Government of Tamilnadu

STANDARD SEVEN

TERM III

VOLUME 2

MATHEMATICS | SCIENCE | SOCIAL SCIENCE

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Untouchability is Inhuman and a Crime

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Term III

MATHEMATICS

1

ALGEBRA

1.1 Simple expressions with two variables

We have learnt about rectangle. Its area is $l \times b$ in which the letters 'l' and 'b' are variables.

Variables follow the rules of four fundamental operations of numbers.

Let us now translate a few verbal phrases into expressions using variables.

Operation	Verbal phrase	Algebraic Expression
Addition	Sum of x and y	$x + y$
Subtraction	Difference between a and b	$a - b$ (*if* $a > b$) (or) $b - a$ (*if* $b > a$)
Multiplication	product of x and y	$x \times y$ (or) xy
Division	p divided by q	$p \div q$ (or) $\frac{p}{q}$

The following table will help us to learn some of the words (phrases) that can be used to indicate mathematical operations:

Addition	Subtraction	Multiplication	Division
The sum of	the difference of	the product of	the quotient of
increased by	decreased by	multiplied by	divided by
plus	minus	times	the ratio of
added to	subtracted from		
more than	less than		

Example 1.1

Write the algebraic expressions for the following:

1) Twice the sum of m and n.
2) b decreased by twice a.
3) Numbers x and y both squared and added.
4) Product of p and q added to 7.

5) Two times the product of a and b divided by 5.

6) x more than two-third of y.

7) Half a number x decreased by 3.

8) Sum of numbers m and n decreased by their product .

9) 4 times x less than sum of y and 6.

10) Double the sum of one third of a and m.

11) Quotient of y by 5 added to x.

Solution:

1)	$2(m+n)$	2)	$b-2a$
3)	x^2+y^2	4)	$7+pq$
5)	$\frac{2ab}{5}$	6)	$\frac{2}{3}y+x$
7)	$\frac{x}{2}-3$	8)	$(m+n)-mn$
9)	$(y+6)-4x$	10)	$2\left(\frac{1}{3}a+m\right)$
11)	$\frac{y}{5}+x$		

Try these

Express each of the following as an algebraic expression

(i) a times b.

(ii) 5 multiplied by the sum of a and b.

(iii) Twice m decreased by n .

(iv) Four times x divided by y .

(v) Five times p multiplied by 3 times q.

Exercise 1.1

1. Choose the correct answer:

(i) The sum of 5 times x, 3 times y and 7

(A) $5(x+3y+7)$ (B) $5x+3y+7$

(C) $5x+3(y+7)$ (D) $5x+3(7y)$

(ii) One half of the sum of numbers a and b

(A) $\frac{1}{2}(a+b)$ (B) $\frac{1}{2}a+b$ (C) $\frac{1}{2}(a-b)$ (D) $\frac{1}{2}+a+b$

(iii) Three times the difference of x and y

(A) $3x-y$ (B) $3-x-y$ (C) $xy-3$ (D) $3(y-x)$

(iv) 2 less than the product of y and z

(A) $2 - yz$ (B) $2 + yz$ (C) $yz - 2$ (D) $2y - z$

(v) Half of p added to the product of 6 and q

(A) $\frac{p}{2} + 6q$ (B) $p + \frac{6q}{2}$ (C) $\frac{1}{2}(p + 6q)$ (D) $\frac{1}{2}(6p + q)$

2. Write the algebraic expressions for the following using variables, constants and arithmetic operations:

(i) Sum of x and twice y.

(ii) Subtraction of z from y.

(iii) Product of x and y increased by 4

(iv) The difference between 3 times x and 4 times y.

(v) The sum of 10, x and y.

(vi) Product of p and q decreased by 5.

(vii) Product of numbers m and n subtracted from 12.

(viii) Sum of numbers a and b subtracted from their product.

(ix) Number 6 added to 3 times the product of numbers c and d.

(x) Four times the product of x and y divided by 3.

1.2 Simple Linear Equations

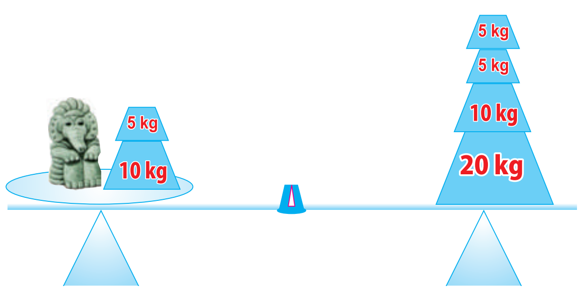
Malar's uncle presented her a statue. She wants to know the weight of that statue. She used a weighing balance to measure its weight. She knows her weight is 40kg . She finds that the weight of the statue and potatoes balance her weight.

i.e.,

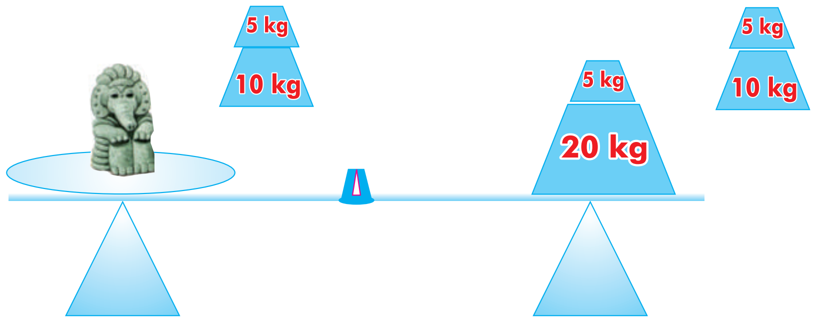
Weight of statue	Plus	Weight of potatoes	Equal	Malar's weight
s	+	15	=	40

Table 1.1

Now we will think about a balance to find the value of s.



Take away 15 from both sides.



Now the balance shows the weight of the statue.

$$s + 15 = 40 \text{ (from Table 1.1)}$$

$$s + 15 - 15 = 40 - 15 \text{ (Taking away 15 from both the sides)}$$

$$s = 25$$

So the statue weighs 25 kg.

The statement $s + 15 = 40$ is an equation. i.e., a statement in which two mathematical expressions are equal is called an equation.

In a balance, if we take away some weight from one side, to balance it we must take away the same weight from the other side also.

If we add some weight to one side of the balance, to balance it we must add the same weight on the other side also.

Similarly, an equation is like a weighing balance having equal weights on each side. In an equation there is always an equality sign. This equality sign shows that value of the expression on the left hand side (LHS) is equal to the value of the expression on the right hand side (RHS).

✶ Consider the equation $x + 7 = 15$

Here LHS is $x + 7$

RHS is 15

We shall subtract 7 from both sides of the equation

$$x + 7 - 7 = 15 - 7 \quad \text{(Subtracting 7 reduces the LHS to } x\text{)}$$

$$x = 8 \quad \text{(variable } x \text{ is separated)}$$

✶ Consider the equation $n - 3 = 10$

LHS is $n - 3$

RHS is 10

Adding 3 to both sides, we get

$$n - 3 + 3 = 10 + 3$$

$$n = 13 \qquad \text{(variable } n \text{ is separated)}$$

✶ Consider the equation $4m = 28$

Divide both sides by 4

$$\frac{4m}{4} = \frac{28}{4}$$

$$m = 7$$

✶ Consider the equation $\frac{y}{2} = 6$

Multiply both sides by 2

$$\frac{y}{2} \times 2 = 6 \times 2$$

$$y = 12$$

So, if we add (or subtract) any number on one side of an equation, we have to add (or subtract) the same number the other side of the equation also to keep the equation balanced. Similarly, if we multiply (or divide) both sides by the same non-zero number, the equation is balanced. Hence to solve an equation, one has to perform the arithmetical operations according to the given equations to separate the variable from the equation.

Example 1.2

Solve $3p + 4 = 25$

Solution: $3p + 4 - 4 = 25 - 4$ (Subtracting 4 from both sides of the equation)

$$3p = 21$$

$$\frac{3p}{3} = \frac{21}{3} \qquad \text{(Dividing both sides by 3)}$$

$$p = 7$$

Example 1.3

Solve $7m - 5 = 30$

Solution: $7m - 5 + 5 = 30 + 5$ (adding 5 on both sides)

$$7m = 35$$

$$\frac{7m}{7} = \frac{35}{7} \qquad \text{(Dividing both sides by 7)}$$

$$m = 5$$

While solving equations, the commonly used operation is adding or subtracting the same number on both sides of the equation. Instead of adding or subtracting a number on both sides of the equation, we can transpose the number.

Transposing a number (i.e., changing the side of the number) is the same as adding or subtracting the number from both sides. While transposing a number we should change its sign. Let us see some examples of transposing.

Example 1.4

Solve $2a - 12 = 14$

Solution:

Adding or subtracting on both sides	Transposing
$2a - 12 = 14$	$2a - 12 = 14$
$2a - 12 + 12 = 14 + 12$ (adding 12 on both sides)	Transpose (– 12) from LHS to RHS
$2a = 26$	$2a = 14 + 12$ (on transposing -12 becomes $+12$)
$\frac{2a}{2} = \frac{26}{2}$ (dividing both sides by 2)	$2a = 26$
$a = 13$	$\frac{2a}{2} = \frac{26}{2}$ (Dividing both sides by 2)
	$a = 13$

Example 1.5

Solve $5x + 3 = 18$

Solution: Transposing +3 from LHS to RHS

$$5x = 18 - 3 \quad \text{(on Transposing } +3 \text{ becomes } -3\text{)}$$

$$5x = 15$$

$$\frac{5x}{5} = \frac{15}{5} \qquad \text{(Dividing both sides by 5)}$$

$$x = 3$$

Example 1.6

Solve $2(x+4)=12$

Solution: Divide both sides by 2 to remove the brackets in the LHS.

$$\frac{2(x+4)}{2}=\frac{12}{2}$$

$$x+4=6$$

$$x=6-4 \qquad \text{(transposing +4 to RHS)}$$

$$x=2$$

Example 1.7

Solve $-3(m-2)=18$

Solution: Divide both sides by (-3) to remove the brackets in the LHS.

$$\frac{-3(m-2)}{-3}=\frac{18}{-3}$$

$$m-2=-6$$

$$m=-6+2 \qquad \text{(transposing } -2 \text{ to RHS)}$$

$$m=-4$$

Example 1.8

Solve $(3x+1)-7=12$

Solution:

$$\begin{aligned}(3x+1)-7 &= 12\\ 3x+1-7 &= 12\\ 3x-6 &= 12\\ 3x &= 12+6\\ \frac{3x}{3} &= \frac{18}{3}\\ x &= 6\end{aligned}$$

Example 1.9

Solve $5x+3=17-2x$

Solution:

$$5x+3=17-2x$$

$$5x + 2x = 17 - 3 \quad \text{(transposing + 3 to RHS and } - 2x \text{ to LHS)}$$

$$7x = 14$$

$$\frac{7x}{7} = \frac{14}{7}$$

$$x = 2$$

Example 1.10

Sum of three consecutive integers is 45. Find the integers.

Solution: Let the first integer be x.

$\Rightarrow$ second integer $= x + 1$

Third integer $= x + 1 + 1 = x + 2$

Their sum $= x + (x + 1) + (x + 2) = 45$

$$3x + 3 = 45$$

$$3x = 42$$

$$x = 14$$

Hence, the integers are $x = 14$

$$x + 1 = 15$$

$$x + 2 = 16$$

Example 1.11

A number when added to 60 gives 75. What is the number?

Solution: Let the number be x.

The equation is $60 + x = 75$

$$x = 75 - 60$$

$$x = 15$$

Example 1.12

20 less than a number is 80. What is the number?

Solution: Let the number be x.

The equation is $x - 20 = 80$

$$x = 80 + 20$$

$$x = 100$$

Example 1.13

$\frac{1}{10}$ of a number is 63. What is the number?

Solution: Let the number be x.

The equation is $\frac{1}{10}(x) = 63$

$$\frac{1}{10}(x) \times 10 = 63 \times 10$$

$$x = 630$$

Example 1.14

A number divided by 4 and increased by 6 gives 10. Find the number.

Solution: Let the number be x.

The equation is $\frac{x}{4} + 6 = 10$

$$\frac{x}{4} = 10 - 6$$

$$\frac{x}{4} = 4$$

$$\frac{x}{4} \times 4 = 4 \times 4$$

$\therefore$ the number is 16.

Example 1.15

Thendral's age is 3 less than that of Revathi. If Thendral's age is 18, what is Revathi' s age?

Solution: Let Revathi's age be x

$\Rightarrow$ Thendral's age $= x - 3$

Given, Thendral's age is 18 years

$$\Rightarrow \quad x - 3 = 18$$

$$x = 18 + 3$$

$$x = 21$$

Hence Revathi's age is 21 years.

Exercise 1.2

1. Choose the correct answer.

(i) If $p + 3 = 9$, then p is

(A) 12 (B) 6 (C) 3 (D) 27

(ii) If $12 - x = 8$, then x is

(A) 4 (B) 20 (C) -4 (D) -20

(iii) If $\frac{q}{6} = 7$, then q is

(A) 13 (B) $\frac{1}{42}$ (C) 42 (D) $\frac{7}{6}$

(iv) If $7(x - 9) = 35$, then x is

(A) 5 (B) -4 (C) 14 (D) 37

(v) Three times a number is 60. Then the number is

(A) 63 (B) 57 (C) 180 (D) 20

2. Solve :

(i) $x - 5 = 7$ (ii) $a + 3 = 10$ (iii) $4 + y = -2$

(iv) $b - 3 = -5$ (v) $-x = 5$ (vi) $-x = -7$

(vii) $3 - x = 8$ (viii) $14 - n = 10$ (ix) $7 - m = -4$

(x) $20 - y = -7$

3. Solve :

(i) $2x = 100$ (ii) $3l = 42$ (iii) $36 = 9x$

(iv) $51 = 17a$ (v) $5x = -45$ (vi) $5t = -20$

(vii) $-7x = 42$ (viii) $-10m = -30$ (ix) $-2x = 1$

(x) $-3x = -18$

4. Solve :

(i) $\frac{1}{2}x = 7$ (ii) $\frac{a}{6} = 5$ (iii) $\frac{n}{3} = -8$

(iv) $\frac{p}{-7} = 8$ (v) $\frac{-x}{5} = 2$ (vi) $\frac{-m}{3} = -4$

5. Solve :

(i) $3x + 1 = 10$ (ii) $11 + 2x = -19$ (iii) $4z - 3 = 17$

(iv) $4a - 5 = -41$ (v) $3(x + 2) = 15$ (vi) $-4(2 - x) = 12$

(vii) $\frac{y + 3}{5} = 14$ (viii) $\frac{x}{3} + 5 = 7$ (ix) $6y = 21 - y$

(x) $11m = 42 + 4m$ (xi) $-3x = -5x + 22$ (xii) $6m - 1 = 2m + 1$

(xiii) $3x - 14 = x - 8$ (xiv) $5x - 2x + 7 = x + 1$ (xv) $5t - 3 = 3t - 5$

6. The sum of two numbers is 33. If one number is 18, what is the other number?
7. A number increased by 12 gives 25. Find the number.
8. If 60 is subtracted from a number, the result is 48. Find the number.
9. 5 times a number is 60. Find the number.
10. 3 times a number decreased by 6 gives 18. Find the number.
11. The sum of 2 consecutive integers is 75. Find the numbers.
12. Ram's father gave him ₹70. Now he has ₹130. How much money did Ram have in the beginning?
13. 8 years ago, I was 27 years old. How old am I now?

Solve:

(i) $y + 18 = -70$ (ii) $-300 + x = 100$

(iii) $\frac{t}{3} - 5 = -6$ (iv) $2x + 9 = 19$

(v) $3x + 4 = 2x + 11$

Fun game

Ram asked his friends Arun, Saranya and Ravi to think of a number and told them to add 50 to it. Then he asked them to double it. Next he asked them to add 48 to the answer. Then he told them to divide it by 2 and subtract the number that they had thought of. Ram said that the number could now be 74 for all of them. Check it out if Arun had thought of 16, Saranya had thought of 20 and Ravi had thought of 7.

		Arun	Saranya	Ravi
Think of a number	x	16	20	7
Add 50	$x+50$			
Double it	$2x + 100$			
Add 48	$2x + 148$			
Divide by 2	$x + 74$			
Take away the number you thought of	74			

Points to Remember

1. Algebra is a branch of Mathematics that involves alphabet, numbers and mathematical operations.
2. A variable or a literal is a quantity which can take various numerical values.
3. A quantity which has a fixed numerical value is a constant.
4. An algebraic expression is a combination of variables and constants connected by the arithmetic operations.
5. Expressions are made up of terms.
6. Terms having the same variable or product of variables with same powers are called Like terms. Terms having different variable or product of variables with different powers are called Unlike terms.
7. The degree of an expression of one variable is the highest value of the exponent of the variable. The degree of an expression of more than one variable is the highest value of the sum of the exponents of the variables in different terms
8. A statement in which two expressions are equal is called an equation.
9. An equation remains the same if the LHS and RHS are interchanged.
10. The value of the variable for which the equation is satisfied is called the solution of the equation.

2 LIFE MATHEMATICS

2.1 Percent

In the banners put up in the shops what do you understand by 25%, 20% ?

Ramu's mother refers to his report card to analyze his performance in Mathematics in standard VI.

His marks in Maths as given in his report card are

17 / 25 , 36 / 50 , 75 / 100 , 80 / 100 , 22 / 25, 45 / 50

Name: Ramu K. Class & Sec.: VI 'A'

SUBJECTS	Unit Test-I	Mid Term I	Quarterly Exam.	Half Yearly Exam.	Unit Test-II	Mid Term II
Max. Marks.	25	50	100	100	25	50
ENGLISH	23	41	75	80	22	40
II LANGUAGE	20	35	85	80	21	41
MATHEMATICS	17	36	75	80	22	45
SCIENCE	23	39	92	90	21	42
SOCIAL SCIENCE	18	42	86	92	24	42
Sign. of the Teacher						
Sign. of the H.M.						
Sign. of the Parent						

She is unable to find his best mark and his least mark by just looking at the marks.

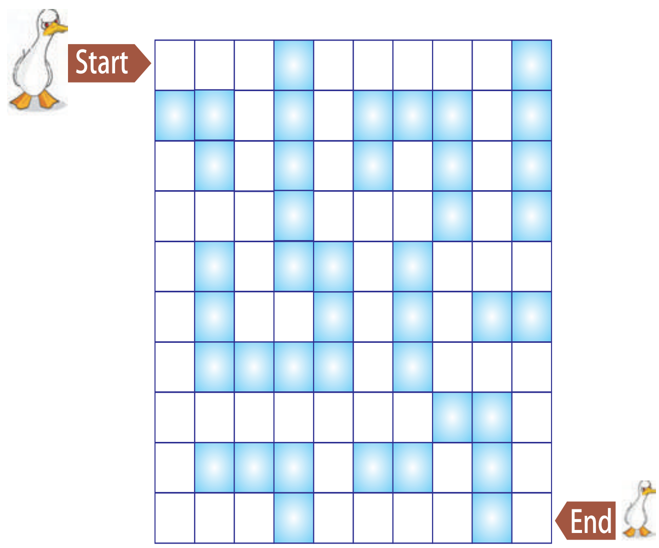
So, she converts all the given marks for a maximum of 100 (equivalent fractions with denominator 100) as given below:

Unit Test 1	Monthly Test 1	Quarterly Exam	Half - yearly Exam	Unit Test 2	Monthly Test 2
$\frac{68}{100}$	$\frac{72}{100}$	$\frac{75}{100}$	$\frac{80}{100}$	$\frac{88}{100}$	$\frac{90}{100}$

Now, all his marks are out of 100. So, she is able to compare his marks easily and is happy that Ramu has improved consistently in Mathematics in standard VI.

Now let us learn about these special fractions.

Try and help the duck to trace the path through the maze from ‘Start’ to ‘End’. Is there more than one path?



