GOVERNMENT OF TAMILNADU

STANDARD SIX

TERM II

VOLUME 2

MATHEMATICS

SCIENCE

SOCIAL SCIENCE

NOT FOR SALE

Untouchability is Inhuman and a Crime

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MATHEMATICS

Standard Six

Term II

1. Ratio, Proportion and Direct Variation

In this chapter we are going to learn about arithmetical concepts like ratio, proportion and variation which we consciously or unknowingly use in our daily activities.

1.1 Introduction

We buy a pen say for 10 rupees and a pencil for 2 rupees. We say that the cost of a pen is 5 times the cost of a pencil.

Divya is 5 years old while her sister is ten years old. Her sister's age is 2 times that of divya or divya 's age is $\frac{1}{2}$th the age of her sister.

In the above cases we are comparing 2 quantities of the same kind (i.e.,) cost in rupees and age in years respectively. The comparison of 2 quantities of the same kind by means of division is termed as **Ratio**.

1.2 Ratio

- Ratio is a way to compare two or more quantities of the same kind
- The ratio of two non-zero quantities a and b is written as a : b. It is read as "a is to b"
- The ratio is represented by the symbol " : "
- a and b are called as the terms of the ratio. 'a' is called as the antecedent and 'b' is called as the consequent
- The ratio is represented in numbers and it does not have any unit.
- Order in a ratio is important. a : b is different from b : a.

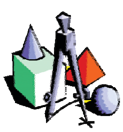
For example : there are 15 boys and 12 girls in a class.

The ratio of boys to girls is 15 : 12 while the ratio of girls to boys is 12: 15.

- When two quantities a and b are compared they must be in the same unit .

For example: If a = 1m 20 cm and b = 90 cm then a must be written as 120 cm and b= 90 cm

and the ratio a : b is 120 : 90



Example : 1

The following table gives us information about Ishwarya and krithika.

S.No.	Information	Ishwarya	krithika
1.	Age	17 years	15 years
2.	Height	1 m 36 cm	123 cm
3.	Weight	31 kg	29 kg
4.	Studying Time	4 hours	180 min
5.	Speed of cycling	10 km/hr	15 km/hr
6.	Playing Time	2 hours	1 hour

From the table we compare the ratios of the same kind and write the ratios as

1. The ratio of the age of Ishwarya to the age of Krithika is 17 : 15
2. The ratio of the age of Krithika to the age of Ishwarya is 15: 17
3. The ratio of the weight of krithika to Ishwarya is 29 : 31
4. The raio of studying time of Ishwarya to Krithika is 4 : 3

From the above table we see that the playing time of krithika is half of that of Ishwarya.

We write the ratio of playing time of krithika to that of Ishwarya as 1 : 2 or it can be expressed as a fraction $\frac{1}{2}$.

- If the terms of a ratio have common factors we can reduce it to its lowest terms by cancelling the common facto₹.

For example from the table the ratio of speed of cycling of Ishwarya to Krithika is 10 :15 .

The common factor is 5 and we can re write it as 2 : 3

Example : 2

S.No.	Quantity	Ratio form	Fraction form	Reduced form
1.	Ratio of 15 men and 10 women	15 : 10	$\frac{15}{10}$	3 : 2
2.	Ratio of 500 gm and 1 kg	500 : 1000	$\frac{500}{1000}$	1 : 2
3.	Ratio of 1 m 25 cm and 2m	125 : 200	$\frac{125}{200}$	5 : 8

Example : 3

1. A student has 11 note books and 7 textbooks. Find the ratio of the notebooks to that of the text books.

Solution : Number of note books = 11

Number of text books = 7

Ratio of the notebooks to the text books = 11 : 7

Example : 4

The cost of a pen is ₹.8 and the cost of a pencil is ₹.2.50

Find (1) The ratio of the cost of a pen to that of a pencil

(2) The ratio of the cost of a pencil to that of a pen.

Solution : The Cost of a pen = ₹.8.00 = 8.00x100 = 800 paise

The Cost of a pencil = ₹.2.50 = 2.50x100 = 250 paise

S.No.	Quantity	Ratio form	Fraction form	Reduced form
1.	Ratio of the cost of a pen to that of a pencil	800 : 250	$\frac{800}{250}$	16 : 5
2.	Ratio of the cost of pencil to that of a pen	250 : 800	$\frac{250}{800}$	5 : 16

Example : 5

In a Village of 10,000 people, 4,000 are Government Employees and the remaining are self-employed. Find the ratio of

i) Government employees to people of the village.

ii) Self employed to people of the village.

iii) Government employees to self-employed.

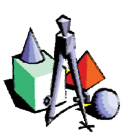
Solution :

Number of people in the village = 10,000

Number of Government employees = 4,000

$\therefore$ Self employed = 10,000 – 4,000 = 6,000

S.No.	Quantity	Ratio form	Fraction form	Lowest form of the Ratio
1.	Government employees to people of the village.	4000 : 10000	$\frac{4000}{10000}$	2 : 5
2.	Self employed to people of the village.	6000 : 10000	$\frac{6000}{10000}$	3 : 5
3.	Government employees to self employed.	4000 : 6000	$\frac{4000}{6000}$	2 : 3



Do These

1. Express the following ratios in the lowest form:
   (i) 3:5 (ii) 15:25 (iii) 22:55 (iv) 24:48

2. Express the following ratios in the lowest form:
   (i) 1kg to 500g (ii) 24cm to 4m (iii) 250ml to 3litres
   (iv) 45min to 2hrs (v) 30paise to 3Rs (vi) 70students to 2teachers

3. Sundar is 50 years old, his son is 10 years old. Write down the ratio between their ages.
   (i) 5 years ago (ii) At present (iii) After 5 years

4. Match the following ratios:

Column A	Column B
3:4	5:15
1:3	9:12
4:5	20:30
2:7	14:49
2:3	12:15

1.3 Equivalent Ratios

Let us divide an apple into 8 equal parts and share it between Raja and Vinod in the ratio 2: 6

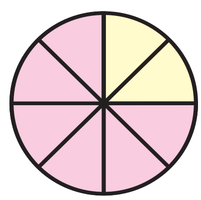
The ratio 2 : 6 can be written as $\frac{2}{6}$; $\frac{2}{6} = \frac{1}{3}$. We know that $\frac{2}{6}$ and $\frac{1}{3}$ are called as equivalent fractions. Similarly we call the ratios 2: 6 and 1: 3 as equivalent ratios.

From a given ratio a : b , we can get equivalent ratios by multiplying the terms 'a' and ' b 'by the same non-zero number.

For example

1: 2 = 2 : 4 = 3: 6

3: 5 = 9 : 15 = 12: 20



Example : 6

Write any 5 equivalent ratios for 5 : 7

Solution :

Given ratio = 5 : 7

The ratio in fractional form = $\frac{5}{7}$

The equivalent fractions of $\frac{5}{7}$ are $\frac{10}{14}, \frac{15}{21}, \frac{20}{28}, \frac{25}{35}, \frac{55}{77}$

$\therefore$ The equivalent ratios of 5 : 7 are 10 : 14, 15 : 21, 20 : 28, 25 : 35 and 55 : 77

Exercise : 1.1

1) Say whether the following are true or false
   - i) The ratios of 4 pens to 6 pens is 4 : 6
   - ii) In a class of 50 students, the ratio between 30 girls and 20 boys is 20 : 30
   - iii) 3 : 2 and 2 : 3 are equivalent ratios
   - iv) 10 : 14 is a equivalent ratio of 5 : 2

2) Choose the correct answer :

   i) The fractional form of 3 : 4 is ________

   (1) $\frac{4}{3}$ (2) $\frac{3}{4}$ (3) $\frac{1}{3}$ (4) 3.4

   ii) The equivalent ratio of 7 : 8 is ________

   (1) 14 : 16 (2) 8 : 9 (3) 6 : 7 (4) 8 : 7

   iii) Simplified form of 16 : 32 ________

   (1) $\frac{16}{32}$ (2) $\frac{32}{16}$ (3) 1:2 (4) 2:1

   iv) If 2 : 3, 4 : _ are equivalent ratios, then the missing term is

   (1) 2 (2) 3 (3) 4 (4) 6

   v) The ratio of 1 cm to 2mm is

   (1) 1:20 (2) 20:1 (3) 10:2 (4) 2:10

3) Simplify the following ratios :

   (i) 20:45 (ii) 100:180 (iii) 144:216

4) Write 4 equivalent ratios for the following :

   (i) 3:5 (ii) 3:7 (iii) 5:9

5) Write the ratio of the following and simplify :

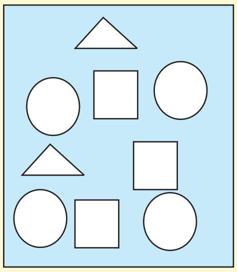
   (i) The ratio of 81 to 108 (ii) The ratio of 30 minutes to 1 hour and 30 minutes

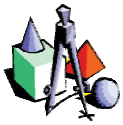
   (iii) The ratio of 60 cm to 1.2 m.

6) Seema's monthly income is ₹.20,000 and her savings is ₹.500. Find the ratio of
   - i) the monthly income to the savings
   - ii) the monthly income to the expenses
   - iii) savings to the expenses.

7) Out of 50 students in a class, 30 are boys. Find the ratio of
   - i) Boys to the total number of students
   - ii) Girls to the total number of students
   - iii) Boys to the Girls

8) From the given figure, find the ratio of
   - i) Number of triangles to Number of circles
   - ii) Number of circles to Number of squares
   - iii) Number of triangles to Number of squares
   - iv) Number of circles to total number of figures
   - v) Number of triangles to total number of figures
   - vi) Number of squares to total number of figures





9) Length and breadth of a rectangular field are 50 m and 15 m respectively. Find the ratio of the length to the breadth of the field.

