RATIO AND PROPORTION

Ratio

A ratio is a comparison of the sizes of two or more quantities of the same kind by division.

Remarks

- Both terms of a ratio can be multiplied or divided by the same (non-zero) number. Usually a ratio is expressed in lowest terms (or simplest form).
- Ratio exists only between quantities of the same kind.
- Quantities to be compared (by division) must be in the same units.
- To compare two ratios, convert them into equivalent like fractions.

The fraction by which the original quantity is multiplied to get a new quantity is called the multiplying ratio (or factor).

Inverse Ratio

One ratio is the inverse of another if their product is 1. Thus a : b is the inverse of b : a and vice–versa.

- A ratio a : b is said to be of greater inequality if a > b and of less inequality if a > b.
- 2. The ratio compound of the two ratios a : b and c : d is ac : bd.
- 3. A ratio compounded of itself is called its duplicate ratio.
- Thus $a^s : b^2$ is the duplicate ratio of a : b. Similarly, the triplicate ratio of a : b is $a^3 : b^3$.
- 4. The sub–duplicate ratio of a : b is $\sqrt{a} : \sqrt{b}$ and the sub triplicate ratio of a : b is $\sqrt[3]{a} : \sqrt[3]{b}$
- 5. Continued Ratio is the relation (or compassion) between the magnitudes of three or more quantities of the same kind. The continued ratio of three similar quantities a, b, c, is written as a : b : c.
- 6. If a = b, the ratio a:b is known as "ratio of equality".

Proportion

An equality of two ratios is called a proportion. Four quantities a, b, c,

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d are said to be in proportion if a : b = c : d (also written as a : b : : c : d) i.e. if a/b = c/d i.e. if ad = bc.

If a : b = c : d then d is called fourth proportional

If a : b = c : d are in proportion then a/b = c/d i.e. ad = bc

i.e. product of extremes = product of means

- (a) This is called cross product rule or cross product property.
- (b) **Reciprocal Property:** If 2 ratio's are equal, then their reciprocals are also equal.

If a, b, c are in continuous proportion, then the middle term b is called the mean proportional between a and c, a is the first proportional and c is the third proportional.

Properties of Proportion

1. If a : b = c : d, then ad = bc

Proof. $\frac{a}{b} = \frac{c}{d}$; \ad = ac (By cross - multiplication)

2. If a : b = c : d, then b : a = d : c (Invertendo)

Proof
$$\frac{a}{b} = \frac{c}{d}$$
 or $\frac{1}{a} = \frac{1}{c}$, or $\frac{b}{a} = \frac{d}{c}$

3. If a : b = c : d, then a : c = b : d (Alternendo)

Proof.
$$\frac{a}{b} = \frac{c}{d}$$
 or, $ad = bc$

Dividing both sides by cd, we get

$$\frac{ad}{cd} = \frac{bc}{cd}$$
, or $\frac{a}{c} = \frac{b}{d}$, i.e. a:c = b:d

- 4. If a : b = c : d, then a + b : b = c + d : d (Componendo) Proof. $\frac{a}{b} = \frac{c}{d}$, or, $\frac{a}{b} + 1 = \frac{c}{d} + 1$ or, $\frac{a+b}{b} = \frac{c+d}{d}$, i.e. a+b:b=c+d:d
- 5. If a : b = c : d, then a b : b = c d : d (Divenddo) Proof. $\frac{a}{b} = \frac{c}{d}$, or, $\frac{a}{b} - 1 = \frac{c}{d} - 1$ $\frac{a-b}{b} = \frac{c-d}{d}$, i.e. a-b:b = c-d:d
- 6. If a : b = c : d, then a + b : a b = c + d : c d(Compoendo and Dividendo)

8. **Continued Proportions:** If a, b, c, are in continued proportion, then $b^2 = ac$ $b = \pm \sqrt{ac}$

9. **Compound Proportion:** If two or more ratio are multiplied together, thus $a^1 a^2 a^3:b^1 b^2 b^3$ is a continued ratio of the ratios $a_1:b_1$; $a_2:b_2$; $a_3:b_3$. This method is known as "Compound rule of three".

SIMPLE AND COMPOUND INTEREST INCLUDING ANNUITY-APPLICATION

FORMULAE

Simple Interest

$$I = \frac{P \times R \times T}{100}$$

1. Int. is payable halfyearly, quarterly, monthly.

2.
$$A = P + 1 = P + P \times i \times n = P(1 + in)$$

i.e., $A = P(1 + n.i)$

Compound Interest

$$C.I. = P\left(1 + \frac{R}{100}\right)^n - P$$

$$1 \quad A = P (1 + i)^n$$

2.
$$P = \frac{A}{(1+i)^n} = A (1+i)^{-n}$$

3. Amount
$$1 = A - P$$

(a) Annual $A = P(1 + i)^n$ $1 = P[(1 + i)^{n-1}]$
(b) Half – Yearly $A = P\left(1 + \frac{i}{2}\right)^{2n}$ $1 = P\left[\left(1 + \frac{i}{2}\right)^{2n} - 1\right]$
(c) Quarterly $A = P\left(1 + \frac{i}{4}\right)^{4n}$ $1 = P\left[\left(1 + \frac{i}{4}\right)^{4n} - 1\right]$

Future Value

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$$F.V. = P.V. \left(1 + \frac{R}{100}\right)^n$$

where *n* is number of periods

Effective Rate of Interest

$$E = \left(1 + \frac{R}{100}\right)^n - 1$$

where *n* is number of periods in a year

$$E = \frac{Re}{100}$$

ANNUITY

Annuity can be defined as a sequence of periodic payments (or receipts) regularly over a specified period of time.