No, there is only one path that can be traced from ‘Start’ to ‘End’.

Total number of the smallest squares = 100

Number of shaded squares = 41

Number of unshaded squares = 59

Number of squares traced by the path = ____

Now, look at the table below and fill in the blanks:

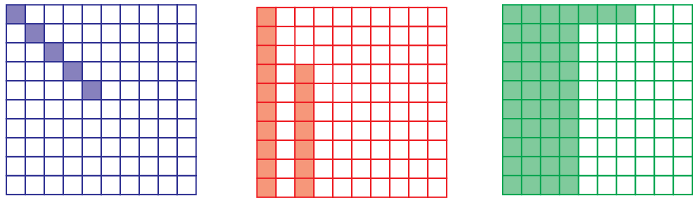
		Ratio	Fraction	Percent
Shaded Portion	41 out of 100	41 : 100	$\frac{41}{100}$	41%
Unshaded Portion	59 out of 100	59 : 100	$\frac{59}{100}$	59%
Portion traced by the path	_____ out of 100	____ : 100	$\frac{\quad}{100}$	_____ %

The fraction with its denominator 100 is called a Percent.

- The word ‘Percent’ is derived from the Latin word ‘Percentum’, which means ‘per hundred’ or ‘hundredth’ or ‘out of 100’.
- Percentage also means ‘percent’.
- Symbol used for percent is %
- Any ratio $x : y$, where $y = 100$ is called ‘Percent’.

To Express Percent in Different Forms:

Pictorial Representation



Shaded portion represented in the form of :

Ratio	5 : 100	17 : 100	43 : 100
Fraction	$\frac{5}{100}$	$\frac{17}{100}$	$\frac{43}{100}$
Percent	5%	17%	43%

Exercise 2.1

1) Write the following as a percent:

(i) 20:100 (ii) $\frac{93}{100}$ (iii) 11 divided by 100 (iv) $\frac{1}{100}$ (v) $\frac{100}{100}$

2) Write the following percent as a ratio:

(i) 43% (ii) 75% (iii) 5% (iv) $17\frac{1}{2}\%$ (v) $33\frac{1}{3}\%$

3) Write the following percent as a fraction:

(i) 25% (ii) $12\frac{1}{2}\%$ (iii) 33% (iv) 70% (v) 82%

Think!

Shop - I

Shop - II

Find the selling price in percentage when 25% discount is given, in the first shop.

What is the reduction in percent given in the second shop?

Which shop offers better price?

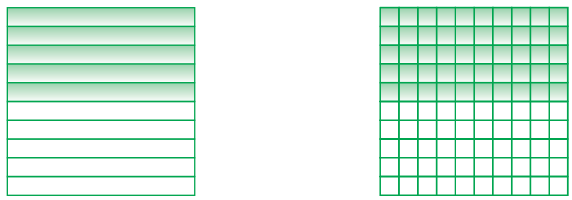
2.2 To Express a Fraction and a Decimal as a Percent

We know that $\frac{5}{100} = 5\%$, $\frac{1.2}{100} = 1.2\%$, $\frac{175}{100} = 175\%$.

To convert $\frac{5}{10}$ to a percent

$\frac{5}{10}$ represented pictorially can be converted to a percent as shown below:

$\frac{5}{10}$ $\frac{50}{100}$



Multiply the numerator and denominator by 10 to make the denominator 100

$$\frac{5\times 10}{10\times 10} = \frac{50}{100} = 50\%$$

This can also be done by multiplying $\frac{5}{10}$ by 100%

$$\left(\frac{5}{10}\times 100\right)\% = 50\%$$

Try these

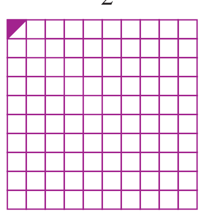
50% of the circle is shaded. 25% of the circle is shaded.

Try drawing circles with (i) 50%, (ii) 25% portion shaded in different ways.

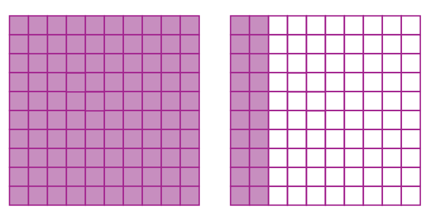
Do you know?

Less than 1 and more than 100 can also be represented as a percent.

$\frac{1}{2}\%$



120%



(i) Fractions with denominators that can be converted to 100

Example 2.1

Express $\frac{3}{5}$ as a percent

Solution:

5 multiplied by 20 gives 100

$$\frac{3\times 20}{5\times 20} = \frac{60}{100} = 60\%$$

$$\frac{3}{5} = 60\%$$

Try these

1) 2 × ____ = 100

2) 5 × 20 = _____

3) 4 × 25 = _____

4) 10 × _____ = 100

5) 1 × _____ = 100

Example 2.2

Express $6\frac{1}{4}$ as a percent

Solution:

$$6\frac{1}{4} = \frac{25}{4}$$

4 multiplied by 25 gives 100

$$\frac{25\times 25}{4\times 25} = \frac{625}{100} = 625\%$$

(ii) Fractions with denominators that cannot be converted to 100

Example 2.3

Express $\frac{4}{7}$ as a percent

Solution: Multiply by 100%

$$\left(\frac{4}{7}\times 100\right)\% = \frac{400}{7}\%$$

$$= 57\frac{1}{7}\% = 57.14\%$$

Example 2.4

Express $\frac{1}{3}$ as a percent

Solution: Multiply by 100%

$$\left(\frac{1}{3}\times 100\right)\% = \left(\frac{100}{3}\right)\%$$

$$= 33\tfrac{1}{3}\% \text{ (or) } 33.33\%$$

Example 2.5

There are 250 students in a school. 55 students like basketball, 75 students like football, 63 students like throw ball, while the remaining like cricket. What is the percent of students who like (a) basket ball? (b) throw ball?

Solution:

Total number of students = 250

(a) Number of students who like basket ball = 55

55 out of 250 like basket ball which can be represented as $\frac{55}{250}$

Percentage of students who like basket ball = $\left(\frac{55}{250} \times 100\right)\%$

$= 22\%$

(b) Number of students who like throw ball = 63

63 out of 250 like throw ball and that can be represented as $\frac{63}{250}$

Percentage of students who like throw ball = $\left(\frac{63}{250} \times 100\right)\%$

$= \frac{126}{5}\% = 25.2\%$

22% like basket ball, 25.2% like throw ball.

(iii) To convert decimals to percents

Example 2.6

Express 0.07 as a percent

Solution:

Multiply by 100%

$(0.07 \times 100)\% = 7\%$

Aliter:

$0.07 = \frac{7}{100} = 7\%$

Example 2.7

Express 0.567 as a percent

Solution:

Multiply by 100%

$(0.567 \times 100)\% = 56.7\%$

Aliter: $0.567 = \frac{567}{1000} = \frac{567}{10 \times 100}$

$= \frac{56.7}{100} = 56.7\%$

Note: To convert a fraction or a decimal to a percent, multiply by 100%.

Think!

1. $\frac{9}{10}$ of your blood is water. What % of your blood is not water.

2. $\frac{2}{5}$ of your body weight is muscle. What % of body is muscle?

About $\frac{2}{3}$ of your body weight is water. Is muscle weight plus water weight more or less than 100 %? What does that tell about your muscles?

Exercise 2.2

1. Choose the correct answer:

(i) 6.25 =

(A) 62.5% (B) 6250% (C) 625% (D) 6.25%

(ii) 0.0003 =

(A) 3% (B) 0.3% (C) 0.03% (D) 0.0003%

(iii) $\frac{5}{20}$ =

(A) 25% (B) $\frac{1}{4}$% (C) 0.25% (D) 5%

(iv) The percent of 20 minutes to 1 hour is

(A) $33\frac{1}{3}$ (B) 33 (C) $33\frac{2}{3}$ (D) none of these

(v) The percent of 50 paise to Re. 1 is

(A) 500 (B) $\frac{1}{2}$ (C) 50 (D) 20

2. Convert the given fractions to percents

i) $\frac{20}{20}$ ii) $\frac{9}{50}$ iii) $5\frac{1}{4}$ iv) $\frac{2}{3}$ v) $\frac{5}{11}$

3. Convert the given decimals to percents

i) 0.36 ii) 0.03 iii) 0.071 iv) 3.05 v) 0.75

4. In a class of 35 students, 7 students were absent on a particular day. What percentage of the students were absent?

5. Ram bought 36 mangoes. 5 mangoes were rotten. What is the percentage of the mangoes that were rotten?

6. In a class of 50, 23 were girls and the rest were boys. What is the percentage of girls and the percentage of boys?

7. Ravi got 66 marks out of 75 in Mathematics and 72 out of 80 in Science. In which subject did he score more?

8. Shyam's monthly income is ₹12,000. He saves ₹1,200 Find the percent of his savings and his expenditure.

2.3 To Express a Percent as a Fraction (or) a Decimal

i) A percent is a fraction with its denominator 100. While expressing it as a fraction, reduce the fraction to its lowest term.

Example 2.8

Express 12% as a fraction.

Solution:

$$12\% = \frac{12}{100} \text{(reduce the fraction to its lowest terms)}$$

$$= \frac{3}{25}$$

Example 2.9

Express $233\frac{1}{3}\%$ as a fraction.

Solution:

$$233\tfrac{1}{3}\% = \frac{700}{3}\%$$

$$= \frac{700}{3 \times 100} = \frac{7}{3}$$

$$= 2\tfrac{1}{3}$$

Percents that have easy fractions

$$50\% = \frac{1}{2}$$

$$25\% = \frac{1}{4}$$

$$33\frac{1}{3}\% = \frac{1}{3}$$

Find more of this kind

Example 2.10

Express $\frac{1}{4}\%$ as a fraction

Solution:

$$\frac{1}{4}\% = \frac{1}{4 \times 100} = \frac{1}{400}$$

(ii) A percent is a fraction with its denominator 100. To convert this fraction to a decimal, take the numerator and move the decimal point to its left by 2 digits.

Example 2.11

Express 15% as a decimal.

Solution:

$$15\% = \frac{15}{100} = 0.15$$

Example 2.12

Express 25.7% as a decimal.

Solution:

$$25.7\% = \frac{25.7}{100}$$

$$= 0.257$$

Math game - To make a triplet (3 Matching cards)

This game can be played by 2 or 3 people.

Write an equivalent ratio and decimal for each of the given percent in different cards as shown.

5%	1 : 20	0.05
$33\frac{1}{3}\%$	1 : 3	0.33

Make a deck of 48 cards (16 such sets of cards) - 3 cards to represent one particular value - in the form of %, ratio and decimal.

Shuffle the cards and deal the entire deck to all the players.

Players have to pick out the three cards that represent the same value of percent, ratio and decimal and place them face up on the table.

The remaining cards are held by the players and the game begins.

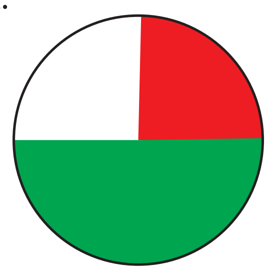
One player chooses a single unknown card from the player on his left. If this card completes a triple (3 matching cards) the 3 cards are placed face up on the table. If triplet cannot be made, the card is added to the player's hand. Play proceeds to the left.

Players take turns to choose the cards until all triplets have been made.

The player with the most number of triplets is the winner.

TO FIND THE VALUES OF PERCENTS

Colour 50% of the circle green and 25% of the circle red.

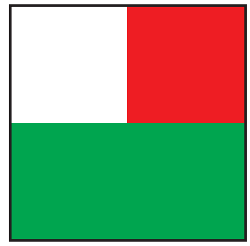


$50\% = \frac{50}{100} = \frac{1}{2}$ of the circle is to be coloured green.

Similarly, $25\% = \frac{25}{100} = \frac{25}{100} = \frac{1}{4}$

$\frac{1}{4}$ of the circle is to be coloured red.

Now, try colouring $\frac{1}{2}$ of the square, green and $\frac{1}{4}$ of the square, red.



Do you think that the green coloured regions are equal in both the figures?

No, 50% of the circle is not equal to 50% of the square.

Similarly the red coloured regions, 25% of the circle is not equal to 25% of the square.

Now, let's find the value of 50% of ₹100 and 50% of ₹10.

What is 50% of ₹100?

$$50\% = \frac{50}{100} = \frac{1}{2}$$

So, $\frac{1}{2}$ of $100 = \frac{1}{2} \times 100 = 50$

50% of ₹100 = ₹50

What is 50% of ₹10?

$$50\% = \frac{50}{100} = \frac{1}{2}$$

$\frac{1}{2}$ of $10 = \frac{1}{2} \times 10 = 5$

50% of ₹10 = ₹5

Example 2.13

Find the value of 20% of 1000 kg.

Solution:

$$\begin{aligned} 20\% \text{ of } 1000 &= \frac{20}{100} \text{ of } 1000 \\ &= \frac{20}{100} \times 1000 \\ 20\% \text{ of } 1000 \text{ kg} &= 200 \text{ kg.} \end{aligned}$$

Example 2.14

Find the value of $\frac{1}{2}\%$ of 200.

Solution:

$$= \frac{\frac{1}{2}}{100} \text{ of } 200$$

$$= \frac{1}{2 \times 100} \times 200$$

$$\frac{1}{200} \times 200 = 1$$

$$\frac{1}{2}\% \text{ of } 200 = 1$$

Example 2.15

Find the value of 0.75% of 40 kg.

Solution:

$$0.75\% = \frac{0.75}{100}$$

$$0.75\% \text{ of } 40 = \frac{0.75}{100} \times 40$$

$$= \frac{3}{10} = 0.3$$

$$0.75\% \text{ of } 40\text{kg} = 0.3\text{kg.}$$

Example 2.16

In a class of 70, 60% are boys. Find the number of boys and girls.

Solution:

Total number of students = 70

Number of boys = 60% of 70

$$= \frac{60}{100} \times 70$$

= 42

Number of boys = 42

Number of girls = Total students – Number of boys

= 70 – 42

= 28

Number of girls = 28

Example 2.17

In 2010, the population of a town is 1,50,000. If it is increased by 10% in the next year, find the population in 2011.

Solution:

Population in 2010 = 1,50,000

Increase in population $= \frac{10}{100} \times 1,50,000$

= 15,000

Population in 2011 = 150000 + 15000

= 1,65,000

Exercise 2.3

1. Choose the correct answer:

(i) The common fraction of 30 % is

(A) $\frac{1}{10}$ (B) $\frac{7}{10}$ (C) $\frac{3}{100}$ (D) $\frac{3}{10}$

(ii) The common fraction of $\frac{1}{2}\%$ is

(A) $\frac{1}{2}$ (B) $\frac{1}{200}$ (C) $\frac{200}{100}$ (D) 100

(iii) The decimal equivalent of 25% is

(A) 0.25 (B) 25 (C) 0.0025 (D) 2.5

(iv) 10% of ₹300 is

(A) ₹10 (B) ₹20 (C) ₹30 (D) ₹300

(v) 5% of ₹150 is

(A) ₹7 (B) ₹7.50 (C) ₹5 (D) ₹100

2. Convert the given percents to fractions:

i) 9% ii) 75% iii) $\frac{1}{4}\%$ iv) 2.5% v) $66\frac{2}{3}\%$

3. Convert the given percents to decimals:

i) 7% ii) 64% iii) 375% iv) 0.03% v) 0.5%

4. Find the value of:

i) 75% of 24 ii) $33\frac{1}{3}\%$ of ₹72 iii) 45% of 80m

iv) 72% of 150 v) 7.5% of 50kg

5. Ram spent 25% of his income on rent. Find the amount spent on rent, if his income is ₹25,000.
6. A team played 25 matches in a season and won 36% of them. Find the number of matches won by the team.
7. The population of a village is 32,000. 40% of them are men. 25% of them are women and the rest are children. Find the number of men and children.
8. The value of an old car is ₹45,000. If the price decreases by 15%, find its new price.
9. The percentage of literacy in a village is 47%. Find the number of illiterates in the village, if the population is 7,500.

Think!

1) Is it true?
   20% of 25 is same as 25% of 20.
2) The tax in a restaurant is 1.5% of your total bill.
   a) Write the tax % as a decimal.
   b) A family of 6 members paid a bill of ₹ 750. What is the tax for their bill amount?
   c) What is the total amount that they should pay at the restaurant?

2.4 Profit and Loss

Ram & Co. makes a profit of ₹1,50,000 in 2008.

Ram & Co. makes a loss of ₹25,000 in 2009.

Is it possible for Ram & Co. to make a profit in the first year and a loss in the subsequent year?

Different stages of a leather product - bag are shown below:

Factory

Wholesale Dealer

Retailer

Where are the bags produced?

Do the manufactures sell the products directly?

Whom does the products reach finally?

PRICE LIST

Mango	₹10 each
Apple	₹6 each
Banana	₹3 each
Orange	₹5 each

PRICE LIST

Mango	₹15 each
Apple	₹8 each
Banana	₹2 each
Orange	₹5 each

Raja, the fruit stall owner buys fruits from the wholesale market and sells them in his shop.

On a particular day, he buys apples, mangoes and bananas.

Each fruit has two prices, one at each shop, as shown in the price list.

The price at which Raja buys the fruit at the market is called the Cost Price (C.P.). The price at which he sells the fruit in his stall is called the Selling Price (S.P.).

From the price list we can say that the selling price of the apples and the mangoes in the shop are greater than their respective cost price in the whole sale market. (i.e.) the shopkeeper gets some amount in addition to the cost price. This additional amount is called the **profit**.

Selling Price of mango = Cost Price of mango + Profit

Selling price – Cost price = Profit

Profit = Selling Price – Cost Price

= 15 – 10

Profit = ₹5

i.e., Profit = Selling Price – Cost Price

In case of the apples,

Selling price of apple > Cost price of apple, there is a profit.

Profit = S.P. – C.P.

= 8 – 6

Profit = ₹2

As we know, bananas get rotten fast, the shop keeper wanted to sell them without wasting them. So, he sells the bananas at a lower price (less than the cost price). The amount by which the cost is reduced from the cost price is called **Loss**.

In case of bananas,

Cost price of banana > selling price of banana, there is a loss.

S.P. of the banana = C.P. of the banana – Reduced amount

S.P. = C.P. – Loss

Loss = C.P. – S.P.

Loss = 3 – 2

Loss = ₹1

So, we can say that

- When the selling price of an article is greater than its cost price, then there is a profit.

  Profit = Selling Price – Cost Price

- When the cost price of an article is greater than its selling price, then there is a loss.

  Loss = Cost Price – Selling Price

- S.P = C.P + Profit
- S.P = C.P – Loss.

To find Profit / Loss %

Rakesh buys articles for ₹10,000 and sells them for ₹11,000 and makes a profit of ₹1,000, while Ramesh buys articles for ₹1,00,000 and sells them for ₹1,01,000 and makes a profit of ₹1,000.

Both of them have made the same amount of profit. Can you say both of them are benefited equally? No.

Try these

1) Any fraction with its denominator 100 is called ___________
2) $\frac{1}{2}$ = __________%
3) 35% = __________ (in fraction)
4) 0.05 = __________%
5) $\frac{1}{4}$ = __ %

To find who has gained more, we need to compare their profit based on their investment.

We know that comparison becomes easier when numbers are expressed in percent. So, let us find the profit %

Rakesh makes a profit of ₹1,000, when he invests ₹10,000.

Profit of ₹1,000 out of ₹10,000

For each 1 rupee, he makes a profit of $\frac{1000}{10000}$

Therefore for ₹100, profit = $\frac{1000}{10,000} \times 100$

Profit = 10%

Ramesh makes a profit of ₹1000, when he invests ₹1,00,000.

$$\text{Profit of 1000 out of 1,00,000} = \frac{1000}{100000}$$

$$\text{Profit} = \frac{1000}{100000} \times 100 = 1\%$$

So, from the above we can say that Rakesh is benefited more than Ramesh.

$$\boxed{\text{So, Profit Percentage} = \frac{\text{Profit}}{\text{C.P}} \times 100}$$

Loss % is also calculated in the same way.

$$\boxed{\text{Loss Percentage} = \frac{\text{Loss}}{\text{C.P.}} \times 100}$$

Profit Percentage or Loss Percentage is always calculated on the cost price of the article.

