APPENDICES
MODEL LESSON TRANSCRIPTS
BASED ON INFORMATION
PROCESSING MODELS
Lesson Transcript No: 1
(Based on Advance Organizer Model)

Name of the teacher : Anila Anna Mani          Subject : Mathematics
Name of the school :                                               Unit : Mensuration of Circles
Standard : IX                                                   Topic : Area of Circles
Strength :                                                      Date :
Duration :

Objectives

To enable the learner,

1) to frame the concept ‘area of circles’.

2) to understand that the area of circle of radius r is $\pi r^2$.

3) to subsume the new information regarding ‘area of circle’ to the global concept of the ‘area of parallelogram’.

4) to meaningfully conceive the relationship between the parallelogram and circle.

5) to develop the ability for ‘progressive differentiation’ of concepts.

6) to develop the ability for integrative reconciliation between the concept.
LEsson Transcript

mathematics  
Model; advance organizer model  
unit  : mensuration of circles  
topic  : area of circles  

Teacher : today we are going to learn a topic in a very interesting manner.  
All of you listen carefully and co-operate with me.

Phase 1: presentation of advance organizer

A farmer has a circular field. He is preparing it for sowing wheat. The larger the region, the greater is the requirement of seed for sowing. In order to find how much of seed is needed, we have to find the area of the circular plot.

We know many other life situations in which we need to find area of the circular region. Can you suggest some life situations where the area of circle is to be found out?

Student : Yes. The circular ground is to be covered with grass.

Student : The circular table top to be painted

Teacher : Good. Today let us find a formula for finding the area of a circle, so that it will be easy in all these situations to find their areas.

At the end of the teaching, all of you will be able to find the area of circular objects quickly and accurately.

Teacher shows a chart of a parallelogram as given below.

Area of a parallelogram = Base \times Altitude
**TEACHER:** Can you identify the base and altitude of the given parallelogram?

**STUDENT:** Yes, teacher (They identify correctly)

**TEACHER:** Do you remember the circumference of a circle with radius ‘r’?

**STUDENT:** Yes, it is $2\pi r$

**TEACHER:** Good.

**PHASE 2: Presentation of Learning material**

**TEACHER:** I will show you a chart of different parallelograms having different measurements. You have to tell me the area.

![Parallelogram chart]

**STUDENT:** 1) $7 \times 3 = 21\text{cm}^2$
   2) $4 \times 4 = 16\text{cm}^2$
   3) $8 \times 3 = 24\text{cm}^2$

**TEACHER:** Correct. Now I will show you a model (Teacher shows a model of a circle)
TEACHER : What is this geometrical shape?

STUDENT : It is a circle

TEACHER : We have to find the area of the circle. We know how to find the area of a parallelogram. So let us do an experiment here.

The circle is cut into strips as shown in the figure1. Students arrange them side by side as in figure2.

![Figure1](image1)

Figure1

![Figure2](image2)

Figure2

TEACHER : What does this figure now look like?

STUDENT : It looks like a parallelogram.

TEACHER : So, instead of finding the area of the circle what we should find out?

STUDENT : It is enough to find the area of the parallelogram.

TEACHER : What all measures do we need to find its area?

STUDENT : Base and altitude.
**PHASE 3: Strengthening cognitive structure**

**TEACHER:** Now compare this parallelogram and the circle and find what measurements of the circle become the base and altitude of the parallelogram.

Students repeat the experiment with more examples and find that base of the parallelogram is equal to half the perimeter of the circle and altitude becomes equal to the radius of the circle.

**TEACHER:** So what about the area of the parallelogram in terms of measurements of the circle?

**STUDENT:** Area = Base × Altitude

\[ = \pi r \times r \]

\[ = \pi r^2 \]

**TEACHER:** Now what is the formula to find the area of a circle of radius ‘r’?

**STUDENT:** Area of a circle = \( \pi r^2 \), where r is the radius.

**TEACHER:** Can you find the area of a circle where radius is 15m?

**STUDENT:** Yes, area = \( \pi \times 15^2 \)

\[ = 225\pi \text{ m}^2 \]

**TEACHER:** Very good.

**TEACHER:** Can you tell me the process through which we have reached at the formula?

**STUDENT:** We know the area of the parallelogram. Using the model we have arranged entire pieces of the circle into a parallelogram. So it was enough to find the area of the parallelogram.

We again understood from the model that here the base and the altitude of the parallelogram are respectively half the circumference and the radius of the circle. From that we found out the result.
**TEACHER** : Diameter of a circle is 6cm. Find out the area and the circumference of that circle.

**STUDENT** : Area = \( \pi r^2 \)
\[ = \pi \times 3^2 = 9\pi \text{ cm}^2 \]

Perimeter = \(2\pi r = 2\pi \times 3 = 6\pi \text{ cm}\)

**TEACHER** : Do you need any further clarification?

**STUDENTS** : We understood every thing.

**SUPPORT SYSTEM**

1) A picture of a cricket ground to explain its area.

2) Chart showing different parallelograms.

3) Models of circles.

4) Flannel board and a model of circle which is divided into strips that can be arranged into a parallelogram.
Objectives

To enable the learner,

1) to frame the concept ‘arc of circles’.
2) to find out examples from among examples and non examples.
3) to discover the essential attributes of the concept, arcs.
4) to generate new examples related to the concept, arcs.
5) to arrive at the proper definition of the concept, arcs.
6) to analyze the thinking processes leading to attainment of the concept, arcs.
7) to develop conceptualization ability.
Elements of the concept

1) Name : Arc of a circle

2) Essential attributes :
   1) Parts of circles
   2) Continuous part of circumference of a circle.
   3) Has two end points.

3) Non essential attributes: Length of the arc.

4) Positive exemplars :
   1) Rainbow
   2) Piece of a bangle
   3) Handle of a cup

4)
5] Negative exemplars

1] Base of a cup

2]

3]

4]

5]

6]

7]

5] Rule

A continuous piece of a circle is called an arc

OR

Any portion of the circumference of circle is called an arc
PHASE I: Presentation of the Data and Identification of the Concept

**TEACHER:** Today we are going to play a game. I have a particular concept in my mind. I will show you some pictures and figures and also some other examples which contain the idea which I have in my mind. They are the “yes” examples (positive exemplars). I will also show you some examples and figures which do not contain the idea in them, which are the “no” examples (negative exemplars). From those examples, you should identify the concept in my mind. You should cite more examples of that concept and form a definition of that concept according to the characteristics you have noted.

Teacher shows some pictures in the class room which are labeled as yes-examples and no-examples. Students observe them carefully and form hypothesis regarding the concept. Then the name of each object exhibited in the class is written on a chart hung on the wall under two headlines written on its top as, YES-EXAMPLES and NO-EXAMPLES.

**TEACHER:** Teacher shows some pairs of examples

<table>
<thead>
<tr>
<th>Piece of bangle</th>
<th>Piece of Eerkil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes example</td>
<td>No example</td>
</tr>
</tbody>
</table>

**STUDENT:** It is curved

**TEACHER:**

<table>
<thead>
<tr>
<th>Bow</th>
<th>Arrow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes example</td>
<td>No example</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Handle of a cup</th>
<th>Bottom of the cup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes example</td>
<td>No example</td>
</tr>
</tbody>
</table>

**ORIENTATION TO THE PROCESS**

First pair of labeled examples presented

1\textsuperscript{st} hypothesis is formed

2\textsuperscript{nd} and 3\textsuperscript{rd} pair of labeled examples presented
**TEACHER:** Compare and contrast the examples and try to discover what the positive exemplars have in common that they do not share with the negative exemplars.

**STUDENT:** Give us some more examples.

**TEACHER:** Okay

Yes example          No example

**STUDENT:** Single curve.

**TEACHER:**

Yes example          No example

**STUDENT:** Not made of straight lines.

**TEACHER:**

Yes example          No example

**STUDENT:** Not closed.

**TEACHER:** Any other conclusion?

**STUDENT:** It is a part of a circle.
TEACHER: One more pair of example I shall show

Yes example  No example

STUDENT: The curve should be continuous and it has two end points.

TEACHER: You have got the concept. Can you name it?

STUDENT: No

TEACHER: It is called the arc of a circle.

STUDENT: We can say that the arc is a portion of the circumference of the circle. Isn’t it?

TEACHER: Yes, very good.

A continuous piece of a circle is called an arc
OR
Any portion of the circumference of a circle is called an arc.

PHASE II: Testing the Attainment of the Concept

TEACHER: Now I am going to test whether you have understood the concept, I shall give you some examples and you should say whether it is an “Yes” example or “No” example for ‘arc of a circle’.

TEACHER:

STUDENT: No example.

TEACHER: What about PQ?
**STUDENT:** Yes example.

**TEACHER:**

What about the colored part?