To be called annuity a series of payments (or receipts) must have following features:

- 1. Amount paid (or received) must be constant over the period of annuity and
- 2. Time interval between two consecutive payments (or receipts) must be the same.

Types of Annuity

- **Ordinary Annuity** An ordinary annuity is an annuity the first payment of which is made at the end of the first payment interval.
- **Annuity Due** An annuity due is an annuity the first payment of which is made at the beginning of the first payment interval.

Thus the amount of an ordinary annuity of ₹ P per period for n periods at the rate I per period is given by

$$A = P\left[\frac{(1+i)^n - 1}{i}\right]$$

PRESENT VALUE OF AN ORDINARY ANNUITY: AMORTIZATION

The present value of an annuity represents the amount of money that must be invested how to purchase the payments due in the future.

The present value P of the amount an due at the end of n interest period at the rate of R% may be obtained by solving for P the equation

$$P = \frac{A_n}{\left(1 + \frac{R}{100}\right)^n}$$

The present value (V) of periodic payment (A) is

$$A = \frac{V}{P(n, i)} \quad \text{where, } i = \frac{R}{100}$$

and
$$P(n, i) = \frac{(1+i)^n - 1}{i(1+i)^n}$$

 $A = \frac{V}{P(n, i)}$ can be used to compute the amount of periodic payments if we

have present value (V) and 'n' the no. of time period and rate of interest. **AMOUNT OF AN ANNUITY DUE**

Hence the formula for the amount of an annuity due is

$$A = P\left[\frac{(1+i)^{n+1}-1}{i}-1\right]$$

Sinking Fund

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It is the fund credited for a specified purpose by way of sequence of periodic payments over a time period at a specified interest rate. Interest is compounded at the end of every period. Size of the sinking fund deposit is computed from A = P.A (n, i) where A is the amount to be saved P the periodic payment in the payment period.

AVERAGE DUE DATE AND ACCOUNT CURRENT

Account current is a running statements / account of transaction between parties for a given period of time which includes interest allowed or charged on various items.

Account current is generally prepared if the frequency of transaction between two parties is very high. Some situation are:

- (a) Manufacture who sells goods frequently to a merchant on credit and revives payment from him in installments at different intervals and charges interests on the amount of which remains outstanding.
- (b) Banker setting out the transaction taking place between him and his customer.

Account current has two parties – one who renders the account and the other to whom the account is rendered. So the heading of an account current should be understood as –"A in account current with B" implies that the account is prepared in B's Books, B is the persons rendering the account is rendered by him to A.

WAY IN WHICH AN ACCOUNT CURRENT IS PREPARED

Interest method	tables	Products method	Product of balance method
Interest is	computed	Interest computed for a	Interest is computed
with the	help of	day on the total product	on the debit or credit
readymade	tables.	(i.e amount x days) the	product, after arriving
(simple Inte	erest com-	balance for each	at (usually in case of
putation)		transaction.	bank).

PREPARATION OF ACCOUNT CURRENT BY THE METHOD OF INTEREST TABLES

Debit side

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Credit side

Arithmetic		7
	-	

Trans date	Due date	Particulars	Amt	No. of days	Interest	Trans date	Due date	Particular	Amt	No. of days	Interest
	Note 1			Note 2	Note 3		Note 1			Note 2	Note 3

Note:

- 1. If no specific date is mentioned as the date in which payment is due the date of the transaction of the itself is presumed to be the due date.
- 2. Number of days is counted from the due date of each transaction to the date of rendering the account.
- 3. Interest column is filled up from the readymade tables (simple interest tables). Interest due on different amounts at given rates for different period of times is fund out and this is entered against each item separately. The interest columns of both the sides are totalled up and the net balance is computed.

PREPARATION OF ACCOUNT CURRENT BY THE METHOD OF PRODUCTS

Debit s	side					Credit side					
Trans date	Due date	Particulars	Amt	No. of days	Product	Trans date	Due date	Particular	Amt	No. of days	Product
	Note 1			Note 2	Note 3		Note 1			Note 2	Note3

Note:

- 1. If no specific date is mentioned as the date on which payment is due, the date of the transaction itself is presumed to be the due date.
- 2. Number of days is counted from the due date of each transaction to the date of rendering the account.
- 3. Each entry in product column = Entry in amount column x No of days.
- 4. At the end of the period the product column in balanced and the net product is the amount on which interest is to be computed. This is called 'Product Balance'.
- 5 Interest = product to balance x rate of interest x 1/365 this interest amount is posted to the account current on the side opposite to the side where the product balance stands.

Note:

This method computes the net interest directly i.e. interest payable and interest. Due are mutually.

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5 explain the preparation of account current by the method of product of balances.

This method is also known as periodic balance method and is usually adopted in case of banks where the balance of the account is taken out every transaction.

FORMAT OF ACCOUNT CURRENT

Trans date	Particulars	Dr.	Cr.	Nature balance (Dr. /Cr.)	of	Balance Amt	No. of days	Dr. Product	Cr. Product
		Note1	Note1	Note2		Note3	Note4	Note5	Note6

Note:

- 1. Debits / credits to the account are entered in the dr. /cr. Columns respectively.
- 2. Nature of the balance i.e. whether the account has a dr. / cr. Balance is written in nature of balance column.
- 3. Amount of balance is written in the balance amount column.
- 4. The number of days from the date of transaction to the next transaction is recorded in the "No. of Days" column.
- 5. "Dr. Product"/ "cr. product" consists of the product of the dr. /cr. Column and the no. of days column.
- Interest is the first computed separately for Dr. and Cr. Products at the appropriate rates of interest. Interest = product total x rate of interest x 1/ 365 Dr. and Cr. Interest are then netted off to arrive at the net interest.
- 7. If the Dr. Product is greater than the Cr. Product the net interest is posted to the debit of the account else it is posted to the credit of the account.

