APPENDIX - III

1. A copy of the instructions given to the pupils for reading the Programmed Learning Material.

2. A copy of the Programmed Learning Material prepared by the investigator for the pupils.

To the pupils

Dear pupils,

All of you are given programmed learning material of the geometry course that you have to learn in fifth-grade. Before you start using it, I would like you to follow the following instructions.

(i) This programme contains a number of small steps called frames. Each frame presents some matter regarding some concept/concepts and includes a question which you are to answer. The correct answer to each question is given immediately below it, but you are not supposed to see it before you answer the same question.

(ii) Although there are questions and answers, the programme itself is not a 'test'. Through questions and answers the material has been organised in logical steps so that it is easy for you to learn by yourself.

(iii) Read the programme at your own speed.

(iv) While reading the programme, you will come across certain word or words underlined. Study these words carefully as they may help you in grasping and understanding the matter of that frame; this in turn will help you in answering the questions that come afterwards.

(v) You will find that the frames are presented between two horizontal lines. Read each frame carefully, thoroughly and repeatedly, if needed, so that you properly understand the question asked in it.

(vi) For the question asked in each frame write your answer in the space provided there, in that frame itself, using a pencil.

(vii) Your answers should be brief and to the point.

(viii) You will keep the given correct answer covered with the card provided for the purpose untill you have written down your own answer to the question of the frame in the space provided.

(ix) After writing your answer, you remove the card and compare your answer with the correct answer. You will find that you are right almost all the times. However, if your answer is wrong sometimes, read the frame again to understand why you were wrong and then only go to the next frame.

(x) In the Programmed Learning Material (PLM) there are certain exercises inserted at proper intervals. You may do them at home while reading this material so that you will develop better understanding and application of the concepts and principles learnt from the PLM.

Hoping that you will enjoy the PLM,

With best wishes,

Your teacher,

H J Patadia

(Mrs. H. J. Patadia)

Programmed Learning Material

GEOMETRY - AN INTRODUCTORY IDEA

Dear Children,

Once you get this learning material on Geometry, I am sure that you are going to read it several times - in the school as well as ' at home (and perhaps, some of you may feel tempted to read it even at the bus stop while waiting for bus! or in a train while travelling in it!). Therefore, surely either your parents or your friend or someone else may put this question to you :

"What is it that you are reading so eagerly?"

Then you will reply to them (though you might not have liked to get disturbed thus):

"Well, it is a learning material on Geometry given to us by our Geometry teacher.

But then, you see, someone inquisitive and smart enough (may be your Dad or Mom) may immediately ask this question:

"My dear, it is alright that you are reading so eagerly this learning material on Geometry, but can you tell what is Geometry ?".

And I understand that perhaps you may find it difficult to answer this question; so let me first explain what Geometry is!

I am certain you must be familiar with different shapes and figures, for example :

* Rectangular shape .... recollect that while playing the games of Hopping (Langadi), Kho-Kho, Football etc. one draws rectangular field on a playground.

* Triangular shape .... don't you know family planning symbol ?

* Circular shape .... for example, shape of a wheel, of a boundary of a cricket ground, or of the full moon you might have seen at night.

* Spherical shape .... haven't you played with ball ? (Football, Volleyball, Cricket ball or tennis ball). Haven't you seen the balls used in bearings ? Also you must have observed the shape of 'Laddu' you eat.

* Conical shape .... Can you forget cone ice-cream that you like very much ? Also you know the shape of the sharpened part of your pencil, shape of the christmus tree etc.

Also you know ellipsoid shape (that of an egg one takes) the cubical shape (that of sugar grain or of a dice one uses while playing the game of serpents and stairs), cylinderical shape (unsharpened) pencil, wires, pipes

used for drainage or water supply), rectangular parallel piped (shape of your book or of sweet box) and so on. You must have also observed various irregular shapes and figures in nature and around us, for example, shapes of leaves of trees, of wings of butterfly, of houses, of different fruits, of city roads etc. Well then

"Geometry is the subject in which we study all possible shapes and figures, their properties etc. in a systematic way and in much detail".

Dear children, I am sure that you have now become very curious to know more and more about the shapes and figures (and their properties) that we see at each and every step of our day to day life; that means you are very eager to study Geometry. But we can not take up any shape or figure and start its study, even we cannot directly talk of rectangle or circle, in fact before we can actually take up any shape for study we have to study some very important basic concepts of Geometry such as a point, a line-segment, a line, a ray, a plane, an angle etc. Let us then understand them one by one.

A Point:

1. The following examples will give you an idea of a point.

Take a pin and look at its sharpened end, touch it by your fingers. The end which you touch by

your fingers gives an idea of a point or we say that it represents a point.

Q. Now take a highly sharpened pencil and touch its end by your fingers. This part which you touch also gives you an idea of a _____.
(Write the answer in your answer sheet).

Answer : The correct answer is : Point.

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2. Consider two adjascent edges of a page in your note-book and touch with your finger the corner of the page where these two edges meet.

Q. This corner which you touch also gives you an idea of a _____ or we say that it represent a _____.

Answer : Point, Point.