**STUDENT:** Yes example.

**TEACHER:**

Can you complete a circle out of the arc given on black board?

**STUDENT:** Yes. (They draw it correctly)

**TEACHER:** Can you draw an arc?

**STUDENT:** Yes.

**TEACHER:** It is arc AB.

**TEACHER:** Now can you give some more yes examples?

**STUDENT:** Shape of arch of buildings, shape of rainbow.
TEACHER: Correct. Can you draw some arcs on black board?

STUDENT: Yes.

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**PHSAE III: Analysis of Thinking Strategies**

TEACHER: Can you explain how did you arrive at the concept?

STUDENT: From the yes examples we found that it is curved and is a part of a circle. Then by comparing the positive and negative examples we understood it should be a continuous part of a circle.

STUDENT: Now we understand that every arc is a part of a circle, even when that circle is not fully drawn.

TEACHER: Very good. We shall use all these ideas in our next classes also.

**SUPPORT SYSTEM**

All the examples given in the lesson transcripts were given as pictures or objects.
# Lesson Transcript No: 3
*(Based on Concept Attainment Model)*

<table>
<thead>
<tr>
<th>Name of the teacher</th>
<th>Anila Anna Mani</th>
<th>Subject</th>
<th>Mathematics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of the school</td>
<td></td>
<td>Unit</td>
<td>Mensuration of Circles</td>
</tr>
<tr>
<td>Standard</td>
<td>IX</td>
<td>Topic</td>
<td>Central angle</td>
</tr>
<tr>
<td>Strength</td>
<td></td>
<td>Date</td>
<td></td>
</tr>
<tr>
<td>Duration</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Objectives**

To enable the learner,

1) to frame the concept ‘central angle’.

2) to find out examples from among examples and non examples.

3) to discover essential attributes of the concept, ‘central angle’.

4) to generate new examples related to the concept, ‘central angle’.

5) to arrive at the proper definition of the concept, ‘central angle’.

6) to analyze the thinking processes leading to attainment of the concept, ‘central angle’.

7) to develop conceptualization ability.
Elements of the concept

1. Name : Central angle of an arc

2. Essential attributes :
   1. Angle formed by an arc
   2. Angle formed at the centre of the circle

3. Non essential attributes : 1. Measure of the angle
                              2. Length of the arc

4. Positive exemplars :

![Diagram](image-url)
5. Negative exemplars:

1. 

2. 

3. 

4. 

5. 

5. Rule:

In a central angle,

(i) vertex of the angle and centre of the circle are the same.

(ii) each arm contains an end point of the arc.

OR

Central angle of an arc is the angle which an arc subtends at the centre of the circle of which it is a part.
**PHASE I: Presentation of the Data and Identification of the concept.**

**TEACHER:** We learned about ‘arc’ through a game. Do you remember what is an arc?

**STUDENT:** We enjoyed that. We remember arc is a continuous part of a circle.

**TEACHER:** What else do you remember?

**STUDENT:** I can see a completed a circle of which every arc is a part.

**TEACHER:** Yes, very good. Today I have another concept in my mind. Let us play the same game again. Listen. Here is a pair of examples.

![Yes example](image1) ![No example](image2)

**STUDENT:** It is related to circle.

**STUDENT:** It is the diameter.

**TEACHER:** Here is your second set of examples.

![Yes example](image3) ![No example](image4)

**STUDENT:** Two radii are given

**TEACHER:**

![Yes example](image5) ![No example](image6)

**TEACHER:**

Orientation to the process

Teacher presents the first pair of labeled examples

Hypothesis 1 is formed

Hypothesis 2 is formed

Teacher presents second pair of labeled examples

Hypothesis 2 is rejected. Hypothesis 3 is formed.

Teacher presents the third pair of labeled examples
**STUDENT:** It is an angle.

**STUDENT:** It is connected to the arc.

**STUDENT:** It is the angle formed by two radii at the centre.

**TEACHER:**

![Yes example and No example diagrams]

**STUDENT:** It is an angle formed at the centre of a circle.

**STUDENT:** It is connected to the arc. But in the negative example it is not connected to an arc.

**TEACHER:**

![Yes example and No example diagrams]

**STUDENT:** Vertex of the angle and the centre of the circle are one and the same.

**TEACHER:** Very good. Can you tell me the peculiarities of this angle once again?

**STUDENT:** It is formed at the centre of the circle.

**TEACHER:** What else?
**STUDENT:** Vertex of the angle and the centre of the circle are the same.

**STUDENT:** Each arm of the angle contains an end point of the arc.

**TEACHER:** Very good. Can you name this angle, which is subtended at the centre of a circle?

**STUDENT:** Can we name it as central angle?

**TEACHER:** Yes, good.

In a central angle,
1. Vertex and the centre of the circle are the same.
2. Each arm contains an end point of the arc.

OR

Central angle of an arc is the angle, which an arc subtends at the centre of the circle of which it is a part.

**PHASE II: Testing Attainment of the Concept**

**TEACHER:** Now I will give you same examples, which you should identify “Yes” or “No”.

**STUDENT:** Yes example.

∠AOC is the central angle of \(\overarc{AEC}\).
∠BOD is the central angle of \(\overarc{BFD}\).
TEACHER:

STUDENT: Yes example.

TEACHER:

STUDENT: No example.

TEACHER: Why?

STUDENT: Angle is not formed at the centre.

TEACHER:

Is \( \angle POQ \) the central angle of \( \overline{PSR} \)?

STUDENT: No

TEACHER: Why?

Students label correctly
**STUDENT:** ∠POQ is subtended at the centre by
the PSQ.

**TEACHER:** Can you draw some examples?

**STUDENT:**

![Diagram of angles](image)

**TEACHER:** Yes, correct.

**TEACHER:** Can you tell me an example of central angle formed by an arc?

**STUDENT:** Yes, the angle, shown by the minute hand and hour hand of a clock?

**TEACHER:** Exactly.

Teacher shows the model of a circular clock and students describe how a central angle can be seen there.

**PHASE III: Analysis of Thinking Strategies**

**TEACHER:** Can you explain how did you arrive at the concept?

**STUDENT:** First we thought that it is related to the diameter of the circle. Later we thought it is about the radii of the circle. Then from the yes examples we understood that it is the angles, which are formed at the centre of the circle.

**STUDENT:** The comparison between the yes and no examples enabled us to understand that the central angle is the angle which an arc subtends at the center of the circle of which it is a part.

**TEACHER:** Very good.
SUPPORT SYSTEM

1. All the examples given in the lesson transcript were given as pictures or as objects.

Lesson Transcript No: 4
(Based on Concept Attainment Model)

Name of the teacher : Anila Anna Mani 
Subject : Mathematics

Name of the school : 
Unit : Mensuration of Circles

Standard : IX 
Topic : Sector

Strength : 
Date : 
Duration :

Objectives

To enable the learner,

1) to frame the concept, ‘sector’.

2) to find out examples from among examples and non examples.

3) to discover essential attributes of the concept, ‘sector’.

4) to generate new examples related to the concept, ‘sector’.

5) to arrive at the proper definition of the concept, ‘sector’.

6) to analyze the thinking processes leading to attainment of the concept, ‘sector’.

7) to develop conceptualization ability.
Elements of the concept

1. Name: Sector of a circle.

2. Essential attributes:
   1) Part of a circle
   2) Area enclosed by 2 radii and an arc of the circle.

3. Non essential attributes:
   Size of the sector.

4. Positive exemplars:
   1) 
   2) 
   3)
5. **Negative exemplars**

1) 

2) 

3)
6. **Rule:** When the end points of an arc of a circle are joined to the centre of the circle, the portion obtained is called sector.

**PHASE I: Presentation of the Data and Identification of the Concept**

**TEACHER:** Today we are going to play a game with another concept in my mind. I will give you “Yes” and “No” examples from which you have to identify the concept and reach the definition of the concept after giving me additional examples. You have to find out all the characteristics of the concept.

(Teacher presents cards with figures drawn on it as given below as Yes and No example. Students stick them on flannel boards.)

**TEACHER:** Here is a pair of Yes and No examples.
STUDENT: It is closed

TEACHER:

Ashoka Chakra
Leaves of fan

Yes example
No example

STUDENT: Something inside the circle

TEACHER:

Yes example
No example

STUDENT: Related to circle and part of circle.

TEACHER: That is right. I shall give one more example.
**TEACHER**: What else do you find now?

**STUDENT**: It is a part of the circle. It is the region enclosed by two radii of the circle.

**TEACHER**: Okay. Listen to the next pair of examples.

**STUDENT**: Two radii connected to the centre.

**TEACHER**: End points of the arc are joined to the centre of the circle.

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Fourth set of labeled examples presented

Hypothesis 4 is formed

Fifth set of labeled examples presented

Hypothesis 5 is formed

Sixth set of labeled examples presented

Hypothesis 6 is formed
**TEACHER**: Compare all the examples once again and tell me the details about the concept once again.

