F, 15\%, 12) + 1000(P/F, 15\%, 18) - 3500(P/A, 15\%, 18)$$

$$= \$ - 45036$$



$$PW_B = -18000 - 18{,}000(P/F, 15\%, 9) + 2000(P/F, 15\%, 9) + 2000(P/F, 15\%, 18) - 3100(P/A, 15\%, 18)$$

$$= \$-41384$$

Supplier B is selected, since it costs less in PW terms

1- Future Worth Analysis

The Future worth F is renamed FW of the alternative.

The following guidelines are applied to justify a single project or to select one from several alternatives

One alternative: **If FW ≥ 0, the requested MARR is met or exceeded and the alternative is economically justified.**

Two or more alternatives: **Select the alternative with the FW that is numerically largest.**

Example - 3

Repeat example – 2 by using **FW** Method

Solution - 3

FW = - $25,000 (*F/P*, 20%, 5) + $8,000 (*F/A*, 20%, 5) + $5,000

FW = -$25,000 (2.4883) + $8,000 (7.4416) + $5,000

FW = $2325.3 > 0

The project is acceptable

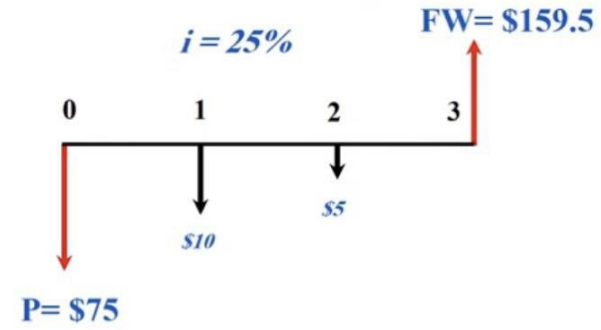
Example 1

A British food distribution conglomerate purchased a Canadian food store chain for $75 million 3 years ago. There was a net loss of $10 million at the end of year 1 of ownership. Net cash flow is increasing with an arithmetic gradient of $+5 million per year starting the second year, and this pattern is expected to continue for the foreseeable future. This means that breakeven net cash flow was achieved this year. Because of the heavy debt financing used to purchase the Canadian chain, the international board of directors expects a MARR of 25% per year from any sale.

(a) The British conglomerate has just been offered $159.5 million by a French company wishing to get a foothold in Canada. Use FW analysis to determine if the MARR will be realized at this selling price.

(b) If the British conglomerate continues to own the chain, what selling price must be obtained at the end of 5 years of ownership to just make the MARR?

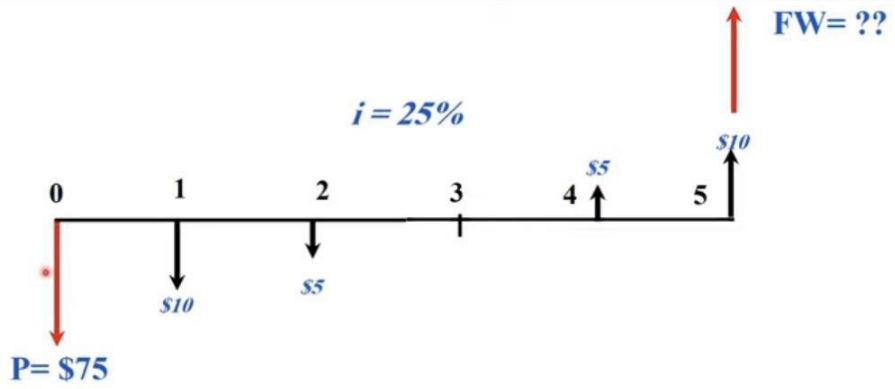
Solution



(a) FW3 = -75(*F*/*P*, 25%, 3) - 10(*F*/*P*, 25%, 2) - 5(*F*/*P*, 25%, 1) + 159.5

= -168.36 + 159.5 = $-8.86 million

No, the MARR of 25% will not be realized if the £159.5 million offer is accepted.

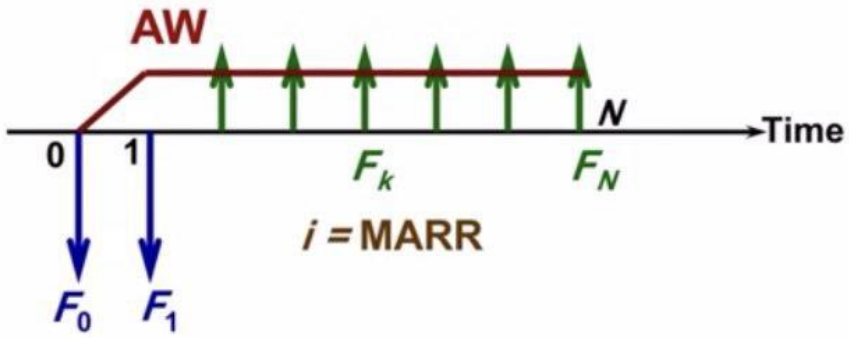


(b) $FW_5 = -75(F/P, 25\%, 5) - 10(F/A, 25\%, 5) + 5(A/G, 25\%, 5)\,(F/A, 25\%, 5)$

= £-246.81 million

The offer must be for at least £246.81 million to make the MARR.