Example 2.18

A dealer bought a television set for ₹10,000 and sold it for ₹12,000. Find the profit / loss made by him for 1 television set. If he had sold 5 television sets, find the total profit/loss

Solution:

Selling Price of the television set = ₹12,000

Cost Price of the television set = ₹10,000

S.P. > C.P, there is a profit

Profit = S.P. – C. P.

= 12000 – 10000

Profit = ₹2,000

Profit on 1 television set = ₹2,000

Profit on 5 television sets = 2000 × 5

Profit on 5 television sets = ₹10,000

Example 2.19

Sanjay bought a bicycle for ₹5,000. He sold it for ₹600 less after two years. Find the selling price and the loss percent.

Solution:

Cost Price of the bicycle = ₹5000

Loss = ₹600

Selling Price = Cost Price – Loss

= 5000 – 600

Selling Price of the bicycle = ₹4400

Loss = $\frac{\text{Loss}}{\text{C.P.}} \times 100$

= $\frac{600}{5000} \times 100$

= 12%

Loss = 12%

Example 2.20

A man bought an old bicycle for ₹1,250. He spent ₹250 on its repairs. He then sold it for ₹1400. Find his gain or loss %

Solution:

Cost Price of the bicycle = ₹1,250

Repair Charges = ₹250

Total Cost Price = 1250 + 250 = ₹1,500

Selling Price = ₹1,400

C.P. > S.P., there is a Loss

Loss = Cost Price – Selling Price

= 1500 – 1400

= 100

Loss = ₹100

Percentage of the loss = $\frac{\text{Loss}}{\text{C.P.}} \times 100$

= $\frac{100}{1500} \times 100$

= $\frac{20}{3}$

= $6\frac{2}{3}$% (or) 6.67%

Loss = 6.67%

Example 2.21

A fruit seller bought 8 boxes of grapes at ₹150 each. One box was damaged. He sold the remaining boxes at ₹190 each. Find the profit / loss percent.

Solution:

Cost Price of 1 box of grapes = ₹150

Cost Price of 8 boxes of grapes = 150×8

= ₹1200

Number of boxes damaged = 1

Number of boxes sold = 8 – 1

= 7

Selling Price of 1 box of grapes = ₹190

Selling Price of 7 boxes of grapes = 190 × 7

= ₹1330

S.P. > C.P, there is a Profit.

Profit = Selling Price – Cost Price

= 1330 – 1200

= 130

Profit = ₹130

$$\text{Percentage of the profit} = \frac{\text{Profit}}{\text{C.P}} \times 100$$

$$= \frac{130}{1200} \times 100$$

= 10.83

Profit = 10.83 %

Example 2.22

Ram, the shopkeeper bought a pen for ₹50 and then sold it at a loss of ₹5. Find his selling price.

Solution:

Cost price of the pen = ₹50

Loss = ₹5

S.P. = C.P. – Loss

= 50 – 5

= 45

Selling price of the pen = ₹45.

Example 2.23

Sara baked cakes for the school festival. The cost of one cake was ₹55. She sold 25 cakes and made a profit of ₹11 on each cake. Find the selling price of the cakes and the profit percent.

Solution:

Cost price of 1 cake = ₹55

Number of cakes sold = 25

Cost price of 25 cakes = 55 × 25 = ₹1375

Profit on 1 cake = ₹11

Profit on 25 cakes = 11 × 25 = ₹275

S.P. = C.P. + Profit

= 1375 + 275

= 1,650

= ₹1,650

Percentage of the profit = $\frac{\text{Profit}}{\text{C. P}} \times 100$

= $\frac{275}{1375} \times 100$

= 20

Profit = 20 %

Exercise 2.4

1. Choose the correct answer:

i) If the cost price of a bag is ₹575 and the selling price is ₹625, then there is a profit of ₹

(A) 50 (B) 575 (C) 625 (D) none of these

ii) If the cost price of the box is ₹155 and the selling price is ₹140, then there is a loss of ₹

(A) 155 (B) 140 (C) 15 (D) none of these

iii) If the selling price of a bag is ₹235 and the cost price is ₹200, then there is a

(A) profit of ₹235 (B) loss of ₹3

(C) profit of ₹35 (D) loss of ₹200

iv) Gain or loss percent is always calculated on

(A) cost price (B) selling price (C) gain (D) loss

v) If a man makes a profit of ₹25 on a purchase of ₹250, then profit% is

(A) 25 (B) 10 (C) 250 (D) 225

2. Complete the table by filling in the appropriate column:

C.P. ₹	**S.P.** ₹	**Profit** ₹	**Loss** ₹
144	168		
59	38		
600	635.45		
26599	23237		
107.50	100		

3. Find the selling price when cost price and profit / loss are given.
   - i) Cost Price = ₹450 Profit = ₹80
   - ii) Cost Price = ₹760 Loss = ₹140
   - iii) Cost Price = ₹980 Profit = ₹47.50
   - iv) Cost Price = ₹430 Loss = ₹93.25
   - v) Cost Price = ₹999.75 Loss = ₹56.25

4. Vinoth purchased a house for ₹27, 50,000. He spent ₹2,50,000 on repairs and painting. If he sells the house for ₹33,00,000 what is his profit or loss % ?

5. A shop keeper bought 10 bananas for ₹100. 2 bananas were rotten. He sold the remaining bananas at the rate of ₹11 per banana. Find his gain or loss %

6. A shop keeper purchased 100 ball pens for ₹250. He sold each pen for ₹4. Find the profit percent.

7. A vegetable vendor bought 40 kg of onions for ₹360. He sold 36 kg at ₹11 per kg. The rest were sold at ₹4.50 per kg as they were not very good. Find his profit / loss percent.

Try these

Choose one product and find out the different stages it crosses from the time it is produced in the factory to the time it reaches the customer.

Think!

Do you think direct selling by the manufacturer himself is more beneficial for the costumers? Discuss.

Do it yourself

1. A trader mixes two kinds of oil, one costing ₹100 per Kg. and the other costing ₹80 per Kg. in the ratio 3: 2 and sells the mixture at ₹101.20 per Kg. Find his profit or loss percent.
2. Sathish sold a camera to Rajesh at a profit of 10 %. Rajesh sold it to John at a loss of 12 %. If John paid ₹4,840, at what price did Sathish buy the camera?
3. The profit earned by a book seller by selling a book at a profit of 5% is ₹15 more than when he sells it at a loss of 5%. Find the Cost Price of the book.

2.5 Simple Interest

Deposit ₹10,000 now. Get ₹20,000 at the end of 7 years.

Deposit ₹10,000 now. Get ₹20,000 at the end of 6 years.

Is it possible? What is the reason for these differences?

Lokesh received a prize amount of ₹5,000 which he deposited in a bank in June 2008. After one year he got back ₹5,400.

Why does he get more money? How much more does he get?

If ₹5,000 is left with him in his purse, will he gain ₹400?

Lokesh deposited ₹5,000 for 1 year and received ₹5,400 at the end of the first year.

When we borrow (or lend) money we pay (or receive) some additional amount in addition to the original amount. This additional amount that we receive is termed as Interest (I).

As we have seen in the above case, money can be borrowed deposited in banks to get Interest.

In the above case, Lokesh received an interest of ₹400.

The amount borrowed / lent is called the Principal (P). In this case, the amount deposited - ₹5,000 is termed as Principal (P).

The Principal added to the Interest is called the Amount (A).

In the above case, Amount = Principal +Interest

= ₹5000 + ₹400 = ₹5,400.

Will this Interest remain the same always?

Definitely not. Now, look at the following cases

(i) If the Principal deposited is increased from ₹5,000 to ₹10,000, then will the interest increase?

(ii) Similarly, if ₹5,000 is deposited for more number of years, then will the interest increase?

Yes in both the above said cases, interest will definitely increase.

From the above, we can say that interest depends on principal and duration of time. But it also depends on one more factor called the rate of interest.

Rate of interest is the amount calculated annually for ₹100

(i.e.) if rate of interest is 10% per annum, then interest is ₹10 for ₹100 for 1 year.

So, Interest depends on:

Amount deposited or borrowed – Principal (P)

Period of time - mostly expressed in years (n)

Rate of Interest (r)

This Interest is termed as Simple Interest because it is always calculated on the initial amount (ie) Principal.

Calculation of Interest

If 'r' is the rate of interest, principal is ₹100, then Interest

for 1 year $= 100 \times 1 \times \frac{r}{100}$

for 2 years $= 100 \times 2 \times \frac{r}{100}$

for 3 years $= 100 \times 3 \times \frac{r}{100}$

for n years $= 100 \times n \times \frac{r}{100}$

So,
$$I = \frac{Pnr}{100}$$
$$A = P + I$$
$$A = P + \frac{Pnr}{100}$$
$$A = P\left(1 + \frac{nr}{100}\right)$$
$$\text{Interest} = \text{Amount} - \text{Principal}$$
$$I = A - P$$

The other formulae derived from

$$I = \frac{Pnr}{100} \text{ are}$$
$$r = \frac{100I}{Pn}$$
$$n = \frac{100I}{Pr}$$
$$P = \frac{100I}{rn}$$

Note: 'n' is always calculated in years. When 'n' is given in months \ days, convert it into years.

Fill in the blanks

Principal ₹	Interest ₹	Amount ₹
5,000	500	
12,500		17,500
	6,000	25,000
8,450	750	
12,000		15,600

Example 2.24

Kamal invested ₹3,000 for 1 year at 7 % per annum. Find the simple interest and the amount received by him at the end of one year.

Solution:

Principal (P) = ₹3,000

Number of years (n) = 1

Rate of interest (r) = 7 %

$$\text{Interest (I)} = \frac{Pnr}{100}$$

$$= \frac{3000 \times 1 \times 7}{100}$$

$$I = ₹210$$

$$A = P + I$$

$$= 3000 + 210$$

$$A = ₹3,210$$

Example 2.25

Radhika invested ₹5,000 for 2 years at 11 % per annum. Find the simple interest and the amount received by him at the end of 2 years.

Solution:

Principal (P) = ₹5,000

Number of years (n) = 2 years

Rate of interest (r) = 11 %

$$I = \frac{Pnr}{100}$$

$$= \frac{5000 \times 2 \times 11}{100}$$

$$= 1100$$

$$I = ₹1,100$$

$$\text{Amount (A)} = P + I$$

$$= 5000 + 1100$$

$$A = ₹6,100$$

Example 2.26

Find the simple interest and the amount due on ₹7,500 at 8 % per annum for 1 year 6 months.

Solution:

P = ₹7,500

n = 1 yr 6 months

$$= 1\frac{6}{12} \textit{ yrs}$$

$$= 1\frac{1}{2} = \frac{3}{2} \textit{ yrs}$$

r = 8 %

Know this

12 months = 1 years

6 months $= \frac{6}{12}$ year

$= \frac{1}{2}$ year

3 months $= \frac{3}{12}$ year

$= \frac{1}{4}$ year

$$I = \frac{Pnr}{100}$$

$$= \frac{7500 \times \frac{3}{2} \times 8}{100}$$

$$= \frac{7500 \times 3 \times 8}{2 \times 100}$$

$$= 900$$

I = ₹900

A = P + I

= 7500 + 900

= ₹8,400

Interest = ₹900, Amount = ₹8,400

Aliter:

P = ₹7,500

$n = \frac{3}{2}$ years

r = 8 %

$$A = P\left(1 + \frac{nr}{100}\right)$$

$$= 7500\left(1 + \frac{\frac{3}{2} \times 8}{100}\right)$$

$$= 7500\left(1 + \frac{3 \times 8}{2 \times 100}\right)$$

$$= 7500\left(\frac{28}{25}\right)$$

$$= 300 \times 28$$

$$= 8400$$

A = ₹8400

I = A – P

= 8400 – 7500

= 900

I = ₹900

Interest = ₹900

Amount = ₹8,400

Example 2.27

Find the simple interest and the amount due on ₹6,750 for 219 days at 10 % per annum.

Solution:

$$P = ₹6{,}750$$

$$n = 219 \text{ days}$$

$$= \frac{219}{365} \text{ year} = \frac{3}{5} \text{ year}$$

$$r = 10\ \%$$

$$I = \frac{Pnr}{100}$$

$$I = \frac{6750 \times 3 \times 10}{5 \times 100}$$

$$= 405$$

$$I = ₹405$$

$$A = P + I$$

$$= 6750 + 405$$

$$= 7{,}155$$

$$A = ₹7{,}155$$

Interest = ₹405, Amount = ₹7,155

> **Know this**
>
> 365 days = 1 year
>
> 219 days = $\frac{219}{365}$ year
>
> = $\frac{3}{5}$ year
>
> 73 days = $\frac{73}{365}$ year
>
> = $\frac{1}{5}$ year

Example 2.28

Rahul borrowed ₹4,000 on 7th of June 2006 and returned it on 19th August 2006. Find the amount he paid, if the interest is calculated at 5 % per annum.

Solution:

P = ₹4,000

r = 5 %

Number of days, June = 24 (30 – 6)

July = 31

August = 18

Total number of days = 73

n = 73 days

> **Know this**
>
> Thirty days hath September, April, June and November. All the rest have thirty - one except February.

$$= \frac{73}{365} \text{ year}$$

$$= \frac{1}{5} \text{ year}$$

$$A = P\left(1 + \frac{nr}{100}\right)$$

$$= 4000\left(1 + \frac{1 \times 5}{5 \times 100}\right)$$

$$= 4000\left(1 + \frac{1}{100}\right)$$

$$= 4000\left(\frac{101}{100}\right)$$

$$= 4{,}040$$

$$\text{Amount} = ₹4{,}040$$

Example 2.29

Find the rate percent per annum when a principal of ₹7,000 earns a S.I. of ₹1,680 in 16 months.

Solution:

$$P = ₹7{,}000$$

$$n = 16 \text{ months}$$

$$= \frac{16}{12} yr = \frac{4}{3} yr$$

$$I = ₹1{,}680$$

$$r = ?$$

$$r = \frac{100I}{Pn}$$

$$= \frac{100 \times 1680}{7000 \times \frac{4}{3}}$$

$$= \frac{100 \times 1680 \times 3}{7000 \times 4}$$

$$= 18$$

$$r = 18\ \%$$

Example 2.30

Vijay invested ₹10,000 at the rate of 5 % simple interest per annum. He received ₹11,000 after some years. Find the number of years.

Solution:

$$A = ₹11{,}000$$

$$P = ₹10{,}000$$

$$r = 5\ \%$$

$$n = ?$$

$$\begin{aligned} \mathrm{I} &= \mathrm{A} - \mathrm{P} \\ &= 11{,}000 - 10{,}000 \\ &= 1{,}000 \end{aligned}$$

$$\mathrm{I} = ₹1000$$

$$n = \frac{100\,\mathrm{I}}{\mathrm{P}r}$$

$$= \frac{100 \times 1000}{10000 \times 5}$$

$$n = 2 \text{ years.}$$

Aliter:

$$\mathrm{A} = \mathrm{P}\left(1 + \frac{nr}{100}\right)$$

$$11000 = 10000\left(1 + \frac{n \times 5}{100}\right)$$

$$\frac{11000}{10000} = 1 + \frac{n}{20}$$

$$\frac{11}{10} = \frac{20 + n}{20}$$

$$\frac{11}{10} \times 20 = 20 + n$$

$$22 = 20 + n$$

$$22 - 20 = n$$

$$n = 2 \text{ years}$$

Example 2.31

A sum of money triples itself at 8 % per annum over a certain time. Find the number of years.

Solution:

Let Principal be ₹P.

$$\begin{aligned} \text{Amount} &= \text{triple the principal} \\ &= ₹3\ \mathrm{P} \end{aligned}$$

$$r = 8\ \%$$

$$n = ?$$

$$I = A - P$$
$$= 3P - P$$
$$= 2P$$
$$I = ₹2\ P$$
$$n = \frac{100I}{Pr}$$
$$= \frac{100 \times 2P}{P \times 8}$$
$$n = 25 \text{ years}$$
$$\text{Number of years} = 25$$

Aliter:

Let Principal be ₹100

$$\text{Amount} = 3 \times 100$$
$$= ₹300$$
$$I = A - P$$
$$= 300 - 100$$
$$I = ₹200.$$
$$n = \frac{100I}{Pr} = \frac{100 \times 200}{100 \times 8}$$
$$n = \frac{200}{8} = 25$$
$$\text{Number of years} = 25.$$

Example 2.32

A certain sum of money amounts to ₹10,080 in 5 years at 8 %. Find the principal.

Solution:

$$A = ₹10,080$$
$$n = 5 \text{ years}$$
$$r = 8\ \%$$
$$P = ?$$
$$A = P\left(1 + \frac{nr}{100}\right)$$
$$10080 = P\left(1 + \frac{5 \times 8}{100}\right)$$

$$10080 = P\left(\frac{7}{5}\right)$$

$$10080 \times \frac{5}{7} = P$$

$$7,200 = P$$

$$\text{Principal} = ₹7,200$$

Example 2.33

A certain sum of money amounts to ₹8,880 in 6 years and ₹7,920 in 4 years respectively. Find the principal and rate percent.

Solution:

Amount at the end of 6 years = Principal + interest for 6 years

$= P + I_6 = 8880$

Amount at the end of 4 years = Principal + Interest for 4 years

$= P + I_4 = 7920$

$$I_2 = 8880 - 7920$$

$$= 960$$

Interest at the end of 2 years = ₹960

Interest at the end of 1st year = $\frac{960}{2}$

$= 480$

Interest at the end of 4 years = 480×4

$= 1,920$

$$P + I_4 = 7920$$

$$P + 1920 = 7920$$

$$P = 7920 - 1920$$

$$P = 6,000$$

Principal = ₹6,000

$$r = \frac{100I}{pn}$$

$$= \frac{100 \times 1920}{6000 \times 4}$$

$$r = 8\ \%$$

Exercise 2.5

1. Choose the correct answer:

i) Simple Interest on ₹1000 at 10 % per annum for 2 years is

(A) ₹1000 (B) ₹200 (C) ₹100 (D) ₹2000

ii) If Amount = ₹11,500, Principal = ₹11,000, Interest is

(A) ₹500 (B) ₹22,500 (C) ₹11,000 (D) ₹11,000

iii) 6 months =

(A) $\frac{1}{2}$ yr (B) $\frac{1}{4}$ yr (C) $\frac{3}{4}$ yr (D) 1 yr

iv) 292 days =

(A) $\frac{1}{5}$ yr (B) $\frac{3}{5}$ yr (C) $\frac{4}{5}$ yr (D) $\frac{2}{5}$ yr

v) If P = ₹14000 I = ₹1000, A is

(A) ₹15000 (B) ₹13000 (C) ₹14000 (D) ₹1000

2. Find the S.I. and the amount on ₹5,000 at 10 % per annum for 5 years.

3. Find the S.I and the amount on ₹1,200 at $12\frac{1}{2}$% per annum for 3 years.

4. Lokesh invested ₹10,000 in a bank that pays an interest of 10 % per annum. He withdraws the amount after 2 years and 3 months. Find the interest, he receives.

5. Find the amount when ₹2,500 is invested for 146 days at 13 % per annum.

6. Find the S.I and amount on ₹12,000 from May 21^{st} 1999 to August 2^{nd} 1999 at 9 % per annum.

7. Sathya deposited ₹6,000 in a bank and received ₹7500 at the end of 5 years. Find the rate of interest.

8. Find the principal that earns ₹250 as S.I. in $2\frac{1}{2}$ years at 10 % per annum.

9. In how many years will a sum of ₹5,000 amount to ₹5,800 at the rate of 8 % per annum.

10. A sum of money doubles itself in 10 years. Find the rate of interest.

11. A sum of money doubles itself at $12\frac{1}{2}\%$ per annum over a certain period of time. Find the number of years.

