ENGINEERING ECONOMY

INTRODUCTION

CASH FLOW DIAGRAMS

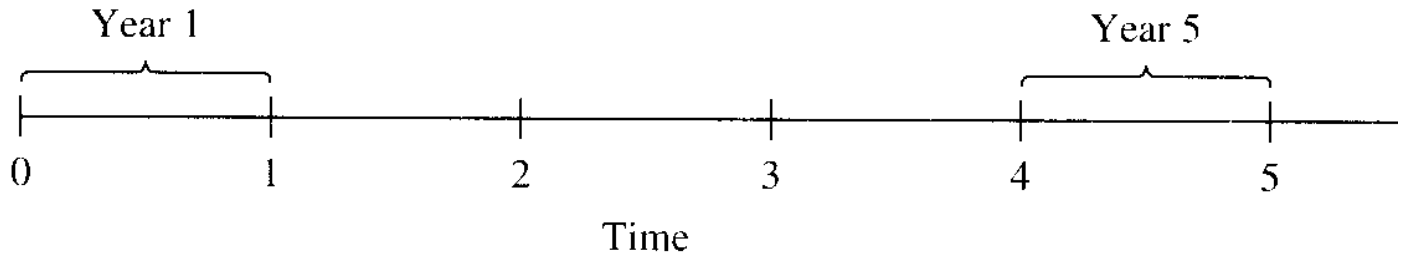
CASH FLOWS

- To financially analyze engineering projects, we need to model the projects in terms of cash flows
- Cash flows represent the flow or movement of money at some specific time over some period of time
- Outflows represent cash that is leaving an account such as a withdrawal (expenses or disbursements or losses or costs)
- Inflows represent cash that is entering an account such as a deposit (revenues or receipts or benefits or incomes)

CASH FLOWS AND ENGINEERING PROJECTS

- An engineering project can be viewed as an account with *outflows* and *inflows*

- Cash flow movements can be visually displayed through the use of a cash flow diagram



CASH FLOW DIAGRAM

- A cash flow diagram is a picture of a financial problem that shows all cash inflows and outflows plotted along a horizontal time line

- The cash flows over time are represented by arrows at relevant periods: upward arrows denote positive flows and downward arrows denote negative flows

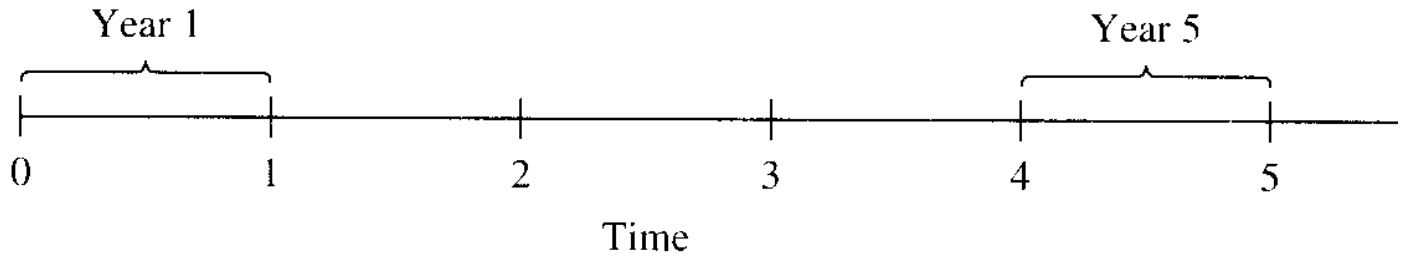
- Arrows represent net cash flows since two or more values at the same time are summed and shown as a single arrow

- *Net cash flows = receipts – disbursement*
  = cash inflows – cash outflows

CASH FLOW DIAGRAM

- Generally, the start of the diagram represents the *beginning* of the interest period