The Annual Worth Method AW



$$AW = PW\,(A/P, i, N) = FW\,(A/F, i, N)$$

The Annual Worth Method AW

- The project (Alternative) is acceptable for investment when:

$$AW \geq 0$$

- The better alternative is that of higher **AW**

Example - 4

Repeat example – 2 by using **AW** Method

Solution - 4

AW = \$8,000 - \$25,000 (*A/P*, 20%, 5) + \$5,000 (*A/F*, 20%, 5)

AW = \$8,000 - \$25,000 (0.3344) + \$5,000 (0.1344)

AW = \$312 > 0

The project is acceptable

Ex 5:

You purchase a building five years ago for **$100,000**.
Its annual maintenance expense has been **$5,000** per year.
At the end of three years, you spent **$9,000** on roof repairs.
At the end of five years (now), you sell the building for **$120,000**.
During the period of ownership, you rented the building for **$10,000** per year paid at the beginning of each year.
Use the **AW** method to evaluate this investment when your MARR is 12% per year.

Solution:

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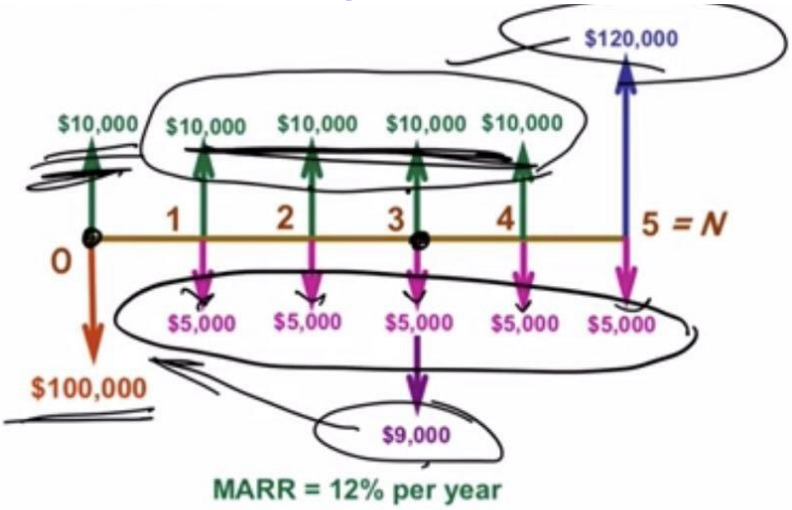
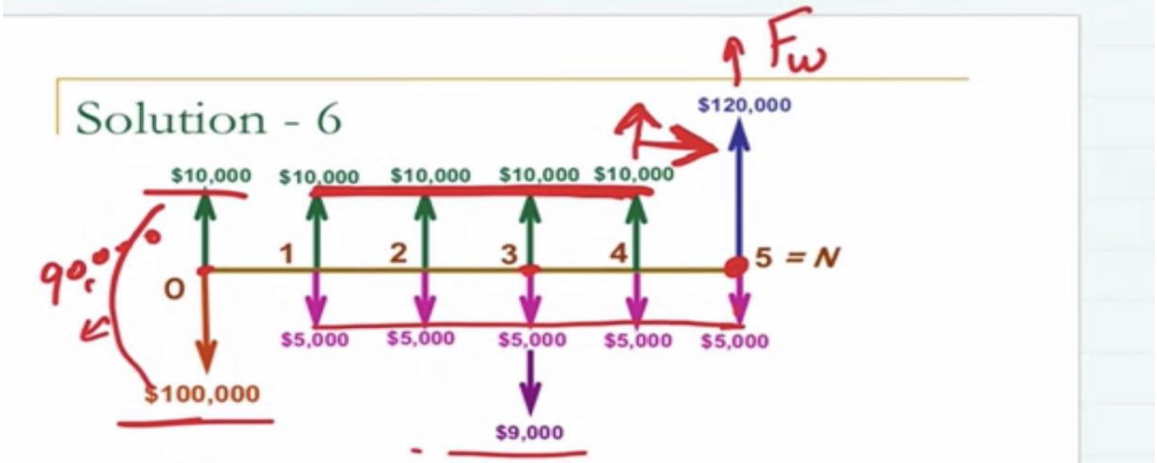