RED INK INTEREST

Meaning: If the due date of all bill falls after the date of closing the account no **interest is allowed for that amount. However interest should be dedicated for that** amount for the number of days the due date falls after the date of the account current. This interest is generally referred to as red ink interest.

Recording: Interest from the date of closing to such due date is written in red ink in the appropriate side of the account current and is hence called red ink interest. This red interest is treated as negative interest. However

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in actual practice the product of such bill [value of bill x (due date – closing date) is written on the opposite side on which the bill is entered.

Example: If the closing date of the account current is 31^{st} December and amount of ₹ 10,000 from a debtor falls due on 7th January interest on the product date i.e. (7 x ₹ 10,000) should be deducted from interest chargeable i.e. it will be credited to the account.

Example 1

Prepare account current for Jagan in respect of the following transaction with Sunder.

	Particulars	₹	Due date
20 x1 September 16	Goods sold to Sunder	200	Due 1 st Oct
October 1	Cash received from Sunder	90	
October 21	Goods purchased from Sunder	500	Due 1 st Dec.
November 1	Paid to Sunder	330	
December 1	Paid to Sunder	330	
December 5	Goods purchased from Sunder	500	Due 1 st Jan.
December 10	Goods purchased from Sunder	200	Due 1 st Jan.
20 x2 January 1	Paid to Sunder	600	
January 9	Goods sold to Sunder	20	Due 1 st Feb.

The account is to be prepared upto1st February. Compute interest at 6% per annum.

Solution:

In the books of Jagan (ledger 16th 20x1 to 1st Feb. 20x2) Sundry account current with Jagan (interest upto 1st February at 6% p.a.)

Dt	Due	Particular	₹	Days	Inter- est	Dt	Due	Particular	₹	Days	Inter- est
200x1 sep 16	Oct 1	To sale	200.00	123	4.40	20x1 Oct 1	Oct 1	By cash	90.00	123	1.82
Nov 1	Nov 1	To cash	330.00	92	5.00	Oct 21	Dec 1	By purchase a/c	500.00	62	5.10
Dec 1	Dec 1	To cash	330.00	62	3.36	Dec 5	Jan 1	By purchase	500.00	31	2.55
200x2 Jan 1	Jan 1	To cash	600.00	31	3.06	Dec 10	Jan 1	By purchase a/c	200.00	31	1.02
Jan 9	Feb 1	To sales	20.00			20x2 Feb 1	Feb 1	By bal. of interest			4.97
Feb 1		To interest	4.97			Feb 1	Feb 1	By balance c/d	194.97		
		Total	1,484,97		15.46			Total	1,484,97		15.46

Note:

Interest for sale made on 16th sep= ₹ 200x6%x123/265=₹ 4.04.interest is computed similarly for other entries.

Example 2:

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From the following particular, prepare the account current to be rendered by Harbhjan to Sunil as on 31^{st} August. Interest must be computed at 10% P.A.(amount in ₹)

June 11	Goods sent to Sunil	1,020	July 7	Gods sent to Sunil	700
June 15	Cash received from Sunil	500	Aug 8	Cash received from Sunil	1,100
June 20	Goods sent to Sunil	650	-		

Solution:

In the books of Harbhjan Sunil in account current with Harbhjan (interest upto 31st August at 10% p.a.) cr.

Dr.											Ci
Dt	Due	Particular	₹	Days	product	Dt	Due	Particular	₹	Days	Product
11 Jun	11 Jun	To sales a/c	1,020	81	82,620	15 Jun	15 Jun	By cash a/c	500	77	38,500
20 Jun	20 Jun	To sales a/c	650	72	46,800	08 Aug	08 Aug	By cash a/c	1,100	23	25,300
7 Jul	7 Jul	To sales a/c	700	55	38,500	31 Aug	31 Aug	By balance of product			1,04,120
15 Mar	15 Mar	To interest	29			31 Aug	31 Aug	By bal. c/d	799		
		Total	2,399		1,67,920			Total	2,399	1,67,920	

Note: interest = ₹ 1,04,120 x 10% x 1/365 = ₹ 29 (approx) Example 3:

From the following transaction is the book of Balasubramaniam an account current, by means of product and by means of product of balances to be sent by him to M/s for the quarter ending 31st March. Interest is to be charged and /or allowed at 12% p.a.

(amount in ₹)

						(*	
Jan 1	Balance	in	Mini's	3,500	Feb 1	Cash received	40,000
	account (c	redit)					
Jan 12	Sold good	s to N	lini(due	30,000	Feb 20	Cash received	7,500

	1 st February)				
Jan 31	Sold goods to Mini(due	27,500	Mar 10	Goods returned by	7,000
	15rh February)			Mini	
			Mar 25	Cash received	6,500

Solution :

In the book of Balasubramaniam(ledger 1st Jan. to 31st March) Mini in account current with Balsubramaniam (interest upto 31st March at 12% p.a.)