12. A certain sum of money amounts to ₹6,372 in 3 years at 6 % Find the principal.

13. A certain sum of money amounts to ₹6,500 in 3 years and ₹5,750 in $1\frac{1}{2}$ years respectively . Find the principal and the rate percent.

14. Find S.I. and amount on ₹ 3,600 at 15% p.a. for 3 years and 9 months.

15. Find the principal that earns ₹ 2,080 as S.I. in $3\frac{1}{4}$ years at 16% p.a.

Think!

1) Find the rate percent at which, a sum of money becomes $\frac{9}{4}$ times in 2 years.

2) If Ram needs ₹6,00,000 after 10 years, how much should he invest now in a bank if the bank pays 20 % interest p.a.

Points to Remember

1. A fraction whose denominator is 100 or a ratio whose second term is 100 is termed as a percent.

2. Percent means per hundred, denoted by %

3. To convert a fraction or a decimal to a percent, multiply by 100.

4. The price at which an article is bought is called the cost price of an article.

5. The price at which an article is sold is called the selling price of an article.

6. If the selling price of an article is more than the cost price, there is a profit.

7. If the cost price of an article is more than the selling price, there is a loss.

8. Total cost price = Cost Price + Repair Charges / Transportation charges.

9. Profit or loss is always calculated for the same number of articles or same units.

10. Profit = Selling Price – Cost Price

11. Loss = Cost Price – Selling Price

12. Profit% = $\frac{\text{Profit}}{\text{C.P.}} \times 100$

13. Loss% = $\frac{\text{Loss}}{\text{C.P.}} \times 100$

14. Selling Price = Cost Price + Profit

15. Selling Price = Cost Price - Loss

16. Simple interest is $\mathrm{I} = \frac{\text{Pnr}}{100}$

17. A = P + I

$$= \mathrm{P} + \frac{\mathrm{P}nr}{100}$$

$$= P\left(1 + \frac{nr}{100}\right)$$

18. I = A – P

19. P = $\frac{100I}{nr}$

20. r = $\frac{100\mathrm{I}}{\mathrm{P}n}$

21. n = $\frac{100I}{\mathrm{Pr}}$

3 MEASUREMENTS

3.1 Trapezium

A trapezium is a quadrilateral with one pair of opposite sides are parallel.

The distance between the parallel sides is the height of the trapezium. Here the sides AD and BC are not parallel, but AB $\parallel$ DC.

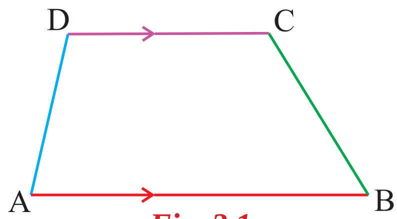


Fig. 3.1

If the non - parallel sides of a trapezium are equal (AD = BC), then it is known as an isosceles trapezium.

Here $\angle A = \angle B$; $\angle C = \angle D$

$AC = BD$

$\angle A + \angle D = 180^\circ$; $\angle B + \angle C = 180^\circ$

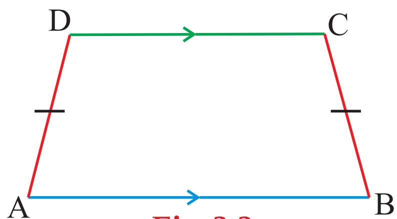


Fig. 3.2

Area of a trapezium

ABCD is a trapezium with parallel sides AB and DC measuring 'a' and 'b'. Let the distance between the two parallel sides be 'h'. The diagonal BD divides the trapezium into two triangles ABD and BCD.

Area of the trapezium

$= \text{area of } \Delta ABD + \text{area of } \Delta BCD$

$= \frac{1}{2} \times AB \times h + \frac{1}{2} \times DC \times h$

$= \frac{1}{2} \times h[AB + DC]$

$= \frac{1}{2} \times h[a + b]$ sq. units

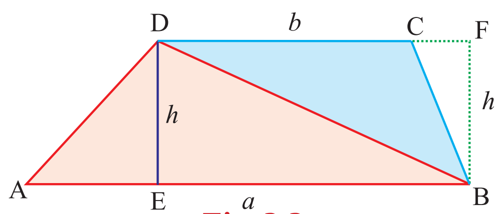


Fig. 3.3

$\therefore$ Area of a trapezium = $\frac{1}{2} \times$ height $\times$ (sum of the parallel sides) sq. units

Example 3.1

Find the area of the trapezium whose height is 10 cm and the parallel sides are 12 cm and 8 cm of length.

Solution

Given: $h = 10$ cm, $a = 12$ cm, $b = 8$ cm

$$\text{Area of a trapezium} = \frac{1}{2} \times h(a+b)$$
$$= \frac{1}{2} \times 10 \times (12+8) = 5 \times (20)$$
$$\therefore \text{ Area of the trapezium} = 100 \text{ sq. cm}^2$$

Example 3.2

The length of the two parallel sides of a trapezium are 15 cm and 10 cm. If its area is 100 sq. cm. Find the distance between the parallel sides.

Solution

Given: $a = 15$ cm, $b = 10$ cm, Area = 100 sq. cm.

$$\text{Area of the trapezium} = 100$$
$$\frac{1}{2}h(a+b) = 100$$
$$\frac{1}{2} \times h \times (15+10) = 100$$
$$h \times 25 = 200$$
$$h = \frac{200}{25} = 8$$

$\therefore$ the distance between the parallel sides = 8 cm.

Example 3.3

The area of a trapezium is 102 sq. cm and its height is 12 cm. If one of its parallel sides is 8 cm. Find the length of the other side.

Solution

Given: Area = 102 cm^2, $h = 12$ cm, $a = 8$ cm.

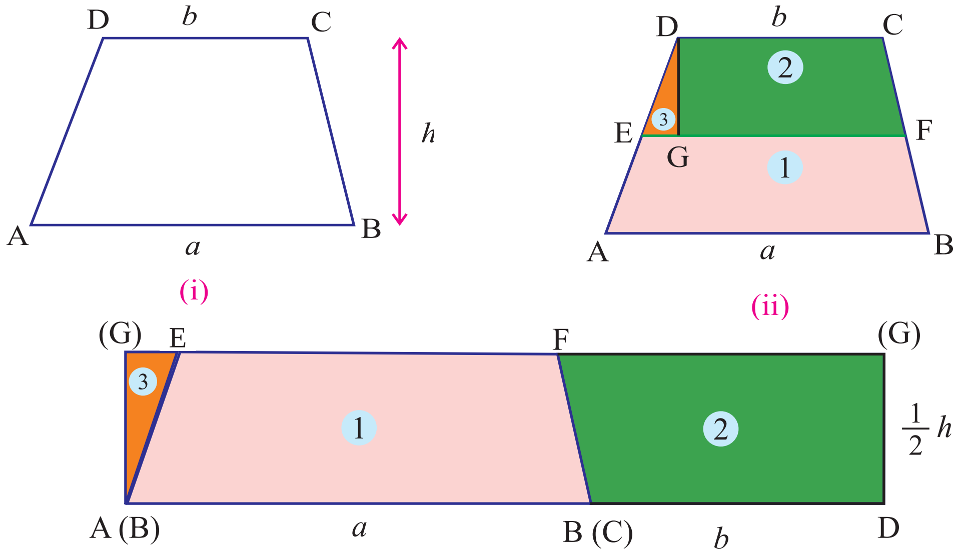
$$\text{Area of a trapezium} = 102$$
$$\frac{1}{2}h(a+b) = 102$$
$$\frac{1}{2} \times 12 \times (8+b) = 102$$
$$6\,(8+b) = 102$$
$$8+b = 17 \quad \Rightarrow \quad b = 17 - 8 = 9$$

$\therefore$ length of the other side = 9 cm

Try these

By paper folding method:

In a chart paper draw a trapezium ABCD of any measure. Cut and take the trapezium separately. Fold the trapezium in such a way that DC lies on AB and crease it on the middle to get EF.



(iii)

Fig. 3.4

EF divides the trapezium in to two parts as shown in the Fig. 4.40 (ii)

From D draw DG ⊥ EF. Cut the three parts separately.

Arrange three parts as shown in the Fig. 3.4 (iii)

The figure obtained is a rectangle whose length is AB + CD = $a + b$

and breadth is $\frac{1}{2}$(height of trapezium) = $\frac{1}{2}h$

$\therefore$ Area of trapezium = area of rectangle as shown in Fig. 3.4 (iii)

$= \text{length} \times \text{breadth}$

$= (a+b)\left(\frac{1}{2}h\right)$

$= \frac{1}{2}h(a+b)$ sq. units

Exercise 3.1

1. Choose the correct answer.

i) The area of trapezium is ____________ sq. units

(A) $h(a+b)$ (B) $\frac{1}{2}$ h (a + b) (C) $h(a-b)$ (D) $\frac{1}{2}$ h $(a-b)$

ii) In an isosceles trapezium

(A) non parallel sides are equal (B) parallel sides are equal

(C) height = base (D) parallel sides = non parallel sides

iii) The sum of parallel sides of a trapezium is 18 cm and height is 15 cm. Then its area is

(A) 105 cm^2 (B) 115 cm^2 (C) 125 cm^2 (D) 135 cm^2

iv) The height of a trapezium whose sum of parallel sides is 20 cm and the area 80 cm^2 is

(A) 2 cm (B) 4 cm (C) 6 cm (D) 8 cm

2. Find the area of a trapezium whose altitudes and parallel sides are given below:
   i) altitude = 10 cm, parallel sides = 4 cm and 6 cm
   ii) altitude = 11 cm, parallel sides = 7.5 cm and 4.5 cm
   iii) altitude = 14 cm, parallel sides = 8 cm and 3.5 cm
3. The area of a trapezium is 88 cm^2 and its height is 8 cm. If one of its parallel side is 10 cm. Find the length of the other side.
4. A garden is in the form of a trapezium. The parallel sides are 40 m and 30 m. The perpendicular distance between the parallel side is 25 m. Find the area of the garden.
5. Area of a trapezium is 960 cm^2. The parallel sides are 40 cm and 60 cm. Find the distance between the parallel sides.

3.2 Circle

In our daily life, we come across a number of objects like wheels, coins, rings, bangles,giant wheel, compact disc (C.D.)

What is the shape of the above said objects?

'round', 'round', 'round'

Yes, it is round. In Mathematics it is called a circle. Now, let us try to draw a circle.

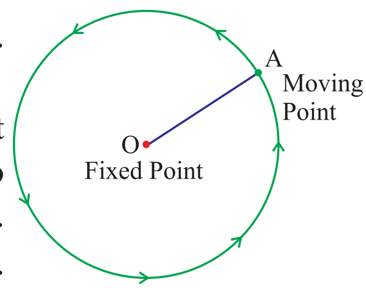


Fig. 3.5

Take a thread of any length and fix one end tightly at a point O as shown in the figure. Tie a pencil (or a chalk) to the other end and stretch the thread completely to a point A.

Holding the thread stretched tightly, move the pencil. Stop it when the pencil again reaches the point A. Now see the path traced by the pencil.

Is the path traced by the pencil a circle or a straight line?

'Circle'

Yes, the path traced by the point, which moves at a constant distance from a fixed point on a given plane surface is called a circle.

Parts of a Circle

The fixed point is called the centre of the circle.

The constant distance between the fixed point and the moving point is called the radius of the circle.

i.e. The radius is a line segment with one end point at the centre and the other end on the circle. It is denoted by 'r'.

A line segment joining any two points on the circle is called a chord.

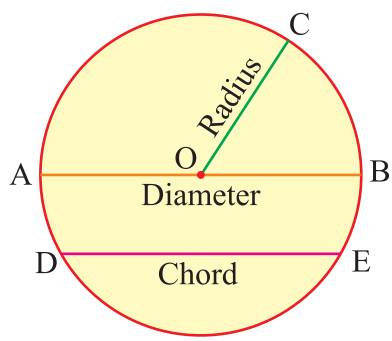


Fig. 3.6

Diameter is a chord passing through the centre of the circle. It is denoted by 'd'.

The diameter is the longest chord. It is twice the radius.(i.e. $d = 2r$)

The diameter divides the circle into two equal parts. Each equal part is a semicircle.

Think it:

How many diameters can a circle have ?

Do you know?

The plural of radius is "radii". All the radii of a circle are equal.

Circumference of a circle:

Fig. 3.7

Can you find the distance covered by an athlete if he takes two rounds on a circular track.

Since it is a circular track, we cannot use the ruler to find out the distance.

So, what can we do ?

Take a one rupee coin.Place it on a paper and draw its outline. Remove the coin. Mark a point A on the outline as shown in the Fig. 3.7

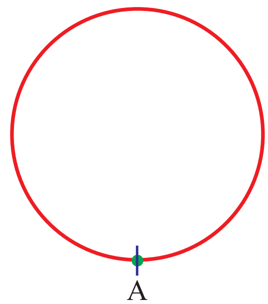


Fig. 3.8

Take a thread and fix one end at A. Now place the thread in such a way that the thread coincides exactly with the outline. Cut the other end of the thread when it reaches the point A.

Length of the thread is nothing but the circumference of the coin.

So,

the distance around a circle is called the circumference of the circle, which is denoted by 'C'. i.e., The perimeter of a circle is known as its circumference.

Try these

Take a bottle cap or a bangle or any other circular objects and find the circumference. If possible find the relation between the circumference and the diameter of the circular objects.

Relation between diameter and circumference of the circle

Draw four circles with radii 3.5 cm, 7 cm, 5 cm, 10.5 cm in your note book. Measure their circumferences using a thread and the diameter using a ruler as shown in the Fig. 3.9 given below.

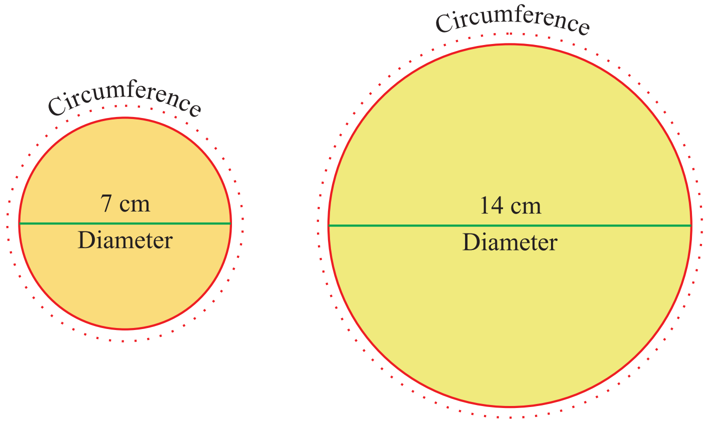


Fig. 3.9

Fill in the missing values in table 3.1 and find the ratio of the circumference to the diameter.

Circle	Radius	Diameter (d)	Circumference (C)	Ratio $\left(\frac{C}{d}\right)$
1	3.5 cm	7 cm	22 cm	$\frac{22}{7} = 3.14$
2	7 cm	14 cm	44 cm	$\frac{44}{14} = \frac{22}{7} = 3.14$
3	5 cm	10 cm	----	----
4	10.5 cm	21 cm	----	----

Table 3.1

What do you infer from the above table?. Is this ratio $\left(\frac{C}{d}\right)$ approximately the same?

Yes !

$$\frac{C}{d} = 3.14 \quad \Rightarrow \quad C = (3.14)d$$

So, can you say that the circumference of a circle is always more than 3 times its diameter ?

Yes !

In all the cases, the ratio $\frac{C}{d}$ is a constant and is denoted by the Greek letter π (read as 'pi'). Its approximate value is $\frac{22}{7}$ or 3.14.

so, $\boxed{\frac{C}{d} = \pi \quad \Rightarrow \quad C = \pi d \text{ units}}$ where d is the diameter of a circle.

We know that the diameter of a circle is twice the radius r. i.e., $d = 2r$.

from the above formula, C = $\pi d = \pi(2r) \Rightarrow$ C = $2\pi r$ units.

The value of π is calculated by many mathematicians.

Babylonians : $\pi = 3$

Greeks : $\pi = \frac{22}{7}$ or 3.14

Archemides : $3\frac{1}{7} < \pi < 3\frac{10}{71}$

Aryabhata : $\pi = \frac{62838}{2000}$ (or) 3.1416

Now, we use $\pi = \frac{22}{7}$ or 3.14

Example 3.4

Find out the circumference of a circle whose diameter is 21 cm.

Solution

$$\begin{aligned} \text{Circumference of a circle} &= \pi d \\ &= \frac{22}{7} \times 21 \qquad \text{Here } \pi = \frac{22}{7} \\ &= 66 \text{ cm.} \end{aligned}$$

Example 3.5

Find out the circumference of a circle whose radius is 3.5 m.

Solution

$$\begin{aligned} \text{Circumference of a circle} &= 2\pi r \\ &= 2 \times \frac{22}{7} \times 3.5 \\ &= 2 \times 22 \times 0.5 \\ &= 22 \text{ m} \end{aligned}$$

Example 3.6

A wire of length 88 cm is bent as a circle. What is the radius of the circle.

Solution

$$\begin{aligned} \text{Length of the wire} &= 88 \text{ cm} \\ \text{Circumference of the circle} &= \text{Length of the wire} \\ 2\pi r &= 88 \\ 2 \times \frac{22}{7} \times r &= 88 \\ \text{r} &= \frac{88 \times 7}{2 \times 22} = 14 \text{ cm} \end{aligned}$$

$\therefore$ radius of a circle is 14 cm.

Example 3.7

The diameter of a bicycle wheel is 63 cm. How much distance will it cover in 20 revolutions?

Solution

When a wheel makes one complete revolutions,

$$\begin{aligned}
\text{Distance covered in one rotation} &= \text{Circumference of wheel} \\
\therefore \text{ circumference of the wheel} &= \pi d \text{ units} \\
&= \frac{22}{7} \times 63 \text{ cm} \\
&= 198 \text{ cm} \\
\text{For one revolution, the distance covered} &= 198 \text{ cm} \\
\therefore \text{ for 20 revolutions, the distance covered} &= 20 \times 198 \text{ cm} \\
&= 3960 \text{ cm} \\
&= 39 \text{ m } 60 \text{ cm} \quad [100 \text{ cm} = 1 \text{ m}]
\end{aligned}$$

Example 3.8

A scooter wheel makes 50 revolutions to cover a distance of 8800 cm. Find the radius of the wheel.

Solution

$$\begin{aligned}
\text{Distance travelled} &= \text{Number of revolutions} \times \text{Circumference} \\
\text{Circumference} &= \frac{\text{Distance travelled}}{\text{Number of revolutions}} \\
2\pi r &= \frac{8800}{50} \\
\text{i.e., } 2\pi r &= 176 \\
2 \times \frac{22}{7} \times r &= 176 \\
r &= \frac{176 \times 7}{2 \times 22} \\
r &= 28 \text{ cm}
\end{aligned}$$

$\therefore$ radius of the wheel = 28 cm.

Example 3.9

The radius of a cart wheel is 70 cm. How many revolution does it make in travelling a distance of 132 m.

Solution

Given: r = 70 cm, Distance travelled = 132 m.

$\therefore$ Circumference of a cart wheel = $2\pi r$

$$\begin{aligned}
&= 2 \times \frac{22}{7} \times 70 \\
&= 440 \text{ cm}
\end{aligned}$$

$$\text{Distance travelled} = \text{Number of revolutions} \times \text{Circumference}$$

$$\therefore \text{Number of revolutions} = \frac{\text{Distance travelled}}{\text{Circumference}}$$

$$= \frac{132 \text{ m}}{440 \text{ cm}}$$

$$= \frac{13200 \text{ cm}}{440 \text{ cm}} \quad (1 \text{ m} = 100 \text{ cm}, 132 \text{ m} = 13200 \text{ cm})$$

$$= 30$$

$\therefore$ Number of revolutions = 30.

