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Annuity

Provides a stream of payments made out on a periodic basis



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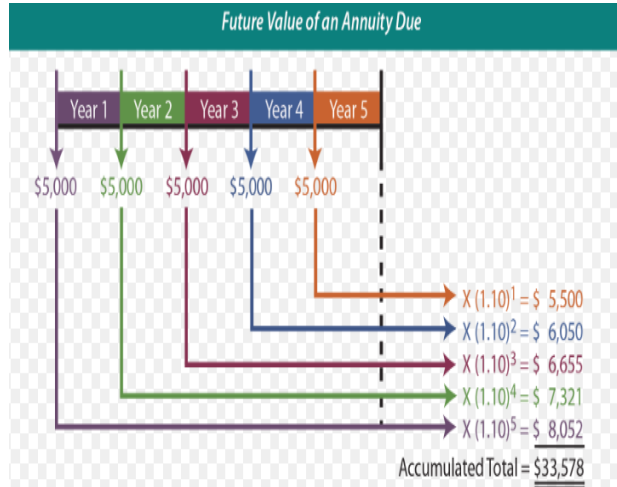
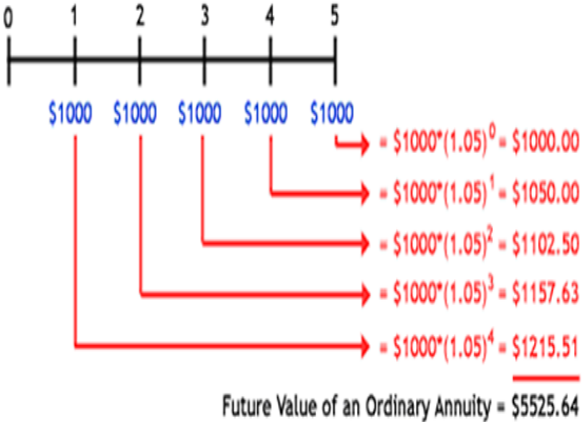
Future value of annuity

Future value of annuity regular

When cash flow in future in a regular interval of time at the end of the period.

Future value of annuity due

When cash flow in future in a regular interval of time at the beginning of the period.



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13. Which of the following is called an annuity:

- (a) Lump Sum after few years
- (b) A Series of Equal and Regular Amounts
- (c) A Series of Unequal Amounts
- (d) A Series of Equal and Irregular Amounts.

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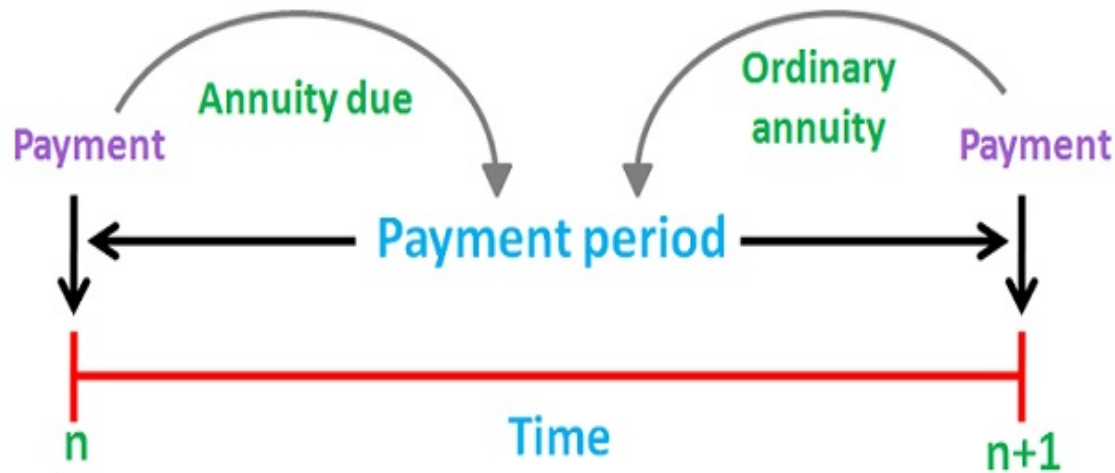
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An annuity is described as a stream of fixed cash flows, i.e. payments or receipts, that occurs periodically, over time. For example, payment of housing loan, life insurance premium, rent, etc. There can be two types of annuities, i.e. ordinary annuity and annuity due. **Ordinary annuity** means an annuity which is related to the period preceding its date, whereas **annuity due** is the annuity related to the period following its date.