Dt	Due	Particular	₹	Days	product	Dt	Due	Particular	₹	Days	Product
Jan 12	Feb1	To sale a/c	30,000	58	17,40,00	Jan 1	Jan 1	By balance b∖d	3,500	90	3,15,000
Jan 31	Feb 15	To sales a/c	27,500	44	12,10,000	Feb 15	Feb 15	By cash a/c	40,000	44	17,60,000
Mar 31	Mar 31	To interest a/c	130			Feb 20	Feb 20	By cash a/c	7,500	39	2,92,500
Mar 31	Mar 31	To bal. b∖d	6,870			Mar 10	Mar 10	By sales return	7,000	21	1,47,000
						Mar 25	Mar 25	By cash a/c	6,500	6	39,000
						Mar 31	Mar 31	By purchase of product			3,96,500
		Total	64,500		29,50,000			total	64,500		29,50,000

Note: Interest = ₹ 3,96,500x12%x1/365 = ₹ 130(approx)

Date	Particular	Dr.	Cr.	Dr./Cr.balance	Net cum balance	Days	Dr. product	Cr. product
Jan 1	Balance b\d	-	3,500	Cr.	3,5000	11	-	38,500
Jan 22	Sale(due date 1 feb)	Na	-	Cr.	3,500	(note)20	-	70,000
Jan 31	Sale(due date 15 feb)	Na	-	Cr.	3,500	(note)1	-	3,500
Feb 1	Invoice of jan 31	30,000	-	Dr.	26,500	14	3,71,000	-
Feb 15	Invoice of jan 31	27,500	-	Dr.	54,000	-	-	-
Feb 15	Cash received	-	40,000	Dr.	14,000	5	70,000	-
Feb 20	Cash received	-	7,500	Dr.	6,500	18	1,17,000	-
Mar 10	Sales return	-	7,000	Cr.	500	15	-	7,500

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Mar 25	Cash received	-	6,500	Cr.	7,000	6	-	42,000
Mar31	Interest(see note below)	130						
Mar 31	Closing balance	6,870						
	Total	64,500	64,500			Total	5,58,000	1,61,500

Note: since rate of interest on Dr. and Cr. Balance uniform at 12% interest can be directly calculated on the next balance of ₹ 5,58,000- ₹ 1,61,500= ₹ 3,96,500. So , interest = ₹ 3,96,500x12%x1/365₹130 (approx.)

Invoices dated 12th Jan and 31st Jan are due only form 1st Feb and 15th Feb respectively. Hence, number of days from 12th Jan to 1st Feb= 20 days, and from 31st Jan to 15 Feb (next due date)=20days and 1 days.

MATHEMATICAL REASONING

Mathematical Statement:

In our daily life we use different types of sentences like Assertive, Interrogative, Exclamatory, Imperative, Optative etc. Among them only assertive sentences are called Mathematical statement. But it is to be noted that all assertive sentences are not Mathematical Statements.

For example:

'The earth moves round the sun': – This is a Mathematical statement. It is true always.

'The sun rises in the west': – This is also a Mathematical statement. But its truth value is 'False'. Again we take the example of assertive sentence:

'Girls are more clever than boys' – This is an assertive sentence but we cannot say whether this sentence is always true or false. For this reasons this sentence is not a mathematical Statement.

Hence, we give the following definition of Mathematical Statement.

A sentence is called a mathematically acceptable statement or simply mathematical statement of it is true or false but not both.

Example 1: The followings are the examples are Mathematical statements.

(i) 2 + 3 = 5. (ii) 3 + 4 = 6.

Example 2 : The followings are not the Mathematical Statements:

(i) $X^2 - 3X + 2 = 0$. (ii) Open the door.

Negation of a Statement:

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Negation of a statement implies the denial or contradiction of the statement. If 'p' be a statement, then

'~p' denotes the Negation of the statement.

For example:

'Manas is a teacher': It is a mathematical statement. Its negation is 'Manas is not a teacher' or it is false that Manas is a teacher'.

Again 'Delhi is the capital of India' is a mathematical statement. Its negation statement is 'Delhi is not the capital of India' or, 'It is false that Delhi is the capital of India'.

Simple and compound Statements:

If the truth value of a statement does not depend on any other statement, then the statement is called a **Simple Mathematical Statement**. Simple statement cannot be subdivided into **simple statements**.

A compound statement is a combination of two or more simple statements connected by the words "and", "or", etc.

A compound statement can be subdivided into two or more simple statements.

Example 3: The followings are simple statements and they cannot be sub-divided into simpler statements.

- (i) The earth moves round the sun.
- (ii) The Sun is a star.
- (iii) Sweta reads in class X.

Example 4:

The followings are compound statements and each of them can be subdivided into two or more simple statements.

- (i) 2 is a rational number and 2 is an irrational number.
- (ii) A rhombus is a parallelogram and its four sides are equal.

Connectives:

Some connecting words are used to form compound statements. These connecting words are called connectives. The connectives are the words namely: "and", "or", "if-then", "only if", "if and only if".

The word "and"

Any two simple statements can be combined by using the word "and" to form compound statements which may be true or false.

If each simple mathematical statements belonging to a compound mathematical statements are true then the compound mathematical statement is only True. But if one or more simple statements connected with a compound mathematical statement is are false, then the compound mathematical statement must be False.

Example 5 :

(i) **r:** Delhi is a big city and it is the capital of India.

The statement r is a compound mathematical statement and is formed by connecting two simple mathematical statements p & q using the connective "and" where

p: Delhi is a big city.

q: Delhi is the capital of West Bengal.

Here both p and q are true, so the truth value of the compound mathematical statement is "True".

(ii) **r**: 41 is a prime number and it is an even number.

Here r is a compound mathematical statement and is formed by connecting two simple mathematical statements p and q using the connective "and" where

p : 41 is a prime number.

q: 41 is an even number.

Here p is true but q is false. So the truth value of r is "False".

The word "or":

Any two simple mathematical statements can be combined by using "or" to form compound mathematical statements whose truth value may be true or false.