10) Out of 30 students in a class, 6 like football, 12 like cricket and remaining like tennis. Find the ratio of

i) Number of students liking football to number of students liking tennis.

ii) Number of students liking cricket to number of students.

11) There are 102 teachers in a school of 3300 students. Find the ratio of the number of teachers to the number of students.

12) Fill in the following blanks : $\frac{15}{18} = \frac{\square}{6} = \frac{10}{\square} = \frac{\square}{30}$ (Are theses equivalent ratios?)

1.4 Comparison of Ratios

Since we can express ratios as a fraction ,so any given ratios can be compared by the method used for fractions.

Let us recall when we had to compare fractions we converted the fractions to have the same denominator.

Example : 7

Compare 3:5 and 4:7

We have to compare $\frac{3}{5}$ and $\frac{4}{7}$

The L.C.M of denominator 5 and 7 is 35.

$\frac{3}{5} = \frac{3}{5} \times \frac{7}{7} = \frac{21}{35}$ $\quad$ $\frac{4}{7} = \frac{4}{7} \times \frac{5}{5} = \frac{20}{35}$

$\frac{21}{35}$ is greater than $\frac{20}{35}$

$\therefore \frac{3}{5}$ is greater than $\frac{4}{7}$

Hence 3:5 is greater than 4:7

Example : 8

Divide ₹. 280 in the ratio 3:5

3:5 means the first quantity is 3 parts and the second quantity in 5 parts.

The Total number of parts = 3 + 5 = 8

8 parts = ₹.280

$\therefore$ 1part = $\frac{280}{8}$ =35

$\therefore$3 parts = $3 \times 35 =$ Rs.105

and 5 parts =5×35 =₹.175

Parts	Amount
8	280
3	?
5	?

Example : 9

The length and breadth of a rectangle are in the ratio 4:7. If the breadth is 77cm, find the length?

Breadth = 77cm

The ratio of length to breadth is 4:7

Parts	Measurements
7	77
1	?
4	?

Breadth = 7 parts

7parts = 77cm

1part $= \frac{77}{7}$ cm = 11cm

length = 4 parts

4parts = 4 × 11 cm = 44cm

∴ Length of the rectangle = 44cm.

Example : 10

In a village of 1,21,000 people, the ratio of men to women is 6 : 5

Find the number of men and women?

Solution : Number of people in the village = 1,21,000

Ratio of men to women = 6 : 5

Total number of parts = 6 + 5 = 11

Parts	No. of people
11	121000
6	?
5	?

11 parts = 1,21,000

$\therefore$ 1 part $= \frac{1,21,000}{11} = 11,000$

∴ Number of men in the village = 6 × 11,000 = 66,000

∴ Number of women in the village = 5 × 11,000 = 55,000

Exercise 1.2

1. Which is greater (i) 2:3 (or) 3:4 (ii) 4:5 (or) 5:7
2. Which is smaller (i) 3:4 (or) 4:5 (ii) 3:7 (or) 7:9
3. (i) Divide ₹. 400 in the ratio 3:5
   (ii) Divide 5kg 500gm in the ratio 5:6
   (iii) Divide 2m 25cm in the ratio 5:4
   (iv) Divide 5hours in the ratio 1:5
4. If ₹.6,600 is divided between Arun and Anand in the ratio 6:5, who will get more and how much more?
5. The length and breadth of a rectangle are in the ratio 7:2. If the length is 49cm. Find the breadth?

6. The ratio of expenditure and savings in a family is 5:3. If the expenditure is Rs3,500. What is the savings?
7. Rahim and Bhashir decides to share the gift money of competition in the ratio 7 : 8. If they receive ₹.7,500. Find the share of each.
8. There are 1,00,000 voters in the city. If the ratio of male to female voters is 11 : 9, find the number of men and women voters in the city.

1.5 Proportion

When two ratios expressed in its simplest form are equal they are said to be in proportion.

Proportion is represented by the symbol ‘ = ‘ or ‘:: ‘

If the ratio a: b is equal to the ratio c : d then a,b,c,d are said to be in proportion.

Using symbols we write as a: b = c: d or a: b :: c: d

Example : 11

1. Show that the ratios (i) 2 : 3, 8 : 12, (ii) 25 : 45, 35 : 63 are in proportion.

Solution :

	Ratio form	Fraction form	Simplified form
i)	2:3	$\frac{2}{3}$	2:3
	8:12	$\frac{8}{12}=\frac{2}{3}$	2:3
	$\therefore$ 2:3, 8:12 are in proportion		
ii)	25:45	$\frac{25}{45}=\frac{5}{9}$	5:9
	35:63	$\frac{35}{63}=\frac{5}{9}$	5:9
	$\therefore$ 25:45, 35:63 are in proportion		

Note : In the above example (ii), multiply 45 by 35 and 25 by 63

We get $25 \times 63 = 45 \times 35 = 1575$

If a : b and c : d are in proportion then $a \times d = b \times c$

The proportion is written as a : b :: c : d

In a proportion, the product of extremes is equal to the product of means.

Example : 12

Show that 12 : 9, 4 : 3 are in proportion.

Solution : The product of the extremes $= 12 \times 3 = 36$

The product of the means $= 9 \times 4 = 36$

$\therefore$ 12 : 9, 4 : 3 are in proportion

(i.e.) 12 : 9 :: 4 : 3

Example : 13

Find the missing term in 3 : 4 = 12 : ____

Solution :

The product of the extremes = The product of the means

Therefore $3 \times$ ____ $= 4 \times 12$; By dividing both sides by 3

we get the missing term $= \frac{4 \times 12}{3} = 16$

Example : 14

Using 3 and 12 as means, write any two proportions.

Given 3 and 12 are means

So, __:3 = 12 : __

The product of the means $3 \times 12 = 36$

The product of Extremes must be 36

36 can be written as 2×18 or 4×9 etc,

$\therefore$ 2:3=12:18 4:3=12:9

Two proportions are 2:3::12:18 and 4:3::12:9

Do These

1. Using 4 and 20 as means, write two proportions.
2. Using 6 and 15 as means, write two proportions.

Example : 15

If the cost of a book is ₹.12, find the ratio of 2, 5, 7 books to their cost. What do you observe from this?

No. of books	Total Cost	Ratio	Fraction form	Simplified form
2	$2 \times 12 = 24$	2 : 24	$\frac{2}{24}$	1 : 12
5	$5 \times 12 = 60$	5 : 60	$\frac{5}{60}$	1 : 12
7	$7 \times 12 = 84$	7 : 84	$\frac{7}{84}$	1 : 12

From the above table, we find that the ratio of the number of books to the cost of books are in proportion.

1.6 Direct Variation

Two quantities are said to be in direct variation if an increase (or decrease) in one quantity results in increase (or decrease) in the other quantity. (i.e.) If two quantities vary always in the same ratio then they are in direct variation.

Example : 16

Shabhana takes 2 hours to travel 35 km. How much distance she will travel in 6 hours?

Solution : When time increases the distance also increases.

Therefore, they are in direct variation

Time (hrs)	Distance (km)
2	35
6	?

$2 : 6 = 35 : \square$

missing term $= \frac{6 \times 35}{2} = 105$

Shabana has travelled 105 km in 6 hou₹.

Example : 17

The cost of uniforms for twelve students is ₹.3,000. How many students can get uniform for ₹.1250.

Solution :

No. of students	Cost of the uniform ₹.
12	3,000
?	1,250

When money spent decreases the number of uniform also drecreases.

They are in direct variation

$12 : \square = 3000 : 1250$

Missing Term $= \frac{12 \times 1250}{3000} = 5$

5 students can be given uniform for ₹.1,250.

Example : 18

Verify whether the following represents direct variation.

Numbers of books	10	8	20	4
Cost (in ₹.)	25	20	50	10

Arrange the data in ascending order.

Numbers of books	4	8	10	20
Cost (in ₹.)	10	20	25	50

Here the ratios are $\frac{4}{10} = \frac{2}{5}, \frac{8}{20} = \frac{2}{5}, \frac{10}{25} = \frac{2}{5}, \frac{20}{50} = \frac{2}{5}$

$$\therefore \frac{4}{10} = \frac{8}{20} = \frac{10}{25} = \frac{20}{25}$$

Here all the ratios are equal.

$\therefore$ They are in direct variation.

Exercise : 1.3

1) State whether the following ratios are in proportion.

i) 1:5 and 3:15 (Yes / No)

ii) 2:7 and 14:4 (Yes / No)

iii) 2:9 and 18:81 (Yes / No)

iv) 15:45 and 25:5 (Yes / No)

v) 30:40 and 45:60 (Yes / No)

2) Choose the correct answer :

i) Which of the following pair of ratios form a proportion.