**STUDENT**: It is a part of a circle.

**STUDENT**: This part lies between two radii of the circle.

**STUDENT**: Third part is an arc of the circle.

**TEACHER**: Very good. Now can you name it?

**STUDENT**: No.

**TEACHER**: Well, I shall tell you the name. It is a sector. Can you define what a sector is?

**STUDENT**: Yes teacher. When the end point of an arc of a circle is joined to the centre of a circle, the portion obtained is called sector.

> When the end points of an arc of a circle are joined to the centre of the circle, the portion obtained is called sector.

**PHASE II: Testing the Attainment of the Concept**

**TEACHER**: Now I am going to test whether you have actually understood the idea. I shall give you some examples. You have to listen very carefully and observe each and every peculiarities and thus identify whether it is a “Yes” or “No” example. I will ask some questions based on it.

**TEACHER**: 

![Diagram of a circle divided into four equal parts](image)
Students identify different sectors and colour them differently and find it is an yes example.

**TEACHER:**

![Diagram of a hexagon]

**STUDENT:** No example

**TEACHER:** What about the following example.

![Diagram of a triangle]

**STUDENT:** Yes example. There are two sectors.

**TEACHER:**

![Diagram of a circle divided into two equal parts]

**STUDENT:** Yes example.

**TEACHER:** Now can you suggest some examples for sectors.

**STUDENT:**

Correctly labels the unlabelled example correctly
STUDENT : A piece of cake.

STUDENT : Wheels of carts

Each shaded portion represents different sectors

TEACHER : Very good.

TEACHER : Now you do a project. Draw a circle on a piece of paper and cut it out of the paper. Mark an arc, join the end points with the centre. Cut that shape out of it. Find what do you get.

PHASE III: Analysis of Thinking Strategies

TEACHER : Can you explain how did you arrive at the concept.

STUDENT : From the first example we understood that it is a closed figure and later understood that it is a part of circle. After that from the yes examples we understood that it is not diameter but an area enclosed by two radii and an arc of a circle.
STUDENT: From the 4th and 5th pair of labeled examples, we got the major details of the concept, sector.

STUDENT: The comparison between the Yes and No examples enabled us to reach at the concept.

SUPPORT SYSTEM

1. All the examples given in the lesson transcripts were given as pictures or as objects.
**Lesson Transcript No: 5**  
*(Based on Inductive Thinking Model)*

Name of the teacher : Anila Anna Mani  
Subject : Mathematics

Name of the school :  
Unit : Mensuration of Circles

Standard : IX  
Topic : Perimeter of Circle.

Strength :  
Date : 

Duration :

**Objectives**

To enable the learner,

1) to frame the concept ‘perimeter of circles’.

2) to understand the number obtained by dividing perimeter by diameter is the same for all circles.

3) to understand the perimeter of a circle of radius $r$ is $2\pi r$.

4) to enumerate the specific aspects of the concepts.

5) to arrive at broad generalizations based on the conceptualization of specific attribute.

6) to develop inductive thinking ability.

7) to develop the rational outlook for developing concepts.
LESSON TRANSCRIPT

MATHEMATICS
MODEL; INDUCTIVE THINKING MODEL
UNIT : MENSURATION OF CIRCLES
TOPIC : PERIMETER OF A CIRCLE

Strategy I: Data Categorisation (Concept formation)

TEACHER : In the last class we discussed the concepts of area and perimeter. We dealt with certain situations in our daily life, where these measures are to be found out. Now can you tell me certain situations involving these concepts?
Students start listing situations such as,

1. A farmer preparing his field for sowing wheat and finding out the requirement of seed for sowing.
2. Expense to construct a wall around a well.
3. The top of the table is to be painted.
4. Finding the distance covered when a wheel has rotated 5 times.
5. Fixing tiles on the floor of a room.

[All the students are given chances to think and respond]

TEACHER : Very good. Can you group these situations into different categories?

STUDENT : Yes, teacher. In some cases the area is to be found out where as in the other cases the perimeter is to be found out.

TEACHER : Can you group the activities and write them on the chalk board?

STUDENT : Yes. Students actively come forward and write on chalk board with different colour chalk for different groups.

Phase I
Enumeration and listing
Listing different life situations

Phase II
Grouping the activities involving area and perimeter
Identifies the properties of the quantities area and perimeter
<table>
<thead>
<tr>
<th>Situations to find area (A)</th>
<th>Situations to find perimeter (B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Preparing the field for sowing seed.</td>
<td>1. Finding the distance covered as the wheel rotates.</td>
</tr>
<tr>
<td>2. Painting the top of table.</td>
<td>2. Length of wire required to make a ring.</td>
</tr>
<tr>
<td>3. Fixing files in a room.</td>
<td>3. Building a fence around the garden of a circular shape.</td>
</tr>
<tr>
<td></td>
<td>4. Constructing a wall around a well.</td>
</tr>
</tbody>
</table>

**Phase III**
Labeling the two groups

**TEACHER** : In the situations given in group B, we have to find the perimeter of circular objects. So today let us see how we can find the perimeter of circle easily.

Teacher presents certain situations and asks the students to find the length of circumference ‘c’ of the given circle and also the diameter ‘d’. Some are given objects like bangles, some tokens, some draw circular figures; all are activity engaged in activities.

**Strategy II: Interpreting the Data**

**TEACHER** : What did you find? Can you arrange them in a table?

**STUDENT** : Yes teacher.

<table>
<thead>
<tr>
<th></th>
<th>c</th>
<th>d</th>
<th>c/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>25.13cm</td>
<td>8 cm</td>
<td>3.140</td>
</tr>
<tr>
<td>II</td>
<td>31.4 cm</td>
<td>10 cm</td>
<td>3.140</td>
</tr>
<tr>
<td>III</td>
<td>56.40 cm</td>
<td>18 cm</td>
<td>3.133</td>
</tr>
<tr>
<td>IV</td>
<td>62.7 cm</td>
<td>20 cm</td>
<td>3.135</td>
</tr>
</tbody>
</table>

**Phase IV**
Identifying critical relationships
STUDENT : As the diameter increases perimeter also increases

STUDENT : But the perimeter decreases when the diameter decreases.

TEACHER : That means, in which proportion these two variables are?

STUDENT : Diameter of the circle and perimeter are in direct proportion

TEACHER : What do you get about the ratio, c/d?

STUDENT : It is a constant.

TEACHER : This can be represented by the Greek alphabet π (pie). Teacher gives the historical development of π. However big the circle may be, the ratio between ‘c’ and ‘d’ is almost a constant and is termed as π. The value of π can be taken as 3.14.

TEACHER : So what is the result you obtained from the chart?

STUDENT : We got \[ \frac{c}{d} = \pi \]

STUDENT : The ratio between circumference and diameter of a circle is a constant.

TEACHER : How can you write it using symbols if d = 2r

STUDENT : \[ \frac{c}{2r} = \pi \]

TEACHER : Now can you find out ‘c’ easily?

STUDENT : \[ c = 2\pi r \]

TEACHER : What do you infer from this?

STUDENT : Circumference of the circle = \( 2 \times \pi \times \text{radius} \)
c = 2\pi r. where
c = circumference and
r = radius of the circle

**Strategy III: Application of Principles**

**TEACHER**: How you will find the expense of building a wall around a very large circular area?

**STUDENT**: I will not try to measure it directly but find it using the formula \( c = 2\pi r \).

**TEACHER**: Good. If a lid of circular shape has perimeter 30cm, what is the length of its diameter?

Students find the answer quickly and accurately.

**SUPPORT SYSTEM**

1. Circular objects like bangles, tokens etc.
2. Circles cut out of cardboard.
3. A toy vehicle to show the rotation of a wheel as it moves forward.
4. Chart explaining the formula to find the perimeter.

**Phase VII**
Hypothesizing / Predicting

**Phase VIII**
Explaining the prediction

**Phase IX**
Verifying the prediction—applies correctly
Objectives

To enable the learner,

1) to compare lengths of arcs and central angles.

2) to understand, if the central angle of an arc of a circle of radius \( r \) is \( x^\circ \), then the length of the arc is \( \frac{x}{180} \pi r \).

3) to enumerate the specific aspects of the concepts.

4) to arrive at broad generalizations based on the conceptualization of specific attribute.

5) to develop inductive thinking ability.

6) to develop the rational outlook for developing concepts.
Teacher: In the previous class we learned about arcs, different types of arcs and central angle. Can you tell me an example of an arc from life situations?

Student: Arches seen at the top of doors and windows of buildings. The shape of rainbow is like an arc.

Teacher: Yes, Good. Now I want you to draw different arcs and with different measures of angles.

Student:

Students in groups draw different arcs and their central angles.

