Time Value of Money
Part I

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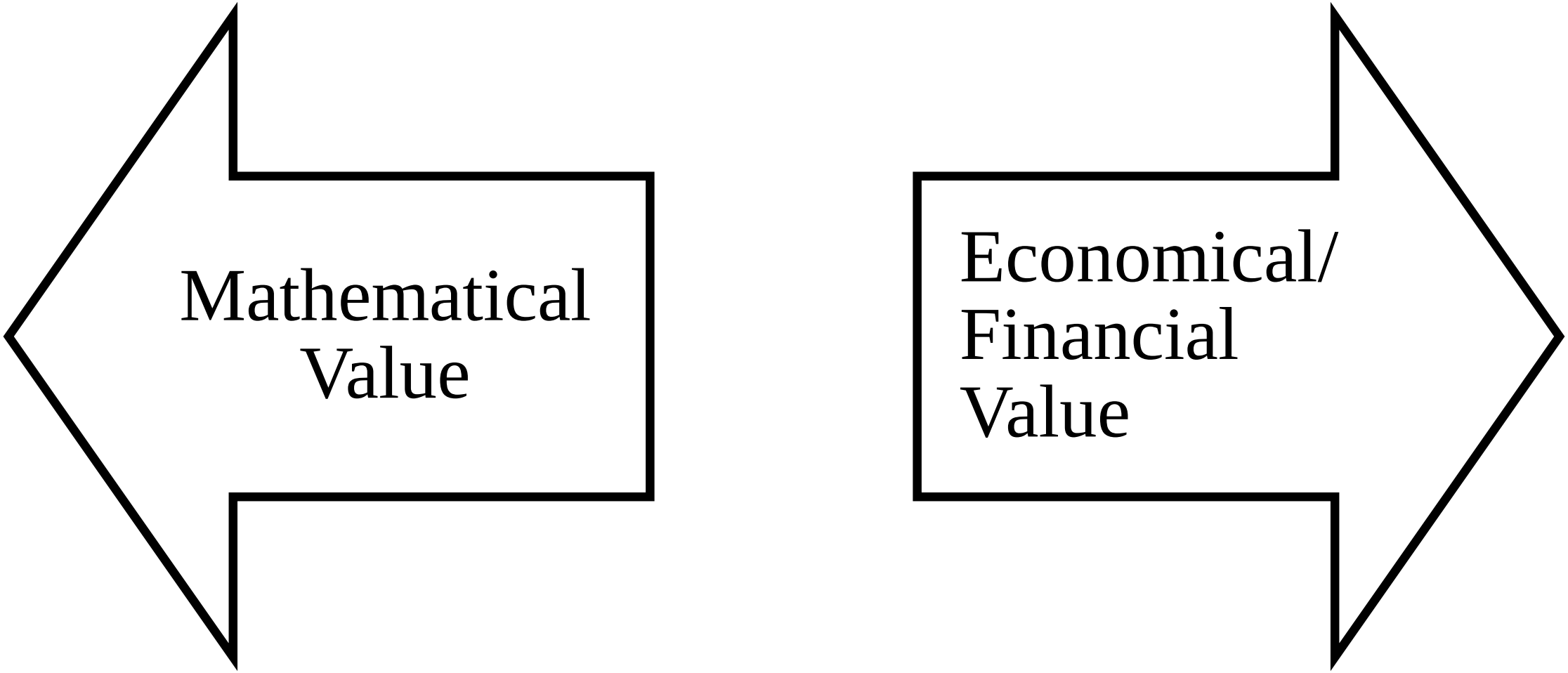
What Will You Do????

You have won a lucky draw prize & you can redeem lottery today Rs.10,000	OR	You can redeem same lucky draw prize after 5 years Rs.10,000
Option A		Option B