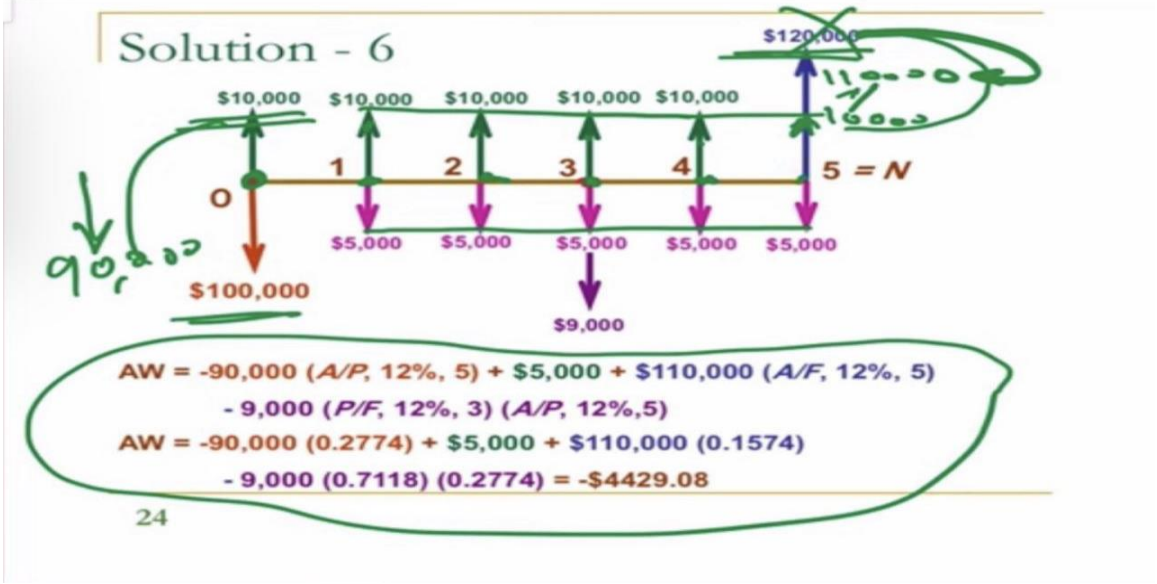
23

$$P_w = +10{,}000 - 100{,}000 - 9000(P/F, 12\%, 3) + 120{,}000(P/F, i, 5) - 5{,}000(P/A, i, 5) + 10{,}000(P/A, i, 4) = 0$$

$$F_w = +120{,}000 - 9000(F/P, i, 2) - 90{,}000(F/P, i, 5) - 5000(F/A, i, 5) + 10{,}000(F/A, i, 4)(F/P, i, 1) = 0$$

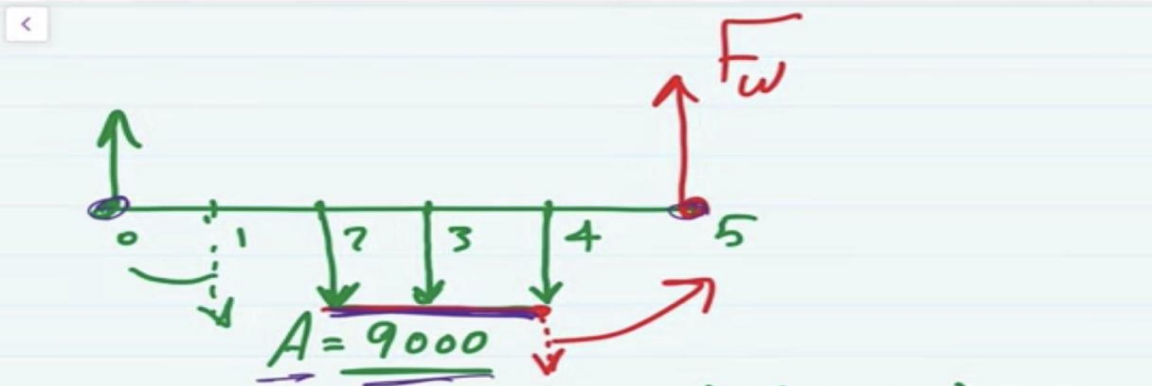


AW = -90,000 (*A/P*, 12%, 5) + $5,000 + $110,000 (*A/F*, 12%, 5)
- 9,000 (*P/F*, 12%, 3) (*A/P*, 12%,5)
AW = -90,000 (0.2774) + $5,000 + $110,000 (0.1574)
- 9,000 (0.7118) (0.2774) = -$4429.08



$$A_w = -5000 + 10{,}000 - 90{,}000\,(A/P, 12\%, 5) + 110{,}000\,(A/F, 12\%, 5) - 9{,}000\,(P/F, 12\%, 3)(A/P, 12\%, 5) = ?$$

Ex 6:



$$P_w = -9000\,(P/A, i, 3)(P/F, i, 1)$$

$$F_w = -9000\,(F/A, i, 3)(F/P, i, 1)$$

$$A_w = -9000\,(P/A, i, 3)(P/F, i, 1)(A/P, i, 5)$$