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3. Remember, these are the examples in which you experience the idea of a point by finger's touch or visualize it by your eyes. So, what should we do if we wish to get the idea of a point with the help of a figure ? That is to say, how the idea of a point is to be represented in your notebook ? This is done as under.

Take a highly sharpened pencil and on a page of your notebook put a small dot like this . , then

this dot gives you an idea of a point, or we say that this dot is a picture of a point, or we may say that the dot in a note book represents a point.

Q. Any dot put on a paper with the inkpen also represents a _____.

Answer : Point.

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4. Now suppose that one drops a ball on the floor. With a highly sharpened pencil put a small dot on the floor where the ball has touched it.

Q. We then say that the dot represents _____ where the ball has touched the floor.

Answer : Point.

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5. Remember very well that in both these cases, clearly the dot itself is not a point, but the dot represents a point. Also different dots represent different points. Thus a point is an abstract idea and dot just represents it.

Q. The symbol fullstop occuring after every complete sentence also _____ _____.

Answer : Represents a point.

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6. Here one may ask : What do we mean by the word 'represents' ? To understand this let us consider the following example:

There is a girl namely Yasha in your class. Suppose her father takes her snap with a camera and then shows that nice photograph to her younger sister Nisha. Then, pointing at the photograph he asks Nisha, "What is it?" Nisha looks at the photograph, observes that; it looks very similar to Yasha and then replies; "it is the photograph/picture of Yasha".

Thus here we know that the photograph looks very similar to Yasha, it gives an idea about Yasha, an idea about how Yasha looks like, but still the photograph itself is not Yasha. Therefore we say that the photograph represents Yasha.

Q. So similarly, the _____ itself is not a point but it gives an idea of a _____, or it _____ _____.

Answer : dot, point, represents a point.

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7. Dear children, you have now learned that

* a tip of a pin or a tip of a sharpened pencil or a dot on a paper gives an idea of a point or represents a point.

* a point can be represented on a paper by a dot.

* a dot just represents a point, but it itself is not a point.
* different dots represent different points.
* a point is an abstract idea which may be experienced, which may be represented, but being an abstract idea it has no size and hence can not be measured.

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8. Uptill now you have learnt what do we mean by a point and how can it be represented by a point? You now know very well that the dot represents a point but it is not a point. To explain the meaning of the word 'represent' we considered an example of Yasha's photograph!

Again, suppose we all take a group photo and each of us gets its copy. Surely, you will then show that photo to your mom! What will you say to her while showing that photo ? You may say, mom, this is me, this is my friend Yatin, she is Leena, here is my friend Pathik, this is our Geometry teacher etc. etc. indicating with your finger their respective photo. Now here, when you say 'this is our Geometry teacher. What you actually mean is 'this is the photo of our Geometry teacher'. Thus, eventhough you know very well that the photo of Geometry teacher is not itself the Geometry teacher, you do tell to your mom, while showing the group

photo, that 'this is our Geometry teacher'. This is done purely for the sake of conveniency. Similarly,

Putting a dot on a paper, we may sometimes say that this is a point eventhough we know very well that the dot itself is not a point but it just represents the point.

* Thus for the sake of conveniency we often call dot as a point. So now if it is asked; Plot any two points in your note book what will you do ?

Answer : You may put two dots like this .. or ' or . or .

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9. Dear children, do you remember that on the first day I asked all of you to tell me your name ? Can you guess why did I want to know your names ? It is simple; I wanted to know your names because then I can call you by your name and thus distinguish different students. Similarly, to distinguish between different points we should name them. This is done using capital letters. Thus,

* We shall denote points (that is, name points) by capital letters such as A, B, P, Q, X, Y, etc.

In this way, if I say 'consider a point A' or 'Take a point A' or (plot a point A' then what

you should do is :

Put a dot in the note book and write A near it -- like this : . or A or A. or .A etc.

Q. Plot two points A and B which are horizontal.

Answer : The horizontal points A and B are plotted as under.

A B or A. .B or A B etc.

Dear children you have read the above frames, now read the following questions carefully and give the answer. If your answer is correct then only go ahead, otherwise read the above frames again and then answer.

Q.1 The sharp end of a niddle gives an idea of a ____ Fill in the gap.

A.1 Point.

Q.2 The sharp end of a thorn represents an idea of a ___. Fill in the gap.

A.2 Point.

Q.3 Tell whether the following examples represent a point.

a) Tip of the injection niddle

b) Tip of your finger.

A.3 Example (a) represents a point but example (b) does not represent a point.

Q.4 What should we do if we wish to get an idea of a point with the help of a figure ?

A.4 To get an idea of a point with the help of a figure we must put a small dot on a page of the note book with the help of a sharpened pencil. This dot gives an idea of a point.

Q.5 Is the following statement true ? correct it if it is not true. "The figure O represents a point".

A.5 The statement is not true. The correct statement is "The figure O does not represent a point".
or "The figure. (i.e. dot) represents a point".

Q.6 Are the points A and B given below vertical ?

•A
•B

A.6 Yes

Q.7 Plot two points A and B which are neither horizontal nor vertical.

A.7 A• B• or A• •B

Q.8 Consider two points A and B which are vertical and such that A is below B.