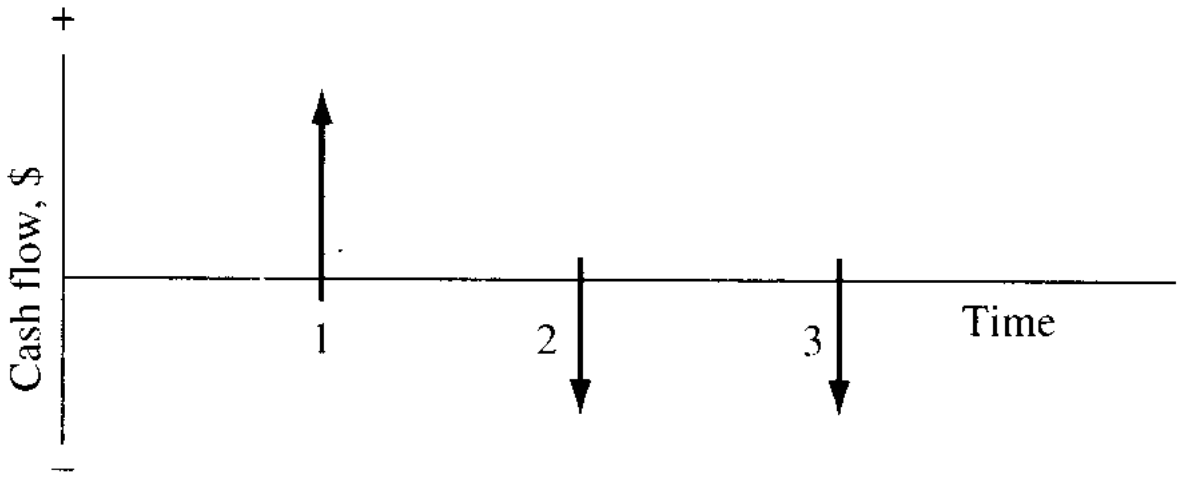
- When t = 0, this is the present
- When t = 1, this is the *end of the first year* (or *beginning of the second year*)



A typical cash flow time scale for 5 years

CASH FLOW DIAGRAM

The figure illustrates a receipt (cash *inflow*) at the end of year 1 and equal disbursements (cash *outflows*) at the end of years 2 and 3

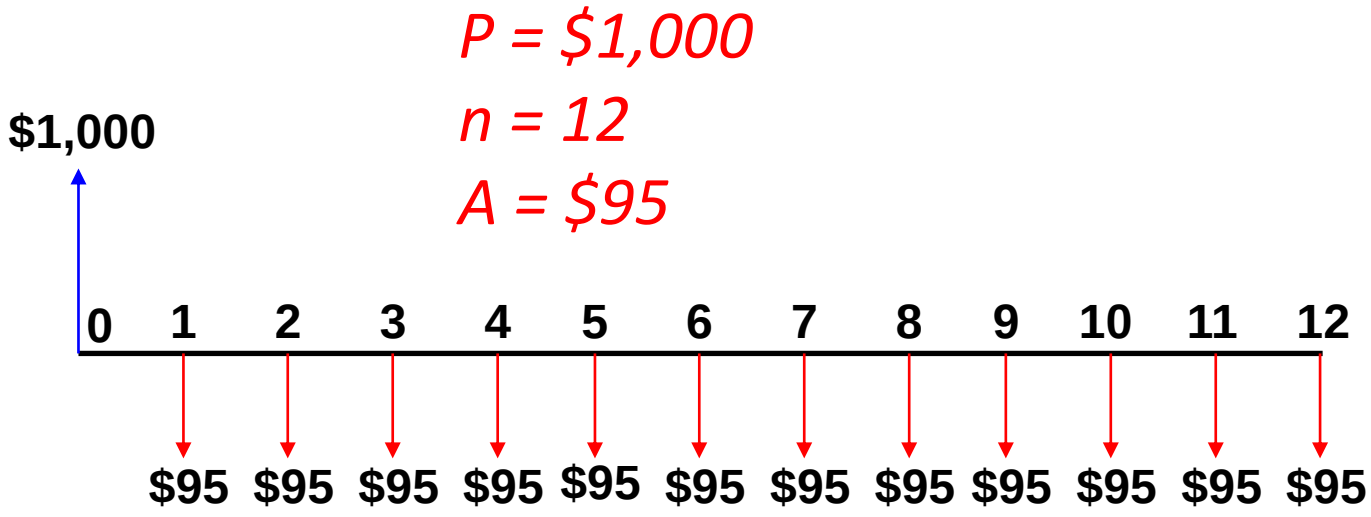


Example of positive and negative cash flows

Cash Flow Diagram – Example [1]