TVM Depends on



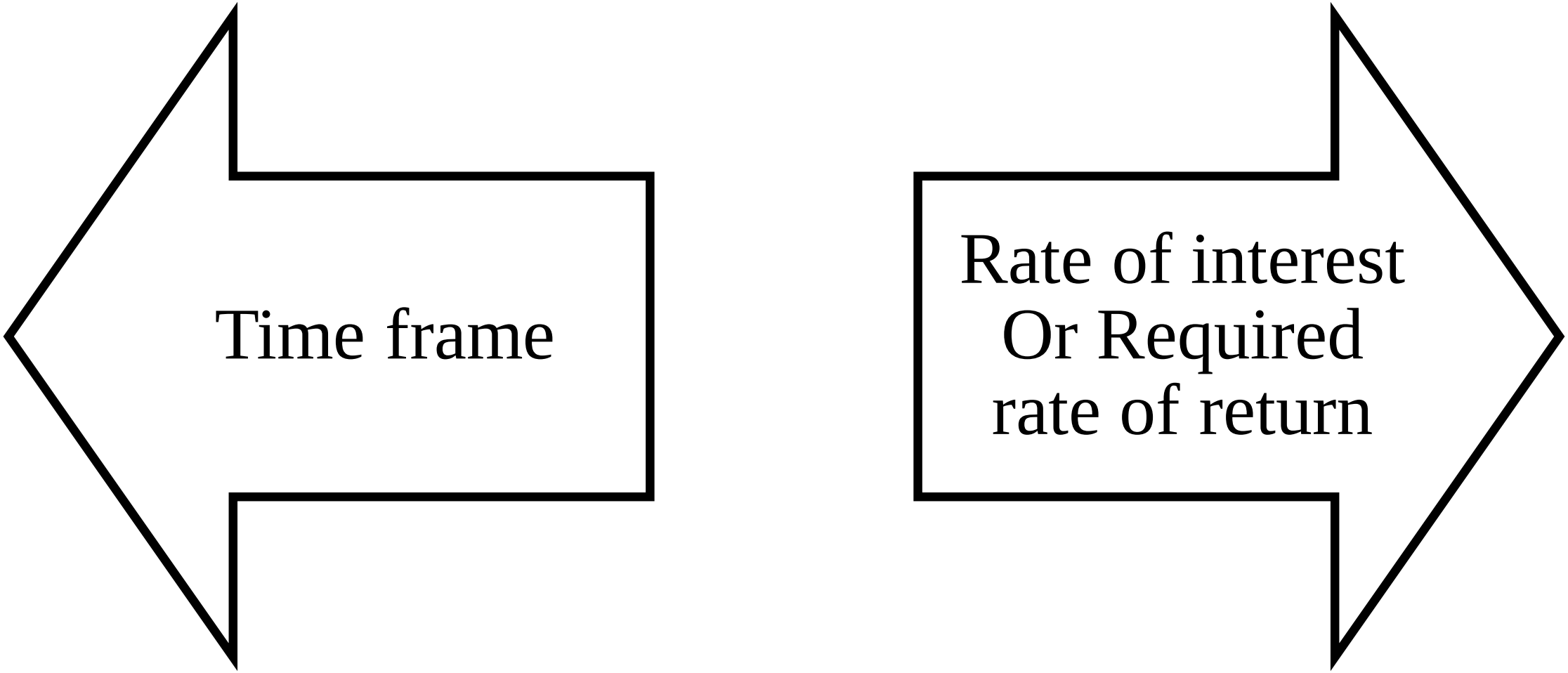
Concept: Time Value (TV) Money

- The TVM is the concept according to which **a sum of money owned** in the **present** has a **greater value** than the value of the **same sum** received at a moment **in the future**.
- Money you have now is worth more than the identical sum in the future due to its **potential earning capacity**.
- Concept of Time Value of Money (TVM) has a large applicability in the financial management of companies, in banking, on the capital market

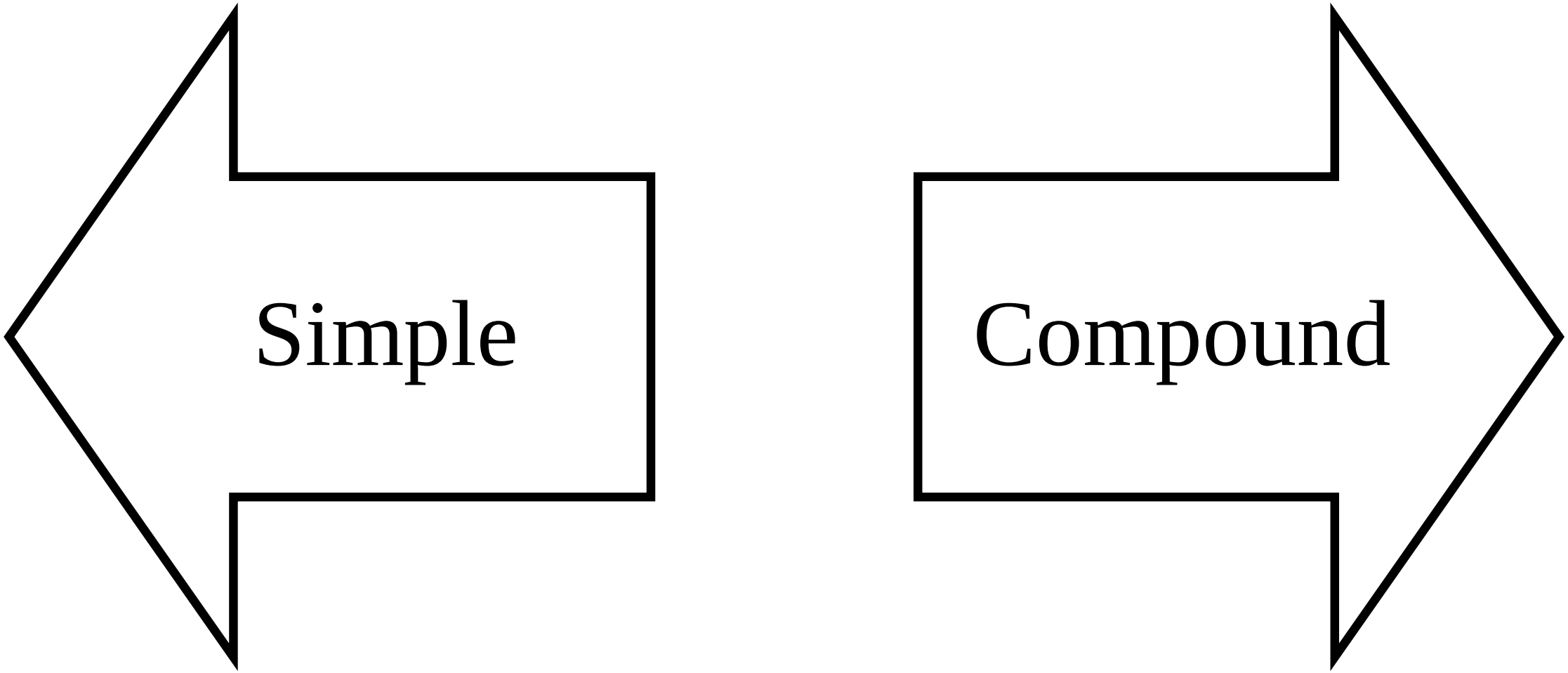
Why TVM Exists?

- **Risk and Uncertainty-** Higher the uncertainty (risk) associated with the cash flow in the future, the less that cash flow will be valued.
- **Inflation-** the value of currency decreases over time.
- **Consumption Preference-** To induce people to give up present consumption you have to offer them more in the future.
- **Investment Opportunities-** More options to invest exist giving higher returns to investors.