A.8 The points are like this : B• A•

Q.9 Plot three points A, B and C such that A and B are vertical while B and C are horizontal.

A.9 A• B• .C or B • A • . C

C• •B or •A or C• •A •B

A Line Segment:

1. We have already studied about point which is an abstract idea. Now we shall learn another concept of Geometry which is namely 'line segment' which is also an abstract idea.

To understand about this idea of a line segment we consider the following examples.

Take a scissor and touch the sharpened edge of its blade by your palm. This sharpened edge which you touch by your palm represents a line segment or gives an idea of a line segment.

Consider the paper of your note book and look at its edge. The edge which you see gives an idea of a line segment.

Consider the bench you use or sit or the desk you use to write and look at its edge. The edge which you see also represents a line-segment or gives an idea of a line segment.

Q. The edge of a black-board gives you an idea of a _____.

Answer : Line segment.

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2. Remember, in all above examples we visualize in our mind the idea of a line segment either by touching the sharpened edge of a blade of a scissors or by looking at

the edges of a bench or paper or black-board etc. But if we wish to represent this idea of a line segment in our note book with the help of a figure then what should be done ?

This is done as under:

Take a sharpended pencil. Plot two points in your note-book and then join them using a ruler (or by your hand if you are careful and precise to make it straight). Then this join of two points gives an idea of a line-segment, or we may say that this join of two points is a picture of a line segment or we may say that this join of two points represents a line segment.

Here, remember very well that the join of two points itself is not a line segment; but it just represents a line segment or gives an idea of a line segment, line segment is an abstract idea.

The two points which are joined using ruler to give a representation of a line segment are called the end points of that line segment.

Q. Thus a line segment has _____ end points.

Answer : Two.

3. Dear children, now you know that the join of two points represents a line-segment, but can you guess what this join is made up of ? Let us see this.

Plot two points as shown beside in figure (1) and in a straight manner put another point inbetween them. Again put another point between them and like this go on putting more and more points between them in a straight manner till no gap is left, that is, till no space is left to put any more points between them in a straight manner.

Fig. 1. . .

Fig. 2. .....

Fig. 3. ———————

You will then see that in this process, first we shall get a figure as in (2) after sometime and then finally when no gap is left we shall get a figure as in (3). But figure (3) looks as if we have joined the two points taken in the begining. Thus a join of two points is made up of points or we can say a line segment is made up of points.

Q. A line segment is made up of _____

Answer : Points.

4. We have seen that line segment is made up of points. There is another way of seeing this. Plot a point, then just beside it plot another point without keeping any gap between them; again plot another point beside this last

ploted point without keeping any gap between them and in a straight manner; continue the process, that is, go on plotting more and more points one after another in a straight manner and without keeping any gap or space inbetween the adjascent points - when we stop after sometime, we shall get a figure ———— - which looks like the join of two points. Therefore, we can say that a line-segment ———→ is made up of points.

Q. Draw a line segment, break it into smaller parts and continue this process of breaking its smaller parts again and again till you can. What will you obtain at the end of the whole process ? What do you conclude from it ?

Answer : At the end of the process of continuous breaking of line segment into smaller and smaller parts; we get point as the smallest parts of the line-segment. From this it can be concluded that line-segment is made up of points.

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5. Now plot two points A and B as shown below in the figure and join them to get a representation of the line-segment.

Figure 1: A ———— B

You know very well that this figure represents line segment but for the sake of convenience we shall call this figure itself as line segment. Now to differentiate or distinguish different line segments from each other we would like to

name different line segments.

Consider figure 1 which is obtained as a join of points A and B. Then the line segment is named as; line segment AB or the line segment BA and is written as $\overline{AB}$ or $\overline{BA}$ in the notational form.

Q. Will there be any difference in the above figure 1 if you join points from B to A instead of A to B ?

Answer : No

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6. Very good, your answer is correct, Now tell, whether the line segment AB obtained by joining the point A to B is same as line segment BA ?

Answer : Yes

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7. Thus you have seen that line segment AB is same as line segment BA and hence we can write line segment AB = $\overline{AB}$ = $\overline{BA}$ = line segment BA.

i.e. $\overline{AB} = \overline{BA}$.

Q. Now write the following line segment in notational form M N

Answer : $\overline{MN}$ or $\overline{NM}$

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8. Now plot the two points A and B and join them as shown below to get the line-segment AB.

A B Then measure the distance between the

points A and B of this line segment using ruler.
This measurement of the distance between the end points is called the length of the line segment AB.

Notice that the distance between A and B is same as the distance between B and A; hence we can say;

the length of the line segment AB = the length of the line segment BA.

To write 'length of a line segment AB' also we have a notation; it is simply written as AB or BA. Thus the length of a line segment AB = AB.

OR we can also say that;

length of $\overline{AB}$ = AB. (because we know that $\overline{AB}$ = line segment AB).

Q. Now write the length of the following in notational form P——— Q

Answer : Length of $\overline{PQ}$ = PQ.

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9. Now if the length of a line segment AB is 3 cm. then we write this in language as : the length of the line segment AB = 3 cm; but in notational form this is written as : AB = 3 cms or BA = 3 cms. (here we know that $\overline{AB}$ = $\overline{BA}$; hence AB = BA)

Q. Measure and write the following line segment in notational form. M——————N

Answer : length of $\overline{MN}$ = MN = 4 cm or NM = 4 cm.