Teacher: You have drawn different types of arcs and some of them are similar with respect
to certain characteristics. Can you arrange them on this flannel board and name each group?

**STUDENT** : Yes, teacher.

(Students group them as minor arcs, major arcs and semicircles with their central angles.)

**TEACHER** : Very good. You told me that the arch is an example of arc. Suppose we want to find the length of it. What can you do to find that?

**STUDENT** : I will take a rope and find its length.

**TEACHER** : Suppose you are an engineer, constructing a very long bridge, 1Km long in a foreign country. Suppose an arch is to be constructed in full length on both the sides of the bridge. For that it is essential that we should calculate its length in advance. Let us find an easy way to find that.

**Strategy II: Interpreting the data**

**TEACHER** : From the arranged figures what can you find out?

Observe them very carefully and find how the arc length and central angle are related. Also find more details about that.
**STUDENT** : Central angle in minor arcs are less than 180°, it is 180° in semicircle and more than 180° in major arc.

**STUDENT** : As the central angle increases the length of the arc also increases.

**STUDENT** : Central angle and length of an arc are directly proportional.

**TEACHER** : Can you find the difference in arc length as the central angle varies. (clue: The total length of the circle is $2\pi r$)

**STUDENT** : When central angle is $90^0$ arc length is $\frac{2\pi r}{4}$, when central angle is $180^0$ arc length is $\frac{2\pi r}{2}$

Teacher shows a working model showing different central angles and corresponding arc lengths. Students identify more details and tabulate their findings.

<table>
<thead>
<tr>
<th>Central angle</th>
<th>Arc length</th>
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<tbody>
<tr>
<td>$360^0$</td>
<td>$2\pi r$</td>
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<tr>
<td>$180^0$</td>
<td>$\frac{2\pi r}{2}$</td>
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<tr>
<td>$90^0$</td>
<td>$\frac{2\pi r}{4}$</td>
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<td>$\frac{2\pi r}{8}$</td>
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<tr>
<td>$1^0$</td>
<td>$\frac{2\pi r}{360}$</td>
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<tr>
<td>$x^0$</td>
<td>$\frac{2\pi r \times x}{360}$</td>
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</tbody>
</table>

**TEACHER** : Very good. What does this mean?

**STUDENT** : If the central angle is $x^0$, the length of the arc is $\frac{2\pi r \times x^0}{360}$
**Strategy III: Application of Principles**

**TEACHER:** Now can you tell me how you can find the length of the arch on the side of the bridge?

**STUDENT:** Yes, I can find it out using this formula when central angle is known.

**TEACHER:** Can you find the length of $\overarc{AOB}$ in the figure given below.

Students find the answer quickly and accurately.

**SUPPORT SYSTEM**

1. Models of arcs and circles.
2. Chart showing different types of arcs.
3. Working model showing different central angles and the corresponding arc lengths.

---

**Phase VII**
Hypothesizing/Predicting

**Phase VIII**
Explaining the prediction

**Phase IX**
Verifying the prediction

Applies correctly
Lesson Transcript No: 7
(Based on Inductive Thinking Model)

Name of the teacher : Anila Anna Mani
Subject : Mathematics

Name of the school :
Unit : Mensuration of Circles

Standard : IX
Topic : Area of sector

Strength :
Date :
Duration :

Objectives

To enable the learner,

1) to compare the central angle and the area of sector.

2) to understand, if the central angle of the sector of a circle of radius $r$ is $x^0$, then its area is $(x/360)\pi r^2$

3) to enumerate the specific aspects of the concepts.

4) to arrive at broad generalizations based on the conceptualization of specific attribute.

5) to develop inductive thinking ability.

6) to develop the rational outlook for developing concepts.
Strategy I: Data Categorisation (Concept formation)

TEACHER: We are familiar with sectors. Can you cut a sector out of a circle drawn on a paper.

STUDENT: (They do it) we get a sector when the end points of an arc are connected to the centre of the circle.

TEACHER: Good. Can you draw different types of sectors on the black board and shade them?

STUDENT: Yes

TEACHER: (Shows a chart containing sectors and Segments). Can you group sectors from these figures?

Phase-I
Enumeration and Listing

Phase-II
Grouping sectors separately
TEACHER : Suppose we want to plant grass in a circular garden in different corners in the shape of sectors. What measure you have to find for that?

STUDENT : It is enough to find the area of the sector.

TEACHER : Today let us find an easy way to find the area of a sector.

**Strategy II: Interpreting the Data**

TEACHER : Can you find the relationship between area of the sector and central angle?

STUDENT : Yes, area of the sector increases as the angle increases.

TEACHER : Look at the figure once again. Can you find the area of sector with respect to central angle?

STUDENT : Yes

TEACHER : What did you notice?
STUDENT : Area is $\pi r^2$ for the full circle.

TEACHER : Can you tabulate your findings?

STUDENT : Yes

<table>
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<tr>
<th>Central angle</th>
<th>Area</th>
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<td>$\frac{\pi r^2}{360}$</td>
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<tr>
<td>$x^0$</td>
<td>$\frac{\pi r^2 \times x}{360}$</td>
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</table>

TEACHER : Yes, very good.

If the central angle is $x^0$, the area of the sector is $\frac{\pi r^2 \times x}{360}$

Strategy III: Application of Principles

TEACHER : How will you find the area of lawn which is in the shape of a sector having central angle $72^0$ and radius 10cm?

STUDENT : $\pi \times 10 \times 10 \times 72 = \frac{20\pi}{360}$ sqcm

TEACHER : Can you find out the radius of a circle if the area of sector and central angle are given?

STUDENT : Yes

TEACHER : If the sector given in the figure is having an area of 70sqcm, can you find out the radius?

Phase-VI
Making inferences about the area of the sector

Phase-VII
Hypothesizing - Predicting

Relating categories to each other
Explaining relationship
Generalizing

**Phase-VI**
Making inferences about the area of the sector

**Phase-VII**
Hypothesizing - Predicting
**STUDENT**: (Explains the method of finding the radius and does correctly)

\[ A = \frac{\pi r^2 \times x}{360} \]

\[ 70 = \frac{\pi \times r^2 \times 130}{360} \]

\[ r^2 = \frac{360 \times 70}{3.14 \times 130} \]

\[ = \frac{25200}{408.2} = 61.7 \]

\[ r = 7.8 \]

**SUPPORT SYSTEM**

1. Model of sector.
2. Paper cuttings in the shape of sector.
3. Models showing sectors with their central angles.

**Phase-VIII**
Explaining the prediction

**Phase-IX**
Verifying the prediction
INSTRUCTIONS TO STUDENTS

1. This test has multiple choice questions. Each question has four options indicated by letters A, B, C and D. Out of these four choices, only one answer is correct. Identify the correct answer. Each question carries one mark.

2. Answers should be marked only in the given answer sheet. Mark your answers against the letters (A, B, C, D) given in your answer sheet.

3. The answers should be marked by darkening the respective circle. (See the example).

   A   B   C   D
   O   O   ●   O

4. If you want to change your answer put a ‘X’ mark above your answer and then darken the newly opted one. (See the example)

   A   B   C   D
   O   ●   ●   O

5. After the duration of the test please return the answer sheet to the teacher.
1. When a circle is divided into 8 equal parts, the central angle of each part is ........
   A. 30°  B. 45°  C. 90°.  D. 100°

2. As central angle increases, the length of the arc ..............
   A. Increases  B. Decreases  
   C. No Change  D. None of these

3. If the number of faces of a prism is 20, then the number of edges of that prism is.......... 
   A. 20  B. 24  C. 54  D. 18

4. If the volume and total surface area of a cube are numerically same, the length of one side of the cube is ...... 
   A. 8  B. 7  C. 6  D. 4

5. The areas of 3 different faces of a rectangle prism are 80 sq.cm, 72 sq.cm and 90 sq.cm. The total length of the edges is .......... 
   A. 90  B. 100  C. 98  D. 108

6. The ratio between the arc length of a sector and the area of the sector is ............ 
   A. 1:r  B. 2: r  C. 3: r  D. 4: r

7. If F is the number of faces, V the number of vertices and E the number of edges of a prism, which of the following is correct? 
   A. F+E-V=2  B. E+V-F=2  
   C. F+V-E=2  D. E-V-F=2

8. A wire 66 cm long is bent into a circle. What is the area enclosed within it? (Taking π = 22/7) 
   A.346.5  B.326.5  C. 382.4  D.296.4

9. The radii of two cylinders are in the ratio 3:4. If they are of equal height, their volumes are in the ratio ............ 
   A. 16:9  B. 3:4  C. 4:3  D. 9:16
10. Total surface area of a cylinder with base radius 5 cm and height 10 cm is........sq.cm
   A. 340 π   B.230 π   C.150 π   D.75 π