(1) 3:4, 6:8 (2) 3:4, 8:6 (3) 4:3, 6:8 (4) 4:8, 6:3

ii) Find the missing term if 2:5 = ___ : 50

(1) 10 (2) 20 (3) 30 (4) 40

iii) If the cost of 6 balls is ₹.30 then the cost of 4 balls is

(1) ₹.5 (2) ₹.10 (3) ₹.15 (4) ₹.20

iv) If 5,6,10 ______ form a proportion (in the same order), the missing term is

(1) 60 (2) 50 (3) 30 (4) 12

v) When you divdide 100 in the ratio 3 : 2, we get ______

(1) 30, 20 (2) 60, 40 (3) 20, 30 (4) 40, 60

3) Verify whether the following represent direct variation or not.

i)

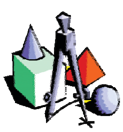
Time (in hrs)	2	5	4	3
Distance (in kms)	80	200	160	120

ii)

Age (in yrs)	2	6	4	8
Weight (in kg)	3.5	10.75	15	23

iii)

Principal (in Rs)	300	450	250	600
Interest (in Rs)	18	27	15	36



4) Complete the table if they are in direct variation.

i)

8	10	15	4	2
16	-	-	-	-

ii)

5	-	12	15	10
-	28	48	-	-

iii)

-	20	-	15	10
45	-	60	-	15

5) Sarath buys 9 cricket bats for ₹.1,350. How much will Manoj spend to buy 13 cricket bats at the same rate.

6) If a person reads 20 pages from a book in 2 hours, how many pages will he read in 8 hours at the same speed?

7) If 15 people can repair a road of length 150 metres, how many people are needed to repair a road of length 420 metres.

8) The rent for a room for 2 months is ₹. 9200 what will be the rent for one year for that room.

9) The cost of 15 chairs is ₹. 7500. Find the numbers of such chairs that can be purchased for ₹.12,000?

10) The cost of 10 kg rice is ₹.400. Find the cost of 3 kg rice?

11) A car needs 12 litres of petrol to cover a distance of 156 km

How much petrol will be required for the car to cover a distance of 1300 km?

1.7 Proportion - Application.

You would have seen models of cars , aircrafts, houses etc. We see that their dimensions have been suitably reduced and they look exactly like the actual cars or aircrafts or buildings. How are the dimensions of these models calculated?

Take your atlas and look at the map of India showing railway route or look at the road map of Chennai. We see that in the corner of the map it is written scale : 1 cm = 200 km. What does this mean? It means if the distance between Chennai and Delhi is say 11 cm the actual distance between the two cities is 11 x 200 = 2200 km.

We see that Ratio and proportion have a number of applications. you can find many more examples of applications of ratio and proportion. Try to find a few more.

Let the actual length of a rectangular garden be ‘a ‘metres. and let ‘ b ‘ be the length of the garden in a diagram. Then ratio between the actual length and the length in the diagram be a : b

Example : 19

A map is drawn to the scale of 1cm to 200km.

(i) What is the representive fraction.

(ii) If the distance between Nellai and Chennai is 3cm on this map, what is the actual distance between the two places?

Note the drawn length and the actual length are not in the same unit.

Therefore convert them into the same unit.

Now 200 km = 200×100000 cm [$\because$ 1km = 100000cm]

= 2,00,00,000cm

(i) The representive fraction = $\frac{1}{20000000}$

(ii) The distance between Nellai and Chennai (on the map) = 3 cm

The actual distance between Nellai and Chennai = $3 \times 200 = 600$ km

Exercise 1.4

1. A map is drawn in the scale 1cm to 1000km

   a) Express this as a representive fraction.

   b) What is the actual distance represented by 3.5cm in the map?

   c) What distance on the map will represent an actual distance of 2100km?

2. A scale used in a map is 1cm to 500m.

   i) Express as a representive fraction.

   ii) What is the actual distance represented by 5.5cm on the map?

   iii)What distance on the map will represent an actual length of 2500m?

3. Fill in the blanks .

	Scale	Actual Length	Drawn Length
i)	1 cm = 200m		4cm
ii)	1 cm = 250m	1750m	
iii)	1 cm =_____m	3700m	5cm

4. The scale of a graph is 1 cm = 200 km. (The distance 1 cm in the graph denotes 200 km in actual length). What would be the length of 3600 km on the graph?

Activity

- ✪ Draw a rough sketch of a rectangular field of length 400m and breadth 250m by taking a suitable scale.
- ✪ Look at the India map showing railway routes.

  Note the scale on the map and find the actual distance between

  1. Chennai and Calcutta   2. Chennai and Mumbai   3. Chennai and Delhi

Project

- ✪ Collect recipes of 2 dishes and find out how you can use them to explain ratio and proportion.
- ✪ Collect information about the height ,weight, study hours and play time of two of your friends and express your data as ratios.
- ✪ Collect data regarding number of students in your school and in your class , number of boys and girls in your class and in your school. Find out as many ratios as possible from your data.

Points to remember

- The comparison of two quantities of the same kind is called a ratio.
- When the terms of ratio are multiplied by the same number, we get equivalent ratios.
- The equality of two ratios is called a proportion.
- In a proportion, the product of extremes = product of means.
- If two quantities vary in the same ratio, then they are in direct variation.

2. Constants, Variables and Expressions

2.1 Introduction

We have so far dealt with numbers and shapes. We have learnt the fundamental operations on numbers and have learnt to apply them in real life situations. The study of numbers, their operations, properties and application is a branch of mathematics called Arithmetic. In this chapter we are going to start learning about another branch of mathematics called Algebra. It is an interesting branch of mathematics and one which provides us with a powerful tool to solve puzzles and problems that occur in science and social sciences.

Let us have a small game on numbers and learn to identify patterns .

The class may be divided into small groups and each group is asked to think of a 2 digit number. Then the groups execute the following steps.

Step 1 : Multiply the two digit number by 2.

Step 2 : Add 4 to the result

Step 3 : Multiply the result by 5

Step 4: then subtract 20 from the result

Step 5: divide the result by 10.

Check

1. $38\times2=76$
2. $76+4=80$
3. $80\times5=400$
4. $400-20=380$

All the groups will find that the final result they get is the same number they had thought of.

Let all the groups compare the number they get in step 4 .

For example if there are 5 groups and the result they get are 230, 420, 380, 370,180.

They should observe the pattern that had resulted and should be able to conclude that the result in the fourth step is always the product of the number they had taken and 10.

Do it Yourself

- Think of a 3 digit number (All the three digits should not be same).
- Form the largest and smallest number with the digits
- Subtract the smaller number from the larger number.
- Keep repeating the step till you get the same number in 2 succesive steps.
- Repeat the steps with another 3 digit number.
- The constant number you get is called as Kaprekar constant.

Exercise : 2.1

1) Find the missing number in the sequence. 5, 10, 15, _, 25, 30.

(i) 20 (ii) 2 (iii) 22 (iv) 23

2) Choose the next three shapes from the pattern

○ △ □ ○ △ — — —

(i) ○ △ □ (ii) □ ○ △ (iii) △ ○ □

(iv) ○ □ △

3.

First number	1	2	3	4	5	6
Second number	10	20	30	40	50	60

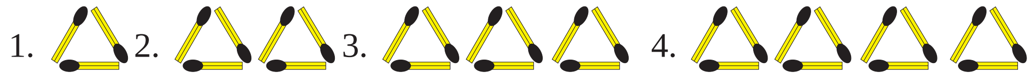
What is the pattern obtained from the table?

(i) Second number = 10 + first number. (ii) Second number = 10 – first number.

(iii) Second number = 10 ÷ first number. (iv)Second number = 10 × first number.

2.2 Introduction of constants and variables through patterns

Latha made the following triangular patterns with the match sticks she had.



To find out the total match sticks used for the above formation she prepared the following table.

Numbers of triangles	1	2	3	4	....	
Number of match sticks used.	3	6	9	12	....	
	3×1	3×2	3×3	3×4	....	

From the table we observe that the number of match sticks required changes with the number of triangles formed.In each case the value of the number of matchsticks is dependent on the number of triangles. If we represent the number of triangles by the letter x we can write the relation as

Number of matchsticks required = 3 x x which is written as $3x$

The above relation is a rule to find the number of matchsticks when x takes values 1,2,3 ….

'x' is an example of a variable.

When $x = 2$, number of matchsticks $= 3 \times 2 = 6$

When $x = 3$, number of match sticks $= 3 \times 3 = 9$.

Hence if we need to know the number of matchsticks needed to form say 15 triangles, we need not draw the pattern or a table. We can take $x = 15$. Then number of matchsticks $= 3 \times 15 = 45$.

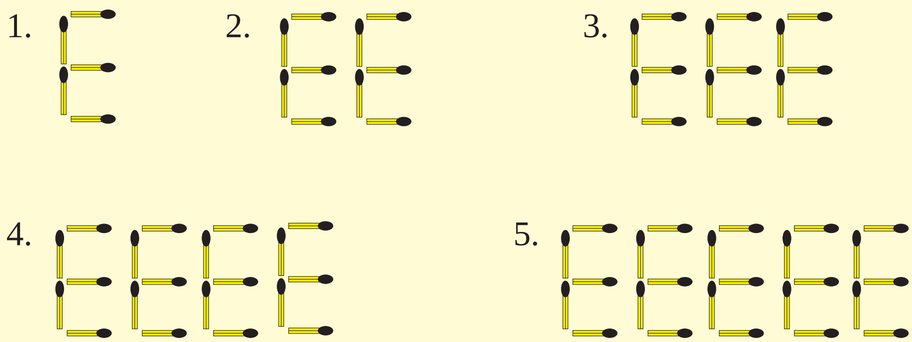
Therefore the quantity that takes different numerical values is called as a variable. variable does not have a fixed value , its value keeps changing.

We represent variables using small case letters of the alphabet, a,b,c……… x,y,z.

From the pattern on triangles we see that the number of match sticks used to form a triangle remains same irrespective of the number of triangles formed.

Such a quantity which takes a fixed numerical value is called as a constant.