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10. Thus you have now studied that $\overline{AB}$ stands for '<u>the line segment</u> AB (i.e. $\overline{AB}$ is notational form for the line segment AB) but AB stands for the length of the line-segment AB (i.e. AB is the notational form for the <u>length</u> of the line-segment AB).

Q. Now write down the following figure in notational form.  Also measure and write its length in notational form.

Answer : The above figure can be written in notational form as $\overline{PA}$ or $\overline{AP}$.

Also AP = 3 cm. or PA = 3 cm.

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11. Thus you have now learned that,

* the sharpened edge of a blade of a scissors or the edge of a table etc. gives an idea of a line-segment or represents a line-segment.

* If we plot two points on a page of the notebook and join them, then this join of two points represents a line-segment or gives an idea of a line-segment.

* The join of two points itself is not a line-segment but it just gives an idea of a line-segment, it just represents a line-segment. But for the sake of convenience we call it as a line-segment.

* The two points which we join to represent a line-segment are called the end points of the line-segment.

* A line-segment thus has two end points.

* The notation $\overline{AB}$ or $\overline{BA}$ stands for 'the line segment AB' (or for the line segment BA).

* A line segment is an abstract idea which can be assigned a length, but it has no thickness.

* The measurement of the distance between the end points of a line-segment is called the length of a line-segment.

* The notation AB or BA stands for the length of the line segment AB.

* Note that AB and $\overline{AB}$ are different.

Dear children, you have now read the above frames, now read the following questions carefully and give the answers. If your answer is correct then only go ahead, otherwise read the above frames again and again and then answer.

Q.1 The sharpened edge of the barber's knife represents _____.

A.1 Line-segment.

Q.2 Does the edge of the crescent moon ( ) represent a line segment ?

A.2 No; because the edge is not straight.

Q.3 Give two examples which represent a line segment.

A.3 An edge of a flooring tiles, an edge of the door.

Q.4 How will you give the idea of a line-segment with the help of a figure ?

A.4 Plot two points on the page of a notebook and join them, this join of two points gives an idea of a line-segment.

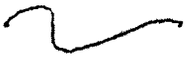
Q.5 Draw three line-segments - one horizontal, another vertical and third neither vertical nor horizontal (i.e. slant).

A.5 (i) Plot point A and B horizontal and join them to get horizontal line-segment like this A——————B.

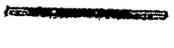
(ii) Plot points C and D vertical and join them to get vertical line-segment like this 

(iii) Plot point X and Y which are neither vertical nor horizontal and join them to get the slant line-segment. 

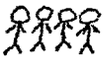
Q.6 Do the following drawing represent a line segment ? Justify your answer.

(1) 

(2) ——————

(3) 

(4) .....

(5) 

A.6 Drawing in (1) does not represent a line-segment as it is not straight.

Drawing in (2) represents a line segment as it is a join of two end points.

Drawing in (3) does not represent a line segment because it has a thickness.

Drawing in (4) does not represent a line-segment because it is not the join of two points but just the collection of some points which are seperated from one another - though arranged in a straight manner.

Drawing in (5) does not represent a line-segment because it consists of objects not representing points and again they are seperated. (It is a queue of four people).

Q.7 Consider the line-segment drawn below.

M N

Now state whether the following statements are true or false.

(1) The line-segment MN is written in the notational form as $\overline{M.N}$

(2) The line segment MN is written in the notational form as $\overline{MN}$ or $\overline{NM}$

(3) The line-segment MN is written in the notational form as MN.

A.7 (1) False (2) True (3) False.

Q.8 Measure the length of CD given by $\overline{CD}$ and write it in the notational form.

A.8 CD = 3 cm.

Q.9 State whether the following statement is true or false; give reason for your answer.

If length of $\overline{PM}$ is 5 cms. then we write it in the notational form as : $\overline{PM}$ = 5 cms.

A.9 Statement is false; because $\overline{PM}$ stands for the line-segment PM and not for the length of the line-segment PM; therefore, since the notation for the length of the line-segment PM is PM, we must write it as : PM = 5 cms and not $\overline{PM}$ = 5 cm.

A Line :

1. The following illustration will give you an idea of the concept line

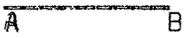
Figure (1) 

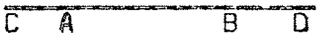
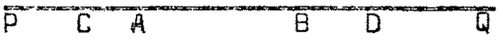
Figure (2) 

Figure (3) 

Consider the line-segment AB as shown in figure (1). Then extend it on both the sides to get a longer line segment CD, as shown in figure (2). Again extend it on both the sides to get a still longer line segment PQ as shown in figure (3). Continue in this way this process of extending a line segment more and more on both the sides to get a longer and longer line segment.

If we stop this process after some time then we get a very very long line segment; but if we continue this process without stopping, that is, if we extend the line-segment AB on both the sides without ever stopping, meaning by, upto infinity, then the figure we may get gives an idea of a line.