TVM Depends on

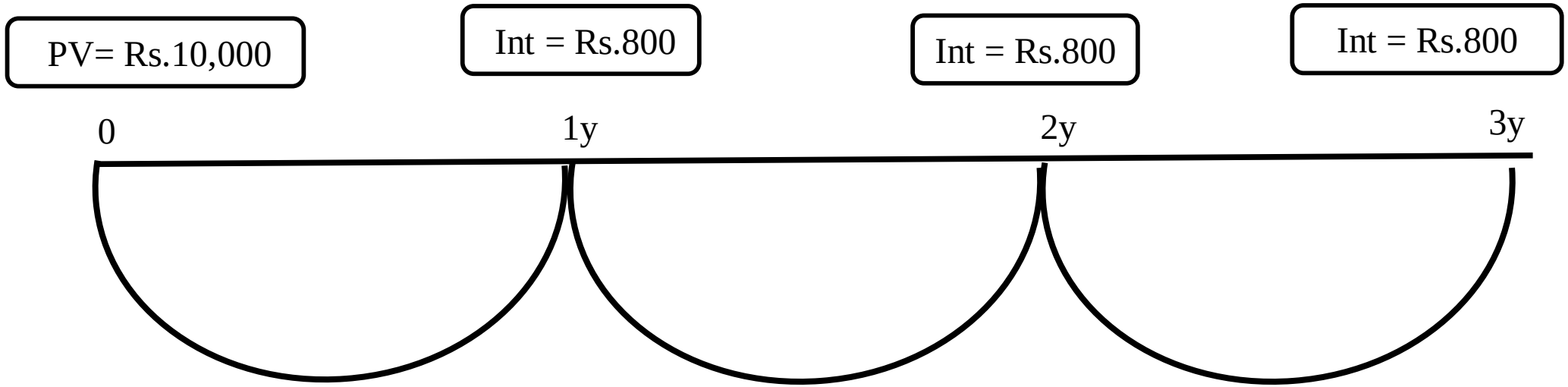


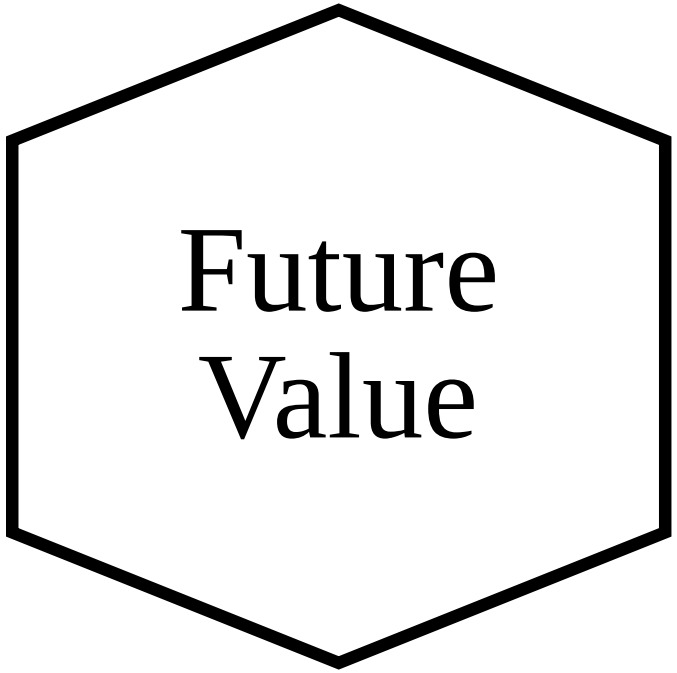
Types of Interest Calculations

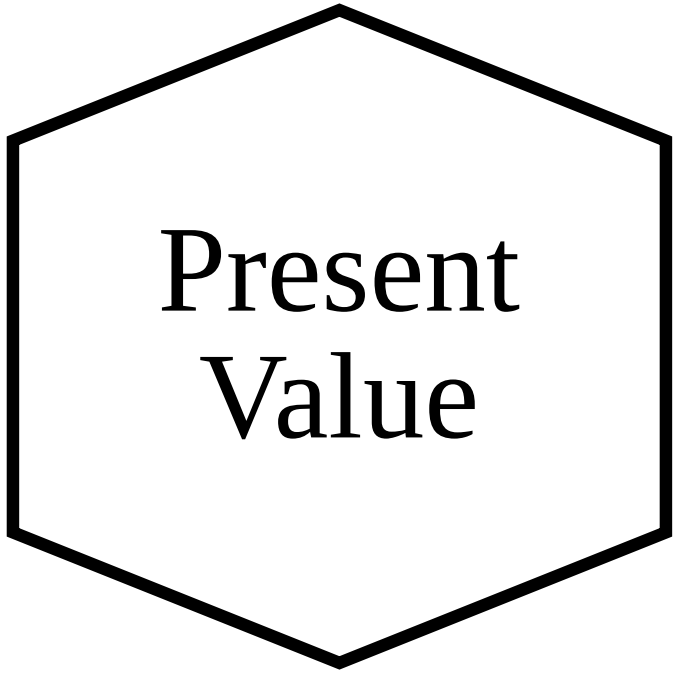


Types of Interest Calculations

- Suppose Mr. A deposits in a bank Rs.10,000 on simple interest basis for 3 years @ 8%p.a.