Example : 1



Number of E formation	1	2	3	4	5	....	
Number of match sticks used	5	10	15	20	25	....	
	5×1	5×2	5×3	5×4	5×5		

Law obtained from the above table.

Number of match sticks used = $5 \times$ (Number of E formation)

Number of E formation is denoted as the variable x.

Therefore, number of match sticks used = $5 \times x = 5x$

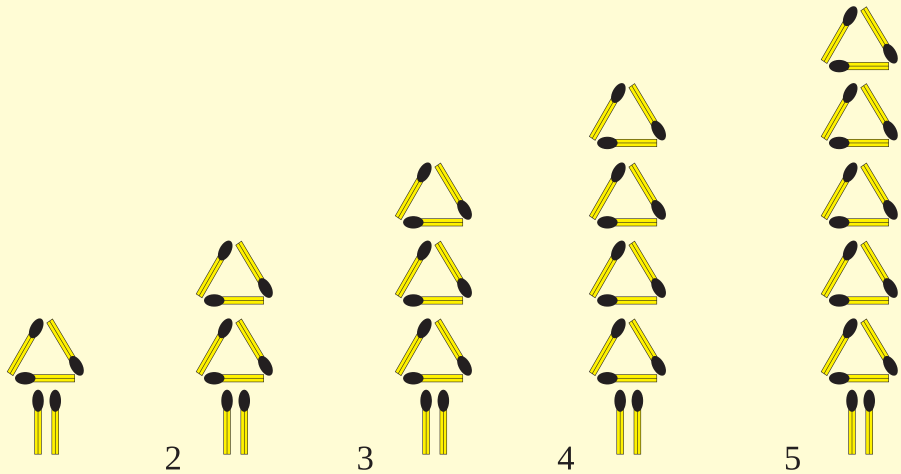
Note :

Step 4 of the game at the beginning can now be written as

Result = 10 y where y is the 2 digit number initially taken.

Example : 2

Look at the pattern of the Asoka tree given. The base is always formed with two match sticks. The top portion of the tree differs in multiples of 3.



1 2 3 4 5

Number of top portions	1	2	3	4	5	....	
Number of match sticks needed for the top portion	3	6	9	12	15	....	
	3×1	3×2	3×3	3×4	3×5	....	
Number of match sticks needed for the base	2	2	2	2	2		
Total number of match sticks used	$(3\times1)+2$	$(3\times2)+2$	$(3\times3)+2$	$(3\times4)+2$	$(3\times5)+2$	....	

Law obtained from the above table,

Number of match sticks used = (3 × Number of top portions) + Number of match sticks used for the base

If the number of triangular formations is denoted as the variable x,

Number of match sticks used $= (3 \times x) + 2 = 3x + 2$

Exercise 2.2

1. Choose the correct answer:

a)

First number	16	26	36	46	56	66
Second number	10	20	30	40	50	60

Choose the law in which the above pairs are based on?

1) Second number = first number $+ 6$

ii) Second number = first number $- 6$

iii) Second number = first number $\div 6$

iv) Second number = first number $\times 6$

b)

First number	1	2	3	4	5
Second number	9	10	11	12	13

Choose the law in which the above pairs are based on?

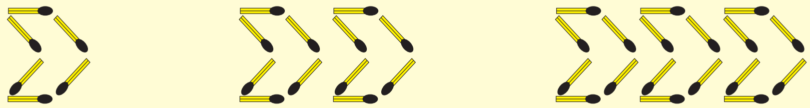
i) Second number = first number $\div 8$ ii) Second number = first number -8

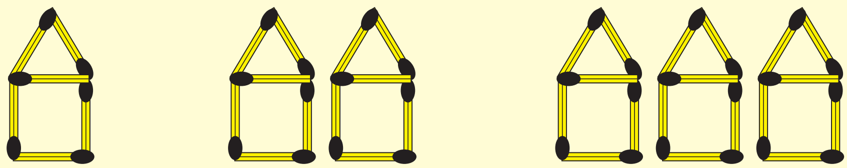
iii) Second number = first number + 8 iv) Second number = first number $\times 8$

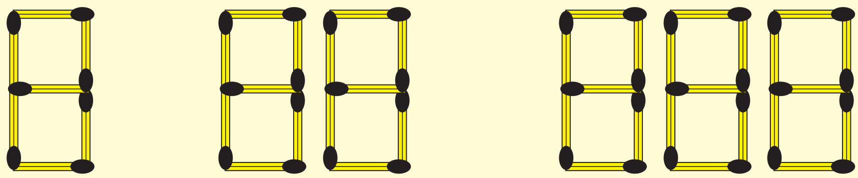
2. If a box contains 40 apples, the total number of apples depends on the number of boxes given. Form an algebraic term (Consider the number of boxes as ‘x’).

3. If there are 12 pencils in a bundle, the total number of pencils depends on the number of boxes given . Form an algebraic term (Consider the number of bundles as ‘b’).

4. From the following patterns given below, form an algebraic term.

i) 

ii) 

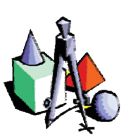
iii) 

Project

✪ Make one square, two squares, three squares ... ten squares using match sticks and listout how many match sticks are required for each squares.

Points to remember

- A variable denotes the quantity that can take different numerical value. The result changes in a rule when the variable changes its value.
- Variables are denoted by small letters a, b, c, ... x, y, z...
- Expressions can be related using variables.
- In arithmetic and geometry, formulae are obtained using variables.



3. Measures of Time

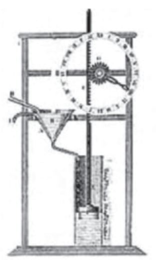
Introduction

The measurement of time began when people started to observe that certain events like rising and setting of sun, change of seasons, waxing and waning of the moon etc. happened at regular intervals. You have learnt in your geography lessons that the earth rotates about its axis and this rotation causes day and night. This regular change was most obvious and was observed byastronomers. This led to the invention of variety of devices to measure the duration of events and the intervals between them based on the se regular changes. The time interval between successive rising of the sun was called a day.

Study of devices measuring time is called horology

Variety of devices has been designed to measure time from early civilisations. Egyptians and Indians have used shadow clock and water clock, Chinese have used rope clocks and oil clocks, and Europeans have used oil, candle and sand clock. In course of time more clocks to measure time accurately have been invented.





Shadow Clock Candle Clock Rope Clock Water Clock Sand Clock

The division of the day into 24 hours, an hour into 60 minutes and a minute into 60 seconds, probably came from the Babylonians. They divided the circular path of the sun across the day sky, into 12 equal parts, awarded the night cycle 12 hours and concluded a 24 hour day.

3.1 Units of time

Second, minute, hour, day, week, month and year are all units of time. Let us learn the relationship between the units.

1 minute = 60 seconds
1 hour = 60 minutes = 60 $\times$ 60 seconds
= 3600 seconds
1 day = 24 hours = 1440 minutes (24 $\times$ 60)
= 86,400 seconds (24 $\times$ 60 $\times$ 60)

60 seconds = 1 minute
1 sec = $\frac{1}{60}$ minute
60 minutes = 1 hour
1 minute = $\frac{1}{60}$ hour

Example : 1

Convert 120 Seconds into minutes

Solution:

120 seconds = 120 $\times \frac{1}{60} = \frac{120}{60}$ = 2 minutes

120 seconds = 2 minutes

$\because$ 60 seconds = 1 minute

1 second = $\frac{1}{60}$ minute

Example : 2

Convert 360 minutes into hours

Solution :

360 minutes = 360 $\times \frac{1}{60}$ = 360/60 = 6 hours

360 minutes = 6 hours.

60 minutes = 1 hour

$\therefore$ 1 minute = $\frac{1}{60}$ hour

Example : 3

Convert 3 hours 45 minutes into minutes

Solution : 1 hour = 60 minutes

3 hours = 3 $\times$ 60 = 180 minutes

3 hours and 45 minutes = 180 minutes + 45 minutes

= 225 minutes.

Example : 4

Convert 5400 seconds into hours

Solution :

5400 Seconds = 5400 $\times \frac{1}{3600}$ hour

$= \frac{9}{6} = \frac{3}{2} = 1\frac{1}{2}$ hours.

5400 seconds = 1 $\frac{1}{2}$ hours.

3600 seconds = 1 hour

$\therefore$ 1 second = $\frac{1}{3600}$ hour

Do it yourself

1) Convert the duration of the lunch break into seconds.

2) Convert play time in the evening into hours.

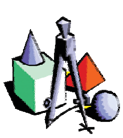
Example : 5

Convert 2 hours 30 minutes 15 seconds into seconds.

Solution : 1 hour = 3600 seconds $\Rightarrow$ 2 hours = 2 $\times$ 3600 = 7200 seconds

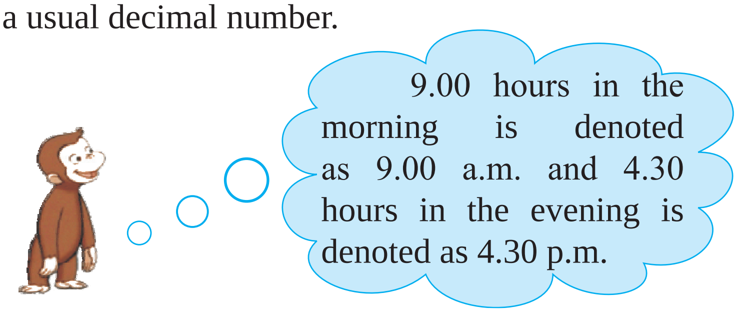
1 minute = 60 seconds $\Rightarrow$ 30 minutes = 30 $\times$ 60 = 1800 seconds

2 hours 3 minutes 15 seconds = 7200 + 1800 +15 = 9015 seconds.