In this illustration, notice that the process of extending a line-segment on both the sides is continued without ever stopping. So, you can very well imagine that however large a paper may be, it will not be sufficient to continue the process of extending the line-segment without ever stopping. This happens because the size of the paper is limited, but our process is unlimited. Therefore, it is impossible to draw the figure of a line in a paper. But, we do want to draw the figure of a line in a paper, then what is to be done ?

Mathematicians have found out the way to draw the figure of line in a paper. This is done as under.

Draw a line segment and put arrows at their ends in opposite directions like this :

Here, the purpose of keeping arrows is to indicate that the line-segment should be extended in the direction of arrows without ever stopping, that is, upto infinity.

Thus, a figure like this :  gives an idea of a line, or we say that it represents a line or we may simply say that it is a line.

Q. Consider a line segment AB. Then just besides A and B, to the left of A and to the right of B, plot points in a straight manner and without keeping any gap or space; again plot points just beside these last plotted points in a stragitht manner and without keeping any gap or space. Continue this process, that is, go on plotting more and more points one after another in both directions of the line-segment AB in a straight manner and without keeping any gap or space in between the adjascent points.

If we continue this process without ever stopping then what will you get ?

Also draw the figure which you obtain as a result of this process.

Answer : If we continue the above mentioned process without ever stopping we get a line. This line can be drawn as under.

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2. Since a line is obtained by extending a line segment on both the sides without ever stopping, we observe that a line goes to infinity in two directions.

Q. Tell whether following statement is true or false with reason.

Statement : A line has two end points.

Answer : The statement is false because a line goes to infinity in two directions; we observe that a line has no end points.

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3. Since a line goes to infinity and has no end points, we can not measure the length of a line.

Also we know that a line-segment is made up of points; and we know that extending a line segment means putting more and more points one beside another along the line-segment; that is by extending a line-segment on both the sides upto infinity.

Q. Hence we say that a line is made up of _____ and it consists of _____ number of points.

Answer : Points, infinite.

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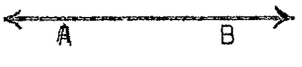
4. Let us now see how we give name to a line so that we can distinguish different lines; that is, let us see how to write a line in the notational form.

Consider a line given by the figure :



Take any two points on the line, say we take points A and B. We can then name this line as : line AB.

In notational form we write this 'line AB' as $\overleftrightarrow{AB}$ or $\overleftrightarrow{BA}$. Thus $\overleftrightarrow{AB}$ reads as : line AB. Clearly,

$$\text{line AB} = \overleftrightarrow{AB} = \overleftrightarrow{BA} = \text{line BA}.$$

Q. Write the following line in notational form.

Answer : Line PQ = $\overleftrightarrow{PQ}$ or $\overleftrightarrow{QP}$

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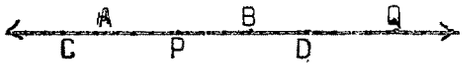
5. Recall that a line consists of infinite number of points, and for naming a line we can take any two points.



Therefore one can take another two points C and D also situated on the same line; and then the same line AB can also have the name: line CD, or in notational form it can be written as $\overleftrightarrow{CD}$ or $\overleftrightarrow{DC}$. Thus we have $\overleftrightarrow{AB} = \overleftrightarrow{CD}$.

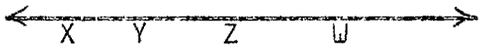
Q. If third pair of points P and Q is on the line AB then can we write $\overleftrightarrow{AB} = \overleftrightarrow{CD} = \overleftrightarrow{PQ}$?

Answer : Yes; because P and Q are also on the same line and we can take any two points lying on the line to write it in notational form.

---

6. Thus in above example we have seen that if A, B, C, D, P, Q are points on the same line then $\overleftrightarrow{AB}$, $\overleftrightarrow{CD}$, $\overleftrightarrow{PQ}$ etc. are all different names of the same line.

Q. Consider the line given in the following figure. Write this line in notational form.



Answer : The line can be written in the notational form as under. $\overleftrightarrow{XY}$ or $\overleftrightarrow{XZ}$, or $\overleftrightarrow{XW}$ or $\overleftrightarrow{YZ}$ or $\overleftrightarrow{YW}$ or $\overleftrightarrow{ZW}$ or $\overleftrightarrow{YX}$ or $\overleftrightarrow{ZX}$ or $\overleftrightarrow{WX}$ or $\overleftrightarrow{ZY}$ or $\overleftrightarrow{WY}$ or $\overleftrightarrow{WZ}$.

---

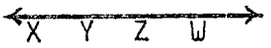
7. Consider the line whose figure is 

; also A and B are points on it. Then, is the following statement true ? Justify your answer.

$\overleftrightarrow{AB}$ contains $\overline{AB}$.

Answer : Yes, the statement is true. This is because $\overline{AB}$ stands for the line segment AB while $\overleftrightarrow{AB}$ stands for line AB and clearly line-segment AB is part of the line AB.

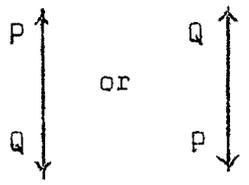
---

8. Dear children, if a point A lies on a line then we say that the line passes through A. For example, consider the line given as this : 

We can then say that the line passes through the points X, Y, Z and W; because all these points X, Y, Z and W lie on it.