- You borrowed $1,000 from a bank to purchase a laptop. The bank requires you to make 12 equal monthly payments of $95 to pay off the loan

- Draw the cash flow diagram for this scenario



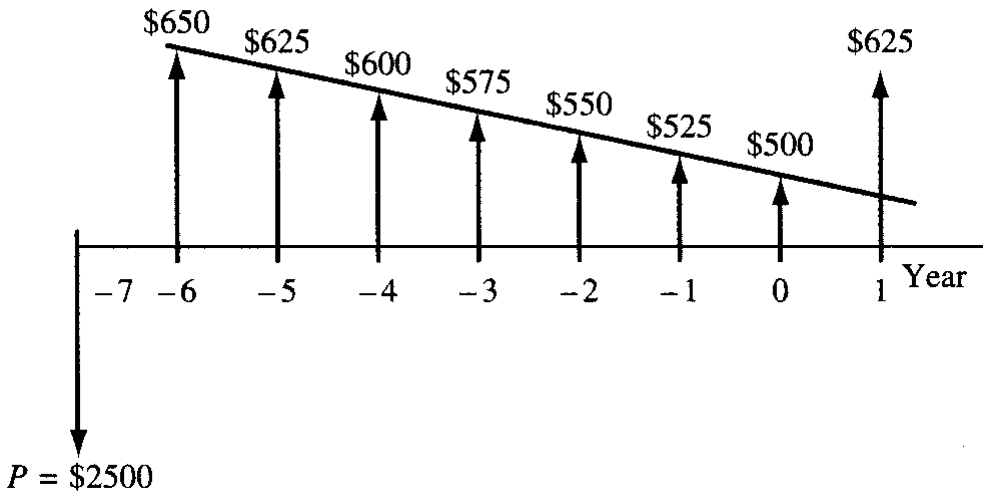
Cash Flow Diagram – Example [2]

- A company spent $2,500 on a new compressor 7 years ago
- The annual *income* from the compressor has been $750
- Additionally, the $100 spent on *maintenance* during the first year has increased each year by $25
- The company plans to sell the compressor at the end of next year for $150
- Construct the cash flow diagram from the *company's perspective*

Cash Flow Diagram – Example [2]

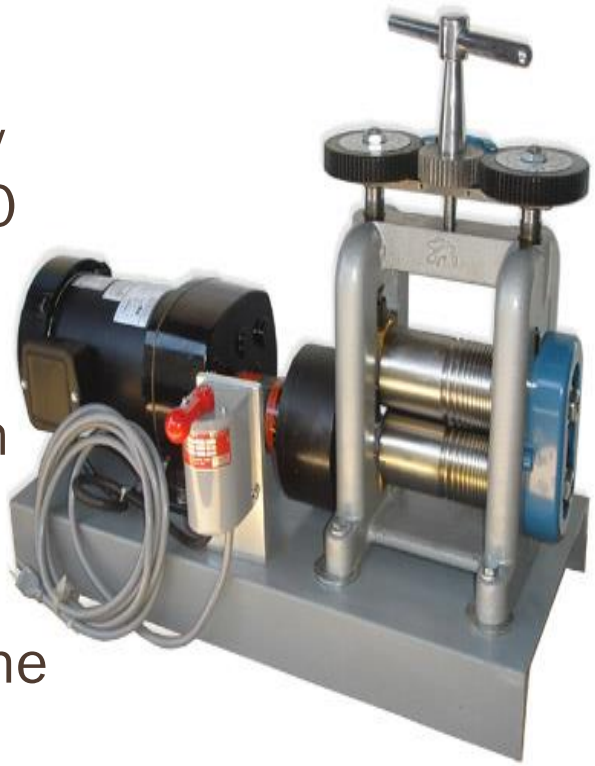
- Use now as time t = 0
- The incomes and costs for years -7 through 1 (next year) are tabulated