11. Find the area of the circle, inscribed in the square, in the square, given below
   
   ![10cm circle in 10cm square]

   A. 25π   B.100π   C.50π   D.10π

12. Find the area of the shaded portion
   
   ![Shaded area]

   A. 10.81   B. 21.81   C. 80.21   D. 80.18

13. A wire of length 132m is bent in the form of a circle and placed into another concentric circle of radius 35m. The area of the path thus formed between the circles is........
   (Taking π = 22/7)
   A. 693 sq m   B. 2464sq m
   C. 539 sq m   D. 1925sq m

14. The diameters and the heights of two cylinders are in the ratio 2 : 3 and 5 :4 respectively. Volume of the first cylinder is 720 c.c. Then which of the following is not true?
   A. The ratio of their radii is 2:3
   B. The volume of the second cylinder is 1296 cm³
   C. Second cylinder has more height
   D. None of these.
15. If the volume of a square prism is 3600 c.c and its base area is 144 sq.cm, its height is .................
   A. 12 cm    B. 20 cm    C. 25 cm    D.30cm
16. Three cubes with sides 3cm, 4cm and 5cm respectively are melted and recasted to form a bigger cube. What is the length of the side of the new cube?
   A.5     B.7     C.6     D.60
17. The length, breadth and height of a rectangular prism are 40 cm, 18 cm and 37.5 cm respectively. The total surface area of a cube whose volume is equal to that of the rectangular prism is .................
   A. 3500    B. 27000    C. 720    D. 5400
18. If the base perimeter of a hexagonal prism is 36cm and the height 20cm, what is its lateral surface area?
   A. 56 cm²    B. 720 cm²    C. 120 cm²    D. 160 cm²
19. A rectangular paper of size 11 cm x 8 cm can exactly be wrapped to cover the curved surface of a right circular cylinder of height 8cm. The volume of the cylinder is .......... (Taking π = 22/7).
   A. 66 cm³    B. 77 cm³    C. 88 cm³    D. 121 cm³
20. The minute hand of a clock is 20 cm long. What is the area it sweeps off from 5:10 AM to 5.25 AM?
   A. 31.4cm²    B. 314 cm²    C. 3.14 cm²    D. None of these
21. The area of a circle with perimeter 10π is ..........
   A. 20π    B. 25π    C. 30π    D. 40π.
22. If the central angle of a sector of a circle of radius 8 cm is 144°, then its area is ..........
   A. 80.38    B. 20.14    C. 85.7    D. 22.36
23. Radius of the sector given below is ..................

A. 15.7  B. 12.5  C. 22.7  D. 15

24. In the picture below, AB and CD are arc of circles centered at O. If OA = 6cm and AC = 3cm

Difference between the lengths of arc AB and arc CD is..................
A. π  B. 2π  C. 3π  D. 4π.

25. The following pie diagram shows that 30% of the earth’s total surface is land and the remaining portion is ocean.

The measure of the angle which represents the land is..................
A. 30°  B. 70°  C. 108°  D. 252°
26. Total surface area of a cube with volume, 1728 c.c is 
A. 144   B. 124   C. 864   D. 824
27. The base perimeter of a regular hexagonal prism is 24 cm. If the height of the prism is 25 cm, its volume is .......... cm$^3$
A. 1028   B. 1038   C. 1048   D. 1018
28. A rectangular block of wood has length 12 cm, breadth 9 cm and height 27 cm. Total surface area of the largest square prism that can be cut out from it is .............. sq cm.
A. 1134   B. 1124   C. 1234   D. 1144
29. A piece of wood in the shape of a square prism has each side of the base 4 cm long and its height 50 cm. What is the maximum volume of a cylinder that can be carved from it?
A. 628 c.c   B. 314 c.c   C. 200 c.c   D. 218 c.c
30. Total surface area of a cylinder with base radius 5 cm and height 10 cm is ........ sq.cm
A. 340$\pi$   B. 230$\pi$   C. 150$\pi$   D. 75$\pi$
31. The height of a cylinder is 2 times the radius of its base. If the radius is x cm, its volume is ............... 
A. $x^3$   B. $\pi x^3$   C. $2\pi x^3$   D. $2x^3$
32. If the length of the diagonal of a face of a cube is 16$\sqrt{2}$ cm, its volume is ............. c.c
A. 32$\sqrt{2}$   B. 4096   C. 256   D. 16/$\sqrt{2}$
33. Area of an equilateral triangle is 17300 sq.cm. Circles are drawn, with each of its vertices as center and half the length of its side as radius, as shown below. Area of the shaded portion is .............. sq.cm.
A. 1570   B. 200   C. 1600   D. 800
34. A rectangular sheet measuring 36 cm by 12 cm is folded along its longer edge to form a regular hexagonal tube. The capacity of the tube is…………..liters
A. 11.22 B. 1.122 C. 112.2 D. 1122
35. Five square glass sheets of side 20 cm are joined along their edges to form an aquarium. How much water will it contain?
A. 8 lit B. 7 lit C. 9 lit D. 6 lit
36. The picture shows a rectangular sheet of metal with two semicircles cut away from the two ends. Area of the remaining portion is ..........sq.cm.

![Diagram of rectangular sheet with semicircles cut away]

A. 192 B. 182 C. 172. D. 162
37. Two cylinders have their diameters in the ratio 2:3 and their heights in the ratio 5:4. The volume of the first cylinder is 900 c.c. The volume of the second cylinder is.........c.c
A. 864 B. 1296 C. 1620 D. 1700
38. When the diameter of a circle is doubled, the area increases.........times
A. 2 B. 3 C. 4 D. 8
39. Total base areas of a rectangular prism is equal to its lateral surface area. If the prism has 20 cm length and 16 cm breadth, its height is........
A. 80/9 B. 9/80 C. 36 D.
40. Pendulum in a clock is 14 cm long. It moves through 40° as it makes one oscillation. What is the distance traveled by the tip of the pendulum during one oscillation?
A. 15.1 cm B. 9.76 cm C. 8.6 cm D. 13.6 cm
41. Radius of the inner circle is 7 cm, perimeter of the outer circle is $16\pi$ cm, area of the shaded portion is $\ldots \ldots \ldots \ldots$ sq cm.

A. $25\pi$  
B. $20\pi$  
C. $15\pi$  
D. $10\pi$

42. In the picture below, C is the center of the circle. Find the area of the shaded portion.

A. 890  
B. 693  
C. 428  
D. 316

43. Perimeter of a circle with area $16\pi$ sq.cm is $\ldots \ldots \ldots \ldots$

A. $2\pi$  
B. $4\pi$  
C. $8\pi$  
D. $16\pi$

44. Which of the following statement is true?

A. Perimeter of the circle decreases as its diameter increases
B. If we divide the perimeter of a circle by its diameter, we get a constant number.
C. $\pi$ is a rational number.
D. If the diameter of a circle is doubled, its perimeter increases 4 times.

45. If the volume of a cube is 1728 cc, what is its surface area?

A. 738  
B. 864  
C. 944  
D. 1024
**APPENDIX – III**

**ANSWER SHEET OF ACHIEVEMENT TEST DRAFT FORM.**

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<tr>
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### APPENDIX – IV

**SCORING KEY OF ACHIEVEMENT TEST**

**DRAFT FORM**

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### APPENDIX- V

**DIFFICULTY INDEX AND DISCRIMINATING POWER OF ACHIEVEMENT TEST- DRAFT FORM**

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INSTRUCTIONS TO STUDENTS

6. This test has multiple choice questions. Each question has four options indicated by letters A, B, C and D. Out of these four choices only one answer is correct. Identify the correct answer. Each question carries one mark.

7. Answers should be marked only in the given answer sheet. Mark your answers against the letters (A, B, C, D) given in your answer sheet.

8. The answers should be marked by darkening the respective circle. (See the example).

\[
\begin{array}{cccc}
A & B & C & D \\
O & O & \bullet & O \\
\end{array}
\]

9. If you want to change your answer put a ‘X’ mark above your answer and then darken the newly opted one. (See the example)

\[
\begin{array}{cccc}
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O & \times & \bullet & O \\
\end{array}
\]

5. After the duration of the test (30 minutes) please return the answer sheet to the teacher.
1. As central angle increases, the length of the arc ............
   A. Increases          B. Decreases
   C. No Change          D. None of these

2. If the number of faces of a prism is 20, then the number of edges of that prism is ...........
   A. 20               B. 24               C. 54               D. 18

3. If the volume and total surface area of a cube are numerically same, the length of one side of the cube is .......
   A. 8               B. 7               C. 6               D. 4

4. If F is the number of faces, V the number of vertices and E the number of edges of a prism, which of the following is correct?
   A. F+E-V=2          B. E+V-F=2
   C. F+V-E=2          D. E-V-F=2

5. A wire 66 cm long is bent into a circle. What is the area enclosed within it?
   A. 346.5             B. 326.5             C. 382.4             D. 296.4

6. The radii of two cylinders are in the ratio 3:4. If they are of equal height, their volumes are in the ratio ...........
   A. 16:9             B. 3:4             C. 4:3             D. 9:16

7. Find the area of the circle, inscribed in the square, in the square, given below

   ![Diagram of a square with a circle inscribed]

   A. $25\pi$          B. $100\pi$          C. $50\pi$          D. $10\pi$
8. Find the area of the shaded portion

![Diagram]

A. 10.81   B. 21.81   C. 80.21   D. 80.18

9. A wire of length 132m is bent in the form of a circle and placed into another concentric circle of radius 35m. The area of the path thus formed between the circles is........