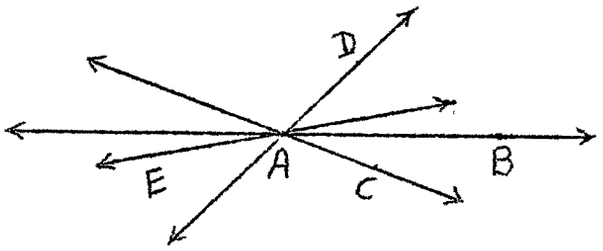
Q. Draw a line which passes through points P and Q and is vertical line.

Answer :



9. Let us now take only one point, say A lying on the line AB. Then we can say that $\overleftrightarrow{AB}$ passes through the point A.

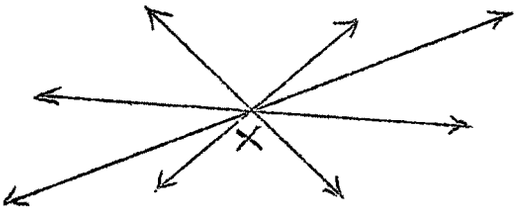
Can you guess how many lines can be drawn through the given point A ? Let us see this : Plot the point A as under through which $\overleftrightarrow{AB}$ passes.



Consider now any other point C not lying on $\overleftrightarrow{AB}$ (see the figure). Then $\overleftrightarrow{AC}$ passes through A. Consider now any point D not lying on $\overleftrightarrow{AB}$ and $\overleftrightarrow{AC}$ (see the figure). Then $\overleftrightarrow{AD}$ also passes through point A. Consider again a point E not lying on any of earlier lines (See figure), then $\overleftrightarrow{AE}$ also passes through A. In this way we can continue the process <u>without stopping</u> and getting more and more lines passing through A. We therefore, <u>can say there are infinitely many lines passing through a given point</u>.

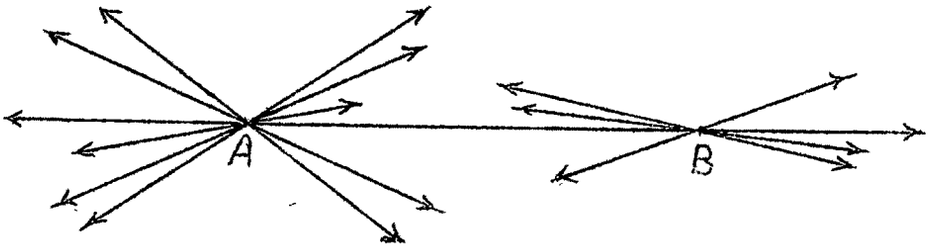
Q. Now consider any point X. How many lines will pass through it ?

Answer :



Infinite number of lines will pass through the point X.

10. Now plot the given points A and B as under and consider AB passing through them. Can we now have second line which also passes through both A and B ?



Answer is obviously 'no'. Infact look at the lines we have drawn above - some of them pass through A but not through B while some of them pass through B but not through A; and $\overleftrightarrow{AB}$ seems the only line passing through A and B both. This means that through A and B only one line can pass and i.e. $\overleftrightarrow{AB}$ itself.

Q. Consider M and N as given below.

How many lines can pass through both of them at a time ?

N

M

Answer :

There is only one line namely $\overleftrightarrow{MN}$ passing through both M and N at a time.

11. You have thus learned that

* If a line segment is extended on both the sides upto infinity then the figure we may get gives an idea of a line.
* A line segment is part of a line.
* A line is represented by a figure like this $\longleftrightarrow$ i.e. drawing a line segment and putting arrows at its ends as shown.
* A line goes to infinity in two directions.
* A line has no end points and has no thickness.
* A line cannot be assigned a length.
* A line is made up of points and it consists of infinite number of points.
* A line passing through two points A and B is written in the notational form as $\overleftrightarrow{AB}$ or $\overleftrightarrow{BA}$; and that the same line can have different names (e.g. if C is also a point on $\overleftrightarrow{AB}$, then $\overleftrightarrow{AB} = \overleftrightarrow{AC} = \overleftrightarrow{BC}$ etc.).
* There is one and only one line passing through two given points.
* There are infinitely many lines passing through a given point.

Dear children, you have read the above frames; now read the following questions carefully and answer them. If your answer is correct then only go ahead, otherwise read the above frame again and then answer them.

Q.1 Do the following figures represent a line ?

Justify your answer.

Figure (1) 

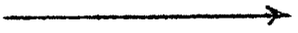
Figure (2) 

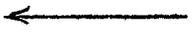
Figure (3) 

Figure (4)

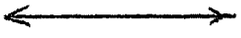
Figure (5) 

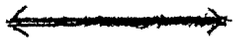
Figure (6) 

Figure (7) 

A.1 Figure 1 does not represent a line as it is not straight.

Figure 2 does not represent a line because the line has arrow only at one of its ends which means that it goes to infinity in only one direction.

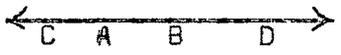
Figure 3 also does not represent a line because of the same reason.

Figure 4 represents a line-segment and not a line.