Future
Value

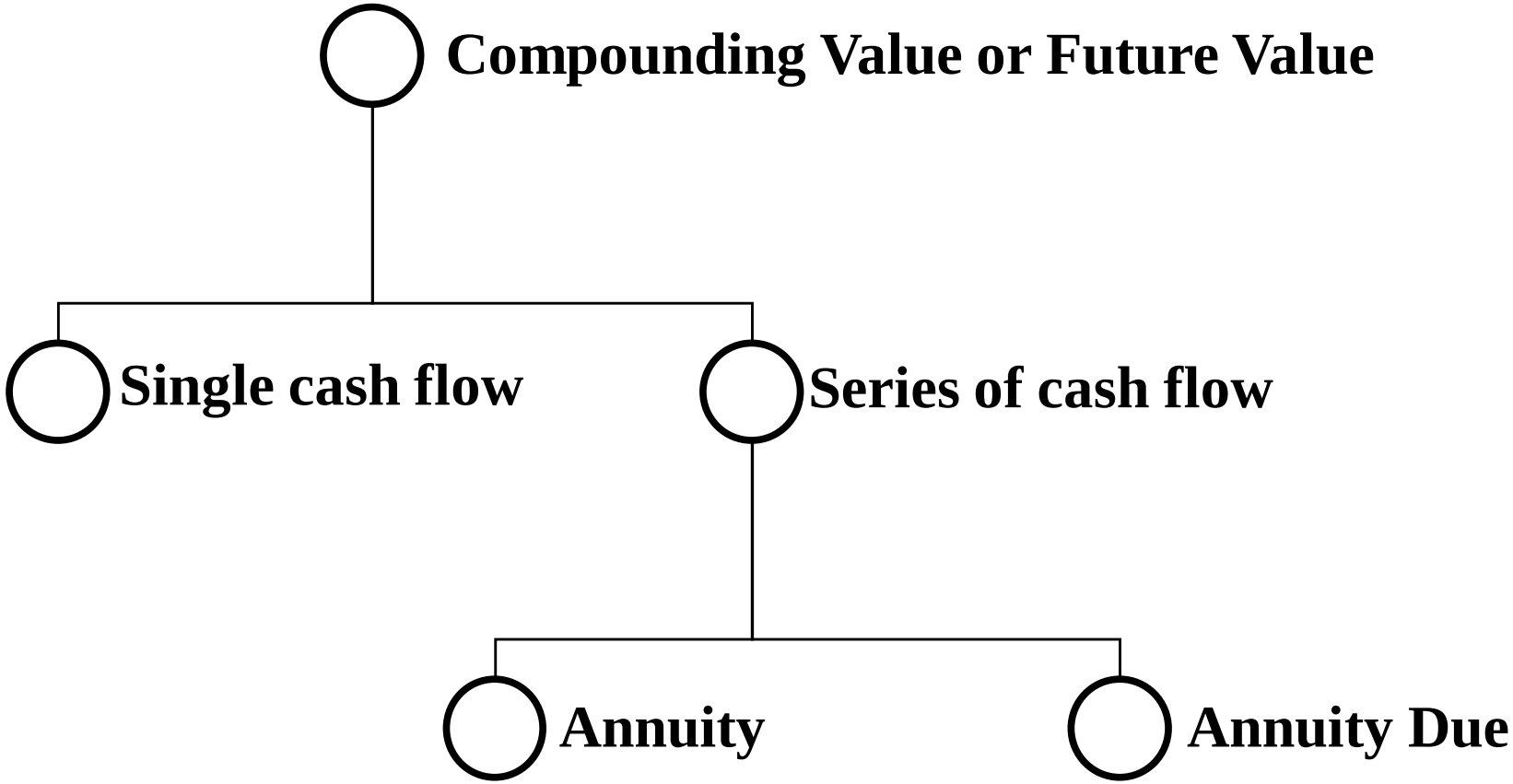

Present
Value

Future Value

- Future value is the value of the present cash flow after a certain time period in the future.
- The process of calculating FV is called as Compounding

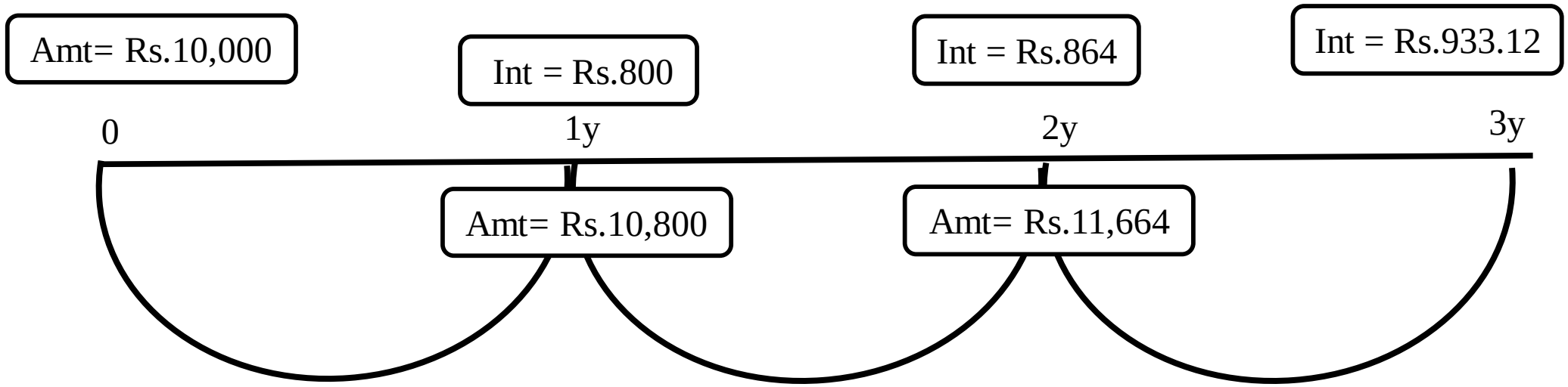
- Suppose we invest Rs.X for 5 years @ Y%p.a. compounded annually what will be the amount that we receive at maturity?
  - Answer to this is **Future value**

Future Value



FV of single cash flows

- Suppose Mr. A deposits in a bank Rs.10,000 on compound (annual) interest basis for 3 years @ 8%p.a.



FV of single cash flows

- FV = $\left[PV\ (1+\frac{r}{m})\right]$ ^$n*m$
- PV = Present value or Principal amount invested Rs.10,000
- r= rate of interest per annum= 8% or 0.08
- m= Frequency of compounding with in a year ; compounded annually i.e.1
- n= period of keeping investments 3 years