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BASIS FOR COMPARISON	ORDINARY ANNUITY	ANNUITY DUE
Meaning	Ordinary annuity is one in which the inflow or outflow of cash fall due for payment at the end of each period.	Annuity due is described as the series of cash flows occurring at the beginning of each period.
Payment	Belongs to the period preceding its date.	Belongs to the period following its date.
Appropriate for	Payments	Receipts
Example	Housing loan, payment of mortgage, coupon bearing bonds, etc.	Rental lease payments, life insurance premium, etc.

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$$FV \text{ of Annuity} = P \left[\frac{(1 + r)^n - 1}{r} \right]$$

P = Periodic Payment

r = rate per period

n = number of periods

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An example of the future value of an annuity formula would be an individual who decides to save by depositing \$1000 into an account per year for 5 years. The first deposit would occur at the end of the first year. If a deposit was made immediately, then the future value of annuity due formula would be used. The effective annual rate on the account is 2%. If she would like to determine the balance after 5 years, she would apply the future value of an annuity formula to get the following equation

$$= \$1000 \left[\frac{(1 + .02)^5 - 1}{.02} \right]$$

The balance after the 5th year would be \$5204.04.

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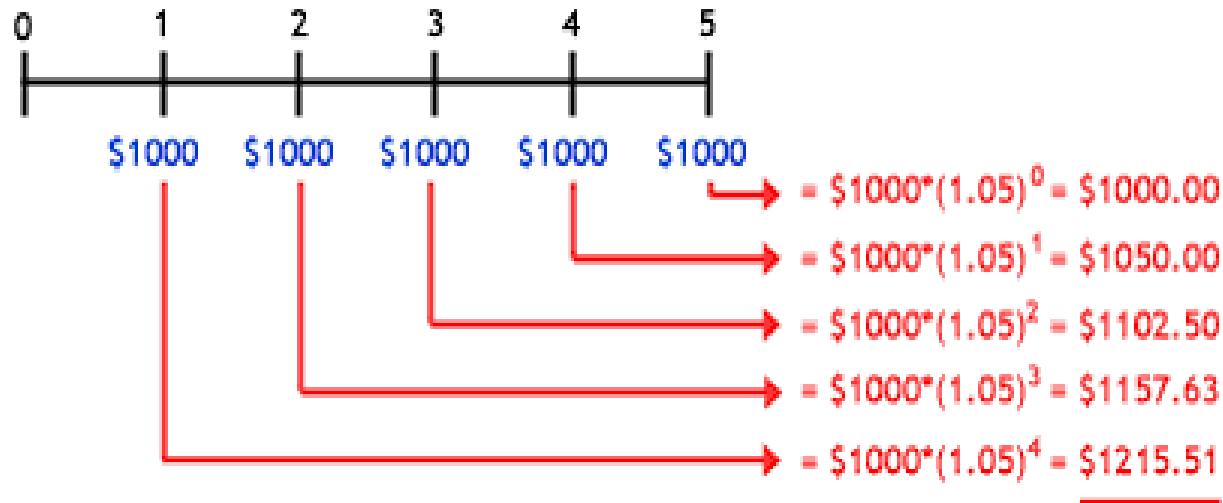
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Future Value of an Ordinary Annuity = \$5525.64

$$FV \text{ of Annuity} = P \left[\frac{(1+r)^n - 1}{r} \right]$$

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$$FV \text{ of Annuity Due} = (1 + r) \times P \left[\frac{(1 + r)^n - 1}{r} \right]$$

$P =$ Periodic Payment

$r =$ rate per period

$n =$ number of periods

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Example of Future Value of Annuity Due Formula

To elaborate on the prior example of the future value of an annuity due, suppose that an individual would like to calculate their future balance after 5 years with today being the first deposit. The amount deposited per year is \$1,000 and the account has an effective rate of 3% per year. It is important to note that the last cash flow is received one year prior to the end of the 5th year.