Example 3.10

The circumference of a circular field is 44 m. A cow is tethered to a peg at the centre of the field. If the cow can graze the entire field, find the length of the rope used to tie the cow.

Solution

$$\text{Length of the rope} = \text{Radius of the circle}$$

$$\text{Circumference} = 44 \text{ m} \quad (\text{given})$$

$$\text{i.e., } 2\pi r = 44$$

$$2 \times \frac{22}{7} \times r = 44$$

$$\therefore r = \frac{44 \times 7}{2 \times 22} = 7 \text{ m}$$

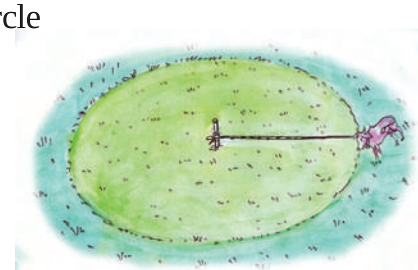


Fig. 3.10

$\therefore$ The length of the rope used to tie the cow is 7 m.

Example 3.11

The radius of a circular flower garden is 56 m. What is the cost of fencing it at ₹10 a metre ?

Solution

$$\text{Length to be fenced} = \text{Circumference of the circular flower garden}$$

$$\text{Circumference of the flower garden} = 2\pi r$$

$$= 2 \times \frac{22}{7} \times 56 = 352 \text{ m}$$

$\therefore$ Length of the fence = 352 m

Cost of fencing per metre = ₹10

$\therefore$ cost of fencing 352 m = ₹10 $\times$ 352

= ₹3520

$\therefore$ Total cost of fencing is ₹3520.

Example 3.12

The cost of fencing a circular park at the rate of ₹5 per metre is ₹1100. What is the radius of the park.

Solution

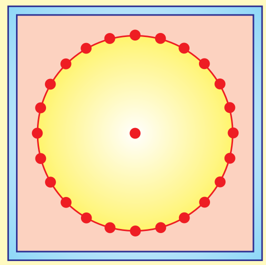
$$\begin{aligned}
\text{Cost of fencing} &= \text{Circumference} \times \text{Rate} \\
\therefore \text{ Circumference} &= \frac{\text{Cost of fencing}}{\text{Rate}} \\
\text{i.e., } 2\pi r &= \frac{1100}{5} \\
2\pi r &= 220 \\
\therefore 2 \times \frac{22}{7} \times r &= 220 \\
r &= \frac{220 \times 7}{2 \times 22} \\
&= 35 \text{ m} \\
\therefore \text{ Radius of the park} &= 35 \text{ m.}
\end{aligned}$$

Activity - Circular Geoboard

Take a square Board and draw a circle.

Fix nails on the circumference of the circle. (See fig)

Using rubber band, form various diameters, chords, radii and compare.



Exercise 3.2

1. Choose the correct answer:

i) The line segment that joins the centre of a circle to any point on the circle is called

(A) Diameter (B) Radius (C) Chord (D) None

ii) A line segment joining any two points on the circle is called

(A) Diameter (B) Radius (C) Chord (D) None

iii) A chord passing through the centre is called

(A) Diameter (B) Radius (C) Chord (D) None

iv) The diameter of a circle is 1 m then its radius is

(A) 100 cm (B) 50 cm (C) 20 cm (D) 10 cm

v) The circumference of a circle whose radius is 14 cm is

(A) 22 cm (B) 44 cm (C) 66 cm (D) 88 cm

2. Fill up the unknown in the following table:

	radius (r)	diameter (d)	circumference (c)
(*i*)	35 cm	-----	-----
(*ii*)	-----	56 cm	-----
(*iii*)	-----	-----	30.8 cm

3. Find the circumference of a circle whose diametre is given below:

   (i) 35 cm (ii) 84 cm (iii) 119 cm (iv) 147 cm

4. Find the circumference of a circle whose radius is given below:

   (i) 12.6 cm (ii) 63 cm (iii) 1.4 m (iv) 4.2 m

5. Find the radius of a circle whose circumference is given below:

   (i) 110 cm (ii) 132 cm (iii) 4.4 m (iv) 11 m

6. The diameter of a cart wheel is 2.1 m. Find the distance travelled when it completes 100 revolutions.

7. The diameter of a circular park is 98 m. Find the cost of fencing it at ₹4 per metre.

8. A wheel makes 20 revolutions to cover a distance of 66 m. Find the diameter of the wheel.

9. The radius of a cycle wheel is 35 cm. How many revolutions does it make to cover a distance of 81.40 m?

10. The radius of a circular park is 63 m. Find the cost of fencing it at ₹12 per metre.

Area of a circle

Consider the following

A farmer levels a circular field of radius 70 m. What will be the cost of levelling?

What will be the cost of polishing a circular table-top of radius 1.5 m ?

How will you find the cost ?

To find the cost what do you need to find actually?

Area or perimeter ?

Area, area, area

Do you know?

The region enclosed by the circumference of a circle is a circular region.

Yes. In such cases we need to find the area of the circular region.

So far, you have learnt to find the area of triangles and quadrilaterals that made up of straight lines. But, a cirlce is a plane figure made up of curved line different from other plane figures.

So, we have to find a new approach which will make the circle turn into a figure with straight lines.

Take a chart paper and draw a circle. Cut the circle and take it separately. Shade one half of the circular region. Now fold the entire circle into eight parts and cut along the folds (see Fig. 3.11).

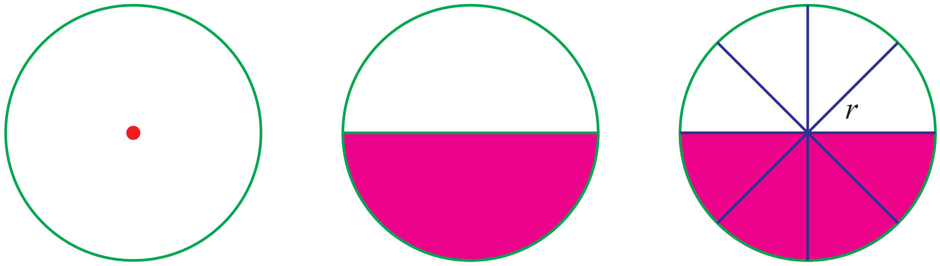


Fig. 3.11

Arrange the pieces as shown below.

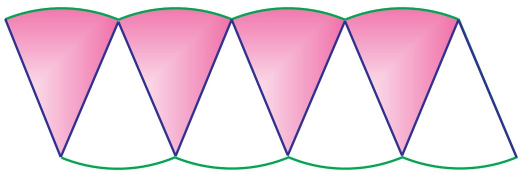


Fig. 3.12

What is the figure obtained?

These eight pieces roughly form a parallelogram.

Similarly, if we divide the circle into 64 equal parts and arrange these, it gives nearly a rectangle. (see Fig. 3.13)

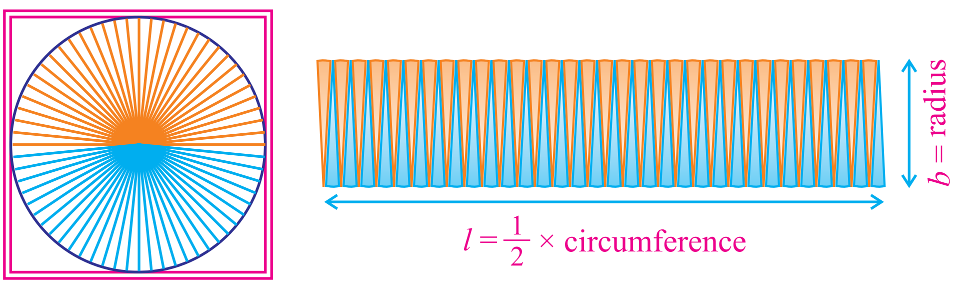


Fig. 3.13

What is the breadth of this rectangle?

The breadth of the rectangle is the radius of the circle.

i.e., breadth $b = r$ ..... (1)

What is the length of this rectangle ?

As the whole circle is divided into 64 equal parts and on each side we have 32 equal parts. Therefore, the length of the rectangle is the length of 32 equal parts, which is half of the circumference of a circle.

$$\therefore \text{ length } l = \frac{1}{2}[\text{circumference of the circle}]$$

$$= \frac{1}{2}[2\pi r] = \pi r$$

$$\therefore l = \pi r \qquad ..... (2)$$

Area of the circle = Area of the rectangle (from the Fig. 4.50)

$$= l \times b$$

$$= (\pi r) \times r \qquad \text{(from (1) and (2))}$$

$$= \pi r^2 \text{ sq. units.}$$

$$\therefore \text{Area of the circle} = \pi r^2 \text{ sq. units.}$$

Example 3.13

Find the area of a circle whose diameter is 14 cm

Solution

Diameter d = 14 cm

So, radius $r = \frac{d}{2} = \frac{14}{2} = 7$ cm

Area of circle $= \pi r^2$

$$= \frac{22}{7} \times 7 \times 7$$

$$= 154 \text{ sq. cm}$$

$\therefore$ Area of circle = 154 sq. cm

Example 3.14

A goat is tethered by a rope 3.5 m long. Find the maximum area that the goat can graze.

Solution

Radius of the circle = Length of the rope

$\therefore$ radius $r = 3.5 \text{ m} = \frac{7}{2}$ m

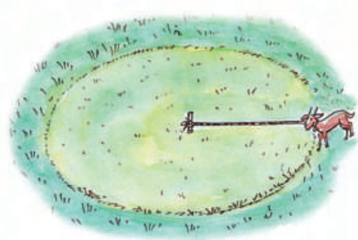


Fig. 3.14

maximum area grazed by the goat $= \pi r^2$ sq. units.

$$= \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2}$$

$$= \frac{77}{2} = 38.5 \text{ sq. m}$$

$\therefore$ maximum area grazed by the goat is 38.5 sq. m.

Example 3.15

The circumference of a circular park is 176 m. Find the area of the park.

Solution

$$\begin{aligned}
\text{Circumference} &= 176 \text{ m} \quad \text{(given)}\\
2\pi r &= 176\\
2 \times \frac{22}{7} \times r &= 176\\
r &= \frac{176 \times 7}{44}\\
\therefore r &= 28 \text{ m}\\
\text{Area of the park} &= \pi r^2\\
&= \frac{22}{7} \times 28 \times 28\\
&= 22 \times 4 \times 28\\
&= 2464 \text{ sq. m.}
\end{aligned}$$

Example 3.16

A silver wire when bent in the form of a square encloses an area of 121 sq. cm. If the same wire is bent in the form of a circle. Find the area of the circle.

Solution

Let a be the side of the square

$$\begin{aligned}
\text{Area of the square} &= 121 \text{ sq. cm.} \quad \text{(given)}\\
a^2 &= 121 \Rightarrow a = 11 \text{ cm} \qquad (11 \times 11 = 121)\\
\text{Perimeter of the square} &= 4a \text{ units}\\
&= 4 \times 11 \text{ cm}\\
&= 44 \text{ cm}\\
\text{Length of the wire} &= \text{Perimeter of the square}\\
&= 44 \text{ cm}
\end{aligned}$$

The wire is bent in the form of a circle

The circumference of the circle = Length of the wire

$\therefore$ circumference of a circle = 44 cm

$$\begin{aligned}
2\pi r &= 44\\
\therefore 2 \times \frac{22}{7} \times r &= 44\\
r &= \frac{44 \times 7}{44}\\
r &= 7 \text{ cm}\\
\therefore \text{Area of the circle} &= \pi r^2\\
&= \frac{22}{7} \times 7 \text{ cm} \times 7 \text{ cm}\\
\text{Area of the circle} &= 154 \text{ cm}^2.
\end{aligned}$$

Example 3.17

When a man runs around circular plot of land 10 times, the distance covered by him is 352 m. Find the area of the plot.

Solution

$$\text{Distance covered in 10 times} = 352 \text{ m}$$

$$\text{Distance covered in one time} = \frac{352}{10} \text{ m} = 35.2 \text{ m}$$

$$\text{The circumference of the circular plot} = \text{Distance covered in one time}$$

$$\therefore \text{circumference} = 35.2 \text{ m}$$

$$2\pi r = 35.2$$

$$2 \times \frac{22}{7} \times r = 35.2$$

$$r = \frac{35.2 \times 7}{44}$$

$$= 0.8 \times 7$$

$$= 5.6 \text{ m}$$

$$\text{Area of the circular plot} = \pi r^2$$

$$= \frac{22}{7} \times 5.6 \times 5.6$$

$$= 22 \times 0.8 \times 5.6$$

$$= 98.56 \text{ m}^2$$

$$\therefore \text{Area of circular plot} = 98.56 \text{ m}^2$$

Example 3.18

A wire in the shape of a rectangle of length 37 cm and width 29 cm is reshaped in the form of a circle. Find the radius and area of the circle.

Solution

$$\text{Length of the wire} = \text{perimeter of the rectangle}$$

$$= 2 \text{ [length + breadth]}$$

$$= 2 \text{ [37 cm + 29 cm]} = 2 \times 66 \text{ cm}$$

$$= 132 \text{ cm.}$$

Since wire is bent in the form of a circle,

$$\text{The circumference of the circle} = \text{The length of the wire}$$

$$\therefore \text{Circumference of a circle} = 132$$

$$2\pi r = 132$$

$$2 \times \frac{22}{7} \times r = 132$$

$$r = \frac{132 \times 7}{44} = 21$$

$$\therefore \text{radius of the circle} = 21 \text{ cm}$$

$$\text{Area of the circle} = \pi r^2$$

$$= \frac{22}{7} \times 21 \times 21 = 22 \times 3 \times 21$$

$$\therefore \text{Area of the circle} = 1386 \text{ sq. cm.}$$

Exercise 3.3

1. Find the area of the circles whose diameters are given below:

   (i) 7 cm (ii) 10.5 cm (iii) 4.9 m (iv) 6.3 m (take $\pi = \frac{22}{7}$)

2. Find the area of the circles whose radii are given below:

   (i) 1.2 cm (ii) 14 cm (iii) 4.2 m (iv) 5.6 m (take $\pi = \frac{22}{7}$)

3. The diameter of a circular plot of ground is 28 m. Find the cost of levelling the ground at the rate of ₹3 per sq. m.

4. A goat is tied to a peg on a grass land with a rope 7 m long. Find the maximum area of the land it can graze.

5. A circle and a square each have a perimeter of 88 cm. Which has a larger area?

6. A wheel goes a distance of 2200 m in 100 revolutions. Find the area of the wheel.

7. A wire is in the form of a circle of radius 28 cm. Find the area that will enclose, if it is bent in the form of a square having its perimeter equal to the circumference of the cirlce.

8. The area of circular plot is 3850 m^2. Find the radius of the plot. Find the cost of fencing the plot at ₹10 per metre.

9. The radius of a circular ground is 70 m. Find the distance covered by a child walking along the boundary of the ground.

10. The area of a circular field is 154 m^2. Find the time taken by an athlate to complete 2 rounds if she is jogging at the rate of 5 km/hr.

11. How many circles of radius 7 cm can be cut from a paper of length 50 cm and width 32 cm.

3.3 Area of the path way

In our day - to - day life we go for a walk in a park, or in a play ground or even around a swimming pool.

Can you represent the path way of a park diagrammatically ?

Have you ever wondered if it is possible to find the area of such paths ?

Can the path around the rectangular pool be related to the mount around the photo in a photo frame ?

Can you think of some more examples?

In this section we will learn to find

- Area of rectangular pathway
- Area of circular pathway

Area of rectangular pathway

(a) Area of uniform pathway outside the rectangle

Consider a rectangular building. A uniform flower garden is to be laid outside the building. How do we find the area of the flower garden?

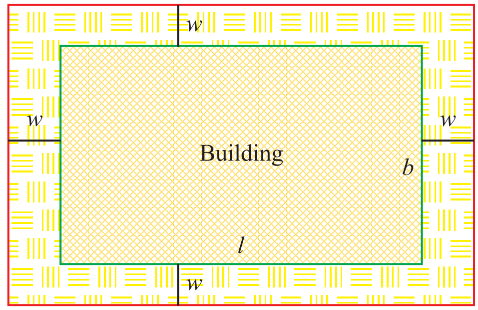


Fig. 3.15

The uniform flower garden including the building is also a rectangle in shape. Let us call it as outer rectangle. We call the building as inner rectangle.

Let l and b be the length and breadth of the building.

$\therefore$ Area of the inner rectangle = lb sq. units.

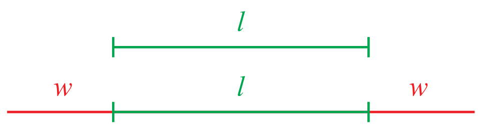


Fig. 3.16

Let w be the width of the flower garden.

What is the length and breadth of the outer rectangle ?

The length of the outer rectangle (L) = $w + l + w = (l + 2w)$ units

The breadth of the outer rectangle (B) = $w + b + w = (b + 2w)$ units

$\therefore$ area of the outer rectangle = $\text{L} \times \text{B}$

$= (l + 2w)(b + 2w)$ sq. units

Now, what is the area of the flower garden ?

Actually, the area of the flower garden is the pathway bounded between two rectangles.

$\therefore$ Area of the flower garden = (Area of building and flower garden) – (Area of building)

Generally,

Area of the pathway = (Area of outer rectangle) – (Area of inner rectangle)

i.e. Area of the pathway = $(l + 2w)(b + 2w) - lb$.

Example 3.19

The area of outer rectangle is 360 m^2. The area of inner rectangle is 280 m^2. The two rectangles have uniform pathway between them. What is the area of the pathway?

Solution

Area of the pathway = (Area of outer rectangle) – (Area of inner rectangle)

$= (360 - 280)\ m^2 \quad = 80\ m^2$

$\therefore$ Area of the pathway $= 80\ m^2$

Example 3.20

The length of a building is 20 m and its breadth is 10 m. A path of width 1 m is made all around the building outside. Find the area of the path.

Solution

Inner rectangle (given)	Outer rectangle
$l = 20$ m $b = 10$ m Area $= l \times b$ Area $= 20\ m \times 10\ m$ $= 200\ m^2$	width, $w = 1$ m L $= l + 2w$ $= 20 + 2 = 22$ m B $= b + 2w$ $= 10 + 2 = 12$ m Area $= (l + 2w)(b + 2w)$ Area $= 22\ m \times 12\ m$ $= 264\ m^2$

Area of the path = (Area of outer rectangle) – (Area of inner rectangle)

$= (264 - 200)\ m^2 = 64\ m^2$

$\therefore$ Area of the path $= 64\ m^2$

Example 3.21

A school auditorium is 45 m long and 27 m wide. This auditorium is surrounded by a varandha of width 3 m on its outside. Find the area of the varandha. Also, find the cost of laying the tiles in the varandha at the rate of ₹100 per sq. m.

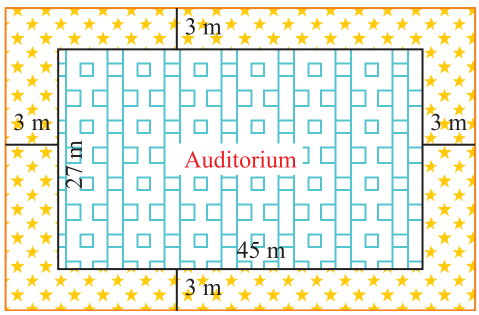


Fig. 3.17

Solution

Inner (given) rectangle	Outer rectangle
$l = 45$ m $b = 27$ m Area $= 45m \times 27$ m $= 1215\ m^2$	Width, $w = 3$ m L $= l + 2w$ $= 45 + 6 = 51$ m B $= b + 2w$ $= 27 + 6 = 33$ m Area $= 51m \times 33$ m $= 1683\ m^2$

(i) Area of the verandha = (Area of outer rectangle) – (Area of inner rectangle)

= $(1683 - 1215)$ m^2

= 468 m^2

$\therefore$ Area of the verandha = 468 m^2 (or) 468 sq. m.