Future Value = 800+864+933.12+10,000 =

Rs. 12,597.12

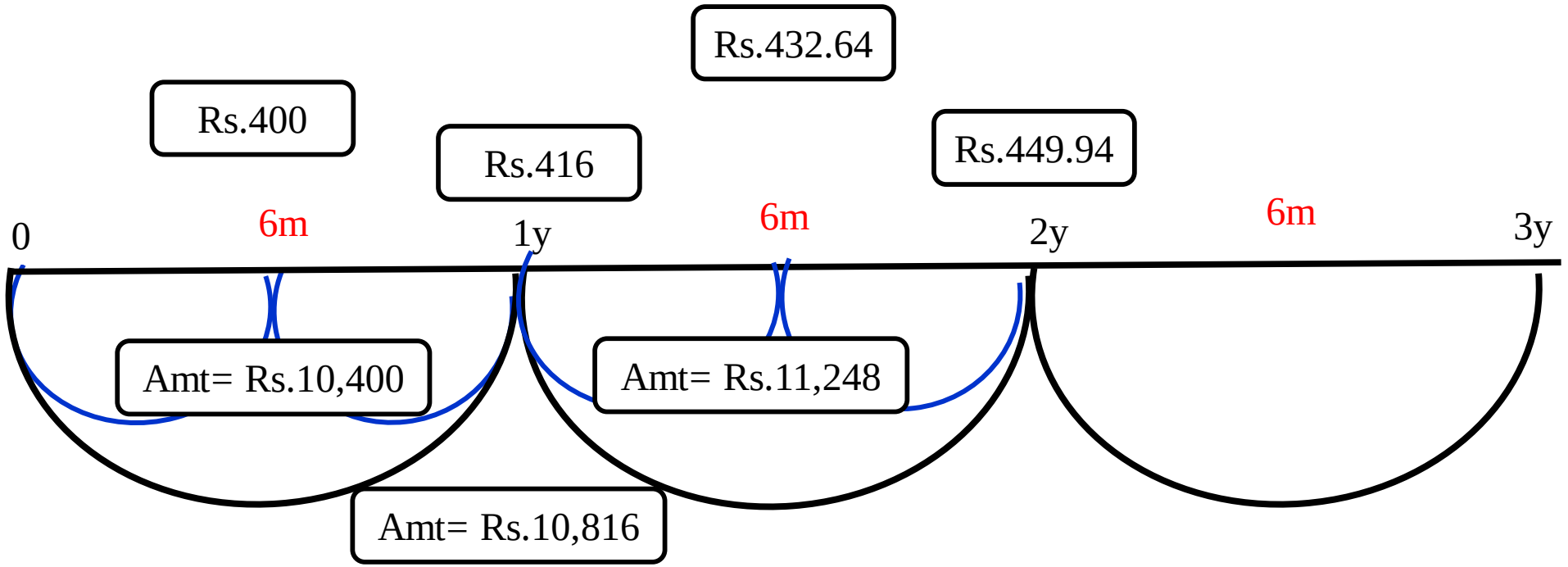
OR

FV = [PV (1+r/m)]^$n*m$

[10,000 (1+0.08/1)]^3*1

FV of single cash flows (Semi annually)

- Suppose Mr. A deposits in a bank Rs.10,000 on compound interest basis for 3 years @ 8%p.a. Compounding begin done semi-annually



FV of single cash flows (Semi annually)

- FV = $PV\left(1+\frac{r}{m}\right)^{n*m}$
- PV = Present value or Principal amount invested Rs.10,000
- r= rate of interest per annum= 8% or 0.08
- m= Frequency of compounding with in a year;compounded Semi- annually i.e.**2**
- n= period of keeping investments 3 years

- FV = $10000\left(1+\frac{0.08}{2}\right)^{\wedge 3*2=}$ Rs. 12,653.19

Effective Rate of Return

- **Effective Rate of Return** determines the effect of compounding for the annual interest **rate**.
- In the previous case (Semi-annual compounding)
- Total interest earned during a year= 400+416 =816
- Effective interest rate is 10816/10000*100= 8.16%

- **Effective Rate of Return**= $[\left(1+\frac{r}{m}\right)\text{^}(m)]-1$
- = $\left(1+\frac{0.08}{2}\right)\text{^}2-1$
- r= rate of interest per annum
- m= Frequency of compounding with in a year

Effective Rate of Return

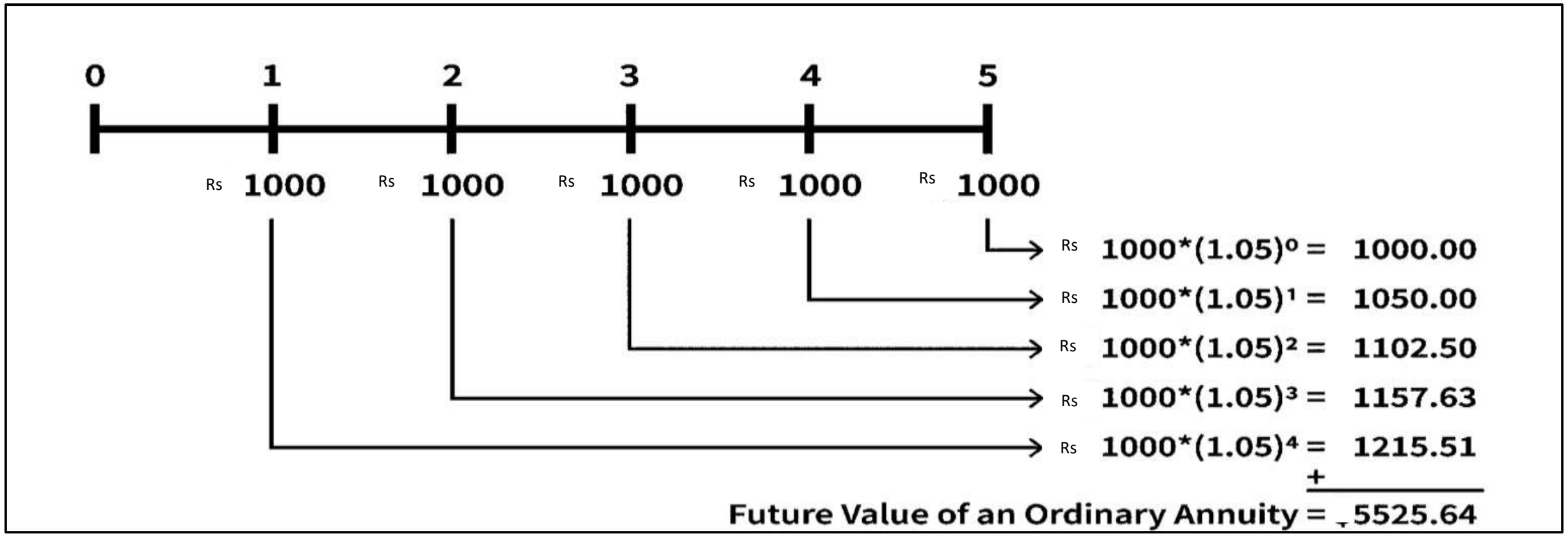
- **Effective Rate of Return** determines the effect of compounding for the annual interest **rate**.
- In the previous case (Semi-annual compounding)
- Total interest earned during a year= 400+416 =816
- Effective interest rate is 10816/10000*100= 8.16%

- When the rate of interest is 10% and compounding happens Quarterly

  - **Effective Rate of Return**= $[\left(1+\frac{r}{m}\right)\text{^}(m)]-1$
  - = $\left(1+\frac{0.08}{2}\right)\text{^}2-1$
  - r= rate of interest per annum
  - m= Frequency of compounding with in a year

FV of Series of Cash Flows of Equal Amount Or Annuity

- Suppose Mr. A deposits Rs. 1,000 per year at the end of the year @ 5% p.a. for 5 years. What will be its maturity value?