We normally denote time from 12 mid-night to 12 noon as a.m. (Ante meridiem) and the time from 12 noon to 12 mid-night is noted as p.m. (post meridiem).

Note : We denote 4 hours and 30 minutes as 4 : 30 (or) 4 . 30. Even though we are using the decimal point it is not a usual decimal number.



Exercise 3.1

1. Fill in the blanks
   - i) 1 hour = -----------------minutes
   - ii) 24 hours = -----------------day
   - iii) 1 minute = -----------------seconds
   - iv) 7 hours and 15 minutes in the morning is denoted as-------------------------
   - v) 3 hours and 45 minutes in the evening is denoted as-------------------------

2. Convert into seconds
   - i) 15 minutes
   - ii) 30 minutes 12 seconds
   - iii) 3 hours 10 minutes 5 seconds
   - iv) 45 minutes 20 seconds

3. Convert into minutes
   - i) 8 hours
   - ii) 11 hours 50 minutes
   - iii) 9 hours 35 minutes
   - iv) 2 hours 55 minutes

4. Convert into hours
   - i) 525 minutes
   - ii) 7200 seconds
   - iii) 11880 seconds
   - iv) 3600 seconds

3.2 Railway time

Study the following table. What do you observe?

Sl.No.	Train Number	Name of the Train	Place of Departure	Destination	Departure Time	Arrival Time
1.	2633	Kanyakumari Express	Egmore	Kanyakumari	17.25 hrs.	6.30 hrs.
2.	2693	Muthunagar Express	Egmore	Tuticorin	19.45 hrs.	6.15 hrs.
3.	6123	Nellai Express	Egmore	Nellai	19.00 hrs.	8.10 hrs.
4.	2637	Pandian Express	Egmore	Madurai Junction	21.30 hrs.	6.15 hrs.
5.	6177	Rock Fort Express	Egmore	Trichirappalli	22.30 hrs.	5.25 hrs.
6.	2635	Vaigai Express	Egmore	Madurai	12.25 hrs.	20.10 hrs.
7.	2605	Pallavan Express	Egmore	Trichirappalli	15.30 hrs.	20.50 hrs.

We see that in the departure and arrival time we see time written as 21.30 hours, 17.25 hours etc. It is different from what we generally use like 5.30 a.m. or 5.30 p.m. The railways follow a 24 hour clock to avoid any confusion between am and pm.

In a 24 hour clock, 12 o' clock midnight is taken as zero hour. 1 o' clock in the afternoon will be 13 hours , 2 o' clock as 14 hours ,……………….. and 11 o' clock as 23 hours.

In the following examples you will learn how to convert time in 12 hour format to a 24 hour format and vice versa.

Example : 6

Convert the following into 24 hour format.

i) 8 a.m. ii) 12 noon iii) 5.30 p.m.

i) In this case when the time is before noon the time is same in the 12 hour and 24 hour format. $\therefore$ 8 a.m. = 8.00 hours

ii) 12 noon = 12 hours

iii) for time in the afternoon add 12 to the given time

$\therefore$ 5.30 pm will become 5.30 + 12 = 17.30 hours.

Example : 7

Convert the following into 12 hour format

i) 6.00 hours ii) 23.10 hours iii) 24 hours

i) If the number is less than 12 it will be taken as am and the time remains same
$\therefore$ 6.00 hours = 6 .00 a.m.

ii) If it is greater than 12, 12 will be subtracted from the given time and it will be taken as p.m.
23.10 – 12 = 11.10 p.m.

iii) 24 hours = 24 – 12 = 12 midnight

Exercise 3.2

1. Express in 24 hour format.
   (i) 6.30 a.m. (ii) 12.00 midnight (iii) 9.15 p.m. (iv) 1.10 p.m.
2. Express in 12 hour format.
   (i) 10.30 hours (ii) 12.00 hours (iii) 00.00 hours (iv) 23.35 hours

3.3 Calculating time interval

Deepa said to her friend Jancy that she studied for 3 hours from 8.00 a.m. to 11.00 a.m. How did Deepa calculate the duration of time as 3 hours?

Example : 8

Find the duration of time from 4.00 a.m. to 4.00 p.m.

Solution :

4.00 pm = 4 + 12 = 16 hours.

4.00 am = 4 hours

$\therefore$ Duration of time interval = 16 – 4 = 12 hours

Example : 9

Cheran Express departs from Chennai at 22.10 hours and reaches Salem at 02.50 hours the next day. Find the jouney time.

Solution :

Arrival at Salem	=	02.50 hrs.
Departure time form Chennai (previous day)	=	22.10 hrs.
Journey time	=	(24.00 – 22.10) + 2.50 = 1.50 + 2.50 = 4.40

$\therefore$ Journey time = 4 hours 40 minutes.

Example : 10

A boy went to school at 9.00 a.m. After school, he went to his friend's house and played. If he reached back home at 5.30 p.m. find the duration of time he spent out of his house.

Solution :

Starting time from home = 9.00 a.m.

Duration between starting time and 12.00 noon = 12.00 – 9.00

= 3.00 hours

Reaching time (home) = 5.30 p.m

$\therefore$ Duration of time he spent out of his house = 3.00 + 5.30 = 8.30 hours.

Exercise 3.3

1. Calculate the duration of time
   (i) from 3.30 a.m to 2.15 p.m. (ii) from 6.45 a.m. to 5.30 p.m.
2. Nellai Express departs from Tirunelvelli at 18.30 hours and reaches Chennai Egmore at 06.10 hours. Find the running time of the train.
3. Sangavi starts from her uncle's house at 10.00 hours and reaches her house at 1.15 p.m. What is the duration of time to reach her house?

3.4 Leap Year

Rama was celebrating his birth day happily. His friend Dilip was sitting aloof at a corner. Rama asked Dilip "why are you sad?". Dilip replied "I can't invite you every year for my birthday". When Rama asked 'why', Dilip said "I can celebrate my birth day only once in 4 years". Rama exclaimed "why is that so?"

"Because my birthday falls on 29th February" replied Dilip.

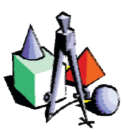
Satish asked "29" February! what are you talking Dilip? But February has only 28 days". "Yes Satish, generally it is 28 days. But once in 4 years February has 29 days. We call that year as a leap year. There are 366 days in a leap year and 365 days in an ordinary year" Dilip said.

"Why do we have an extra day in a leap year?"

"I don't know. Let us ask our teacher" replied Dilip.

Both went to meet their teacher and expressed their doubt. The teacher explained the reason as follows:

You know that the earth takes one year to make one complete revolution around the sun and 365 days make 1 year. But in fact the earth takes 365.25 days to make one revolution.



This extra 0.25 day x 4 gives one full day. This extra one day is added to the month of February once in 4 years. Every year that has 366 days it is called a leap year. Therefore in a leap year February will have 29days.

1day	=	24 hours
1 week	=	7 days
1 year	=	12 months
1 year	=	365 days
1 leap year	=	366 days
10 years	=	1 decade
100 years	=	1 century
1000 years	=	1 millennium

Know yourself
1. Which century are we in?
2. Which is a millennium year?

How will you identify a leap year?

A year which is divisible by 4 is a leap year. For example the years 1980, 2012, and 2016 are all leap years.

100, 200 are divisible by 4. Are they leap years?

No. We have a second rule which states that years which are multiples of 100 though they are divisible by 4 have to be divisible by 400 then only the years will be leap years.

100, 200, 300 are not leaping years while 1200, 1600, 2000 are all leap years.

Example : 11

Which of the following are leap years?

(i) 1400 (ii) 1993 (iii) 2800 (iv) 2008

solution : (i) Divide 1400 by 400

1400 ÷ 400 gives

Quotient 3, Remainder 200

∴ 1400 is not a leap year

$$\begin{array}{r} 3 \\ 400\overline{)1400} \\ 1200 \\ \hline 200 \end{array}$$

(ii) Divide 1993 by 4

1993 ÷ 4 gives Quotient 498 remainder 1

∴ 1993 is not a leap year.

$$\begin{array}{r} 498 \\ 4\overline{)1993} \\ 16 \\ \hline 39 \\ 36 \\ \hline 33 \\ 32 \\ \hline 1 \\ \hline \end{array}$$

(iii) Divide 2800 by 400

2800 ÷ 400 gives Quotient = 7, Remainder = 0

∴ 2800 is leap year.

$$\begin{array}{r} 7 \\ 400\overline{)2800} \\ 2800 \\ \hline 0 \\ \hline \end{array}$$

(iv) Divide 2008 by 4

2008 ÷ 4 gives Quotient = 502, Remainder = 0

∴ 2008 is leap year.

$$\begin{array}{r} 502 \\ 4\overline{)2008} \\ 20 \\ \hline 08 \\ 08 \\ \hline 0 \\ \hline \end{array}$$

Example : 12

Find the number of days from 15th August to 27th October.

Solution :

There are 31 days in August.

Number of days in August = 31 – 14 = 17 days

Number of days in September = 30 days

Number of days in October = 27 days

Total = 74 days

Note :
Since it is given from 15th August Substract 14 days (Prior to 15th) from 31 (The total number of days of the month)

Example : 13

Convert 298 days into weeks.

Solution :

298 days = $\frac{298}{7}$ weeks

$\therefore$ 298 days = 42 weeks and 4 days.

1 week = 7 days.
1 day = $\frac{1}{7}$ week.