(ii) Cost of laying tiles for 1 sq. m = ₹100

Cost of laying tiles for 468 sq. m = ₹100 $\times$ 468

= ₹46,800

$\therefore$ Cost of laying tiles in the verandha = ₹46,800

(b) Area of uniform pathway inside a rectangle

A swimming pool is built in the middle of a rectangular ground leaving an uniform width all around it to maintain the lawn.

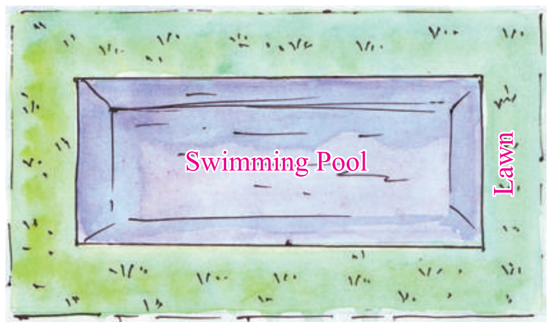


Fig. 3.18

If the pathway outside the pool is to be grassed, how can you find its cost ?

If the area of the pathway and cost of grassing per sq. unit is known, then the cost of grassing the pathway can be found.

Here, the rectangular ground is the outer rectangle where l and b are length and breadth.

$\therefore$ Area of the ground (outer rectangle) = $l\,b$ sq. units

If w be the width of the pathway (lawn), what will be the length and breath of the swimming pool ?

The length of the swimming pool = $l - w - w$

= $l - 2w$

The breadth of the swimming pool = $b - w - w$

= $b - 2w$

$\therefore$ Area of the swimming pool (inner rectangle) = $(l - 2w)(b - 2w)$ Sq. units

Area of the lawn = Area of the ground – Area of the swimming pool.

Generally,

Area of the pathway = (Area of outer rectangle) – (Area of inner rectangle)

= $lb - (l - 2w)\,(b - 2w)$

Example 3.22

The length and breadth of a room are 8 m and 5 m respectively. A red colour border of uniform width of 0.5 m has been painted all around on its inside. Find the area of the border.

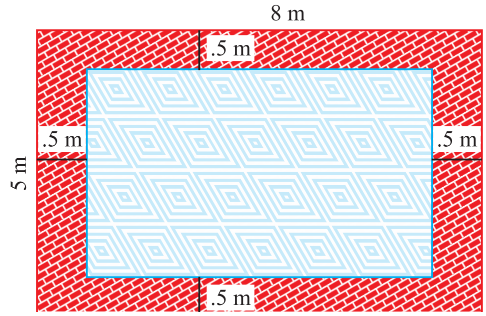


Fig. 3.19

Solution

Outer (given)rectangle	Inner rectangle
$l = 8$ m b $= 5$ m Area $= 8\text{m} \times 5$ m $= 40$ m^2	width, $w = 0.5$ m L $= l - 2w$ $= (8 - 1)$ m $= 7$ m B $= b - 2w$ $= (5 - 1)$ m $= 4$ m Area $= 7\text{m} \times 4$ m $= 28$ m^2

Area of the path = (Area of outer rectangle) – (Area of inner rectangle)

= $(40 - 28)$ m^2

= 12 m^2

$\therefore$ Area of the border painted with red colour = 12 m^2

Example 3.23

A carpet measures 3 m $\times$ 2 m. A strip of 0.25 m wide is cut off from it on all sides. Find the area of the remaining carpet and also find the area of strip cut out.

Solution

Outer rectangle carpet before cutting the strip	Inner rectangle carpet after cutting the strip
$l = 3$ m $b = 2$ m Area $= 3\text{m} \times 2\text{m}$ $= 6$ m^2	width, $w = 0.25$ m L $= l - 2w = (3 - 0.5)$ m $= 2.5$ m B $= b - 2w = (2 - 0.5)$ m $= 1.5$ m Area $= 2.5\text{m} \times 1.5\text{m}$ $= 3.75$ m^2

The area of the carpet after cutting the strip = 3.75 m^2

Area of the strip cut out = (Area of the carpet) – (Area of the remaining part)

= $(6 - 3.75)\ m^2$

= $2.25\ m^2$

$\therefore$ Area of the strip cut out = $2.25\ m^2$

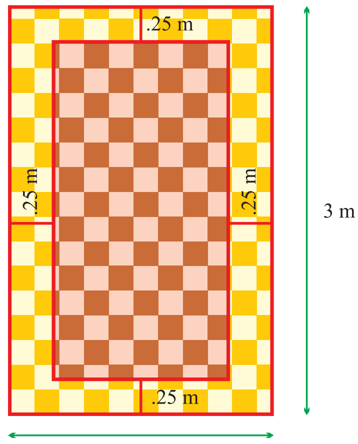


Fig. 3.20

Note: If the length and breadth of the inner rectangle is given, then the length and breadth of the outer rectangle is $l + 2w$, $b + 2w$ respectively where w is the width of the path way.

Suppose the length and breadth of the outer rectangle is given, then the length and breadth of the inner rectangle is $l - 2w$, $b - 2w$ respectively.

Exercise 3.4

1. A play ground 60 m $\times$ 40 m is extended on all sides by 3 m. What is the extended area.
2. A school play ground is rectangular in shape with length 80 m and breadth 60 m. A cemented pathway running all around it on its outside of width 2 m is built. Find the cost of cementing if the rate of cementing 1 sq. m is ₹20.
3. A garden is in the form of a rectangle of dimension 30 m $\times$ 20 m. A path of width 1.5 m is laid all around the garden on the outside at the rate of ₹10 per sq. m. What is the total expense.
4. A picture is painted on a card board 50 cm long and 30 cm wide such that there is a margin of 2.5 cm along each of its sides. Find the total area of the margin.
5. A rectangular hall has 10 m long and 7 m broad. A carpet is spread in the centre leaving a margin of 1 m near the walls. Find the area of the carpet. Also find the area of the un covered floor.
6. The outer length and breadth of a photo frame is 80 cm , 50 cm. If the width of the frame is 3 cm all around the photo. What is the area of the picture that will be visible?

Circular pathway

Concentric circles

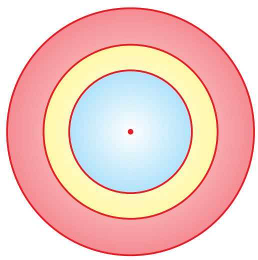


Fig. 3.21

Circles drawn in a plane with a common centre and different radii are called concentric circles.

Circular pathway

A track of uniform width is laid around a circular park for walking purpose.

Can you find the area of this track ?

Yes. Area of the track is the area bounded between two concentric circles. In Fig. 3.22, O is the common centre of the two circles.Let the radius of the outer circle be R and inner circle be *r*.

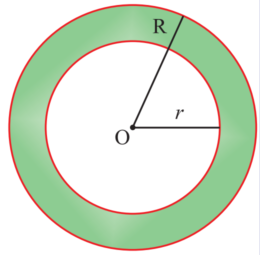


Fig. 3.22

The shaded portion is known as the circular ring or the circular pathway. i.e. a circular pathway is the portion bounded between two concentric circles.

width of the pathway, $w = R - r$ units

i.e., $w = R - r \Rightarrow R = w + r$ units

$r = R - w$ units.

The area of the circular path $=$ (area of the outer circle) – (area of the inner circle)

$= \pi R^2 - \pi r^2$

$= \pi(R^2 - r^2)$ sq. units

$\therefore$ The area of the circular path $= \pi(R^2 - r^2)$ sq. units

$= \pi(R + r)(R - r)$ sq. units

Example 3.24

The adjoining figure shows two concentric circles. The radius of the larger circle is 14 cm and the smaller circle is 7 cm. Find

(i) The area of the larger circle.

(ii) The area of the smaller circle.

(iii) The area of the shaded region between two circles.

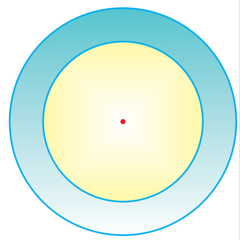


Fig. 3.23

Solution

i) Larger circle

$R = 14$

area $= \pi R^2$

$= \frac{22}{7} \times 14 \times 14$

$= 22 \times 28$

$= 616 \text{ cm}^2$

ii) Smaller circle

$r = 7$

area $= \pi r^2$

$= \frac{22}{7} \times 7 \times 7$

$= 22 \times 7$

$= 154 \text{ cm}^2$

iii) The area of the shaded region

$=$ (Area of larger circle) – (Area of smaller circle)

$= (616 - 154) \text{ cm}^2 = 462 \text{ cm}^2$

Example 3.25

From a circular sheet of radius 5 cm, a concentric circle of radius 3 cm is removed. Find the area of the remaining sheet ? (Take $\pi = 3.14$)

Solution

Given: R = 5 cm, r = 3 cm

Area of the remaining sheet $= \pi(R^2 - r^2)$

$= 3.14\ (5^2 - 3^2)$

$= 3.14\ (25 - 9)$

$= 3.14 \times 16$

$= 50.24\ \text{cm}^2$

Aliter:

Outer circle	Inner circle
R = 5 cm	r = 3 cm
Area $= \pi R^2$ sq. units	Area $= \pi r^2$ sq. units
$= 3.14 \times 5 \times 5$	$= 3.14 \times 3 \times 3$
$= 3.14 \times 25$	$= 3.14 \times 9$
$= 78.5\ \text{cm}^2$	$= 28.26\ \text{cm}^2$

Area of the remaining sheet = (Area of outer circle) – (Area of inner circle)

$= (78.5 - 28.26)\ \text{cm}^2$

$= 50.24\ \text{cm}^2$

$\therefore$ Area of the remaining sheet $= 50.24\ \text{cm}^2$

Example 3.26

A circular flower garden has an area 500 m^2. A sprinkler at the centre of the garden can cover an area that has a radius of 12 m. Will the sprinkler water the entire garden (Take π = 3.14)

Solution

Given, area of the garden = 500 m^2

Area covered by a sprinkler $= \pi r^2$

$= 3.14 \times 12 \times 12$

$= 3.14 \times 144$

$= 452.16\ \text{m}^2$

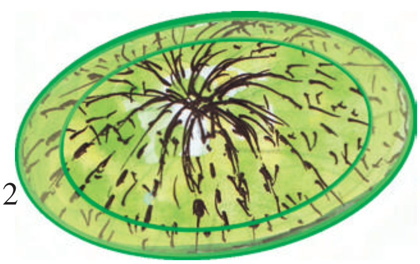


Fig. 3.24

Since, the area covered by a sprinkler is less than the area of the circular flower garden, the sprinkler cannot water the entire garden.

Example 3.27

A uniform circular path of width 2 m is laid out side a circular park of radius 50 m. Find the cost of levelling the path at the rate of ₹5 per m^2 (Take π = 3.14)

Solution

Given: $r = 50$ m, $w = 2$ m, R $= r + w = 50 + 2 = 52$ m

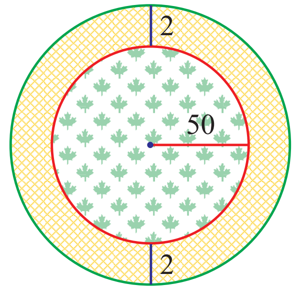


Fig. 3.25

Area of the circular path $= \pi(R + r)(R - r)$

$= 3.14 \times (52 + 50)(52 - 50)$

$= 3.14 \times 102 \times 2$

$= 3.14 \times 204$

$= 640.56 \text{ m}^2$

The cost of levelling the path of area 1 sq m = ₹5

The cost of levelling the path of 640.56 m^2 = ₹5 $\times$ 640.56

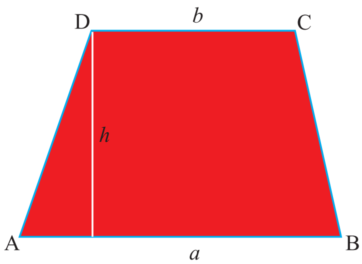
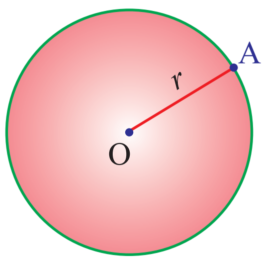
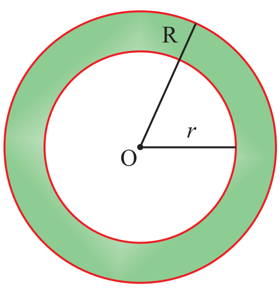
= ₹3202.80

$\therefore$ the cost of levelling the path = ₹3202.80

Exercise 3.5

1. A circus tent has a base radius of 50 m. The ring at the centre for the performance by an artists is 20 m in radius. Find the area left for the audience. (Take $\pi = 3.14$)
2. A circular field of radius 30 m has a circular path of width 3 m inside its boundary. Find the area of the path (Take $\pi = 3.14$)
3. A ring shape metal plate has an internal radius of 7 cm and an external radius of 10.5 cm. If the cost of material is ₹5 per sq. cm, find the cost of 25 rings.
4. A circular well has radius 3 m. If a platform of uniform width of 1.5 m is laid around it, find the area of the platform . (Take $\pi = 3.14$)
5. A uniform circular path of width 2.5 m is laid outside a circular park of radius 56m. Find the cost of levelling the path at the rate of ₹5 per m^2 (Take $\pi = 3.14$)
6. The radii of 2 concentric circles are 56 cm and 49 cm. Find the area of the pathway.
7. The area of the circular pathway is 88 m^2. If the radius of the outer circle is 8 m, find the radius of the inner circle.
8. The cost of levelling the area of the circular pathway is ₹ 12,012 at the rate of ₹ 6 per m^2. Find the area of the pathway.

Points to Remember

Figure	Area	Forumula
 Trapezium	$\frac{1}{2}$ × height × sum of parallel sides	$\frac{1}{2} \times h \times (a + b)$ sq. units
 Circle	Perimeter of the circle = 2 × π × radius	$2\pi r$ units
	Area of the circle = π × radius × radius	πr^2 sq. units
	**Area of the pathway** i) area of the rectangular pathway	Area of outer rectangle – Area of inner rectangle
 Circular Pathway	ii) area of the circular pathway	Area of outer circle – Area of inner circle $= \pi\ (R^2 - r^2)$ sq. units $= \pi\ (R + r)\ (R - r)$ sq. units

4

GEOMETRY

4.1 Triangle: Revision

A triangle is a closed plane figure made of three line segments.

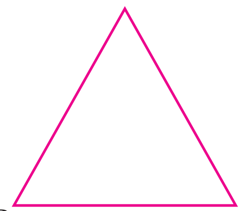


Fig. 4.1

In Fig. 4.1 the line segments AB, BC and CA form a closed figure. This is a triangle and is denoted by ΔABC. This triangle may be named as ΔABC or ΔBCA or ΔCAB.

The line segments forming a triangle are the three sides of the triangle. In Fig.4.1 $\overline{AB}$, $\overline{BC}$ and $\overline{CA}$ are the three sides of the triangle.

The point where any two of the three line segments of a triangle intersect is called the vertex of the triangle. In Fig. 4.1 A,B and C are the three vertices of the ΔABC.

When two line segments intersect, they form an angle at that point. In the triangle in Fig. 4.1 $\overline{AB}$ and $\overline{BC}$ intersect at B and form an angle at that vertex. This angle at B is read as angle B or $\angle B$ or $\angle ABC$. Thus a triangle has three angles $\angle A$, $\angle B$ and $\angle C$.

In Fig. 4.1 ΔABC has

Sides : $\overline{AB}, \overline{BC}, \overline{CA}$

Angles : $\angle CAB$, $\angle ABC$, $\angle BCA$

Vertices : A, B, C

The side opposite to the vertices A, B, C are BC, AC and AB respectively. The angle opposite to the side BC, CA and AB is $\angle A$, $\angle B$ and $\angle C$ respectively.

A triangle is a closed figure made of three line segments. It has three vertices, three sides and three angles.

4.2 Types of Triangles

Based on sides

A triangle is said to be

Equilateral, when all its sides are equal.

Isosceles, when two of its sides are equal.

Scalene, when its sides are unequal.

Based on angles

A triangle is said to be

Right angled, when one of its angle is a right angle and the other two angles are acute.

Obtuse - angled, when one of its angle is obtuse and the other two angles are acute.

Acute - angled, when all the three of its angles are acute.

The sum of the lengths of any two sides of a triangle is always greater than the length of the third side.

4.3 Angle sum property of a triangle:

Activity 1

Draw any triangle ABC on a sheet of paper and mark the angles 1, 2 and 3 on both sides of the paper as shown in Fig. 4.2 (i).

Try these

Is it possible to form a triangle whose sides are 7cm, 5cm and 13cm?

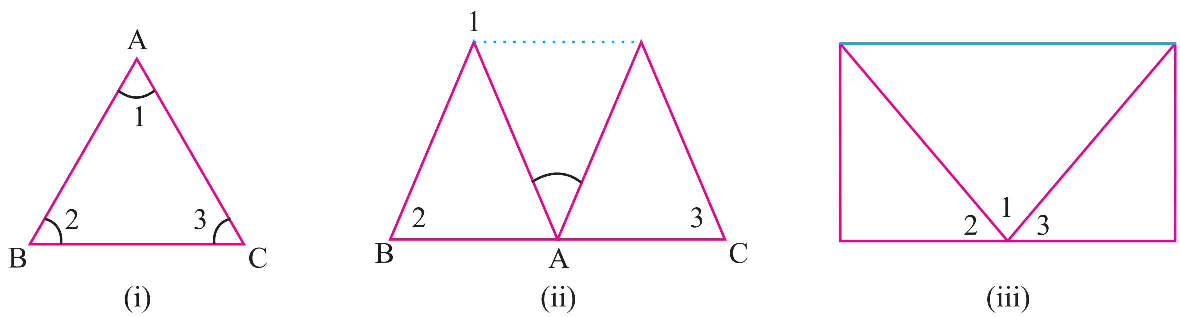


Fig. 4.2

Cut a triangle ABC in a paper. Fold the vertex A to touch the side BC as shown in the Fig. 4.2 (ii) Fold the vertices B and C to get a rectangle as shown in the Fig. 4.2 (iii) Now you see that $\angle 1$, $\angle 2$ and $\angle 3$ make a straight line.

From this you observe that

$$\angle 1 + \angle 2 + \angle 3 = 180°$$

$$\angle A + \angle B + \angle C = 180°$$

The sum of the three angles of a triangle is 180°

Activity 2

Draw a triangle. Cut on the three angles. Re arrange them as shown in Fig. 4.2 (ii). You observe that the three angles now constitute one angle. This angle is a straight angle and so has measure 180°

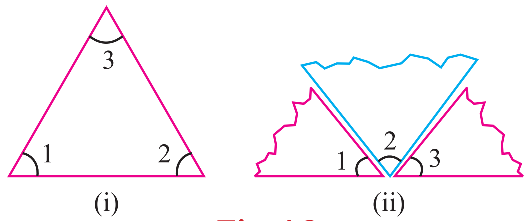


Fig. 4.3

The sum of the three angles of a triangle is 180°

Think it.

1. Can you have a triangle with the three angles less than 60°?
2. Can you have a triangle with two right angles?

4.4 Exterior angle of a triangle and its property

Activity 3

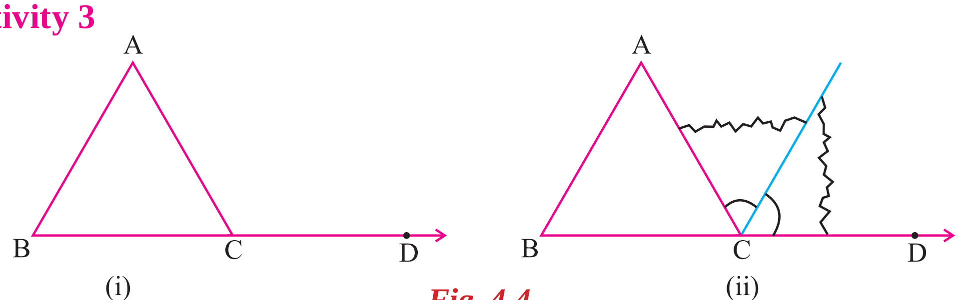


Fig. 4.4

Draw a triangle ABC and produce one of its sides, say BC as shown in Fig. 4.4 (i) observe the angles ACD formed at the point C. This angle lies in the exterior of ΔABC formed at vertex C.