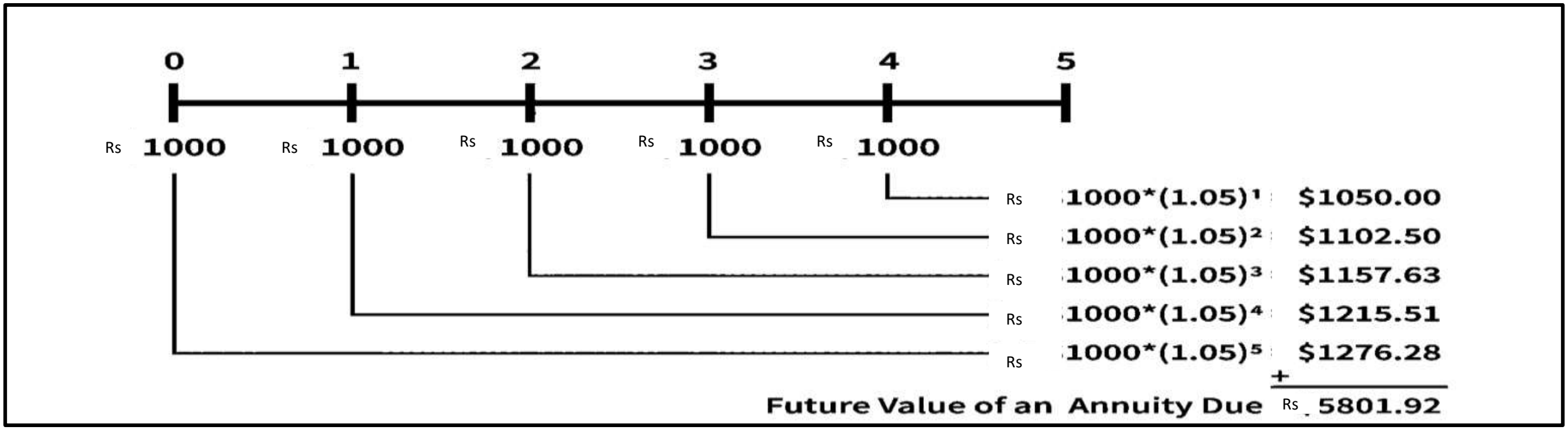


FV of Series of Cash Flows of Equal Amount Or Annuity

- Annuity means series of cash flows of equal amount
- Ordinary Annuity: Amount is paid at the end of the year.
- FV Ordinary Annuity= $\left[\frac{A\times\{(1+r)\text{^}n-1\}}{r}\right]$
- Where: A=cash flow per period; R =interest rate; n=number of payments
- FV Ordinary Annuity= $\left[\frac{1000\times\{(1+0.05)\text{^}5-1\}}{0.05}\right]$= Rs.5525.64
- Suppose Mr. A deposits Rs. 2500 per year at the end of the year @ 8% p.a. for 6 years. What will be its maturity value? Ans: 18,340.625

FV of Series of Cash Flows of Equal Amount Or Annuity Due

- Suppose Mr. A deposits Rs. 1,000 per year at the beginning of the year @ 5% p.a. for 5 years. What will be its maturity value?



FV of Series of Cash Flows of Equal Amount Or Annuity Due

- **Annuity Due:** Amount is paid at the beginning of the year.
- FV Annuity due = $\left[\frac{A\times\{(1+r)^n-1\}}{r}\right](1+r)$
- **Where:** A=cash flow per period; r =interest rate; n=number of payments

- FV Annuity due = $\left[\frac{1000\times\{(1+0.05)^5-1\}}{0.05}\right](1+0.05)$= Rs.5,801.92

References:

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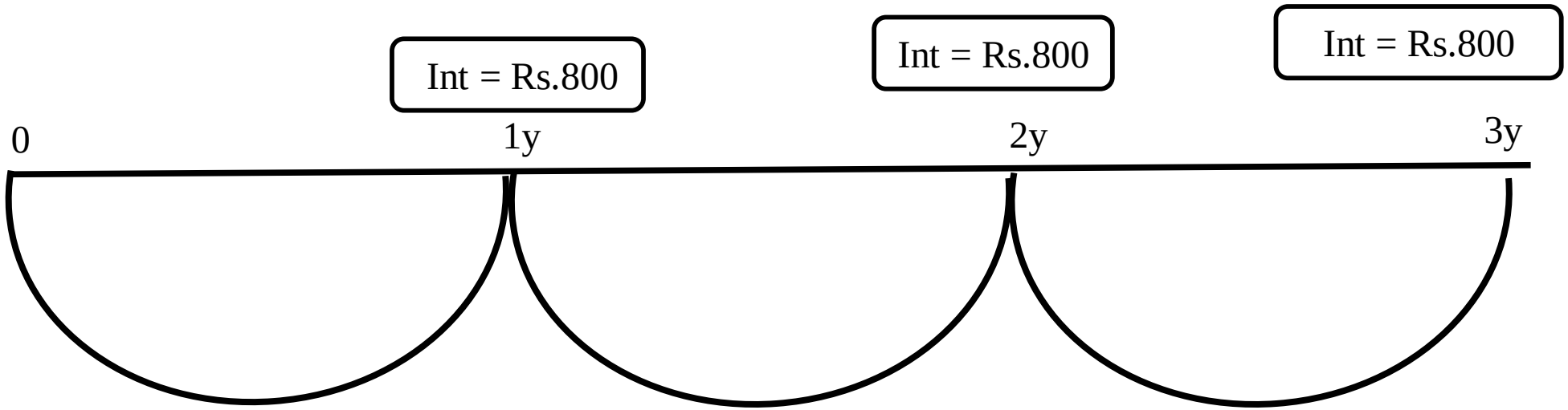
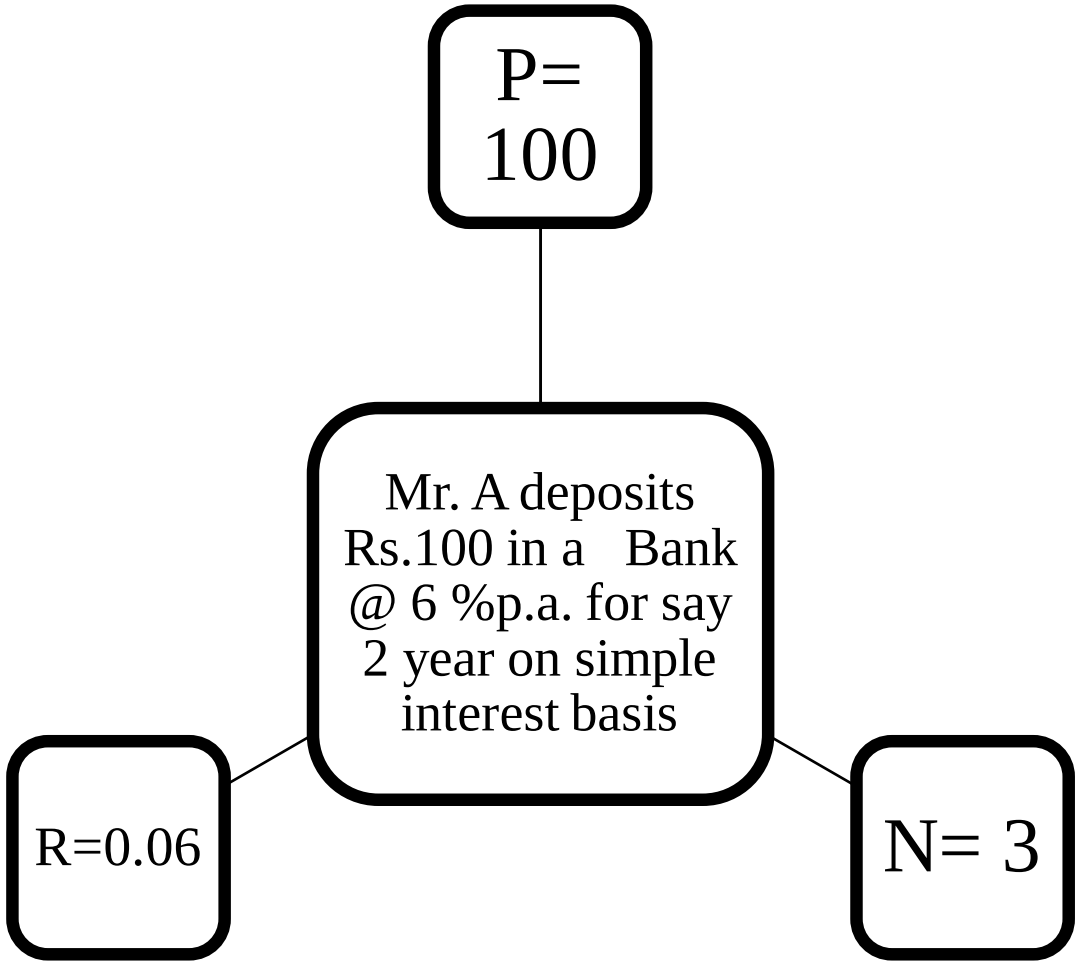
Concept of Simple Interest:

- Interest is calculated on principal value through the life of investment.
- How it works: Simple Interest = **PNR**, & Maturity Value= **P+PNR**
- Where P= principal amount or present value of deposit. N= duration of deposit R= rate of return
- Suppose Mr. A deposits in a bank Rs.10,000 on simple interest basis for 3 years @ 8%p.a.



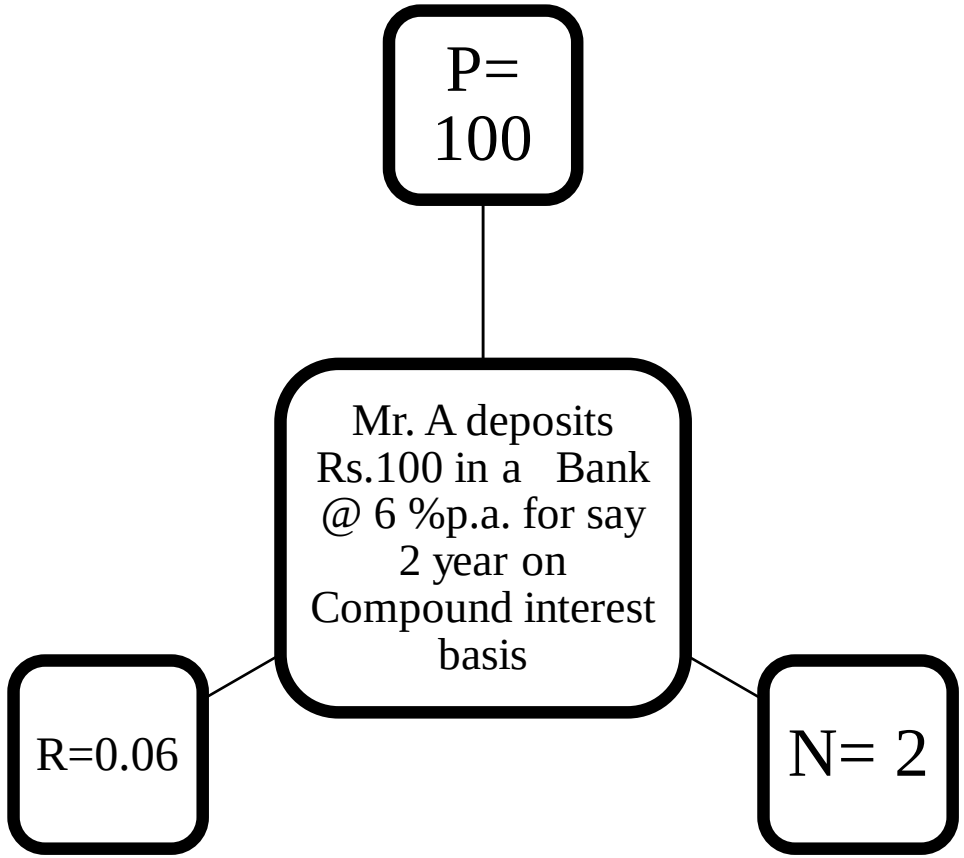
Simple Interest: Interest is calculated on principal value through the life of investment.