Example : 14

Find the number of days between 12th January 2004 and 7th March 2004.

Solution :

Find whether the given year is a leap year or not.

2004 $\div$ 4

Quotient = 501, remainder = 0.

$\therefore$ 2004 is a leap year and has 29 days in February.

Number of days in January = 31–12 = 19 days

Number of days in February = 29 days

Number of days in March = 6 days

Total Number of days = 54 days

$\therefore$ Number of days between 12th January 2004 and 7th March 2004 are 54 days.

Exercise 3.4

1. Fill in the blanks.

(i) 1 week = __________ days.

(ii) In a leap year, February has __________days.

(iii) 3 days = __________ hours.

(iv) 1 year = __________ months.

(v) 1 hour = __________ seconds.

2. Which of the following are leap years?

   (i) 1992 (ii) 1978 (iii) 2003 (iv) 1200 (v) 1997

3. Find the number of days from 4th January 1996 to 8th April 1996.
4. Find the number of days from 5th January 2001 to 28th April 2001.
5. Find the number of days between 26th February 2000 and 7th June 2000.
6. Find the number of days between 20th February 2004 and 27th May 2004.
7. Convert into weeks.

   (i) 328 days (ii) 175 days

Example : 15

An office functions from 10 in the morning till 5.45 in the evening with a lunch break in the afternoon from 12.45 to 1.30. If the office works for 6 days a week, find the total duration of working hours in a week.

Solution :

		hrs.	min.
The closing time of the office	=	17	45
The opening time of the office	=	10	00
Time in between	=	07	45
Lunch break [13:30-12:45]	=	00	45
Working hours for 1 day	=	07	00

5.45 p.m. = 17.45 hrs

1.30 p.m. = 13.30 hrs.

Hrs.	Min.
12	90
$\cancel{13}$	$\cancel{30}$
12	45
0	**45**

$\therefore$ Total working hours for 6 days = 7×6 hrs.

= 42 hrs.

$\therefore$ Total duration of working hours in a week = 42 hrs.

Example : 16

A clock is fast by 5 seconds per hour find the time that it will show at 4 p.m. if it was adjusted to correct time at 6 a.m.

Solution :

4 p.m. = 16.00 hrs.

6 a.m . = 06.00 hrs.

Duration of time = 10.00 hrs.

In 1 hr, the clock runs fast by 5sec.

In 10 hrs, it runs fast by 10×5sec. = 50sec.

Hence, the clock will show 50sec more than the correct time at 4 p.m. (i.e.) at 4 p.m., the clock will show 4 hrs 00 Min 50 sec in the afternoon.

Do These

1. A bank functions from 9 in the morning till 3.30 in the afternoon with a lunch break in the afternoon from 12.30 to 1.15. If the bank works for 6 days in a week, find the total duration of working hours in a week.
2. A clock is slow by 6 seconds. per hour. If it was adjusted to correct time at 5.a.m. find the time the clock will show at 3.00.p.m.

Activity

- List your daily routines in 24 hour timings and convert them into 12 hour timings.
- Make them to find out the leap years between 1980 to 2012.
- Divide the class into different groups. Ask them to compare their ages and find out the eldest. Compare all the groups and find the eldest and youngest in the class.
- Find out the years of your birthday and family members as ordinary year or a leap year.

Do These

1. Convert the following into seconds:

i) 2 minutes = $\boxed{}$ sec

ii) 5 minutes 7 seconds = $\boxed{}$ sec

iii) 2.5 minutes = $\boxed{}$ sec

iv) 3.5 hrs = $\boxed{}$ sec

2. Convert the following into minutes

i) 30 seconds = ☐ min.

ii) 2.4 hrs = ☐ min.

iii) 1 hr. 16 min. = ☐ min.

iv) 2 days 1 hr. = ☐ min.

3. Convert the following into hours.

i) 90 minutes = ☐ hrs.

ii) 2.25 days = ☐ hrs.

iii) 2 days 14 hrs = ☐ hrs.

iv) 1 week 2days = ☐ hrs.

4. Calculate the time interval for the following

i) 4.45 p.m. to 9.50 p.m. Ans : ☐ hrs. ☐ mins.

ii) 7.15 a.m. to 7.25 p.m. Ans : ☐ hrs. ☐ mins.

iii) 2.05 p.m. to 6.45 a.m. the next day. Ans : ☐ hrs. ☐ mins.

iv) 5.36 a.m. yesterday to 9.38 p.m. today. Ans : ☐ hrs. ☐ mins.

Points to remember

- Seconds, minutes, hours, day, week, month and year are the units of time.
- 12.00 midnight to 12.00 noon is forenoon.
- 12.00 noon to 12.00 midnight is afternoon.
- 12 hours in forenoon and 12 hours in afternoon together gives 24 hours of railway timings.
- An ordinary year has 365 days. But a leap year has 366 days.

4. Angles

4.1 Introduction

Mark a point ‘O’ on a sheet of paper. From ‘O’ draw two rays $\overrightarrow{OA}$, $\overrightarrow{OB}$ as shown in the figure.

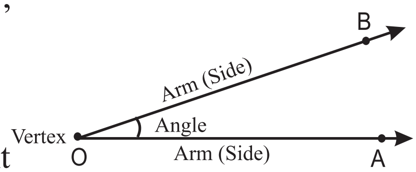


fig.1

In this figure both the rays start from a single point ‘O’. An angle is formed at ‘O’. Two rays $\overrightarrow{OA}$, $\overrightarrow{OB}$ are called as arms (or sides) of the angle. The common point ‘O’ is called as the ‘vertex’ of the angle. The angle is represented by a small curve as shown in the figure 1.

The figure formed by two rays with the same initial point is called an angle.

The angle shown in fig. 1 is represented as $\angle AOB$ or $\angle BOA$. We read it as angle AOB or angle BOA. Vertex of the angle is always written in the middle. Sometimes the angle is represented as $\angle O$.

Observe the adjacent figure (fig.2)

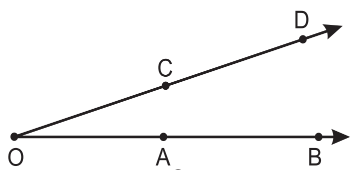


fig.2

We know that rays are named by two points - one at its start and one on the remaining portion. So, $\overrightarrow{OA}$, $\overrightarrow{OB}$ represent the same ray. Likewise $\overrightarrow{OC}$, $\overrightarrow{OD}$ also represent the same ray. Therefore, the angles can be represented by the following ways.

$\angle O$, $\angle COA$, $\angle DOA$, $\angle COB$, $\angle DOB$, $\angle AOC$, $\angle AOD$, $\angle BOC$, $\angle BOD$

In fig.3, with ‘O’ as the centre, $\overrightarrow{OA}$ rotates in the anticlockwise direction and reaches $\overrightarrow{OB}$.

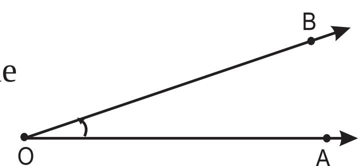


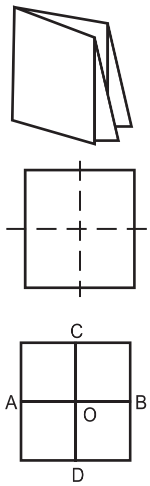
fig.3

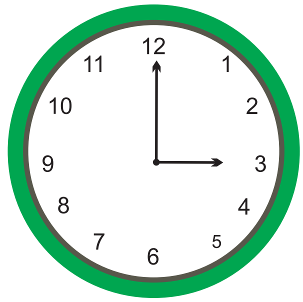
The rotation made by the ray is called the measure of that angle.

Right angle

Fold a piece of paper as shown in the figure and unfold it. We get two intersecting line segments. Name these as AB and CD. These line segments make four angles at the point of intersection 'O'. We see that the four angles

∠AOC, ∠BOC, ∠DOB, ∠AOD are equal.

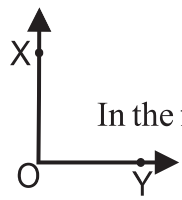




The measure of the angle at 3 o' clock = 90°.

Each of them is called a right angle.

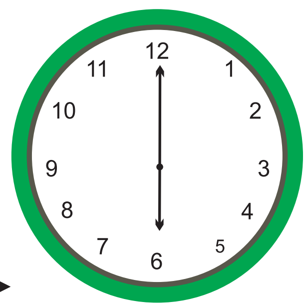
Right angle measures 90°.



In the fig. ∠XOY is a right angle

Straight angle

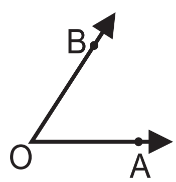
An angle whose measure is 180° is called a striaght angle.

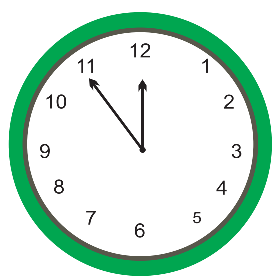


Measure of the angle at 6 o' clock = 180°.

Acute angle

An angle whose measure is greater than 0° but less than 90° is called an acute angle Example : 2°, 10°, 37°, 80°, 89°.



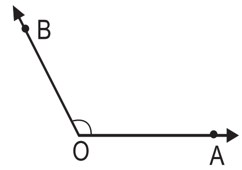


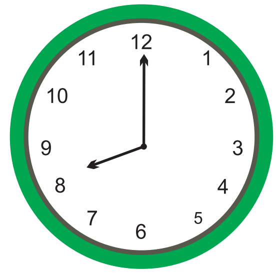
Measure of the angle at 11.55.