$\angle BCA$ is an adjacent angle to $\angle ACD$. The remaining two angles of the triangle namely $\angle A$ nd $\angle B$ are called the two interior opposite angles.

Now cut out (or make trace copies of) $\angle A$ and $\angle B$ and place them adjacent to each other as shown in Fig. 4.4 (ii)

You observe that these two pieces together entirely cover $\angle ACD$.

From this we conclude that the exterior angle of a triangle is equal to the sum of the two interior opposite angles.

The relation between an exterior angle and its two interior angles is referred to as the exterior angle property of a triangle.

Draw a triangle ABC and produce one of its sides BC as shown in Fig. 4.4 (i) $\angle$ACD formed at the point C. Now take a protractor and measure $\angle$ ACD, $\angle$A and $\angle$B.
Find the sum $\angle$ A + $\angle$ B. and compare it with the measure of $\angle$ACD. Do you observe that $\angle$ACD = $\angle$A + B?

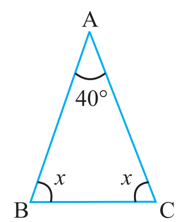
Example 4.1

In the given figure find the value of x.

Solution

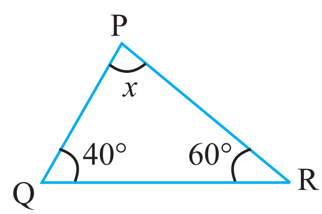
$$\begin{aligned} \angle CAB + \angle ABC + \angle BCA &= 180^\circ \\ 40^\circ + x + x &= 180^\circ \\ 40^\circ + 2x &= 180^\circ \\ 2x &= 180^\circ - 40^\circ \\ 2x &= 140^\circ \\ x &= \frac{140^\circ}{2} = 70^\circ \\ \text{The value of } x &= 70^\circ. \end{aligned}$$

(Since sum of the three angles of a triangle is 180°)



Example 4.2

Two angles of a triangle are 40° and 60°. Find the third angle.



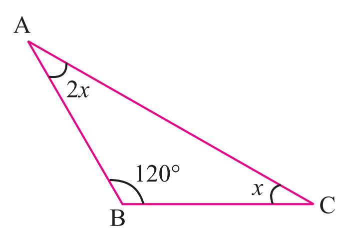
Solution

$$\begin{aligned} \angle RPQ + \angle PQR + \angle QRP &= 180^\circ \\ x + 40^\circ + 60^\circ &= 180^\circ \\ x + 100^\circ &= 180^\circ \\ x &= 180^\circ - 100^\circ \\ &= 80^\circ \\ \therefore \text{ The third angle } x &= 80^\circ \end{aligned}$$

(Since sum of the three angles of a triangle is 180°)

Example 4.3

In the given figure, find the measure of $\angle$A.



Solution

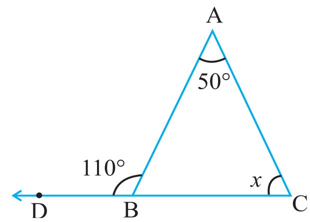
$$\begin{aligned} \angle CAB + \angle ABC + \angle BCA &= 180^\circ \\ 2x + 120^\circ + x &= 180^\circ \end{aligned}$$

(Since sum of the three angles of a triangle is 180°)

$$3x + 120° = 180°$$
$$3x = 180° - 120°$$
$$3x = 60°$$
$$x = \frac{60°}{3}$$
$$= 20°$$
$$\therefore \angle A = 2x = 2 \times 20° = 40°$$

Example 4.4

In the given figure. Find the value of x.



Solution

In the figure exterior angle = $\angle ABD = 110°$.

Sum of the two interior opposite angle = $\angle BCA + \angle CAB$

$= x + 50°$

$x + 50° = 110°$ (Since the sum of the two interior opposite

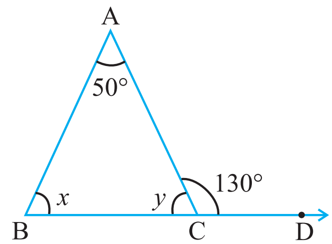
$x = 110° - 50°$ angle is equal to the exterior angle)

$= 60°$

$\therefore$ The value of x is 60°.

Example 4.5

In the given figure find the values of x and y.



Solution

In the give figure,

Exterior angle $= \angle DCA = 130°$

$50° + x = 130°$ (Since sum of the two interior opposite

$x = 130° - 50°$ angle is equal to the exterior angle)

$= 80°$

In ΔABC,

$\angle A + \angle B + \angle C = 180°$ (Since sum of three angles of a triangle is 180°)

$50° + x + y = 180°$

$50° + 80° + y = 180°$

$130° + y = 180°$

$y = 180° - 130° = 50°$

$\therefore$ The values of $x = 80°$ and $y = 50°$.

Aliter:

$$\begin{aligned} \angle ACB + \angle DCA &= 180^\circ \quad \text{(Since sum of the adjacent angles on a line is } 180^\circ\text{)} \\ y + 130^\circ &= 180^\circ \\ y &= 180^\circ - 130^\circ \\ &= 50^\circ \end{aligned}$$

In Δ ABC,

$$\begin{aligned} \angle A + \angle B + \angle C &= 180^\circ \quad \text{(Since sum of the three angles of a triangle is } 180^\circ\text{)} \\ 50^\circ + x + y &= 180^\circ \\ 50^\circ + x + 50^\circ &= 180^\circ \\ 100^\circ + x &= 180^\circ \\ x &= 180^\circ - 100^\circ \\ &= 80^\circ \end{aligned}$$

Example 4.6

Three angles of a triangle are $3x + 5^\circ$, $x + 20^\circ$, $x + 25^\circ$. Find the measure of each angle.

Solution

$$\begin{aligned} \text{Sum of the three angles of a triangle} &= 180^\circ \\ 3x + 5^\circ + x + 20^\circ + x + 25^\circ &= 180^\circ \\ 5x + 50^\circ &= 180^\circ \\ 5x &= 180^\circ - 50^\circ \\ 5x &= 130^\circ \\ x &= \frac{130^\circ}{5} \\ &= 26^\circ \\ 3x + 5^\circ &= (3 \times 26^\circ) + 5^\circ = 78^\circ + 5^\circ = 83^\circ \\ x + 20^\circ &= 26^\circ + 20^\circ = 46^\circ \\ x + 25^\circ &= 26^\circ + 25^\circ = 51^\circ \end{aligned}$$

$\therefore$ The three angles of a triangle are 83°, 46° and 51°.

Exercise 4.1

1. Choose the correct answer.

i) The sum of the three angles of a triangle is

(A) 90° (B) 180° (C) 270° (D) 360°

ii) In a triangle, all the three angles are equal, then the measure of each angle is

(A) 30^0 (B) 45^0 (C) 60^0 (D) 90^0

iii) Which of the following can be angles of a triangle?

(A) $50^0, 30^0, 105^0$ (B) $36^0, 44^0, 90^0$ (C) $70^0, 30^0, 80^0$ (D) $45^0, 45^0 80^0$

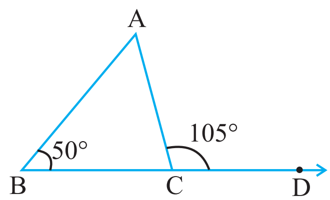
iv) Two angles of a triangle are 40° and 60°, then the third angle is

(A) 20^0 (B) 40^0 (C) 60^0 (D) 80^0

v) In ΔABC, BC is produced to D and $\angle ABC = 50^0$, $\angle ACD = 105^0$, then $\angle$ BAC will be equal to

(A) 75° (B) 15°

(C) 40° (D) 55°



2. State which of the following are triangles.

(i) $\angle A = 25^0$ $\angle B = 35^0$ $\angle C = 120^0$

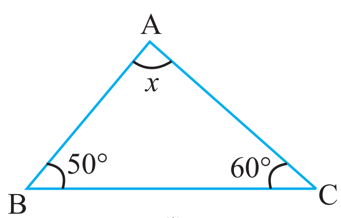
(ii) $\angle P = 90^0$ $\angle Q = 30^0$ $\angle R = 50^0$

(iii) $\angle X = 40^0$ $\angle Y = 70^0$ $\angle Z = 80^0$

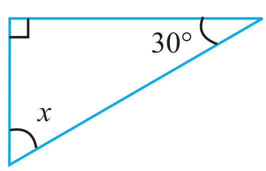
3. Two angles of a triangle is given, find the third angle.

(i) $75^0, 45^0$ (ii) $80^0, 30^0$ (iii) $40^0, 90^0$ (iv) $45^0, 85^0$

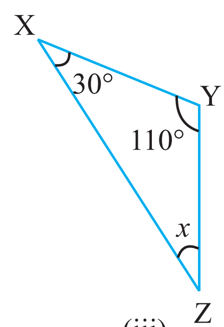
4. Find the value of the unknown x in the following diagrams:



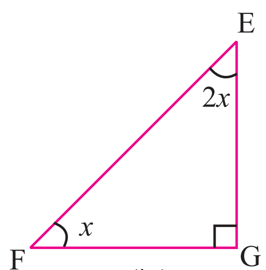
(i)



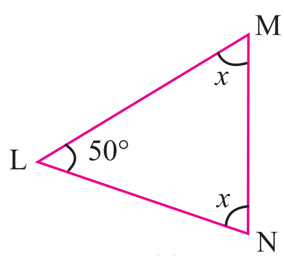
(ii)



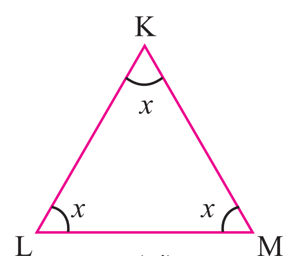
(iii)



(iv)

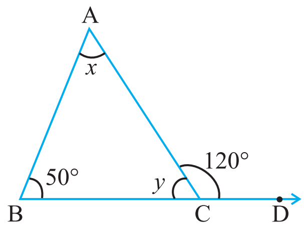


(v)

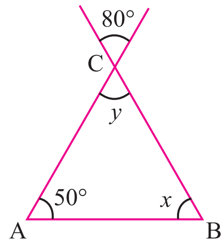


(vi)

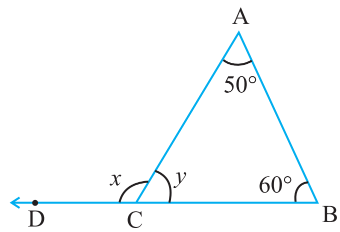
5. Find the values of the unknown x and y in the following diagrams:



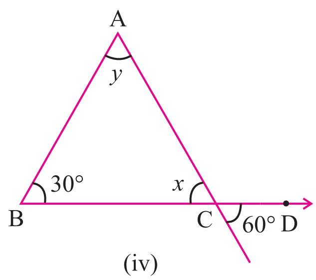
(i)



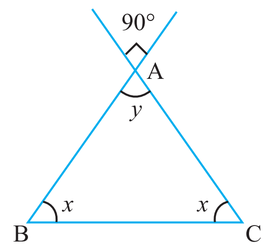
(ii)



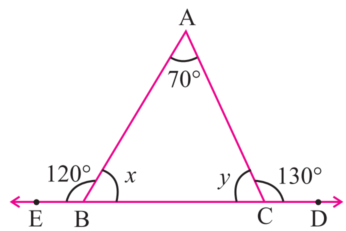
(iii)



(iv)



(v)



(vi)

6. Three angles of a triangle are $x + 5°$, $x + 10°$ and $x + 15°$ find x.

Points to Remember

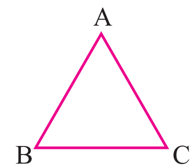
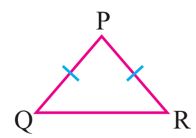
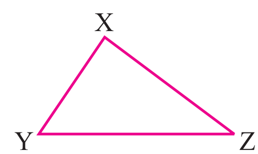
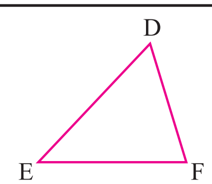
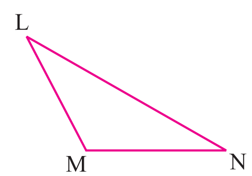
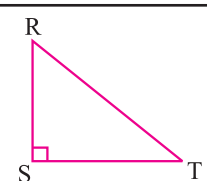
1. The sum of the three angles of a triangle is 180°.
2. In a triangle an exterior angle is equal to the sum of the two interior opposite angles.

5 PRACTICAL GEOMETRY

5.1 Construction of triangles

In the previous class, we have learnt the various types of triangles on the basis of their sides and angles. Now let us recall the different types of triangles and some properties of triangle.

Classification of triangles

CLASSIFICATION OF TRIANGLES		No.	Name of Triangle	Figure	Note
	on the basis SIDES	1	Equilateral triangle		Three sides are equal
		2	Isosceles triangle		Any two sides are equal
		3	Scalene triangle		Sides are unequal
	on the basis ANGLES	4	Acute angled triangle		All the three angles are acute (less than 90°)
		5	Obtuse angled triangle		Any one of the angles is obtuse (more than 90°)
		6	Right angled triangle		Any one of the angles is right angle (90°)

Some properties of triangle

1. The sum of the lengths of any two sides of a triangle is greater than the third side.
2. The sum of all the three angles of a triangle is 180°.

To construct a triangle we need three measurements in which at least the length of one side must be given. Let us construct the following types of triangles with the given measurements.

(i) Three sides (SSS).

(ii) Two sides and included angle between them (SAS).

(iii) Two angles and included side between them (ASA).

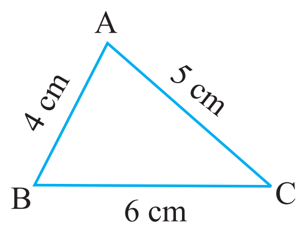
(i) To construct a triangle when three sides are given (SSS Criterion)

Example 5.1

Construct a triangle ABC given that AB = 4cm, BC = 6 cm and AC = 5 cm.

Solution

Rough Diagram

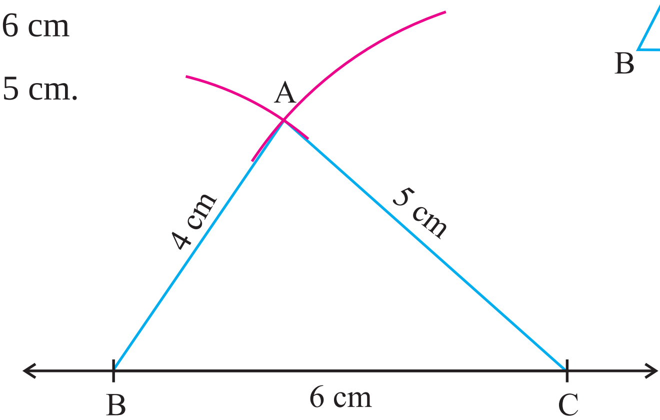


Given measurements

AB = 4cm

BC = 6 cm

AC = 5 cm.



Steps for construction

Step 1 : Draw a line segment BC = 6cm

Step 2 : With 'B' as centre, draw an arc of radius 4 cm above the line BC.

Step 3 : With 'C' as centre, draw an arc of 5 cm to intersect the previous arc at 'A'

Step 4 : Join AB and AC.

Now ABC is the required triangle.

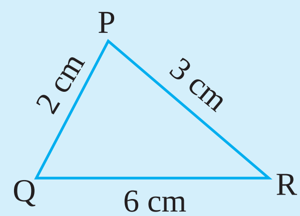
Try these

By using protector measure all the angles of a triangle. Find the sum of all the three angles of a triangle.

Do you know?

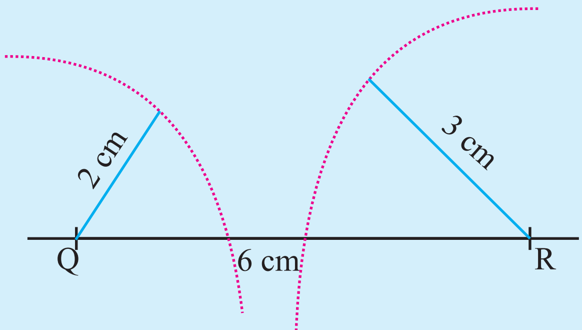
1. A student attempted to draw a triangle with given measurements PQ = 2cm, QR = 6cm, PR = 3 cm. (as in the rough figure). First he drew QR = 6cm. Then he drew an arc of 2cm with Q as centre and he drew another arc of radius 3 cm with R as centre. They could not intersect each to get P.

Rough Figure



   (i) What is the reason?

   (ii) What is the triangle property in connection with this?



The sum of any two sides of a triangle is always greater than the third side.

Try these

Draw the bisectors of the three angles of a triangle. Check whether all of them pass through a same point. This point is incentre.

(ii) To construct a triangle when Two sides and an angle included between them are given. (SAS Criterion)

Example 5.2

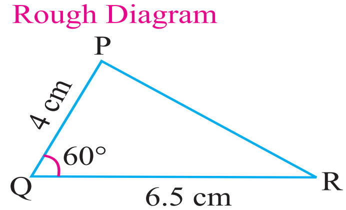
Construct a triangle PQR given that PQ = 4 cm, QR = 6.5 cm and $\angle$PQR = 60°.

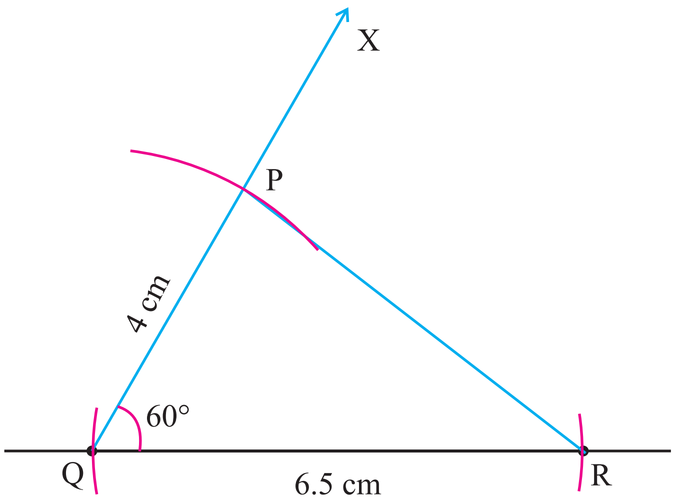
Solution

Given measurements

PQ	=	4 cm
QR	=	6.5 cm
$\angle$PQR	=	60°

Rough Diagram





Steps for construction

Step 1 : Draw the line segment QR = 6.5 cm.

Step 2 : At Q, draw a line QX making an angle of 60^0 with QR.

Step 3 : With Q as centre, draw an arc of radius 4 cm to cut the line (QX) at P.

Step 4 : Join PR.

PQR is the required triangle.

Construct a triangle with the given measurements XY = 6cm, YZ = 6cm and ∠XYZ = 70°. Measure the angles of the triangle opposite to the equal sides. What do you observe?

(iii) To construct a triangle when two of its angles and a side included between them are given. (ASA criterion)

Example 5.3

Construct a triangle XYZ given that XY = 6 cm, ∠ZXY = 30° and ∠XYZ = 100°. Examine whether the third angle measures 50°.