End of year	Income	Cost	Net Cash Flow
−7	$ 0	$2500	$−2500
−6	750	100	650
−5	750	125	625
−4	750	150	600
−3	750	175	575
−2	750	200	550
−1	750	225	525
0	750	250	500
1	750 + 150	275	625

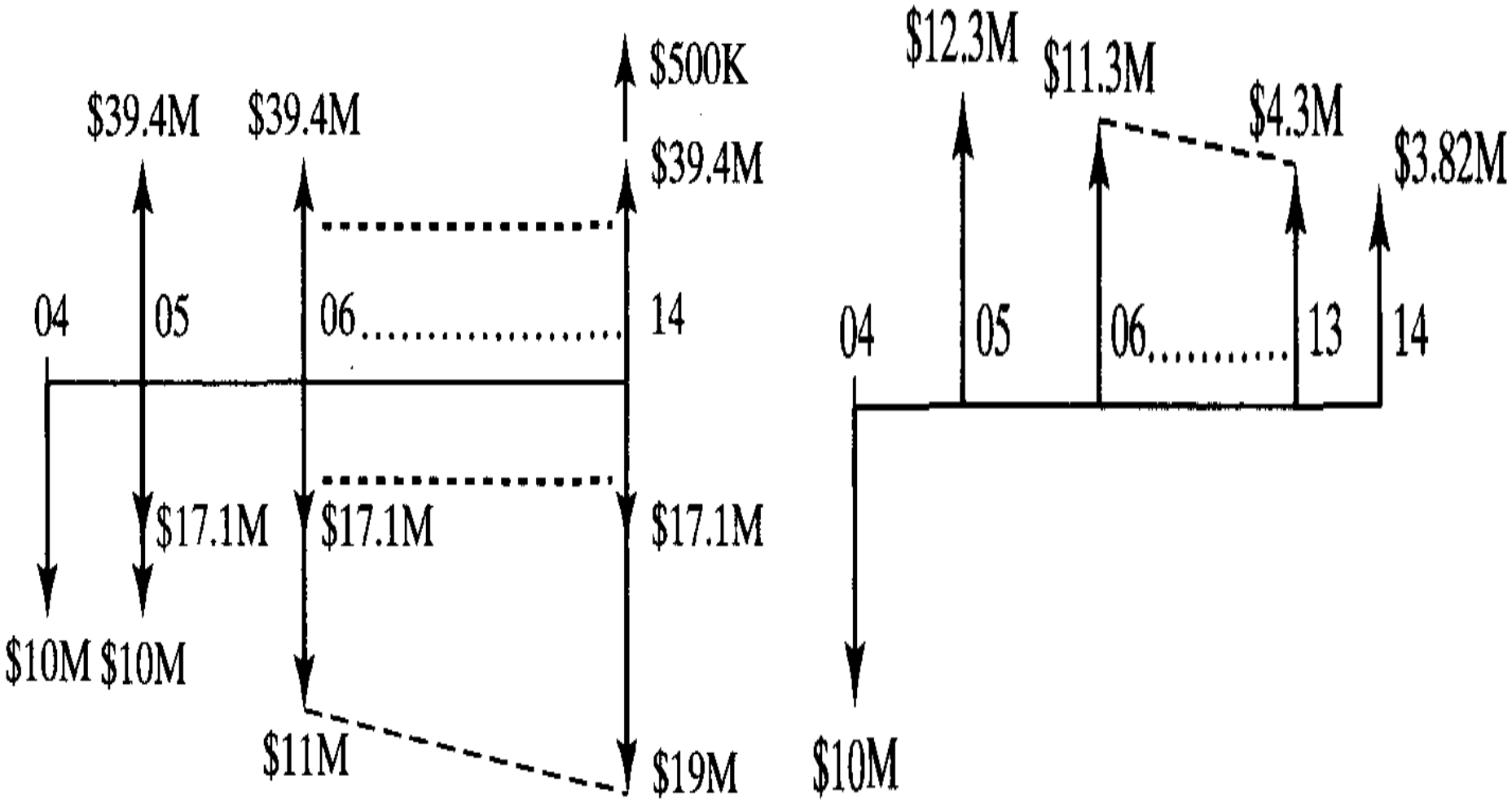


Cash Flow Diagram – Example [3]