If both "or" any one of the component simple mathematical statements of a compound mathematical statements when formed using the connective "or" are / is true then the truth value of the compound mathematical statement is true. If both compound simple mathematical statements are false, then the truth value of the compound mathematical statement is "false".

If both the component simple mathematical statements of a compound mathematical statement formed by using the connective "or" are true, then the "or" is called Inclusive "or". Again if one is true and other is false, then the "or" used in compound mathematical statement is called Exclusive "or".

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Example 6 : Let **p:** Rhombus is a quadrilateral.

q: Rhombus is a parallelogram.

Here p & q both are simple mathematical statements and both are true.

r: Rhombus is a quadrilateral or a parallelogram.

Hence r is a compound mathematical statement which is obtained by connecting p and q with the connective "or". Since both p and q are true, the truth value of r is "**True**" and here "**or**" is Inclusive "**or**".

Example 7: Let **p**: Two straight lines intersect at a point.

q: Two straight lines are parallel.

Here both p and q are simple mathematical statement. If p is true, then q is false or if p is false, then q is true but p and q cannot be both true or cannot be both false. Only one of p and q is true. So the truth value of r is true where

r: Two straight lines either intersect at a point or they are parallel.

Here "or" use is Exclusive "or".

Implications:

A compound mathematical statement is formed connecting two simple mathematical statements using the connecting words "if – then", "only if" and "if and only if". These connecting words are called **Implications**.

(i) The word "if – then":

Let p and q be two simple mathematical statements. If a compound mathematical statement is formed with p and q using "if p then q" – then its meaning is "if p is true then q must be true". Symbolically it is written as $p \Rightarrow q$ of $p \Rightarrow q$. (We read this as p implies q)

Example 8 : "If 42 is divisible by 7, then sum of the digits of 42 is divisible by 7". – It is a compound mathematical statement.

p: 42 is divisible by 7. Q: The sum of the digits of 42 is divisible by 7.

Here p is true but q is not true.

 \therefore p x q is false.

: The truth value of the given statement is false.

Example 9 : "If 123 is divisible by 3, then the sum of the digits of 123 is not divisible by 3". – It is a compound mathematical statement.

p: 123 is divisible by 3. **q:** the sum of the digits of 123 is not divisible by 3. Here p is true and q is not true.

• $p \Rightarrow q$ is false.

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• The truth value of the given statement is false.

Example 10 : "If anybody is born in India, then he is a citizen of India". It is compound mathematical statement.

p: Anybody is born in India. Q: He is a citizen of India.

Here if p is true, then q is true. So p \sum q is true.

Contrapositive and converse statement:

If a compound mathematical statement is formed with two simple mathematical statements p and q using the connective "if-then" then the contrapositive and converse statements of compound statement can also be formed.

The contrapositive statement of "if p, then q" is "if -q, then -p" and the converse statement is "if q then p". Example: "If a number is divisible by 6, then it is divisible by 3". – It is a compound mathematical statement.

Its contrapositive statement is

"If a number is not divisible by 3, then it cannot be divisible by 6".

The converse statement is

"If the require of a number is an even number, then the number is even".

The word "only if":

Let p and q be two given simple mathematical statements. If a compound mathematical statement is formed with p and q using the connective word "only if" then it implies that p only if q that is p happens only if q happens.

Example 11 : "The triangle ABC, will be equilateral only if AB = BC = CA." Here, p: The triangle ABC is equilateral.

q: In the triangle ABC, AB = BC = CA.

Example 12 : "A number is an even integer only if the number is divisible by 2."

Here, p : A number is an even integer.

q : The number is divisible by 2

Example 13 : Obtain the truth value of

- (i) If 5 + 6 = 11, then 11 6 = 5.
- (ii) If 5 + 8 = 12, then 12 + 8 = 20.
- (iii) If 6 + 9 = 14, then 14 7 = 8
- (iv) If 7 + 8 = 15, then 8 7 = 2

Solution:

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- (i) Since p: 5 + 6 = 1 is true and q: 11 6 = 5 is true, so $p \Rightarrow q$ i.e., the given statement is true.
- (ii) Since p:5 + 8 = 12 is false and q: 12 + 8 = 20 is true, so p \Rightarrow q i.e., the given statement is true.
- (iii) Since p:6 + 9 = 14 is false and q: 14 7 = 8 is false, so p \Rightarrow q i.e., the given statement is true.
- (iv) Since p: 7 + 8 = 15 is true and 8 7 = 2 is false, so $p \Rightarrow q$ i.e., the given statement is false.

The word "if and only if":

When a compound mathematical statement is formed with two simple mathematical statements using the connecting words "if and only if" then the statement is called Biconditional statement. Let p and q be two simple mathematical statements. The compound statement formed with p and q using "if and only if" then the biconditional statement can be written symbolically as $p \Rightarrow q$ and $q \Rightarrow p$ or $p \Leftrightarrow q$. In short "if and only if" is written as "iff".

The biconditional statement $p \Leftrightarrow q$ is true only when both p and q are true or both p and q are false.

Quantifiers:

In some mathematical statements some phrases like "There exists", "For all" (or for every) are used. These are called **Quantifiers.**

For example "There exists a natural number such that x + 6 > 9"; "There exists a quadrilateral whose diagonals bisect each other"; "For all natural numbers x, x > 0"; "For every real number $x \neq 0$, $x^2 > 0$ ".

In the above statements "There exists", "For all", "For every" etc phrases are Quantifiers.

"There exists", "For some", "For at least" are called Existential Quantifier and they are expresses as E. "For all", "For every" are called Universal Quantifiers and they are expressed by the symbol A.