For this example, we would use the future value of annuity due formula to come to the following equation:

$$FV \text{ of Annuity Due} = (1 + .03) \times \$1,000 \left[\frac{(1 + .03)^5 - 1}{.03} \right]$$

After solving, the balance after 5 years would be \$5468.41.

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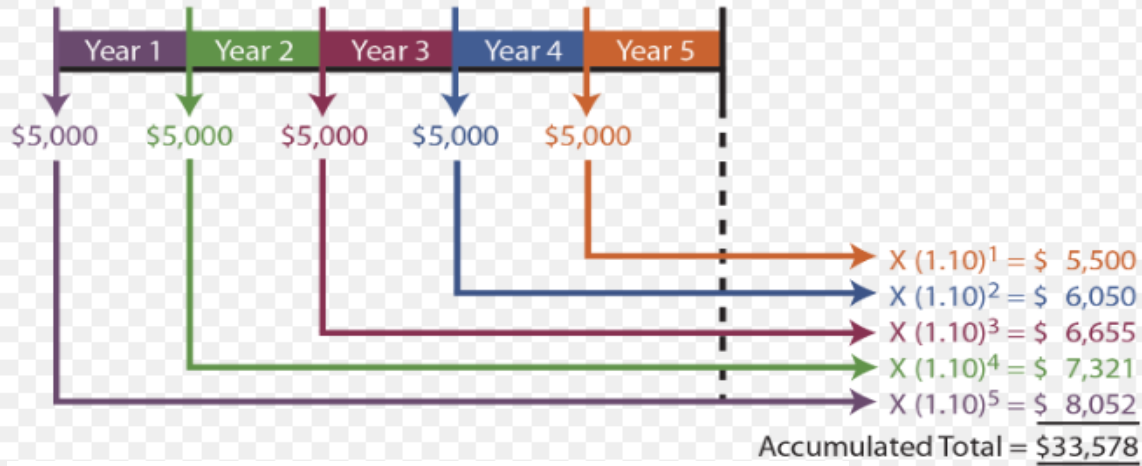
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Future Value of an Annuity Due



$$FV \text{ of Annuity Due} = (1 + r) \times P \left[\frac{(1 + r)^n - 1}{r} \right]$$

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4. Equal Annual amounts occurring in the beginning of certain years are known as :

- (a) Annuity
- (b) Perpetuity
- (c) Annuity Due
- (d) Deferred Payments.

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3. Equal annual Cash Flows occurring at the end of each year for certain period are known as:

- (a) Annuity
- (b) Perpetuity
- (c) Annuity Due
- (d) Deferred Payments.

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18. Future Value of an annuity is :

- (a) Equal to Annuity Amount
- (b) Less than Annuity Amount
- (c) More than total of Annuity Amount
- (d) None of the above.

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53. The amount of an annuity certain of ₹ 150 for 12 years at 3.5% p.a. C.I is

(a) ₹ 2,190.28

(b) ₹ 1,290.28

(c) ₹ 2,180.28

(d) none of these

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55. $A = ₹ 1,200$ $n = 12$ years $i = 0.08$, $V = ?$

Using the formula $V = \frac{A}{i} \left[1 - \frac{1}{(1+i)^n} \right]$ value of v will be

(a) ₹ 3,039

(b) ₹ 3,,990

(c) ₹ 9930

(d) none of these

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56. $a = ₹ 100$, $n = 10$, $i = 5\%$ find the FV of annuity

Using the formula $FV = a / \{1 + i\}^n - 1\}$ FV is equal to

(a) ₹ 1,258

(b) ₹ 2,581

(c) ₹ 1,528

(d) none of these

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57. If the amount of an annuity after 25 years at 5% p.a C.I is ₹ 50,000 the annuity will be

(a) ₹ 1,406.90

(b) ₹ 1,046.90

(c) ₹ 1,146.90

(d) none of these

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58. Given annuity of ₹ 100 amounts to ₹ 3137.12 at 4.5% p.a C. I. The number of years will be

- (a) 25 years (appx.) (b) 20 years (appx.)
(c) 22 years (d) none of these

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65. $A = ₹ 5,200$, $R = 5\%$ p.a., $T = 6$ years, P will be
- (a) ₹ 2,000 (b) ₹ 3,880
(c) ₹ 3,000 (d) none of these