- A company expanded its operations with the *purchase* of a $10 million rolling mill in 2004
- Assume that the new mill runs at peak capacity (4.375 million pounds of output per year) for 10 years
- Assume that a pound of output generates $9 in revenues while costing $3.90 to produce
- Maintenance of the equipment is $10 million the first year and grows by $1 million per year
- Finally, the mill is to be scrapped at the end of 10 years for $500,000



Cash Flow Diagram – Example [3]



Cash Flow Diagram – Example [4]

- You *deposited* a $1,000 in your account in a bank that gives a ***daily*** interest of 0.003% where interest is paid monthly. Assume simple interest

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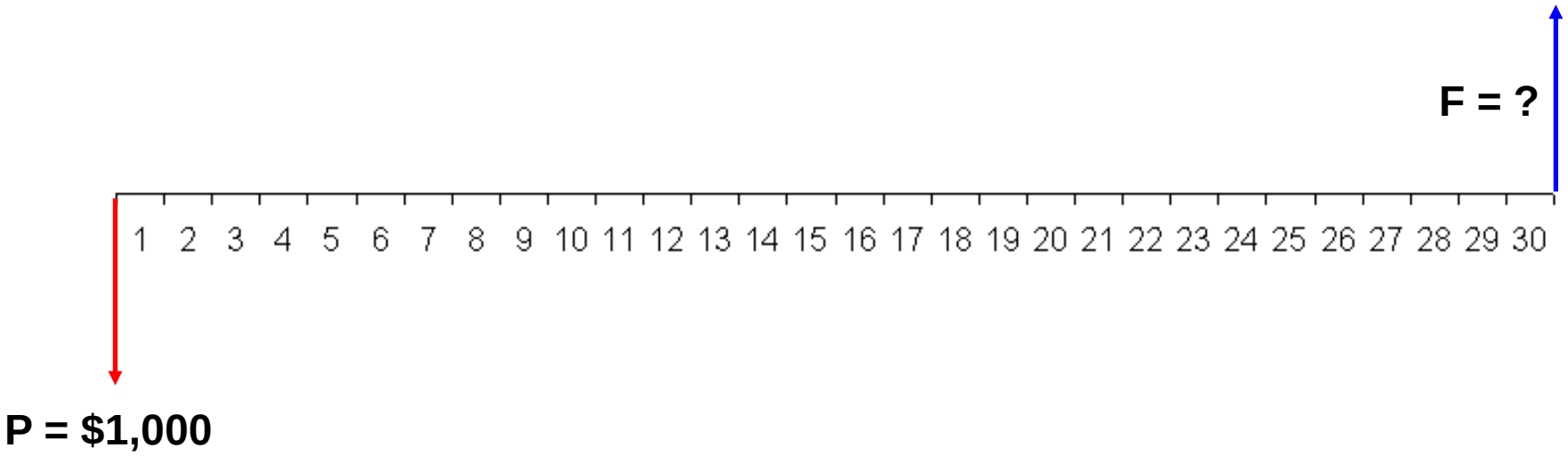
- [1] For this scenario, what is your balance after 30 days?
- [2] If you deposit another $2,000 on the 11th day and withdraw $500 on the 26th day, what is your balance at the end of the 30th day?
- In both cases, draw the cash flow diagram

Cash Flow Diagram – Example [4]

- [1] Since we have simple interest, then F = P(1+ni)

  → F = $1,000 × (1+30 × 0.003%) = $1,000.9



Cash Flow Diagram – Example [4]

- [2] F = $\$1{,}000 \times (1+\underline{\mathbf{30}} \times 0.003\%) + \$2{,}000 \times (1+\underline{\mathbf{20}} \times 0.003\%)$