Obtuse angle

An angle whose measure is greater than 90° and less than 180° is called an obtuse angle

Example : 91°, 96°, 142°, 160°, 178°.

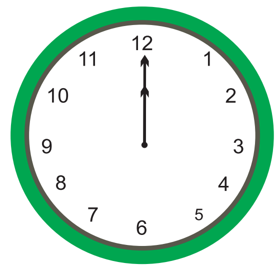




Measure of the angle at 8 o' clock.

Zero angle

If both the rays coincide, the angle formed is 0°.



Measure of the angle at 12 o' clock.

Note

The angle traced out by the minute hand in one hour or 60 minutes = 360 degree

Hence angle traced out by the minute hand in one minute = $\frac{360}{60}$ = 6 degree

Let number of minutes = m then the rule for calculating the angle traced in m minutes = 6m

If m = 5 minutes then angle traced by the minute hand in 5 minutes = 6 × 5 = 30 degree

Exercise 4.1

1. State whether the given angles are acute, right or obtuse angle.

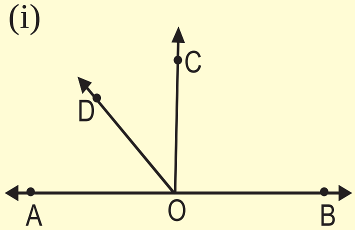
   (i) 45° (ii) 138° (iii) 100° (iv) 175°

2. Classify the type of the angle formed by the hour hand and minute hand of a clock for the following timings:

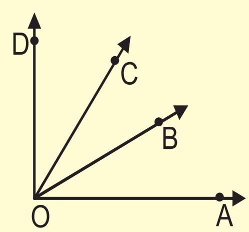
   (i) 12.10 (ii) 4.00 (iii) 9.00 (iv) 7.45

3. Name the angles and write its kind.

(i)



(ii)



Activity

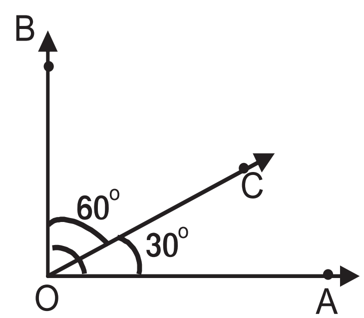
1. Through how many degrees does the minute - hand turn in 15 minutes?
2. Through how many degrees does the minute-hand turn in 30 minutes?
3. Through how many degrees does the minute-hand turn in 1 hour?
4. Through how many degrees does the hour-hand turn in 3 hours?
5. Through how many degrees does the hour-hand turn in 6 hours?
6. Give some examples for right angle from your environment?

4.2 Complementary angles and Supplementary angles

Complementary angles

In the figure given $\angle AOB = 90^\circ$, we know that it is a right angle. The other angles are

$\angle \text{AOC} = 30^\circ, \angle \text{COB} = 60^\circ$. Sum of $\angle$AOC and $\angle$COB is 90^o.



(i.e) $30^o + 60^o = 90^o$

30^o and 60^o are complementary angles.

If the sum of the measures of two angles is 90^o then they are called complementary angles.

For Example :

When a ladder is leaning on a wall, the angles made by the ladder with the floor and the wall are always complementary.

Example : 1

The complement of $40^o = 90^o - 40^o = 50^o$

The complement of $66^o = 90^o - 66^o = 24^o$

The complement of $35^o = 90^o - 35^o = 55^o$

Supplementary angles

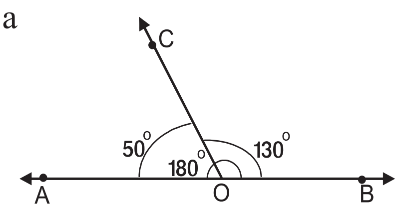
In the given figure the angle formed by AB with 'O' is a straight angle (ie) 180^o.

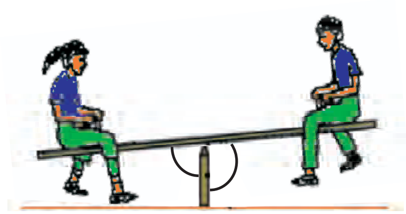
Here $\angle \text{AOC} = 50^\circ, \angle \text{COB} = 130^\circ$.

Moreover the sum of these two is 180^o.

(i.e.) $130^o + 50^o = 180^o$

130^o and 50^o are supplementary angles.





If the sum of measures of two angles is 180° then they are called supplementary angles.

Example : The angles formed at the centre point of a see-saw are always supplementary angles.

supplement of 40° = 180° – 40° = 140°	supplement of 78° = 180° – 78° = 102°
supplement of 110° = 180° – 110° = 70°	supplement of 66° = 180° – 66° = 114°

Exercise 4.2

1. Find the complementary angles for the following.

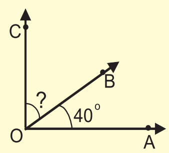
   (i) 37° (ii) 42° (iii) 88° (iv) 0° (iv) 16°

2. Find the supplementary angles for the following.

   (i) 6° (ii) 27° (iii) 88° (iv) 104° (v) 116° (vi) 146° (vii) 58° (viii) 179°

3. Find the measures of the angle from the figure.

   $\angle BOC$ = _______



4. State whether true or false.

   (i) Measure of a striaght angle is 180°.

   (ii) If the sum of the measure of two angles is 90°, then they are called complementary angles.

   (iii) Complement of 26° is 84°.

   (iv) If the sum of the measures of two angles is 180°, then it is called a right angle.

   (v) The Complement of an acute angle is an acute angle.

   (vi) The supplement of 110° is 70°.

5. State whether the given angles are complementary or supplementary

   (i) 25°, 65° (ii) 120°, 60° (iii) 45°, 45° (iv) 100°, 80°

6. (i) Find the angle which is equal to its complement?

   (ii) Find the angle which is equal to its supplement?

7. Fill in the blanks

   (i) Supplement of a right angle is ....

   (ii) Supplement of a acute angle is ....

   (iii) Supplement of a obtuse angle is ....

   (iv) Complement of an acute angle is ....

Project

- Use paper folding method to form different angles and list them.
- From your home or school environment identify different angles and classify as acute, obtuse or right angle. For example angle formed at the corner of a room = 90 degree.
- Make a model of a clock and trace different angles of your choice.

Try These

1. State the type of angle (acute, right, obtuse or straight) for the following:

   i) 45^o Type of angle : ☐ ii) 62^o Type of angle : ☐

   iii) 90^o Type of angle : ☐ iv) 105^o Type of angle : ☐

   v) 180^o Type of angle : ☐ vi) 32^o Type of angle : ☐

   vii) 155^o Type of angle : ☐ viii) 162^o Type of angle : ☐

2. Calculate the complementary angles for

   i) 15^o complementary angle = ☐ degrees

   ii) 79^o complementary angle = ☐ degrees

   iii) 56^o complementary angle = ☐ degrees

3. a and b are complementary angles. If a = b find the value of a.

   a = ☐ degrees

4. x and y are complementary angles. If x = 2y find the values of x and y.

   x = ☐ degrees, y = ☐ degrees

5. Calculate the supplementary angles for

   i) 56^o supplementary angle = ☐ degrees

   ii) 92^o supplementary angle = ☐ degrees

   iii) 105^o supplementary angle = ☐ degrees

6. a and b are supplementary angles. If a = 2b find the values of a and b.

   a = ☐ degrees, b = ☐ degrees

7. x and y are supplementary angles. If x = 5y find the values of x and y.

   x = ☐ degrees, y = ☐ degrees

5. Constructing and Measuring Angles

5.1 Constructing and Measuring Angles

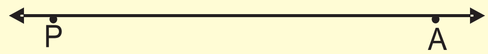
We have studied the concept of an angle and the different kinds of angle in the previous chapter. We shall now learn how to measure and draw the given angle.

The unit for measurement of an angle is degree and an angle is measured with the help of the protractor.

Example : 1

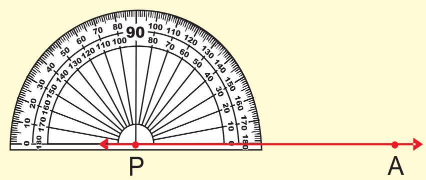
Construct an acute angle of 60^o.

Sept 1 : Draw a line segment PA.

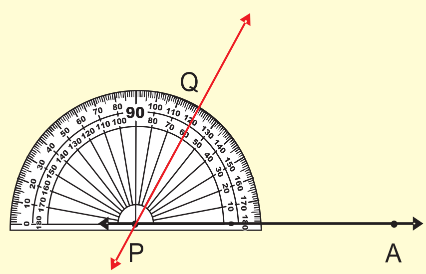


Sept 2 : (i) Place the protractor on the line segment PA

(ii) Place the mid point of the protractor at point P as shown in the figure.



Sept 3 : (i) On PA from the right start counting from 0^o in the ascending order (anticlock wise direction and finally mark a point Q using a sharp pencil at the point showing 60^o on the semi-circular edge of the protractor.



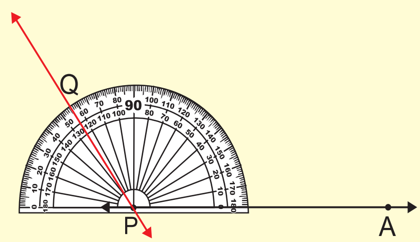
(ii) Remove the protractor and join PQ

(iii) We get the required angle $m\angle APQ = 60^\circ$

Example : 2

Construct an obtuse angle 125^o

Follow the procedure given in example 1 for step 1 and step 2



Sept 3 : (i) On PA from the right start counting from 0^o in the ascending order (anticlock wise direction) and finally mark a point Q using a sharp pencil at the point between 120^o and 130^o showing 120^o on the semi-circular edge of the protractor.