(Taking $\pi = 22/7$)

A. 693 sq m   B. 2464sq m   C. 539 sq m   D. 1925sq m

10. The diameters and the heights of two cylinders are in the ratio 2 : 3 and 5 :4 respectively. Volume of the first cylinder is 720 c.c. Then which of the following is not true?

A. The ratio of their radii is 2:3  
B. The volume of the second cylinder is 1296 cm$^3$  
C. Second cylinder has more height  
D. None of these.

11. Three cubes with sides 3cm, 4cm and 5cm respectively are melted and recasted to form a bigger cube. What is the length of the side of the new cube?

A.5   B.7   C.6   D.60

12. If the base perimeter of a hexagonal prism is 36cm and the height 20cm, what is its lateral surface area?

A. 56 cm$^2$   B. 720 cm$^2$   C. 120 cm$^2$   D. 160 cm$^2$
13. A rectangular paper of size 11 cm x 8 cm can exactly be wrapped to cover the curved surface of a right circular cylinder of height 8 cm. The volume of the cylinder is .........
(Taking $\pi = \frac{22}{7}$).
A. 66 cm$^3$  B. 77 cm$^3$  C. 88 cm$^3$  D. 121 cm$^3$

14. The minute hand of a clock is 20 cm long. What is the area it sweeps off from 5:10 AM to 5:25 AM?
A. 31.4 cm$^2$  B. 314 cm$^2$  C. 3.14 cm$^2$  D. None of these

15. If the central angle of a sector of a circle of radius 8 cm is $144^\circ$, then its area is..........
A. 80.38  B. 20.14  C. 85.7  D. 22.36

16. Radius of the sector given below is .................

A. 15.7  B. 12.5  C. 22.7  D. 15

17. In the picture below, AB and CD are arc of circles centered at O. If OA = 6 cm and AC = 3 cm

Difference between the lengths of arc AB and arc CD is.................
A. $\pi$  B. $2\pi$  C. $3\pi$  D. $4\pi$. 

15
18. The following pie diagram shows that 30% of the earth’s total surface is land and the remaining portion is ocean.

The measure of the angle which represents the land is....................
A. 30° B. 70° C. 108° D. 252°

19. A rectangular block of wood has length 12 cm, breadth 9 cm and height 27 cm. Total surface area of the largest square prism that can be cut out from it is.................sq cm.
A. 1134 B. 1124 C. 1234 D. 1144

20. The height of a cylinder is 2 times the radius of its base. If the radius is x cm, its volume is....................
A. x³ B. πx³ C. 2πx³ D. 2x³

21. Area of an equilateral triangle is 17300 sq.cm. Circles are drawn, with each of its vertices as center and half the length of its side as radius, as shown below. Area of the shaded portion is...............sq.cm.
A. 1570 B. 200 C. 1600 D. 800
22. Two cylinders have their diameters in the ratio 2:3 and their heights in the ratio 5:4. The volume of the first cylinder is 900 c.c. The volume of the second cylinder is ........... c.c.
   A. 864          B. 1296          C. 1620          D. 1700

23. When the diameter of a circle is doubled, the area increases ........... times
   A. 2          B. 3          C. 4          D. 8

24. Pendulum in a clock is 14 cm long. It moves through 40° as it makes one oscillation. What is the distance traveled by the tip of the pendulum during one oscillation?
   A. 15.1 cm          B. 9.76 cm          C. 8.6 cm          D. 13.6 cm

25. Which of the following statement is true?
   A. Perimeter of the circle decreases as its diameter increases
   B. If we divide the perimeter of a circle by its diameter, we get a constant number.
   C. \( \pi \) is a rational number.
   D. If the diameter of a circle is doubled, its perimeter increases 4 times.
### APPENDIX – VII

#### ANSWER SHEET OF ACHIEVEMENT TEST
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### APPENDIX – VIII

#### SCORING KEY OF ACHIEVEMENT TEST

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INSTRUCTIONS TO STUDENTS

1. This test has multiple choice questions. Each question has four options indicated by letters A, B, C and D. Out of these four choices only one answer is correct. Identify the correct answer. Each question carries one mark.

2. Answers should be marked only in the given answer sheet. Mark your answers against the letters (A, B, C, D) given in your answer sheet.

3. The answers should be marked by darkening the respective circle. (See the example).

   A  B  C  D  
   O  O  O  O

4. If you want to change your answer put a 'X' mark above your answer and then darken the newly opted one. (See the example)

   A  B  C  D  
   O  X  O  O

5. After the duration of the test please return the answer sheet to the teacher
1. What comes next?
   P2C, R4E, T6G, ........
   A) V7H  B) V8I  C) U8I  D) V7I

2. What comes next?
   MNOP, ANOP, AAOP, AAAP, ........
   A) OAAP  B) MANA  C) PAAA  D) AAAA

3. Find the correct alternative
   ab.... .... abb.... ab.... a
   A) baab  B) abab  C) abba  D) aabb

4. Find the correct alternative
   b.... a.... bab.... ab.... a
   A) abab  B) baba  C) babb  D) abba

5. Z, A, Y, B, X.C, ........
   A) W  B) V  C) D  D) P

6. If A=1, B=3, C=5, then, J= ........
   A) 10  B) 19  C) 17  D) 21

7. 6, 5, 24, 25, ........
   A) 175  B) 210  C) 164  D) 144

8. 2, 10, 40, ?  240, 240
   A) 60  B) 30  C) 120  D) 140

9. 7, 5, 10, 7, 21, 17, 68, ?
   A) 65  B) 63  C) 21  D) 69

10. Which of the following figures correctly represent the relation among language, English and Hindi?

A)  

B)  

C)  

D)  

11. Which of the following diagram best illustrate the three classes, “eagles, birds, dogs”?

A)  
B)  
C)  
D)  

12. Spot out the dissimilar
A) PRT  B) QOM  C) CEG  D) IKM

13. Spot out the dissimilar
A) abC  B) mpR  C) sTp  D) ImU

14. The time shown in the clock now is 5 o’clock. What will be its mirror image?
A) 7 o’clock  B) 8 o’clock  C) 11 o’clock  D) 10 o’clock

15. Which letter has no change in its mirror image?
A) A  B) B  C) C  D) E

16. SLEA : BFMT :: ? : DHOV
A) CGNU  B) CGUN  C) GCNU  D) UNGC

17. EGIK : FILO :: FHJL : ?
A) JGMP  B) JGPM  C) GJPM  D) GJMP

18. 12 : 35 :: 16 : ?
A) 32  B) 48  C) 49  D) 63

19. Aab : aAB :: Pqr : ?
A) PqR  B) PQR  C) pQr  D) pQR

20. 9 persons can plough a field in 25 days. In how many days will 15 persons be able to complete the job?
A) 11  B) 15  C) 20  D) 18
21. The average weight of students in a class of 35 is 50 kg. If however, the weight of the teacher be included, the average will be increased by 500 gms. Find the weight of the teacher.
   A) 75 kg
   B) 68 kg
   C) 70 kg
   D) 77 kg

22. Eight years from now, Radha will be twice the age she was six years ago. What is her present age?
   A) 14
   B) 8
   C) 12
   D) 20

23. If twice the son’s age is added to father’s age, the sum is 70 years. But, if twice the father’s age is added to son’s age, the sum is 95 years. The age of father is
   A) 40 years
   B) 35 years
   C) 42 years
   D) 38 years

24. Which number will go in to the empty space?

   A) 3
   B) 4
   C) 8
   D) 6
25. Identify the total number of triangles in the given figure.

![Diagram of triangles]

A) 8  
B) 10  
C) 12  
D) 14

26. Raj is richer than Syam but not so rich as John, but poorer than Ramesh. Who is the poorest?

A) Ramesh  
B) John  
C) Syam  
D) Raj

27. Mohan and Ram play hockey and football. Edward and Ram play football and cricket. Mohan and Rafiq play tennis and hockey. Rafiq and Edward play cricket and tennis. Name the boy who plays hockey, football and cricket.

