

which pays compound interest at the rate of 4.5% for first two years then at the rate of 3% for the next three years. Find his amount after five years.

6. For what ^{time} will a sum of money double itself at 10% p.a. compound interest payable half yearly?

7. Purchasing of national saving certificate makes the investment double itself in 6 years. Find the rate of interest accrued, if compounded half yearly.

8. For what on the difference between simple and compound interest for three years at the rate of 20% p.a. is Rs. 1600?

9. Mr. Sen borrowed Rs. 6000 from a money lender, but he could not pay any amount in a period of 4 years. Accordingly, the money lender demanded now Rs. 7500 from him. What rate of compound interest did the lender require for lending his money?

10. If the population of a town increases every year by 1.8% of the population at the beginning of that year, in how many years will the total increase of population be 90%?

6.3 ANNUITIES

Introduction

Annuity is a series of payments, usually equal in size, made at equal intervals of times. The interval may be one year, half-year, quarter, month and so on.

Some examples are: the premium payments of a life insurance policy, the monthly instalments that amortize a debt, the monthly instalments of a recurring deposit in a bank and other such uniform periodic payments.

The interval between two successive payments is called payment period, the total time from the beginning of the first payment period to the end of the last payment period is called term of an annuity. The size of each payment of an annuity is known as periodic payment and the total sum payable in a year is called annual rent. The sum of all the payments at the end of an annuity is called amount or future value of an annuity. The sum of present values

of all the payments of an annuity is called present value of an annuity.

The major classification of annuities is : annuity certain, perpetual annuity or perpetuity and contingent annuity.

An annuity in which payment begins and ends at fixed dates is known as annuity certain. This can be classified into ordinary annuity or immediate annuity, annuity due and ~~def~~ deferred annuities.

If the payments are made at the end of each payment period then the annuity is called ordinary annuity or immediate annuity. If the payment is made at the beginning of each payment period then the annuity is called annuity due. Again, the deferred annuity is an annuity; the payment of which will commence after a certain period.

An annuity in which payment ~~begin~~ begins at a fixed date but continued for ever is called perpetuity. For example, in endowment funds without touching the principal the interest part is used for welfare activities.

Contingent annuity is an annuity in which payments are dependent on some conditions. For example, premium on a life insurance policy is

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paid quarterly, or annually but stops when the insured person dies.

Amount of immediate Annuity or ordinary annuity

The amount (or the future value) of an annuity is the value at the end of the term, of all the payments. Thus, it is the total of the compound amount of all the payments made.

Let us consider an annuity of n payments of Rs. A each, where the interest rate per period is i , and the first payment is made one period from the beginning.

The first payment of Rs. A made at the end of first period accrues interest for $(n-1)$ periods; hence, its compound amount is $A(1+i)^{n-1}$, the second payment of Rs. A made at the second period accrues interest for $(n-2)$ periods; hence, its compound amount is $A(1+i)^{n-2}$. In the same way, the third, fourth, ..., $(n-1)$ th and n th payments of Rs. A made at the end of third, fourth, ..., $(n-1)$ th and n th period accrue interest for $(n-3)$, $(n-4)$, ..., 1 , 0 periods, respectively, and their respective compound amounts