Example 14: Indicate the Quantifiers from the following statements and write the truth value in case;

- (i) For every natural number x, x + 1 > 0
- (ii) For at least one natural number x, $x \in A$ where $A = \{-1, 2, 3, 0, -3'\}$
- (iii) There exists a natural number n, n 2 > 5.
- (iv) For all real number x, $x^2 > 0$.

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Solution :

- (i) The quantifier is "For every". The truth value of the statement is "truth" because for any natural number x, x10 + * is always true.
- "For at least" is the quantifier. The truth value of the statement is (ii) "true" because A $2 \in$, A $3 \in$ and 2, 3 are natural number.
- "There exists" is the quantifier. The truth value of the statement is (iii) "true" because for any natural number n > 8, the relation n-2)5.
- (iv) "For all" is the quantifier. The truth value of the statement is "True", because x = 0 is a real number and $x^2 > 0$.

Example 15: Using Quantifiers, express the following in equations into a statement :

(i) $n + 2 > n, n \in N$. (ii) $x^2 < 0, x \in I$

(Where I denote the set of all negative integers) (iii) x + 1 > 3, $x \in R$. Solution :

- (i) There exists a natural number N n \in such that n 2 n >+. The statement is true. The quantifier is "There exists".
- (ii) For all negative integers $x \in I$, $x^2 < 0$. The statement is false because the square of any negative integer is greater than zero. The quantifier is "For all".
- (iii) There exists a real number $x \in R$ such that x+1 > 3. The statement is true because for all real number x>2, the relation x+1>3 is true. The quantifier is "There exists".

Questions and Answers of September 2014

- 1. The monthly salaries of two persons are in the ratio of 3:5. If each receives an increase of ₹ 20 in salary, the ratio is altered to 13:21. Find the respective salaries
 - (a) ₹ 300, ₹ 500
 - (c) ₹240, ₹400

- (b) ₹130, ₹210

Answer: (c)

- (d) ₹400, ₹240
- 2. If the two numbers 20 and x+2 are in the ratio of 2:3; Find x

			Arithmetic	■ 19
	(a) 14 (c) 32 Answer: (b)	(b) (d)	28 29	
3.	The simple interest or	a sum of money	of the end of 8 yea	rs is $\frac{2}{5}$ th of
	the sum itself. Find the (a) 15% (c) 20%	e rate percent p.a. (b) (d)	5% 10%	3
4.	In what time will be th for 8 years at 5%.	ie S.I. on ₹ 900 at	: 6% be equal to S	.l. on ₹ 540
	(a) 4 years(c) 8 yearsAnswer: (a)	(b) (d)	10 years 6 years	
5.	The difference betwee days at 5% p.a. is ₹ 1. (a) ₹ 5,000 (c) ₹ 20,000	en interest and tru Find the sum. (b) (d)	ue discount on a s ₹15,000 ₹10,000	um due 73
	Answer: (d)			

Questions and Answers of December 2014

1. What must be subtracted from each of the numbers 17, 25, 31, 47 so that the remainders may be in proportion.

(a) 12	 (b)	6
(c) 9	(d)	3
A / IN		

Answer: (d)

2. The ratios of 200 gm to 2 kg. is:

(a) 100:1	(b) 10:1
(c) 1:1	(d) 1:10

Answer: (d)

3. The difference between interest and true discount on a sum due in 73 days at 5% p.a. is ₹ 1. Find the sum.

(a)	₹ 10,000	(b)) ₹	8,000
(C)	₹ 6,000	(d) ₹	12,000

|--|

(d) ₹12,000



- 4. Write the truth value of each of the following sentences and comment whether a mathematical statement or not:
 - (i) Tomorrow is Wednesday
 - (ii) Every rectangle is a square
 - (iii) $\sqrt{2}$ is an irrational number
 - (iv) Alas! I am undone
 - (v) There are 31 days in the month of July and August in each year
 - (vi) Mathematics is an interesting subject.
 - (a) (ii) and (iii)

- (b) (i) and (iv)
- (c) (v) and (vi) (d) (iii) and (v)
- Answer: (d)
- 5. If the 5th and 11th terms is an A.P. be 41 and 20, then find its first terms and the sum of first 11th terms.
 - (a) 65, 410.5 (c) 50, 412.5

- (b) 55, 412.5
- (d) 53, 400.5

Answer: (b)

Questions and Answers of March 2015

- 1. The Ratio of 5kg 55gm to 35kg 50gm:
 - (a) 5:7

- (b) 1,011:7,010
- (d) None of these

(c) 111:710 **Answer:** (b)

- 2. If A:B = 3.4, B:C = 2:5 then A:B:C: (a) 3:4:5 (b) 3:4:10
 - (a) 3:4:5 (b) 3:4:10 (c) 4:3:10 (d) 3:4:8
 - Answer: (b)
- Gulshan Kumar borrows ₹ 300 at 5% and ₹ 450 at 6% at the same time and on the condition that the whole loan will be repaid when the total interest amounts to ₹ 126. The loan will have to be repaid after how many years:

)	3
)	5
	,

Answer: (b)

To find out the total compound interest accrued on a sum of money after 5 years, which of the following information given in the statements P and Q will be sufficient?
 P: The sum was ₹ 20,000