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66. If $P = 1,000$, $n = 4$ years., $R = 5\%$ p.a then C. I will be
- | | |
|--------------|-------------------|
| (a) ₹ 215.50 | (b) ₹ 210 |
| (c) ₹ 220 | (d) none of these |

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67 The time in which a sum of money will be double at 5% p.a C.I is

- (a) ₹ 10 years (b) 12 years
(c) 14.2 years (d) none of these



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68. If $A = ₹ 10,000$, $n = 18\text{yrs.}$, $R = 4\%$ p.a C.I, P will be
- (a) ₹ 4,000 (b) ₹ 4,900
- (c) ₹ 4,500 (d) none of these

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69. The time by which a sum of money would treble it self at 8% p. a C. I is
- (a) 14.28 years (b) 14 years
(c) 12 years (d) none of these

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SINKING FUND

A SINKING FUND is like a special purpose saving account. Co. deposits money with an intention to repay a debt/replace an asset or acquisition in the future. The money in fund is put regularly and one uses only for the predefined purpose.

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WHAT'S THE NEED?

- Eases the debt burden.
- Regularly depositing an amount into the fund for a predefined purpose.
- Lowers the default risk of the borrowers, boosting the creditors' confidence in turn creating goodwill.
- One fund can be used for several debt obligations.

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Sinking fund factor (amortisation of a future value)

This is used for working out the amount that will need to be set aside periodically so that, when compounded at a given interest rate, it will accumulate to a specified future sum.

This is the reciprocal of the future value of an annuity.

$$\text{PMT} = \text{FV} \left[\frac{i}{(1+i)^n - 1} \right]$$

For example, let us suppose that an investor wants to accumulate \$1,000 in five years and that the interest rate is 5%. How much does he/she need to set aside annually in order to accumulate \$1,000 at the end of five years?

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Using our formula:

$$\text{PMT} = \$1000 \left[\frac{0.05}{(1 + 0.05)^5 - 1} \right]$$

$$\text{PMT} = \$1000 \left[\frac{0.05}{1.27 - 1} \right]$$

$$\text{PMT} = \$1000 \times 0.1809748$$

$$\text{PMT} = \$180.974$$

Thus, as the sinking fund factor is a reciprocal of the future value of an annuity, let us take an annuity of \$180.974 and compound this forward at 5% per annum.

$$\text{FVA} = \$180.974 \left[\frac{(1 + 0.05)^5 - 1}{0.05} \right]$$

$$\text{FVA} = \$180.974 \times 5.525631$$

$$\text{FVA} = \$1000$$

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Q. 6. An amount of Rs. 1, 00, 000 is required at the end of 5 years from now to repay a debenture liability. What amount should be accumulated every year at 10% rate of interest so that it ultimately becomes Rs. 1, 00, 000 after 5 years?

Ans. 16380

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Q.10. A company has issued debentures of Rs. 50 lacs to be repaid after 7 years. How much should the company invest in a sinking fund earning 12% in order to be able to repay debentures ?

Ans. 495589

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Q.15. Novelty Industries is establishing a sinking fund to redeem Rs. 50, 00, 000 bond issue which matures in 15 years. How much do they have put into the fund at the end of each year to accumulate the Rs. 50, 00, 000, assuming the funds are compounded at 7% annually?

Ans. 19873

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Q.16. XYZLtd. is creating a sinking fund to redeem its Preference capital of Rs. 5 lac issued on Jan 1, 1998 and maturing on Dec 31, 2009. The annual payment will start on Jan 1, 1998. The company will make equal payments and expects that the fund will earn 12% per year. How much will be the amount of sinking fund payment?

Ans. 18500

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• **EFFECTIVE RATE OF INTEREST**

Q. 1. A deposit of Rs. 10, 000 is made in a bank for a period of 1 year. The bank offers two options:

(i) to receive interest at 12% p.a. compounded monthly or

Ans. 12.68 %

(ii) to receive interest at 12.25% p.a. compounded half yearly.

Which option should be accepted?

Ans. 12.65%

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