(ii) Remove the protractor and join PQ

(iii) We get the required angle $m\angle APQ = 125^\circ$

Exercise 5.1

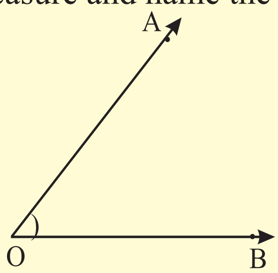
1. Draw and name the following angles.

   (i) 65^o (ii) 35^o (iii) 110^o (iv) 155^o (v) 69^o

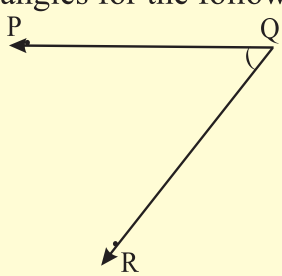
2. Draw and measure the angle formed by the hour and minute hand of a clock at

   (i) 9 o' clock (ii) 4 o ' clock (iii) 7 o' clock (iv) 2 o' clock

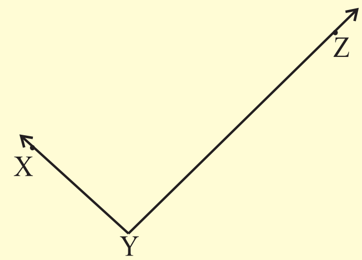
3. Measure and name the angles for the following figures.



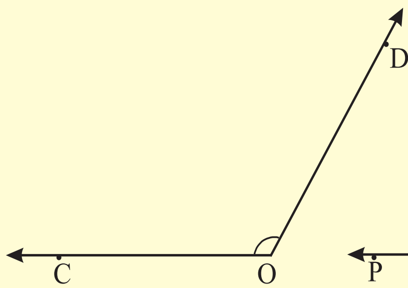
i)



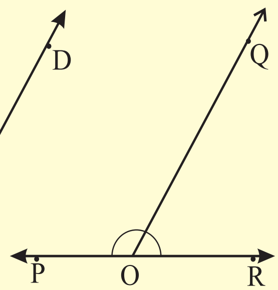
ii)



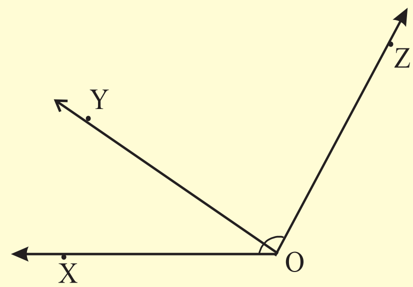
iii)



iv)

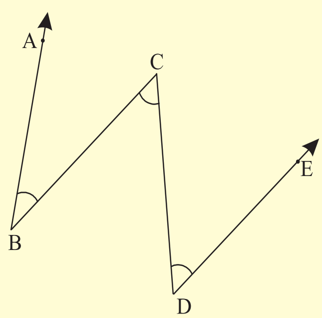


v)

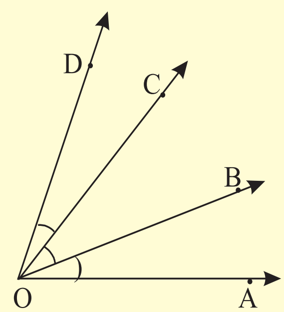


vi)

4. From the given figure measure and write $m\angle ABC$, $m\angle BCD$, $m\angle CDE$

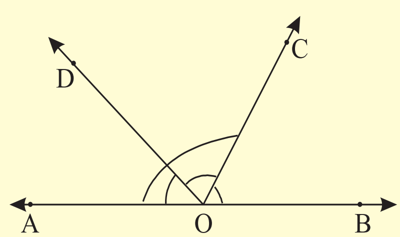


5. Measure the following six angles in the figure given below.



1. $m\angle AOB$
2. $m\angle AOC$
3. $m\angle AOD$
4. $m\angle BOC$
5. $m\angle BOD$
6. $m\angle COD$

6. Measure and name the angles in the following figure.



Do These

1. Draw different angles and measure them.
2. Draw angles for different measures as you like.

ANSWERS

Exercise 1.1

1. (i) True (ii) False (iii) False (iv) False

2. (i) 2 (ii) 1 (iii) 3 (iv) 4 (v) 3

3. (i) 4 : 9 (ii) 5 : 9 (iii) 2 : 3 **4.** (i) 6 : 10, 9 : 15, 12 : 20, 24 : 40
(ii) 6 : 14, 12 : 28, 15 : 35, 30 : 70 (iii) 10 : 18, 15 : 27, 30 : 54, 40 : 72

5. (i) 3 : 4 (ii) 1 : 3 (iii) 1 : 2 **6.** (i) 40 : 1 (ii) 40 : 39 (iii) 1 : 39

7. (i) 3 : 5 (ii) 2 : 5 (iii) 3 : 2

8. (i) 1 : 2 (ii) 4 : 3 (iii) 2 : 3 (iv) 4 : 9 (v) 2 : 9 (vi) 1 : 3

9. 10 : 3 **10.** (i) 1 : 2 (i) 2 : 5 **11.** 17 : 550 **12.** 5, 12, 25 yes

Exercise 1.2

1. (i) 3 : 4 (ii) 4 : 5 **2.** (i) 3 : 4 (ii) 3 : 7

3. (i) 150, 250 (ii) 2k.g 500g, 3kg. (iii) 1m 25c.m, 1m. (iv) 50 min, 6hr 10min.

4. Arun got ₹. 600 more than Anand

5. 14c.m, **6.** ₹. 2,100 **7.** ₹. 3,500, ₹. 4,000

8. 55,000, 45,000

Exercise 1.3

1) (i) yes (ii) No (iii) Yes (iv) No (v) Yes

2) (i) 1 (ii) 2 (iii) 4 (iv) 4 (v) 2

3) (i) yes (ii) No (iii) No

4) (i) 20, 30, 8, 4 (ii) 20, 7, 60, 40 (iii) 30, 30, 40, 22.5

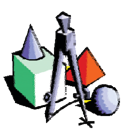
5) Rs. 1950 **6)** 80 **7)** 42 **8)** ₹. 55,200 **9)** 24 **10)** 120 **11)** 100

Exercise 1.4

1) (i) $\frac{1}{10,00,00,000}$ (ii) 3,500 k.m. (iii) 2.1 c.m.

2) (i) $\frac{1}{50,000}$ (ii) 2,750 k.m. (iii) 5 c.m.

3) (i) 800 m. (ii) 7 c.m. (iii) 740 m **4)** 18 c.m.



Exercise 2.1

1) (i) 20 **2)** (ii) □ ○ △ **3)** (iv) Second number = 10 x First number

Exercise 2.2

1) a) (ii) b) (iii) **2)** $40x$ **3)** $12b$

4) (i) $6x$ (ii) $6y$ (iii) $7z$

Exercise 3.1

1) (i) 60 (ii) 1 (iii) 60 (iv) 07.15 a.m. (v) 3.45 p.m.

2) (i) 900 seconds (ii) 1812 seconds (iii) 11,405 seconds (iv) 2720 seconds

3) (i) 480 minutes (ii) 710 minutes (iii) 575 minutes (iv) 175 minutes

4) (i) 8 hours 45 minutes (ii) 2 hours (iii) 3 hours 18 minutes (iv) 1 hour

Exercise 3.2

1) (i) 6.30 hours (ii) 0 hour (iii) 21.15 hours (iv) 13.10 hours

2) (i) 10.30 a.m. (ii) 12 noon (iii) Midnight 12 (iv) 11.35 p.m.

Exercise 3.3

1) (i) 10 hours 45 minutes (ii) 10 hours 45 minutes

2) 11 hours 40 minutes **3)** 3 hours 15 minutes

Exercise 3.4

1) (i) 7 (ii) 29 (iii) 72 (iv) 12 (v) 3600

2) (i), (iv) **3)** 96 **4)** 114 **5)** 101 **6)** 96

7) (i) 46 weeks and 6 days (ii) 25 weeks

Exercise 4.1

1. (i) Acute angle (ii) Obtuse angle (iii) Obtuse angle (iv) Obtuse angle

2. (i) Acute angle (ii) Obtuse angle (iii) Right angle (iv) Acute angle

3. (i) $\angle$AOB Straight angle $\angle$DOB Obtuse angle $\angle$BOA Straight angle

$\angle$AOD Acute angle $\angle$DOC Acute angle $\angle$AOC Right angle

(ii) $\angle$AOB Acute angle $\angle$AOC Acute angle $\angle$AOD Right angle

$\angle$BOC Acute angle $\angle$COD Acute angle

Exercise 4.2

1) (i) 53^o (ii) 48^o (iii) 2^o (iv) 90^o (v) 74^o

2) (i) 174^o (ii) 153^o (iii) 92^o (iv) 76^o (v) 64^o

(vi) 34^o (vii) 122^o (viii) 1^o

3) 50^o

4) (i) True (ii) True (iii) False (iv) False (v) True (vi) True

5) (i) Complementary (ii) Supplementary (iii) Complementary (iv) Supplementary

6) (i) 45^o (ii) 90^o

7) (i) Right angle (ii) Obtuse angle (iii) Acute angle (iv) Acute angle

'I can, I did'

Student's Activity Record

Subject:

Sl.No	Date	Lesson No.	Topic of the Lesson	Activities	Remarks