2. Time Value of Money

* Simple Interest (SI)

(1) SI is charged always on the original ~~price~~ principal amount (P) for all years.
$\therefore$ SI is always same for each & every year.

(2) $\boxed{SI = \frac{PNR}{100}}$

(3) $\boxed{A = P + SI}$

$\therefore A = P + \frac{PNR}{100}$

$\boxed{\therefore A = P\left(1 + \frac{NR}{100}\right)}$

(4) $SI = A - P$

(5) If $N = \checkmark$, than the sum of money (P) gets doubled at $\boxed{\frac{100}{N} \text{ \% p.a.}}$

(6) If $R = \checkmark$, than the sum of money (P) gets doubled in $\boxed{\frac{100}{R} \text{ years.}}$

(7) A sum of money becomes 'n' times, in $\boxed{\frac{(n-1) \times 100}{R} \text{ years.}}$

* COMPOUND INTEREST

Def^N: C.I. is charged on the accumulated principal amount (i.e. on proceeding years amount)

→ FORMULA :

1. $$\boxed{A = P\left(1+\frac{R}{100}\right)^N}$$

2. $$\boxed{CI = A - P}$$

$$CI = P\left(1+\frac{R}{100}\right)^N - P$$

$$\boxed{\therefore CI = P\left[\left(1+\frac{R}{100}\right)^N - 1\right]}$$

3.

COMPOUNDED	AMOUNT
ANNUALLY	$A = P\left(1+\frac{R}{100}\right)^N$
HALF - YEARLY	$A = P\left(1+\frac{R}{200}\right)^{2N}$
QUATERLY	$A = P\left(1+\frac{R}{400}\right)^{4N}$
MONTHLY	$A = P\left(1+\frac{R}{1200}\right)^{12N}$

4. Effective Rate of Interest (E):

$$\boxed{E = \left[\left(1+\frac{i}{m}\right)^m - 1\right] \times 100}$$

where, $i = \frac{R}{100}$ (i.e. Nominal Rate of Interest)

$m = 2$ [Compounded half-yearly]
$m = 4$ (Compounded quaterly)
$m = 12$ [Compounded monthly]

5. Depreciation

$$\boxed{\text{Depreciated Value (scrap value)} = \text{Original Cost}\left(1-\frac{R}{100}\right)^N}$$

where, R = Rate of Depreciation p.a.
N = Useful life of an asset

6. Relation between ST & CT:

(i) For 1 year, CT − ST = 0

(ii) For 2 years, CT − ST = Pi^2

(iii) For 3 years, CI − SI = $Pi^2(i+3)$

7. Rule of 72

A sum of money gets DOUBLED in $\boxed{\frac{72}{R}}$ no. of years (approx.).

8. RULE OF 114

A sum of money gets TRIPLED in $\boxed{\frac{114}{R}}$ no. of years (approx.).

9. If a sum of money becomes 'n' times in 't' years, then it becomes n^m in $\boxed{mt}$ years.

E.g. A sum of money gets tripled in 7 years, than it becomes 27 times in 21 years.

3 times $\longrightarrow$ 7 yrs
27 times $\longrightarrow$ 21 yrs

$3^3 = 3 \times 7 = 21$

* ANNUITY (INSTALLMENTS)

→ Def^N : Annuity is defined as a series payments (or receipts) of equal amounts made at equals intervals of time.

→ TYPE OF ANNUITIES:

(i) Immediate (Ordinary) Annuity:

When the payments falls due at the End of each period, it is known as Immediately Annuity.

(ii) Annuity Due:

When the payments falls due at the Beginning of each period is known as Annuity Due.

(iii) Perpetual OR Perpetuity Annuity:

When the payments continue forever i.e. (infinitely) endlessly it is known as perpetuity.

Note: For Perpetual annuity, there is NO future Value.

→ FORMULAS :

(I) Immediate Annuity (At the end)

(1) Accumulated (Future) Value (A)

$$\boxed{A = \frac{C}{i}\left[(1+i)^{N} - 1\right]}$$

where,

C = equal amounts of annuities
N = Period (Term)
R = Rate of C.I p.a.

(2) Present Value (P)

$$\boxed{P = \frac{C}{i}\left[1 - (1+i)^{-N}\right]}$$

(3) Relation between A & P

(i) $\boxed{A = P(1+i)^{N}}$

(ii) $\boxed{\frac{1}{P} - \frac{1}{A} = \frac{i}{C}}$

(II) Annuity Due (At the Beginning):

(1) Accumulated (Future) Value (A')

$$\boxed{A' = A(1+i)}$$

$$A' = \frac{c}{i}\left[(1+i)^N - 1\right](1+i)$$

(2) Present Value (P)

$$\boxed{P' = \frac{c}{i}\left[1 - (1+i)^{-(N-1)}\right] + c}$$

(3) Relation between A' & P'

(i) $\boxed{A' = P'(1+i)^N}$

(ii) $\boxed{\frac{1}{P'} - \frac{1}{A'} = \frac{i}{c(1+i)}}$

III Perpetuity (Forever)

(1) Present Value (P.V.)

$$\boxed{P.V = \frac{c}{i}}$$

Note :

Compounded	i	N
Annually	$\frac{R}{100}$	N years
Half-yearly OR Semi-annually	$\frac{R}{200}$	2N half years
Quaterly	$\frac{R}{400}$	4N quarters
Monthly	$\frac{R}{1200}$	12N months