P: The sum was ₹ 20,000

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Q: The total amount of simple interest on the sum after 5 years was ₹4,000. (a) Only P is sufficient (b) Only Q is sufficient (c) Either P or Q is sufficient (d) Both P & Q are needed. Answer: (c) If $\frac{\sqrt{a + \sqrt{b}}}{\sqrt{a - \sqrt{b}}} = \frac{2}{1}$ then $\frac{a + b}{a - b}$ is equal to: 5. (a) 5/4 (b) 4/5 (d) None of these. (c) 3 Answer: (a) **Questions and Answers of June 2015** 1. If A : B = 2 : 3, B : C = 4 : 5, then A : C = 4(a) 6:7 (b) 7:6 (c) 8:15 (d) 15:8 Answer: (c) 2. The ratio of two numbers is 11: 15. The sum of 3 times the first number and twice the second number is 630. The H.C.F. of the number is: (a) 10 (b) 12 (c) 15 (d) None of these. Answer: (a) 3. If $a^{1/3} + b^{1/3} + c^{1/3} = 0$, then $(a + b + c)^3$: (b) 27 abc (a) 3 abc (c) -27 abc (d) None of these. Answer: (b) 4. The simple interest on ₹ 10 for 4 months at the rate of 3 paise per rupee per month is: (a) ₹1.20 (b) ₹12 (c) ₹120 (d) ₹1200 Answer: (a)

Questions and Answers of September 2015

- A machine the useful life of which is estimated to be 10 years costs ₹ 10,000. Rate of depreciation is 10% p.a. The scrap value at the end of its life is
 - (a) ₹ 3,486.78
 - (b) ₹ 43,833

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- (c) ₹ 3,400
- (d) None of these.

Answer: (a)

- 2. A sum of money doubles itself in 10 years. The number of years it would triples itself is
 - (a) 25 years
 - (b) 15 years
 - (c) 20 years
 - (d) 10 years
 - Answer: (c)
- 3. The fourth proportional of ₹ 5, ₹ 3.50, 150 gm is:
 - (a) 100 gm
 - (b) 105 gm
 - (c) 125 gm
 - (d) None of these.

Answer: (b)

- 4. If 2A = 3B = 4C, then A : B : C is :
 - (a) 2:3:4
 - (b) 4:3:2
 - (c) 6:4:3
 - (d) 3:4:6.
 - Answer: (c)
- 5. A person borrowed ₹ 500 at the rate of 5% per annum S.I. what amount will he pay to clear the debt after 4 years?
 - (a) ₹200
 - (b) ₹550
 - (c) ₹600
 - (d) ₹700

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Answer: (c)

- 6. A sum of money at compound interest amounts to thrice itself in 3 years. In how many years will it be 9 times itself in?
 - (a) 12
 - (b) 9
 - (c) 6
 - (d) 8

Answer: (c)

Questions and Answers of December 2015

- 1. The C.I. on ₹ 40,000 at 10% p.a. for 1 year when the interest is payable quarterly is: (a) ₹4,000 (b) ₹4,100
 - (c) ₹4,15,251

Answer: (c)

- (d) None of these
- 2. If A:B = 2:3 B:C = 4:5 then A:C
 - (a) 6:7 (c) 7:6 (c) 8:15 (d) 15:8

Answer: (c)

- 3. The third proportional of 1 hour 20 minutes 1 hour 40 minutes is:
 - (a) 1 hours 50 minutes (c) 2 hours 5 minutes
- (b) 2 hours (d) 2 hours 25 minutes

- Answer: (c)
- 4. If 15% of x is the same as 20% of y, then x : y is (a) 3:4 (b) 4:3
 - (c) 17:16 (d) 16:17 Answer: (b)

5. A friction which bears the same ratio to $\frac{1}{27}$ that $\frac{3}{11}$ does to $\frac{5}{9}$ is:

(a)
$$\frac{1}{55}$$
 (b) 55
(c) $\frac{1}{11}$ (c) 14

Answer: (a)

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6. The simple interest on ₹ 10 for 4 months at the rate of 3 paise per rupee per months is:

(a)	₹1.20	(b)	₹12
(C)	₹120	(d)	₹1,200

Answer: (a)

7. To find out the total compound interest accrued on a sum of money after 5 years, which of the following information given in the statements P and Q will be sufficient?

P: The sum was ₹ 20,000.

Q: The total amount of simple interest on the sum after 5 year was \gtrless 4,000.

- (a) Only P is sufficient
- (c) Either P or Q is sufficient

Answer: (d)

(b) Only Q is sufficient

(d) Both P & Q is necessary.

Questions and Answers of March 2016

- 1. If A:B = 2:3, B:C = 4:5, then A:C =
 - (a) 6:7
 - (b) 7:6
 - (c) 8:15
 - (d) 15:8

Answer: (c)

- 2. The inverse ratio of $1\frac{3}{4}: 2\frac{1}{4}$ is _____.
 - (a) 32:45
 - (b) 45:32
 - (c) 18:5
 - (d) 5:18
 - Answer: (b)
- 3. The ratio $\frac{5}{3}:2\frac{1}{4}$ is:
 - (a) Ratio of lesser inequality
 - (b) Ratio of greater inequality
 - (c) 20:9
 - (d) 5:27

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Answer: (a)

- 4. The ratio of 5kg. 55gm. to 35kg. 50gm.:
 - (a) 5:7
 - (b) 1,011:7010
 - (c) 111:710
 - (d) None of these

Answer: (b)

- 5. The ratio is 1 year 6 months : 2 years : 2 years 6 months:
 - (a) 3:4:5
 - (b) 2:3:5
 - (c) 2:4:5
 - (d) None of these

Answer: (a)

- $\left[\frac{1}{2} + \frac{1}{3}\right] : \left[\frac{1}{2} \times \frac{1}{3}\right]$ 6.