Solution

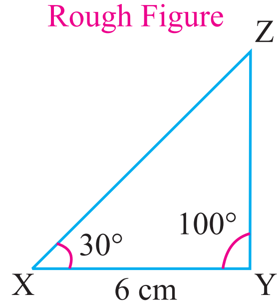
Given measurements

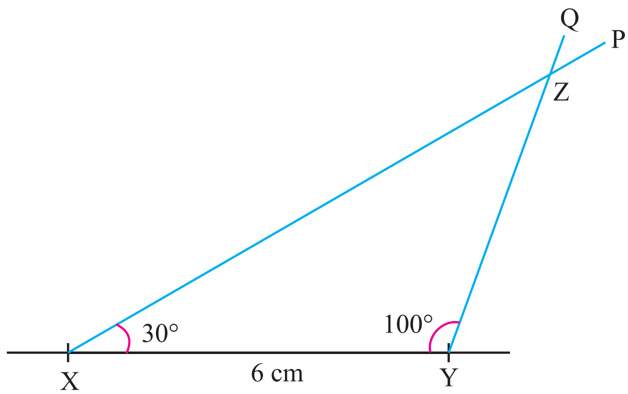
XY = 6 cm

∠ZXY = 30°

∠XYZ = 100°

Rough Figure





Step 1 : Draw the line segment XY = 6cm.

Step 2 : At X, draw a ray XP making an angle of 30° with XY.

Step 3 : At Y, draw another ray YQ making an angle of 100° with XY. The rays XP and YQ intersect at Z.

Step 4 : The third angle measures 50° i.e $\angle Z = 50°$.

Construct a triangle PQR given that PQ = 7 cm, $\angle Q = 70°$, $\angle R = 40°$.

Hint: Use the Angle Sum Property of a triangle.

Exercise : 5.1

I. Construct the triangles for the following given measurements.

1. Construct $\triangle PQR$, given that PQ = 6cm, QR = 7cm, PR = 5cm.
2. Construct an equilateral triangle with the side 7cm. Using protector measure each angle of the triangle. Are they equal?
3. Draw a triangle DEF such that DE = 4.5cm, EF = 5.5cm and DF = 4.5cm. Can you indentify the type of the triangle? Write the name of it.

II. Construct the triangles for the following given measurements.

4. Construct $\triangle XYZ$, given that YZ = 7cm, ZX = 5cm, $\angle Z = 50°$.
5. Construct $\triangle PQR$ when PQ = 6cm, PR = 9cm and $\angle P = 100°$.
6. Construct $\triangle ABC$ given that AB = 6 cm, BC = 8 cm and $\angle B = 90°$ measure length of AC.

III. Construct the triangles for the following given measurements.

7. Construct $\triangle XYZ$, when $\angle X = 50°$, $\angle Y = 70°$ and XY = 5cm.
8. Construct $\triangle ABC$ when $\angle A = 120°$, $\angle B = 30°$ and AB = 7cm.
9. Construct $\triangle LMN$, given that $\angle L = 40°$, $\angle M = 40°$ and LM = 6cm. Measure and write the length of sides opposite to the $\angle L$ and $\angle M$. Are they equal? What type of Triangle is this?

6 DATA HANDLING

6.1 Mean, Median and Mode of ungrouped data

Arithmetic mean

We use the word 'average' in our day to day life.

Poovini spends on an average of about 5 hours daily for her studies.

In the month of May, the average temperature at Chennai is 40 degree celsius.

What do the above statements tell us?

Poovini usually studies for 5 hours. On some days, she may study for less number of hours and on other days she may study longer.

The average temperature of 40 degree celsius means that, the temperature in the month of May at chennai is 40 degree celsius. Some times it may be less than 40 degree celsius and at other times it may be more than 40 degree celsius.

Average lies between the highest and the lowest value of the given data.

Rohit gets the following marks in different subjects in an examination.

62, 84, 92, 98, 74

In order to get the average marks scored by him in the examination, we first add up all the marks obtained by him in different subjects.

$$62 + 84 + 92 + 98 + 74 = 410.$$

and then divide the sum by the total number of subjects. (i.e. 5)

The average marks scored by Rohit $= \frac{410}{5} = 82.$

This number helps us to understand the general level of his academic achievement and is referred to as mean.

$\therefore$ **The average or arithmetic mean or mean is defined as follows.**

$$\textbf{Mean} = \frac{\text{Sum of all observations}}{\text{Total number of observations}}$$

Example 6.1

Gayathri studies for 4 hours, 5 hours and 3 hours respectively on 3 consecutive days. How many hours did she study daily on an average?

Solution:

$$\text{Average study time} = \frac{\text{Total number of study hours}}{\text{Number of days for which she studied.}}$$
$$= \frac{4+5+3}{3} \text{ hours}$$
$$= \frac{12}{3}$$
$$= 4 \text{ hours per day.}$$

Thus we can say that Gayathri studies for 4 hours daily on an average.

Example 6.2

The monthly income of 6 families are ₹ 3500, ₹ 2700, ₹ 3000, ₹ 2800, ₹ 3900 and ₹ 2100. Find the mean income.

Solution:

$$\text{Average monthly income} = \frac{\text{Total income of 6 familes}}{\text{Number of families}}$$
$$= \frac{₹\ 3500+2700+3000+2800+3900+2100}{6}$$
$$= ₹\ \frac{18000}{6}$$
$$= ₹\ 3{,}000.$$

Example 6.3

The mean price of 5 pens is ₹ 75. What is the total cost of 5 pens?

Solution:

$$\text{Mean} = \frac{\text{Total cost of 5 pens}}{\text{Number of pens}}$$
$$\text{Total cost of 5 pens} = \text{Mean} \times \text{Number of pens}$$
$$= ₹\ 75 \times 5$$
$$= ₹\ 375$$

Median

Consider a group of 11 students with the following height (in cm)

106, 110, 123, 125, 115, 120, 112, 115, 110, 120, 115.

The Physical EducationTeacher Mr. Gowtham wants to divide the students into two groups so that each group has equal number of students. One group has height lesser than a particular height and the other group has student with height greater than the particular height.

Now, Mr. Gowtham arranged the students according to their height in ascending order.

106, 110, 110, 112, 115, 115,115, 120, 120, 123, 125

The middle value in the data is 115 because this value divides the students into two equal groups of 5 students each. This value is called as median. Median refers to the value 115 which lies in the middle of the data.Mr. Gowtham decides to keep the middle student as a referee in the game.

Median is defined as the middle value of the data when the data is arranged in ascending or descending order.

Try these

Find the actual distance between your school and house. Find the median of the place.

Find the median of the following:

40, 50, 30, 60, 80, 70

Arrange the given data in ascending order.

30, 40, 50, 60, 70, 80.

Here the number of terms is 6 which is even. So the third and fourth terms are middle terms. The average value of the these terms is the median.

(i.e) Median $= \frac{50+60}{2} = \frac{110}{2} = 55.$

(i) **When the number of observations is odd, the middle number is the median.**

(ii) **When the number of observations is even, the median is the average of the two middle numbers.**

Do you know?

In highways, the yellow line represents the median.

Example 6.4

Find the median of the following data.

3, 4, 5, 3, 6, 7, 2.

Solution:

Arrange the data in ascending order.

2, 3, 3, 4, 5, 6, 7

The number of observation is 7 which is odd.

∴The middle value 4 is the median.

Example 6.5

Find the median of the data

12, 14, 25, 23, 18, 17, 24, 20.

Solution:

Arrange the data in ascending order

12, 14, 17, 18, 20, 23, 24, 25.

The number of observation is 8 which is even.

$\therefore$ Median is the average of the two middle terms 18 and 20.

$$\text{Median} = \frac{18 + 20}{2} = \frac{38}{2} = 19$$

Example 6.6

Find the median of the first 5 prime numbers.

Solution:

The first five prime numbers are 2, 3, 5, 7, 11.

The number of observation is 5 which is odd.

$\therefore$ The middle value 5 is the median.

Mode

Look at the following example,

Mr. Raghavan, the owner of a ready made dress shop says that the most popular size of shirts he sells is of size 40 cm.

Observe that here also, the owner is concerned about the number of shirts of different sizes sold. He is looking at the shirt size that is sold, the most. The highest occurring event is the sale of size 40 cm. This value is called the mode of the data.

Mode is the variable which occurs most frequently in the given data.

Mode of Large data

Putting the same observation together and counting them is not easy if the number of observation is large. In such cases we tabulate the data.

Example 6.7

Following are the margin of victory in the foot ball matches of a league.

1, 3, 2, 5, 1, 4, 6, 2, 5, 2, 2, 2, 4, 1, 2, 3, 2, 3, 2, 3,

1, 1, 2, 3, 2, 6, 4, 3, 2, 1, 1, 4, 2, 1, 5, 3, 4, 2, 1, 2. Find the mode of this data.

Solution:

Margin of victory	Tally Marks	Number of Matches
1	𝍸 ||||	9
2	𝍸 𝍸 ||||	14
3	𝍸 ||	7
4	𝍸	5
5	|||	3
6	||	2
	Total	40

Table 6.1

Now we quickly say that '2' is the mode. Since 2 has occurred the more number of times, then the most of the matches have been won with a victory margin of 2 goals.

Example 6.8

Find the mode of the following data.

3, 4, 5, 3, 6, 7

Try these

Find the mode of the transport in your place.

Solution:

3 occurs the most number of times.

$\therefore$ Mode of the data is 3.

Example 6.9

Find the mode of the following data.

2, 2, 2, 3, 3, 4, 5,5, 5, 6,6, 8

Try these

Find the mode of the flower.

Solution:

2 and 5 occur 3 times.

$\therefore$ Mode of the data is 2 and 5.

Example 6.10

Find the mode of the following data

90, 40, 68, 94, 50, 60.

Solution:

Here there are no frequently occurring values. Hence this data has no mode.

Example 6.11

The number of children in 20 families are 1, 2, 2, 1, 2, 1, 3, 1, 1, 3

1, 3, 1, 1, 1, 2, 1, 1, 2, 1. Find the mode.

Solution:

Number of Children	Tally Marks	Number of Families
1	$\cancel{||||}$ $\cancel{||||}$ $||$	12
2	$\cancel{||||}$	5
3	$|||$	3
	Total	20

Table 6.2

12 families have 1 child only, so the mode of the data is 1.

Exercise: 6.1

1. Choose the correct answer:

i) The arithmetic mean of 1, 3, 5, 7 and 9 is

(A) 5 (B) 7 (C) 3 (D) 9

ii) The average marks of 5 children is 40 then their total mark is

(A) 20 (B) 200 (C) 8 (D) 4

iii) The median of 30,50, 40, 10, 20 is

(A) 40 (B) 20 (C) 30 (D) 10

iv) The median of 2, 4, 6, 8, 10, 12 is

(A) 6 (B) 8 (C) 7 (D) 14

v) The mode of 3, 4, 7, 4, 3, 2, 4 is

(A) 3 (B) 4 (C) 7 (D) 2

2. The marks in mathematics of 10 students are

   56, 48, 58, 60, 54, 76, 84, 92, 82, 98.

   Find the range and arithmetic mean

3. The weights of 5 people are

   72 kg, 48 kg, 51 kg, 69 kg, 67 kg.

   Find the mean of their weights.

4. Two vessels contain 30 litres and 50 litres of milk separately. What is the capacity of the vessels if both share the milk equally?

5. The maximum temperature in a city on 7 days of a certain week was 34.8°C, 38.5°C, 33.4°C, 34.7°C, 35.8°C, 32.8°C, 34.3°C. Find the mean temperature for the week.

6. The mean weight of 10 boys in a cricket team is 65.5 kg. What is the total weight of 10 boys.

7. Find the median of the following data.

   6, 14, 5, 13, 11, 7, 8

8. The weight of 7 chocolate bars in grams are

   131, 132, 125, 127, 130, 129, 133. Find the median.

9. The runs scored by a batsman in 5 innings are

   60, 100, 78, 54, 49. Find the median.

10. Find the median of the first seven natural numbers.

11. Pocket money received by 7 students is given below.

    ₹ 42, ₹ 22, ₹ 40, ₹ 28, ₹ 23, ₹ 26, ₹ 43. Find the median.

12. Find the mode of the given data.

    3, 4, 3, 5, 3, 6, 3, 8, 4.

13. Twelve eggs collected in a farm have the following weights.

    32 gm,40 gm, 27 gm, 32 gm, 38 gm, 45 gm,
    40 gm, 32 gm, 39 gm, 40 gm, 30 gm, 31 gm,

    Find the mode of the above data.

14. Find the mode of the following data.

    4, 6, 8, 10, 12, 14

15. Find the mode of the following data.

    12, 14, 12, 16, 15, 13, 14, 18, 19, 12, 14, 15, 16, 15, 16, 16,
    15, 17, 13, 16, 16, 15, 13, 15, 17, 15, 14, 15, 13, 15, 14.

Points to Remember

1. Average lies between the highest and the lowest value of the given data.
2. Mean = $\dfrac{\text{sum of all the observations}}{\text{total number of observations}}$
3. Median is defined as the middle value of the data, when the data is arranged in ascending or descending order.
4. Mode is the variable which occurs most frequently in the given data.

MATHEMATICS

ANSWERS

Unit 1

Exercise 1.1

1. (i) B (ii) A (iii) D (iv) C (v) A
2. (i) $x + 2y$ (ii) $y - z$ (iii) $xy + 4$
   (iv) $3x - 4y$ (if $3x > 4y$) or $4y - 3x$ (if $4y > 3x$)
   (v) $10 + x + y$ (vi) $pq - 5$ (vii) $12 - mn$
   (viii) $ab - (a + b)$ (ix) $3cd + 6$ (x) $\frac{4xy}{3}$

Exercise 1.2

1. (i) B (ii) A (iii) C (iv) C (v) D
2. (i) $x = 12$ (ii) $a = 7$ (iii) $y = -6$ (iv) $b = -2$ (v) $x = -5$
   (vi) $x = 7$ (vii) $x = -5$ (viii) $n = 4$ (ix) $m = 11$ (x) $y = 27$
3. (i) $x = 50$ (ii) $l = 14$ (iii) $x = 4$ (iv) $a = 3$ (v) $x = -9$
   (vi) $t = -4$ (vii) $x = -6$ (viii) $m = 3$ (ix) $x = \frac{-1}{2}$ (x) $x = 6$
4. (i) $x = 14$ (ii) $a = 30$ (iii) $n = -24$ (iv) $p = -56$ (v) $x = -10$
   (vi) $m = 12$
5. (i) $x = 3$ (ii) $x = -15$ (iii) $z = 5$ (iv) $a = -9$ (v) $x = 3$
   (vi) $x = 5$ (vii) $y = 67$ (viii) $x = 6$ (ix) $y = 3$ (x) $m = 6$
   (xi) $x = 11$ (xii) $m = \frac{1}{2}$ (xiii) $x = 3$ (xiv) $x = -3$ (xv) $t = -1$
6. 15 7. 13 8. 108 9. 12 10. 8
11. 37, 38 12. 60 13. 35

Unit - 2

Exercise 2.1

1. (i) 20% (ii) 93% (iii) 11% (iv) 1% (v) 100%
2. (i) 43 : 100 (ii) 75 : 100 (iii) 5 : 100 (iv) 35:200 (v) 100 : 300
3. (i) $\frac{25}{100}$ (ii) $\frac{25}{200}$ (iii) $\frac{33}{100}$ (iv) $\frac{70}{100}$ (v) $\frac{82}{100}$

Exercise 2.2

1. (i) C (ii) C (iii) A (iv) A (v) C

2. (i) 100% (ii) 18% (iii) 525% (iv) 66.67% (v) 45.45%
3. (i) 36% (ii) 3% (iii) 7.1% (iv) 305% (v) 75%
4. 20%
5. 13.89%
6. Girls 46%; Boys 54 %
7. He got more marks in Science.
8. Savings 10%; Expenditure 90%

Exercise 2.3

1. (i) B (ii) B (iii) A (iv) C (v) B
2. (i) $\frac{9}{100}$ (ii) $\frac{3}{4}$ (iii) $\frac{1}{400}$ (iv) $\frac{1}{40}$ (v) $\frac{2}{3}$
3. (i) 0.07 (ii) 0.64 (iii) 3.75 (iv) 0.0003 (v) 0.005
4. (i) 18 (ii) ₹ 24 (iii) 36 m (iv) 108 (v) 3.75 kg
5. ₹ 6250
6. 9 matches
7. 12,800 men; 11,200 children
8. ₹ 38250
9. 3975 illiterates

Exercise 2.4

1. (i) A (ii) C (iii) C (iv) A (v) B
2. Profit = ₹ 24, Loss = ₹ 21;
   Profit = ₹ 35.45, Loss = ₹ 3362, Loss = ₹ 7.50
3. (i) ₹ 530 (ii) ₹ 620 (iii) ₹ 1027.50 (iv) ₹ 336.75 (v) ₹ 943.50
4. Profit 10%
5. Loss 12%
6. Profit 60%
7. Profit 15%

Exercise 2.5

1. (i) B (ii) A (iii) A (iv) C (v) A
2. ₹ 2,500; ₹ 7,500
3. ₹ 450; ₹ 1,650
4. ₹ 2,250
5. ₹ 2,630
6. ₹ 216; ₹ 12,216
7. 5%
8. ₹ 1,000

9. 2 years 10. 10% 11. 8 years

12. ₹ 5,400 13. ₹ 5,000; 10% 14. S.I. = 2025; ₹ 5,625 15. ₹ 4,000

Unit - 3

Exercise 3.1

1. (i) B (ii) A (iii) D (iv) D
2. (i) 50 cm^2 (ii) 66 cm^2 (iii) 80.5 cm^2
3. 12 cm 4. 875 m^2 5. 19.2 cm

Exercise 3.2

1. (i) B (ii) C (iii) A (iv) D (v) D
2. (i) d = 70 cm, c = 220 cm

   (ii) r = 28 cm, c = 176 cm

   (iii) r = 4.9 cm, d = 9.8 cm
3. (i) 110 cm (ii) 264 cm (iii) 374 cm (iv) 462 cm
4. (i) 79.2 cm (ii) 396 cm (iii) 8.8 m (iv) 26.4 m
5. (i) 17.5 cm (ii) 21 cm (iii) 0.7 m (iv) 1.75 m
6. 660 m 7. ₹ 1232 8. 1.05 m 9. 37 10. ₹ 4,752

Exercise 3.3

1. (i) 38.5 cm^2 (ii) 86.625 cm^2

   (iii) 18.865 m^2 (iv) 124.74 m^2
2. (i) 4.525 cm^2 (ii) 616 cm^2

   (iii) 55.44 m^2 (iv) 98.56 m^2
3. ₹ 1848 4. 154 m^2 5. circle has larger area
6. 38.5 m^2 7. 1936 cm^2 8. r = 35, ₹ 2200
9. 440 m 10. 63.36 Second 11. 10

Exercise 3.4

1. 636 m^2 2. ₹ 1152 3. ₹ 1590
4. 375 cm^2 5. 40 m^2, 30 m^2 6. 3256 cm^2

Exercise 3.5

1. 6594 m^2 2. 536.94 m^2 3. ₹ 24,050 4. 21.195 m^2
5. ₹ 4494 6. 2310 cm^2 7. 6 m 8. 2002 m^2

Unit - 4

Exercise 4.1

1. (i) B (ii) C (iii) C (iv) D (v) D
2. (i) $\angle A = 25°$, $\angle B = 35°$, $\angle C = 120°$
3. (i) 60° (ii) 70° (iii) 50° (iv) 50°
4. (i) 70° (ii) 60° (iii) 40° (iv) 30°
   (v) 65°, 65° (vi) 60°, 60°, 60°
5. (i) $y = 60°$, $x = 70°$ (ii) $y = 80°$, $x = 50°$ (iii) $y = 70°$, $x = 110°$
   (iv) $x = 60°$, $y = 90°$ (v) $y = 90°$, $x = 45°$ (vi) $x = 60°$, $y = 50°$
6. $x = 50°$.

Unit - 6

Exercise 6.1

1. (i) A (ii) B (iii) C (iv) C (v) B
2. Range is 50; A.M. = 70.8
3. 61.4 kg. 4. 40 litres 5. 34.9°C
6. 655.0 kg 7. 8 8. 130 gram 9. 60 10. 4 11. ₹ 28
12. 3 13. 32 gm and 40 gm 14. no mode 15. 15

'I can, I did'

Student's Activity Record

Subject :

Sl. No.	Date	Lesson No.	Topic of the Lesson	Activities	Remarks