Figure 5 represents a line.

Figure 6 does not represent a line because it has thickness while line has no thickness.

Figure 7 does not represent a line it has a break in it.

Q.2 Consider the figure : 

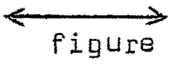
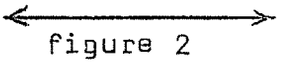
Is the following statement true ? Give reason for your answer. $\overleftrightarrow{AB}$ contains $\overline{CD}$.

A.2 Yes, the statement is true. This is because $\overleftrightarrow{AB}$ stands for line AB and $\overline{CD}$ = line segment CD and line segment CD is the part of the line AB.

Q.3 A line goes to infinity in _____directions and a line segment goes to infinity in _____ direction. (No, 1, 2, 3, 4).

Select the appropriate answers from the breacket to fill in the blank.

A.3 In the first blank put 2 and in the other blank put no.

Q.4 Consider the figures  ,and 
figure 1 figure 2

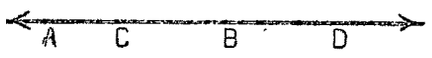
Is it true that line in figure (2) is longer than line in (1) ? Justify your answer.

A.4 This is not true; we cannot say whether one line is longer than or shorter than the other because a line cannot be assigned a length, but all lines go to infinity in two opposite directions.

Q.5 Select appropriate answers from the bracket to fill in the blanks in the following.

A line has _____ end points but a line segment has _____ end points (No, 1, 3, 2).

A.5 No, 2.

Q.6 Consider the figure 

which of the following represent this line ?

$\overrightarrow{AB}$, $\overleftarrow{AC}$, $\overleftrightarrow{CB}$, $\overleftrightarrow{CD}$ and $\overleftrightarrow{DA}$.

A.6 $\overleftrightarrow{CB}$ $\overleftrightarrow{CD}$ $\overleftrightarrow{DA}$.

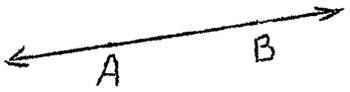
Q.7 Through a given point A, we can draw only 50 lines. Is this statement true ?

A.7 No, through a given point we can draw infinitely many lines; that is, as many lines as we want, and not just 50 lines.

Q.8 Through two given points we can draw infinitely many line-segments but one and only one line - Is this statement true ?

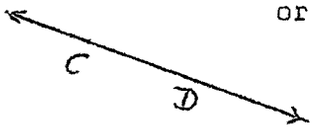
A.8 Yes.

Q.9 Draw a slant line and write it in notational form.

A.9 (i) 

This is $\overleftrightarrow{AB}$

or

(ii) 

This is slant line $\overleftrightarrow{CD}$.

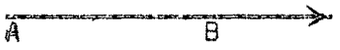
A Ray :

1. You have learned that if a line segment is extended on both the sides (in straight manner) upto infinity then the figure we may get gives an idea of a line.

Now suppose that instead of extending the line segment on both the sides; it is extended only in one direction (in straight manner) upto

infinity. Then can you guess what type of figure you will get ?

Answer : We shall get the following type of figure by extending the line-segment AB in direction of B upto infinity.



Here the arrow in one direction mean that the line segment is extended in straight manner upto infinity i.e. extended without stopping ever.

2. Now you know that if line segment AB is extended in one direction in straight manner without ever stopping then you get the following figure.

, such figure which has a starting point but no end point (because it goes to infinity in one direction) gives us an idea of a geometrical concept: a ray. In other words one may say that above figure represents a ray.

Thus a ray has a starting point and it goes to infinity in one direction only.

We know very well that a line segment is made up of points. Now can't you say a ray is made up of infinite number of points? Justify your answer.

Answer : Yes, a ray is made up of infinite number of points; because it is obtained by extending line segment upto infinity in one direction by adding more

points to the line segment and line segment itself is also made up of points.

---

3. Thus we have seen that a ray is made up of infinite number of points and also it has a starting point but no end point as it goes to infinity in one direction.

Now consider the following figure and tell what does it represent? Which is the starting point ? Does it show any end point ?

Answer : The above figure represents a ray. Point M is its starting point and it has no end point.

---

4. Dear children, you now very well know what do we mean by the ray. Following are some examples given from day to day life. Tell whether they are the examples of ray.

(i) Sun rays (ii) Edge of blackboard

(iii) Rays of a torch light.

Answer : (i) and (iii) are examples of rays or they represent ray. But (ii) is not example of ray. (ii) represents a line segment.

---

5. You have seen that how a ray can be represented in figure. Now you will learn about how a ray can be written in the notational form. For that consider the following ray with the starting point A.

We see that point B lies on the ray but it is not the starting point of the ray. The above ray in language is written as ray AB and in notational form it is written as $\overrightarrow{AB}$ and read as 'ray AB'.

Here remember that in notational form we write 'A' first because it is the starting point and then next to it 'B' is written because it is not the starting point.

Now suppose that point P is another point on the same ray AB.