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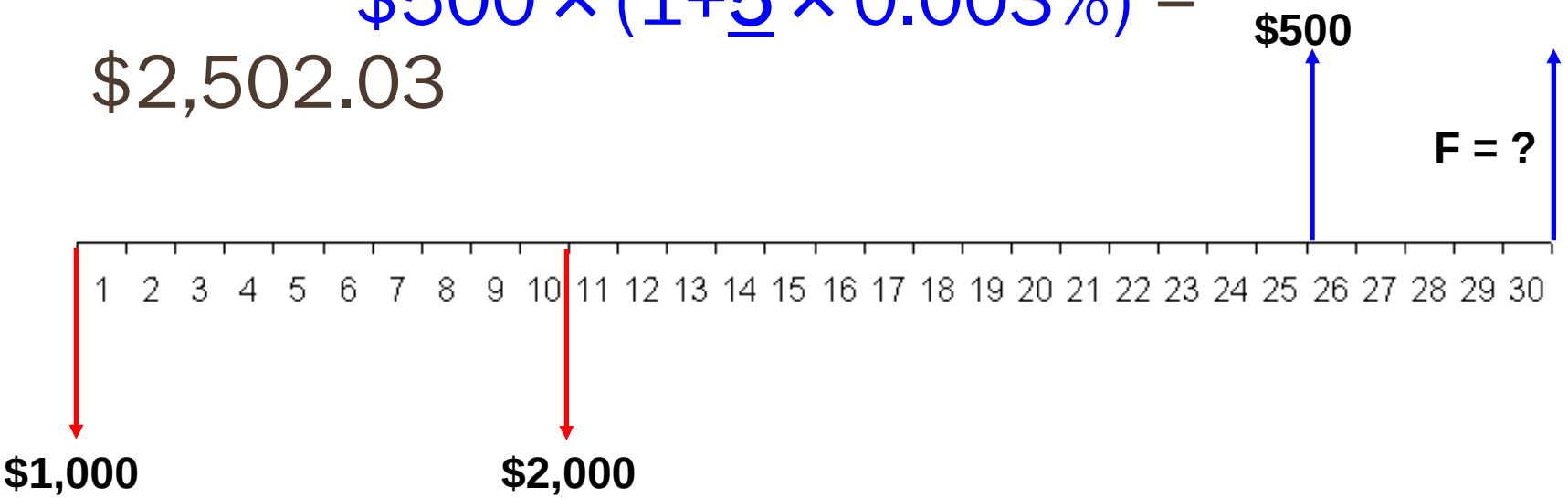
  $\$500 \times (1+\underline{\mathbf{5}} \times 0.003\%) = \$2{,}502.03$



Just keep in mind that the day is represented by its beginning

Cash Flow Diagram – Example [5]

- You have deposited $1,000 with an interest rate of 3% every 6 months where the interest is computed every 6 months

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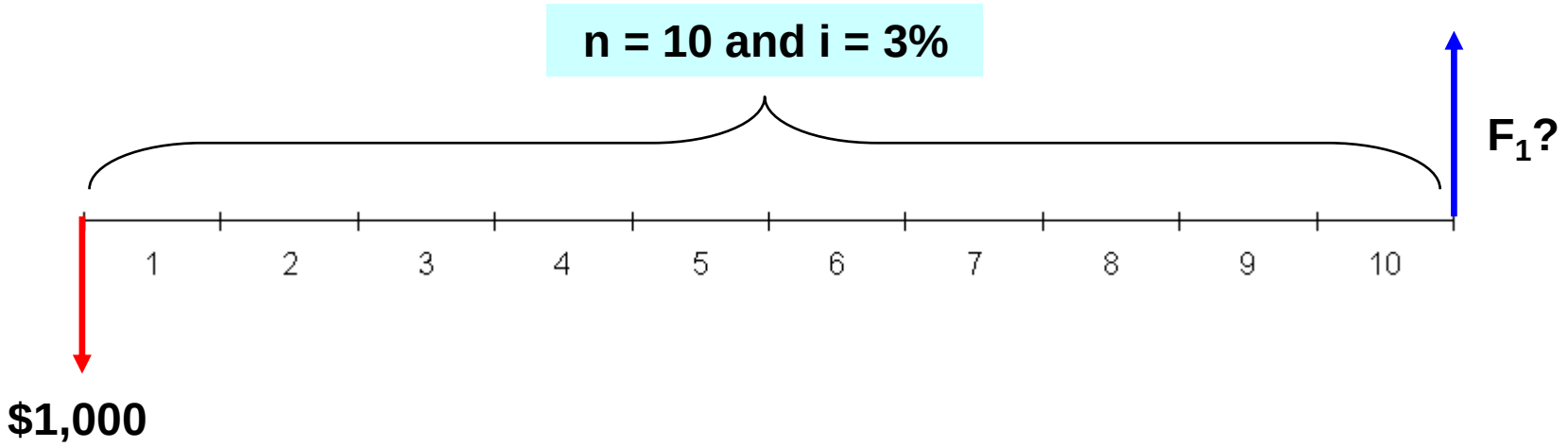
- How much you will have after 5 years?