 - (a) 2:3
 - (b) 3:2
 - (c) 5:1
 - (d) 1:5

Answer: (c)

- 7. The mean proportional of 4X and 16X³ is _____.
 - (a) 10 × 2
 - (b) 12 × 2
 - (c) 8 × 2
 - (d) 64 × 4
 - Answer: (c)
- 8. If $\frac{1}{5}:\frac{1}{x}=\frac{1}{x}:\frac{1}{1.25}$ the value of x is:

 - (a) 1.5
 - (b) 2
 - (c) 2.5
 - (d) 3.5

Answer: (c)



Answer: (a)

Questions and Answers of June 2016

- 1. The fourth proportional of 0.2, 0.12 and 0.3 is:
 - (a) 0.13
 - (b) 0.15
 - (c) 0.18
 - (d) 0.8
 - Answer: (c)
- 2. The third proportional to (x^2-y^2) and (x-y) is:
 - (a) $\frac{x+y}{x-y}$

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(b) $\frac{x-y}{x+y}$ (c) x + y(d) (x-y)**Answer:** (b)

3. A friction which bears the same ratio to $\frac{1}{27}$ that $\frac{3}{11}$ does to $\frac{5}{9}$ is:

- (a) $\frac{1}{55}$
- (b) 55
- (c) $\frac{1}{11}$ (d) $\frac{3}{11}$

Answer: (a)

5. The mean proportional between $\sqrt{11} - \sqrt{5}$ and $13\sqrt{11} + 19\sqrt{5}$ is:

- (a) $\sqrt{33} \sqrt{15}$
- (b) $\sqrt{33} + \sqrt{15}$
- (c) $\sqrt{11} + \sqrt{5}$
- (d) None of these

Answer: (b)

6. A friction which bears the same ratio to $\frac{1}{27}$ and $\frac{3}{11}$ does to $\frac{5}{9}$ is:

(a) $\frac{1}{55}$ (b) 55 (c) $\frac{1}{11}$ (d) $\frac{3}{11}$ Answer: (a)



- 7. The time, in which the ture discount on amount ₹550 due is ₹50 at 4% per annum, is:
 - (a) 2 years

- (b) 3 years
- (c) 2.5 years
- (d) None of them

Answer: (a)

MULTIPLE CHOICE QUESTIONS

- 1. S.I. on ₹ 3,500 for 3 years at 12% per annum is (a) ₹ 1,200 (b) ₹ 1,260 (d) None of these (c) ₹ 2,260 Answer: 2. P = 5,000 R = 15 T = 4 $\frac{1}{2}$ using I = PRT/100 I will be (a) ₹ 3,375 (b) ₹ 3,300 (c) ₹ 3,735 (d) None of these Answer: 3. If P = 5,000 T = 1 I = ₹ 300 R will be (a) 5% (b) 4% (c) 6% (d) none of these Answer:
- 4. P = ₹ 12,000 A = ₹ 16500 T = 2 ½ % year. Rate percent per annum simple interest will be
 - (a) 15% (c) 10%
- (b) 12%
- (d) none of these

Answer:

- 5. P = ₹ 10,000 I = ₹ 2,500 R = 12 ½ % SI. The number of years T will be
 - (a) $1\frac{1}{2}$ years (b) 2 years
 - (c) 3 years (d) none of these
 - Answer:

- 6. P = ₹ 8,500, A = ₹ 10,200 R = 12 ½ % SI I will be



13. A machine is depreciated the rate of 20% on reducing balance. The original cost of the machine was ₹ 1,00,000 and its ultimate 30

scrap value was ₹30,000. The effective life of the machine is (a) 4.5 years (appx.) (b) 5.4 years (appx.) (c) 5 years (appx.) (d) none of these Answer: 14. If A = ₹ 1,000 n = 2 years R = 6% p.a compound interest payable half-yearly then principal (P) is (a) ₹ 888.49 (b) ₹ 880.00 (c) ₹800.00 (d) none of these Answer: 15. The population of a town increases every year by 2% of the population at the beginning of that year. The number of years by which the total increase of population be 40% is (a) 7 years (b) 10 years (c) 17 years (app) (d) none of these [Hint $\log(1.4) = 0.1461$, $\log(1.02) = .0086$] Answer: 16. The difference between S.I and C.I on a certain sum of money interested for 3 years at 6% p.a is ₹ 110.16. the sum is (b) ₹ 3,700 (a) ₹ 3.000 (c) ₹ 12,000 (d) ₹ 10,000 Answer: 17. A machine the useful life of which is estimated to be 10 years costs ₹10,000. Rate of depreciation is 10% p.a. The scrap value at the end of its life is (a) ₹ 3,486.78 (b) ₹ 43,833 (c) ₹ 3,400 (d) none of these Answer: 18. The effective rate of interest corresponding a nominal rate of 7% p.a convertible quarterly is (a) 7% (b) 7.5%

(c) 7.19%

- (d) none of these

Answer:

- 19. The C.I. on ₹ 16,000 for 1 ½ years at 10% p.a. payable half yearly is

- (a) ₹ 2,222
- (c) ₹ 2,500

- (b) ₹ 2,522
- (d) none of these

- Answer:
- 20. The C.I. on ₹ 40,000 at 10% p.a. for 1 year when the interest is payable quarterly is
 - (a) ₹ 4,000

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(C)

- (c) ₹ 4,152.51
- Answer:

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(b)

- (b) ₹ 4,100
- (d) none of these

Answer											
1	(b)	2	(a)	3	(C)	4	(a)	5	(b)	6	(a)
7	(C)	8	(a)	9	(C)	10	(a)	11	(C)	12	(c)
13	(b)	14	(a)	15	(C)	16	(d)	17	(a)	18	(C)