- How it works: Simple Interest = PNR,
- Maturity Value= P+PNR

- SI = PNR =100*1*0.06= Rs.6 as interest
- Say if N=3 then,
- Mr. A would get 100*2*0.06= Rs. 12 as interest

Compound Interest: is interest paid not only on the principal, but also on the interest that has already been earned.

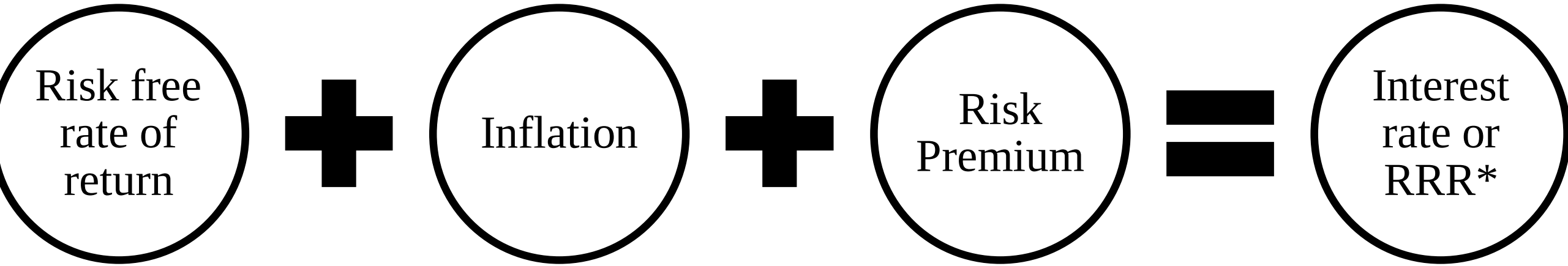


- How it works:

Compound Interest =$[P(1+R)^{n}]$ –P ,

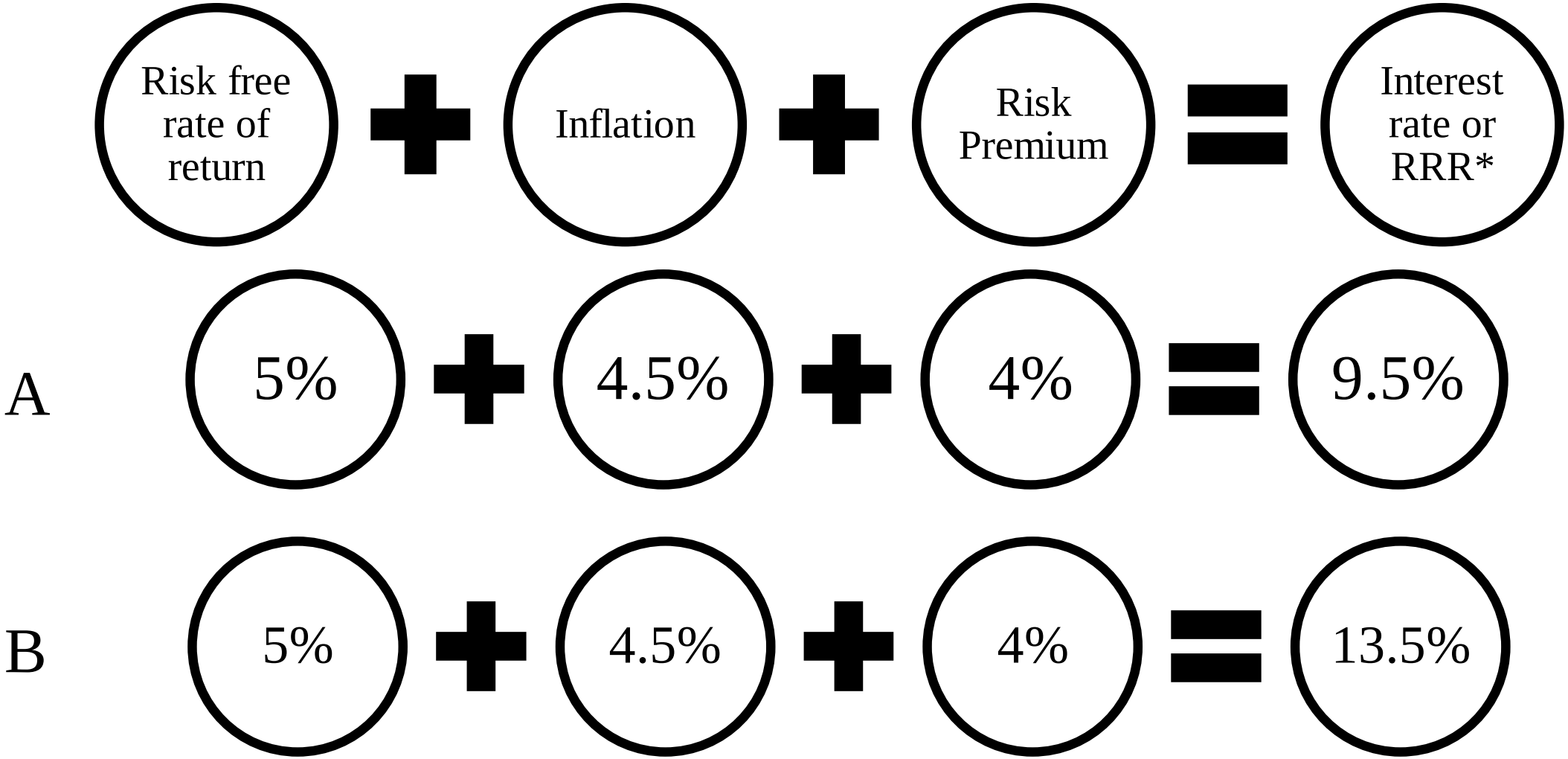
- Maturity Value= $P(1+R)^{n}$
- Say if N=2 then,
- Mr. A would get $100(1+0.06)^{2}$
  Rs.112.36-Rs.100 = Rs.12.36 as interest

Components of Interest Rates



RRR*Required rate of return

What would you do?



RRR*Required rate of return

- Annuities are of two types
  - Ordinary Annuity: Amount is paid at the end of the year
  - Annuity due: Amount is paid at the beginning of the year

- Suppose we invest Rs.10,000 at the end of the year @ 5%p.a. compounded annually for 3 years what will be the amount that I receive at maturity?