A) Mohan  
B) Ram  
C) Edward  
D) Rafiq

28. Mohan and Sohan are studying Physics and English. Sohan and Ramesh are studying Chemistry and English. Roshan and Mohan are studying Geometry and Physics. Ramesh and Roshan are studying Chemistry and Geometry. One who is not studying Geometry is

A) Mohan  
B) Sohan  
C) Ramesh  
D) Roshan

29. P is the brother of Q. R is the sister of P. S is the son of R. The relation of P to S is,

A) son  
B) uncle  
C) nephew  
D) father

30. If X is the husband of Y and Z is the mother of P and Y, how Z is related to X?

A) mother  
B) aunt  
C) sister-in-law  
D) mother-in-law
31. Which number will occupy the blank space?

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A) 22   B) 18   C) 16   D) 24

32. One doctor gave 5 tablets to his patient and asked him to take each tablet at an interval of half an hour. How much of time will he take to finish all the five tablets?
A) 2 ½ hours   B) 3 hours
C) 2 hours   D) 3 ½ hours

33. If the fifth of the month falls two days after Monday. What day of the week will be the 19th of the month?
A) Tuesday   B) Monday
C) Thursday   D) Wednesday

34. Manoj was born on February 29, in the year 1960. How many birthdays will he celebrate up to 1978 February?
A) 16   B) 8   C) 4   D) 5

35. Manish was born on 3rd March, 1980. Sanju was born 4 days before Manish. The republic day of that year fell on Saturday. Which day was Sanju’s birthday?
A) Wednesday   B) Friday
C) Thursday   D) Tuesday

36. Geeta walks 6 km towards north, turns her left and walks 8 km again she turns to her left and walks 6 km. How far is she from the starting point?
A) 6 km   B) 8 km   C) 10 km   D) 14 km

37. Six boys are so standing that they form a circle each facing the centre. Alok is to the left of Prabhat. Sunil is between Ashok and Vikas. Hari is between Alok and Ashok. Who is to the left of Vikas?
A) Prabhat   B) Hari   C) Ashok   D) Sunil
38. Five boys are sitting in a row. A is on the right of B. E is on the left of B but is on the right of C. A is on the left of D. Who is sitting first from the left?  
   A) E  
   B) C  
   C) D  
   D) A

39. Five books are lying in a file. E is lying on A and C is lying under B. A is lying above B and D is lying under C. Which book is lying at the bottom?  
   A) A  
   B) B  
   C) C  
   D) D

40. Five poles are standing in arrow. M is on the left of N, O is on the right of P, which is on the right of N. If L is on the left of M, which pole is in the centre?  
   A) L  
   B) M  
   C) N  
   D) O

41. In the class, Latha’s rank is 8th from the top and 37 from the bottom. Then what is the total number of students in the class?  
   A) 44  
   B) 45  
   C) 46  
   D) 43

42. Rema ranks 21st in a class of forty five students. What is her rank from the last?  
   A) 24th  
   B) 23rd  
   C) 20th  
   D) 25th

43. Rajeev is taller than Khan but shorter than Kiran. Ganesh is taller than Mary. Khan is taller than Ganesh. Who is the shortest?  
   A) Khan  
   B) Kiran  
   C) Mary  
   D) Rajeev