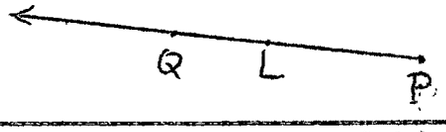
Then the ray AB can also be written as $\overrightarrow{AP}$ in notational form; where point A is still the starting point of the ray and point B and P are other points on the ray. Thus we have ray AB = $\overrightarrow{AB}$ = $\overrightarrow{AP}$ = ray AP. Thus ray AB and ray AP are same ray because both P and B lie on $\overrightarrow{AB}$.

Q. Write down the following ray in notational form.

Answer : Ray MN = $\overrightarrow{MN}$ or $\overrightarrow{ML}$

6. Every ray has its starting point. This starting point is also known as <u>initial point</u> or <u>origin</u> of the ray.

Q. In the following figure of ray PL what is the origin ?

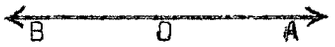


Answer : P is the origin or initial point.

7. Now suppose we draw a horizontal ray OA with origin O and ray OB exactly in opposite direction to ray OA but with the same origin O. Then we shall get the following figure

In above figure of opposite horizontal rays $\overrightarrow{OA}$ and $\overrightarrow{OB}$ what do you observe ?

Answer : The figure of horizontal and exactly opposite rays $\overrightarrow{OA}$ and $\overrightarrow{OB}$ with same origin O ; it is observed that this figure looks like a horizontal line AB with points A, O and B lying on it.

Thus , 

,

a line AB or $\overrightarrow{BA}$ or $\overrightarrow{OA}$ or $\overrightarrow{OB}$ contains opposite rays $\overrightarrow{OA}$ and $\overrightarrow{OB}$ in it which are horizontal rays with common origin or initial point O. i.e. to say that opposite rays are also parts of a line.

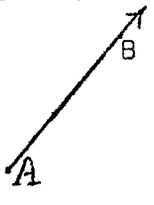
---

8. Thus you have studied that

* If a line segment is extended on one side (one direction) in a straight manner upto infinity then the figure we may get gives an idea of a ray.

* A ray is a part of a line.

* A ray AB is represented as under by the figure



* Ray AB can written in the notational form as under.

  Ray AB = $\overrightarrow{AB}$ Here A is the origin or initial point or starting point of ray AB.

  $\overrightarrow{A\ P\ B}$

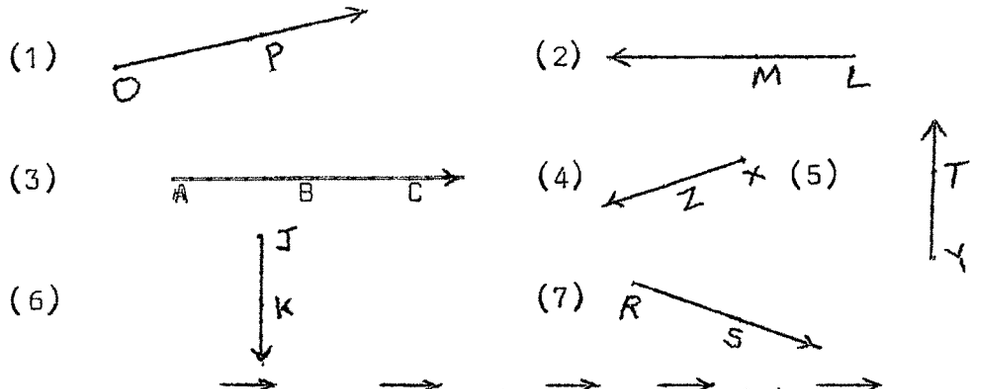
* If P is another point on ray AB then $\overrightarrow{AB}$ can be also written as $\overrightarrow{AP}$ in notational form. Also we write $\overrightarrow{AB} = \overrightarrow{AP}$; as points P & B are lying on the same ray AB.

* A ray cannot be assigned length as it goes to infinity in one direction; the length can not be measured eventhough it has a starting point (but not end point).

* Two opposite rays with same origin lie on the same one line and they are parts of that line.

Dear children, you have read the above frames carefully; now read the questions given here carefully and answer them. If your answer is correct then only go ahead, otherwise read the above frames again and then answer them.

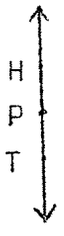
Q.1 Write the following rays in notational form.



A.1 (1) $\overrightarrow{OP}$ (2) $\overrightarrow{LM}$ (3) $\overrightarrow{AB}$ or $\overrightarrow{AC}$ (4) $\overrightarrow{XZ}$
(5) $\overrightarrow{YT}$ (6) $\overrightarrow{JK}$ (7) $\overrightarrow{RS}$

Q.2 Draw two vertical opposite rays with common origin P.

A.2



Q.3 Fill in the blank.

A ray has _____joint but no _____point.

A.3 starting end.

Q.4 Let O be any given point, then which of the following statement is true.

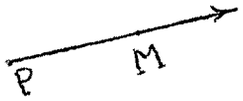
(i) Infinite number of rays can be drawn with origin O.

(ii) Only four rays can be drawn with origin O.

A.4 Statement (i) is true.

Q.5 Draw a ray with origin P and give two illustrative example from day to day life which represents ray.

A.5



This is gigure of $\overrightarrow{PM}$

Illustrative examples for ray:

(i) Sun rays (ii) Rays of the lightened candle