- Two years later after the initial deposit of the money, you deposited additional $1,000 with an interest rate of *2%* every 6 months (*applies only to this deposit*). How much will you have after 5 years?

Cash Flow Diagram – Example [5]

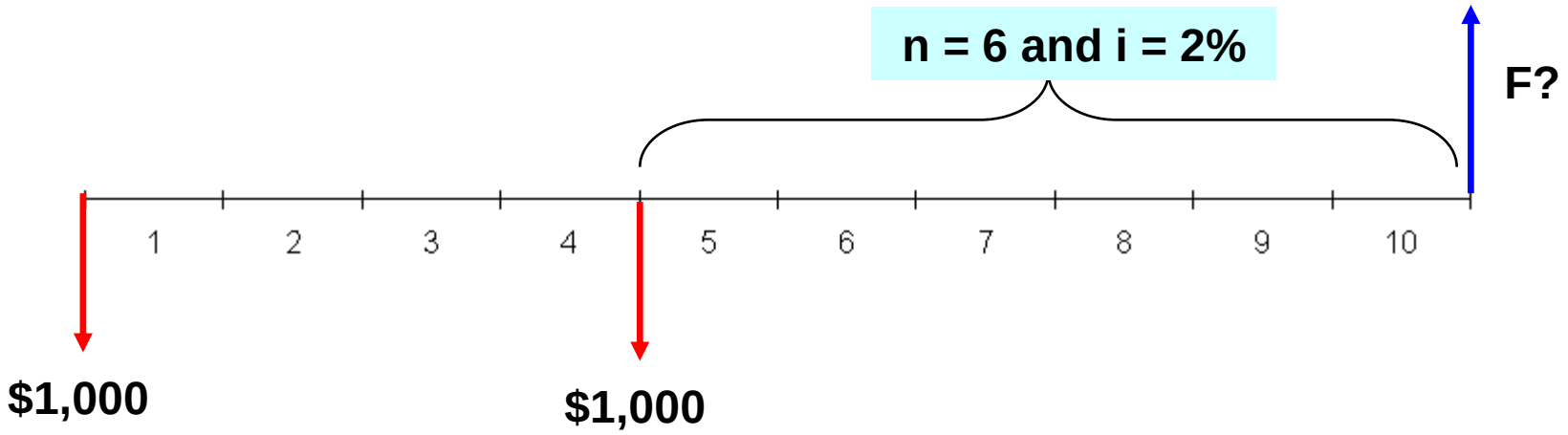
- We have a total of 10 periods each period of 6 months for the $1,000

- $F1 = P(1+i)^n = \$1,000 \times (1+3\%)^{10} = \$1,343.92$



Cash Flow Diagram – Example [5]

- We have a total of 10 periods each period of 6 months for the first $1,000 [F1]
- We have a total of 6 periods each period of 6 months for the second $1,000 [F2]
- $F = F1+F2 = \$1{,}000 \times (1+3\%)^{10} + \$1{,}000 \times (1+2\%)^{6} = \$2{,}470.08$



EXAMPLE [6]

- What would be the future worth after two years of a deposit of $1,000 now if the interest rate for the first year is 10% and for the second year is 5%?

- By the end of the *first* year, the total amount becomes:

  $1{,}000(1+10\%)^1 = \$1{,}100$

- By the end of the *second* year, the total amount becomes:

  $1{,}100(1+5\%)^1 = \$1{,}155$