44. What is the sum of the numbers which appears in one shape only?  

```
    6
   / 
  5   1
 /   / 
 7   8
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   A) 31  
   B) 26  
   C) 22  
   D) 21

45. Two statements are given below. Take them true and decide which one of the five conclusions logically follows from the given statements.  
   Statement:  
   1) Ajay is an artist  
   2) Artists are beautiful
Conclusions:  
A) All beautiful persons are artists  
B) Ajay is beautiful  
C) Beautiful persons are not artists  
D) Ajay is not beautiful

46. Pointing to a boy, Ramesh said, ‘His only brother’s mother is my father’s wife. How is Ramesh related to that boy?  
A) Uncle  
B) Father  
C) Nephew  
D) Brother

47. A cat runs two meters towards east and turns to right, and runs one meter. Now in which direction the cat is running?  
A) East  
B) West  
C) North  
D) South

48. The cricket ball is lighter than the hockey ball and volleyball is lighter than the football. Hockey ball is lighter than the football but heavier than the tennis ball. Which of the following is the heaviest?  
A) Hockey ball  
B) Cricket ball  
C) Volley ball  
D) Football

49. How old is Mary?  
* She is younger than 75 years old.  
* Her age is an odd number  
* The sum of the digits of her age is 8  
* She has three great grand children  
A) 35  
B) 71  
C) 67  
D) 62

50. A street vendor had a basket of apples. Feeling generous one day, he gave away one-half of his apples plus one to the first-stranger he met, one half of his remaining apples plus one to the next stranger he met, and one-half of his remaining apples plus one to the third stranger he met. If the vendor had one left for him, with how many apples did he start?  
A) 12  
B) 31  
C) 22  
D) 14
# APPENDIX- X

**ANSWER SHEET OF TEST OF PROBLEM SOLVING ABILITY – DRAFT FORM**

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## APPENDIX – XI
### SCORING KEY OF TEST OF PROBLEM SOLVING ABILITY - DRAFT FORM

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APPENDIX-XIII

MAHATMA GANDHI UNIVERSITY
SCHOOL OF PEDAGOGICAL SCIENCES
2005

TEST OF PROBLEM SOLVING ABILITY
FINAL FORM

INSTRUCTIONS TO STUDENTS

1. This test has multiple choice questions. Each question has four options indicated by letters A, B, C and D. Out of these four choices only one answer is correct. Identify the correct answer. Each question carries one mark.

2. Answers should be marked only in the given answer sheet. Mark your answers against the letters (A, B, C, D) given in your answer sheet.

3. The answers should be marked by darkening the respective circle.(See the example).

   A   B   C   D

   O   O   ●   O

4. If you want to change your answer put a ‘X’ mark above your answer and then darken the newly opted one.(See the example)

   A   B   C   D

   O   ●   ●   O

5. After the duration of the test please return the answer sheet to the teacher.
1. What comes next?
P2C, R4E, T6G, ....
A) V7H       B) V8I       C) U8I       D) V7I

2. Find the correct alternative
ab.... ab.... ab.... a
A) baab       B) abab       C) abba       D) aabb

3. If A=1, B=3, C=5, then, J=........
A) 10     B) 19     C) 17     D) 21

4. 7, 5, 10, 7, 21, 17, 68, ?
A) 65     B) 63     C) 21     D) 69

5. Which of the following figures correctly represent the relation among language, English and Hindi?

A)     B)
C)     D)

6. Spot out the dissimilar
A) PRT       B) QOM       C) CEG       D) IKM

7. Which letter has no change in its mirror image?
A) A       B) B       C) C       D) E

8. EGIK: FILO:: FHJL : ?
A) JGMP       B) JGPM       C) GJPM       D) GJMP

9. 12 : 35 :: 16 : ?
A) 32       B) 48       C) 49       D) 63

10. 9 persons can plough a field in 25 days. In how many days will 15 persons be able to complete the job?
A) 11       B) 15       C) 20       D) 18
11. Eight years from now, Radha will be twice the age she was six years ago. What is her present age?
   A) 14          B) 8          C) 12          D) 20

12. Which number will go in to the empty space?

   |   | 9  |   |
---|---|---|---|
   | 6 |   | 16|
   | 4 |   | 36|
   | 3 |   | 64|

   A) 3          B) 4          C) 8          D) 6

   A) Mohan       B) Ram       C) Edward     D) Rafiq

14. P is the brother of Q. R is the sister of P. S is the son of R. The relation of P to S is,
   A) son         B) uncle     C) nephew     D) father

15. Which number will occupy the blank space?

   | 4 | 8 | 20 |
---|---|---|----|
   | 9 | 3 | 15 |
   | 6 |   | 6  |

   A) 22          B) 18         C) 16         D) 24
16. One doctor gave 5 tablets to his patient and asked him to take each tablet at an interval of half an hour. How much of time will he take to finish all the five tablets?
   A) 2 ½ hours  
   B) 3 hours  
   C) 2 hours  
   D) 3 ½ hours  

17. If the fifth of the month falls two days after Monday. What day of the week will be the 19th of the month?
   A) Tuesday  
   B) Monday  
   C) Thursday  
   D) Wednesday  

18. Geeta walks 6 km towards north, turns her left and walks 8 km again she turns to her left and walks 6 km. How far is she from the starting point?
   A) 6 km  
   B) 8 km  
   C) 10 km  
   D) 14 km  

19. Five boys are sitting in a row. A is on the right of B. E is on the left of B but is on the right of C. A is on the left of D. Who is sitting first from the left?
   A) E  
   B) C  
   C) D  
   D) A  

20. Five books are lying in a file. E is lying on A and C is lying under B. A is lying above B and D is lying under C. Which book is lying at the bottom?
   A) A  
   B) B  
   C) C  
   D) D  

21. Rema ranks 21st in a class of forty five students. What is her rank from the last?
   A) 24th  
   B) 23rd  
   C) 20th  
   D) 25th  

22. Rajeev is taller than Khan but shorter than Kiran. Ganesh is taller than Mary. Khan is taller than Ganesh. Who is the shortest?
   A) Khan  
   B) Kiran  
   C) Mary  
   D) Rajeev  

23. Two statements are given below. Take them true and decide which one of the five conclusions logically follows from the given statements.
   Statement: 1) Ajay is an artist
              2) Artists are beautiful
   Conclusions: A) All beautiful persons are artists
                B) Ajay is beautiful
                C) Beautiful persons are not artists
                D) Ajay is not beautiful
24. A cat runs two meters towards east and turns to right, and runs one meter. Now in which direction the cat is running?
   A) East  B) West  C) North  D) South

25. A street vendor had a basket of apples. Feeling generous one day, he gave away one-half of his apples plus one to the first-stranger he met, one half of his remaining apples plus one to the next stranger he met, and one-half of his remaining apples plus one to the third stranger he met. If the vendor had one left for him, with how many apples did he start?
   A) 12  B) 31  C) 22  D) 20
### APPENDIX- XIV

**ANSWER SHEET OF TEST OF PROBLEM SOLVING ABILITY – FINAL FORM**

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APPENDIX- XVI
MATHEMATICS ATTITUDE SCALE

Name of Student:

Class No:

Name of School:

Given below are some statements related to Mathematics. Record your opinion in respective columns by marking ✓

**Answer all the questions**

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<th>Disagree</th>
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<td>Mathematics should be made a compulsory subject</td>
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<td>2.</td>
<td>Mathematics is an interesting subject</td>
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<td>3.</td>
<td>In this Scientific era everybody should learn Mathematics</td>
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<td>Even though Mathematics is very difficult, it is very useful</td>
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<td>It is easy to learn Mathematics, if one is attentive in the class</td>
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<td>Mathematics is a subject that is interesting as well as giving knowledge</td>
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<td>With a little hardwork, anyone can learn Mathematics.</td>
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<td>Mathematics is a vast subject</td>
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<td>Life itself is incomplete without learning Mathematics</td>
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<td>Mathematics is more difficult than other subjects.</td>
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<td>Mathematics is only for smart students</td>
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<td>To become successful in life, it is not necessary to learn Mathematics.</td>
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<td>A lot of hard work is required to learn Mathematics.</td>
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<td>The necessity of learning Mathematics is not felt</td>
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<td>Nobody might have learned Mathematics, if it was not a compulsory subject</td>
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<td>Except arithmetic there is nothing in the Mathematics</td>
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<td>There is no specific advantage in life by learning mathematics</td>
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<td>Mathematics has an important role in making learning in school boring.</td>
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<td>O’ God save me from the subject mathematics</td>
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<td>Since mathematics is an important subject teachers who take tuition get a lot of students.</td>
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APPENDIX- XVII

UNIVERSITY OF KERALA
DEPARTMENT OF EDUCATION

MATHEMATICS INTEREST INVENTORY

Three activities or statements are given below against each number. Suppose there is facility for you to do all these works. Put a circle in the answer sheet around the letter of the item you like most.

An example is given below.

I like most,

A. Making question to learn Mathematics.
B. Making question to learn Science.
C. Making question to learn Social Studies

Model answer sheet

A  B  C

Among these if you are interested in Making questions to learn Mathematics put a circle around the letter A in the answer sheet provided.

Forty statements are given like this, please start only after getting the instruction. Read the statements carefully and answer them all.
1. A. Preparing an album using pictures in Mathematics.
   B. Preparing an album using pictures in Science.
   C. Preparing an album using pictures in Social Science.

2. A. Learning new words in Mathematics.
   B. Learning new words in Science.
   C. Learning new words in Social Science.

3. A. Becoming a Mathematics teacher.
   B. Becoming a Science teacher.
   C. Becoming a Social Science teacher.

   B. Drawing pictures in Science.
   C. Drawing pictures in Geometrical patterns.

5. A. Learning definition in Mathematics.
   B. Learning definition in Science.
   C. Learning definition in Social Science.

   B. Doing home work in Social Science.
   C. Doing home work in Mathematics.

7. A. Writing Science examination.
   B. Writing Mathematics examination.
   C. Writing Social Science examination.

8. A. Learning about origin of Mathematics.
   B. Learning about origin of Science.
   C. Learning about origin of History.

9. A. Getting a job in a factory.
    B. Getting a job in a bank.
    C. Getting a job in judiciary.

10. A. Learning about the growth of Mathematics.
    B. Learning about the growth of Science.
    C. Learning about the growth of Geography.

11. A. Attending a Mathematics class through the radio.
    B. Attending a Science class through the radio.
    C. Attending a Social Science class through the radio.
12. A. Observing the Mathematical instrument in the School.
   B. Observing the apparatus used in teaching Social Science.
   C. Observing the laboratory equipments in the school.

13. A. Undergo higher studies in Mathematics.
    B. Undergo higher studies in Science.
    C. Undergo higher studies in Social Science.

14. A. Like to spend more time in studying Science.
    B. Like to spend more time in studying Social Science.
    C. Like to spend more time in studying Mathematics.

15. A. Making clay models for studying Mathematics.
    B. Making clay models for studying Science.
    C. Making clay models for studying Social Science.

16. A. Helping the pupils in lower classes in learning Social Science.
    B. Helping the pupils in lower classes in learning English.
    C. Helping the pupils in lower classes in learning Mathematics.

17. A. Like to be in charge of first aid medicines in an excursion.
    B. Like to be in charge of food in an excursion.
    C. Like to be in charge of income and expenditure.

18. A. Learning about the different methods of measurement in olden days.
    B. Learning about the means of transportation of older days.
    C. Learning about the scientific knowledge of olden days.

19. A. Studying about coins of foreign countries.
    B. Studying about agricultural products of foreign countries.
    C. Studying about scientific advancement.

20. A. Learning about the structure of body.
    B. Learning about the structure of earth.
    C. Learning about the multiplication table.

21. A. To study the biography of Mendel.
    B. To study the biography of Ramanujan.
    C. To study the biography of C.V.Raman.

22. A. To study the characteristics of pyramids.
    B. To study the characteristics of light.
    C. To study the characteristics of micro-organism.
23. A. Filling up the puzzles in Science.  
B. Filling up the puzzles in Social Science.  
C. Filling up the puzzles in Mathematics.  

24. A. Seeing the pictures of men of letters.  
B. Seeing the pictures of Mathematicians.  
C. Seeing the pictures of statesmen.  

25. A. Studying various geometrical patterns that are seen on earth.  
B. Studying various plants on earth.  
C. Studying the climatic variations on the earth.  

26. A. To become a world famous mathematician.  
B. To become a world famous statesman.  
C. To become a world famous scientist.  

27. A. Making model for a Mathematic exhibition.  
B. Making model for a Science exhibition.  
C. Making model for a Geographical exhibition.  

28. A. Becoming a member of Science club.  
B. Becoming a member of Mathematics club.  
C. Becoming a member of Social Science league.  

29. A. Seeing a Mathematics exhibition.  
B. Seeing a Science exhibition.  
C. Seeing an Industrial exhibition.  

30. A. To buy books having scientific principles.  
B. To buy books having Mathematics puzzles.  
C. To buy books having countries and their capital.  

31. A. To read Science magazine.  
B. To read Mathematics magazine.  
C. To read Geographical magazine.  

32. A. Drawing the diagram of respiratory system.  
B. Drawing the Geometrical pattern.  
C. Drawing the map of India.  

33. A. To argue about Political matters with friends.  
B. To argue about Mathematics subjects with friends.  
C. To argue about spiritual matters with friends.
34.  A.  Making clay models.
    B.  Making toys.
    C.  Making Mathematics figures.

35.  A.  Doing Mathematical problems in leisure time.
    B.  Doing transcription in leisure time.
    C.  Drawing picture in leisure time.

36.  A.  Saying Mathematical riddles in leisure time.
    B.  Reciting Malayalam poems in leisure time.
    C.  Reciting English poems in leisure time.

37.  A.  Learning formula in Mathematics.
    B.  Learning formula in Science.
    C.  Learning about eventful years in Social Science.

38.  A.  Colouring Mathematical figures.
    B.  Colouring pictures related to Science.
    C.  Colouring pictures related to Social Science.

39.  A.  To imitate a Mathematics teacher.
    B.  To imitate a Science teacher.
    C.  To imitate a Social Science teacher.

40.  A.  Learning to find out the distance traveled by a cycle when it revolves once.
    B.  Learning about the working of a cycle bell.
    C.  Learning about the importance of cycle.