APPENDICES

Appendix I
School of Pedagogical Sciences
Mahatma Gandhi University

QUESTIONNAIRE TO STUDENTS

Name of the Student : Male/Female

Name of the School : Govt/ Aided

Class

Instructions

This questionnaire is meant for finding out your difficulties in Mathematics with special reference to Geometry, Algebra and Arithmetic. It specifically aims to detect your area of difficulty and the constraints you come across while solving a problem in Mathematics. The difficulties are traced out as per the steps followed in Polya's Approach such as i. Understanding the problem ii. Devising a Plan iii. Carrying out the Plan and iv. Looking back

1. Which is the most difficult area in mathematics for you ?
   a. Geometry
   b. Algebra
   c. Arithmetic

2. What are the difficulties faced by you while solving problems in,
   a. Geometry
      - …………………….
      - ……………………..
      - ……………………..
   b. Algebra
      - …………………….
      - ……………………..
      - ……………………..
   c. Arithmetic
      - …………………….
      - ……………………..
      - ……………………..

i) Understanding the Problem

3. What is the first step in understanding the problem?
   a. Reading the problem silently
   b. Reading the problem casualy
   c. To analyze the problem
4. What is the importance of analyzing the problem?
   a. Connecting the problem with unknown
   b. Don’t know
   c. For separating the various parts of the problem

ii) Devising a Plan

5. How will you connect the unknown statement?
   a. By relating with a similar problem
   b. By writing certain notations
   c. Making guess.
6. What is the importance of connecting the problem to a similar one?
   a. Can do the problem smoothly
   b. No use in connecting the problem
   c. Don’t know how to carry out the plan.
7. After formulating the plan what will you do ?
   a. Start doing the problem
   b. Proceed by following the proper steps
   c. Don’t know
8. What is the importance of drawing a rough figure in the case of geometry?
   a. To complete the problem more easily
   b. To get an idea about the problem
   c. To score marks
9. Do you make a guess while doing the problems?
   a. Yes b. No
10. Do you take into account all the information given in the problem?
    a. Yes b. No

iii) Carrying out the problem

11. What is the use of writing the steps of the problem?

    a. To develop speed

    b. To develop accuracy

    c. To score more marks

12. If you get stuck while solving a problem, what will you do?

    a. Recall the previous knowledge

    b. Leave the problem unsolved

    c. Get disappointed

13. Are you able to find out whether your steps are correct?

    a. Yes b. No

iv) Looking Back

14. What is your opinion about the habit of checking the problem?

    - ……………………………………………………
    - ……………………………………………………
    - …………………………………………………….

15. What will happen if you develop the habit of checking the results?

    - ……………………………………………………
    - ……………………………………………………
    - …………………………………………………….

Appendix II

POLYA’S APPROACH EVALUATION PROFORMA TO TEACHERS

Name of the school Rural / Urban

Name of the Teacher Male/Female

Qualification

Teaching Experience Upto 5 yeas 5-15 years More than 15 years

Instructions

Read the following statements carefully regarding the items related to Polya’s approach followed in the lesson transcripts given to you and indicate your agreement by putting a tick mark in the appropriate column suitable to you.

Sl. No.	Statements	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	Concentrate on all the essential aspects of the problem					
2	Can prove the theorems easily					
3	Make easy the pictorial representation of the problem					
4	Assimilation of the wholistic view of the problem					
5	Accuracy in measurement					
6	Helps to frame the equations with ease					
7	Helps to transfer the variables and constants					
8	Can proceed by following the steps systematically					
9	Avoid guessing the probable outcome					
10	Develop speed in doing the problem					
11	Easy way to find the LCM					
12	Helps in the subtraction of fractions					
13	Analysing the problem by breaking into subparts					
14	Connecting the problem with unknown					
15	Automatically relate with different but similar situations					

APPENDIX-III

POLYA'S APPROACH TO PROBLEM SOLVING

First	**Understanding the Problem**
You have to understand the problem	• What is the unknown? • What are the data? • What is the condition? • Is the condition sufficient to determine the unknown? • Draw a figure • Introduce suitable notation. Separate the various parts of the condition.
Second	**Devising a Plan**
Find the connection between data and the unknown.	• Look for a pattern • Examine related problems and determine if the same technique can be applied. • Examine a simpler or special case of the problem and gain insight into the solution of the original problem. • Make a table • Make a diagram • Write an equation • Use a guess and check • Work backward • Identify a sub goal • Take into account all essential notions involved in the problem.

Third	Carrying out the Plan
Carry out your plan.	• Check each step. • Can you see clearly that the step is correct? • Can you prove that it is correct?
Fourth	**Looking Back**
Examine the solution obtained.	• Is it reasonable? • Determine if there is any other method of finding the solution. • If possible determine other related or more general problems for which the technique will work.

APPENDIX-IV

School of Pedagogical Sciences
Mahatma Gandhi University

LESSON PLAN-POLYA'S APPROACH

Prepared by		**Guided by**
Elizabeth Thomas	**&**	**Dr. Celine Pereira**
(Research Scholar)		**(Professor)**
School of Pedagogical Sciences		**School of Pedagogical Sciences**
Mahatma Gandhi University		**Mahatma Gandhi University**

LESSON PLAN BASED ON POLYA'S APPROACH
(GEOMETRY)

Lesson Plan I

Name of the teacher	:		Subject	:	Mathematics
Name of the school	:		Standard	:	IX
			Unit	:	Circles
			Sub Unit	:	Theorem related to chords of circle

CONCEPT In a circle chords of equal lengths are at equal distances from the centre

OBJECTIVES

- To acquire knowledge about the various terms as chords, and perpendicular bisector of a chord of a circle
- To understand the fact that the perpendicular from the centre of a circle to a chord bisects the chord and the principle that chords of equal length are at equal distances from the centre.
- To apply the above result in new problematic situations
- To develop skill in solving problems related to the above principle
- To develop creativity in framing problems related to the above concept

Problem: Prove that in a circle chords of equal lengths are at equal distances from the centre.

Understanding the problem

- State the theorem in your own words.

  To show that two chords of equal lengths are at equal distances from the centre.
- What is to be proved?

  To prove chords are at equal distance.
- What are the data?

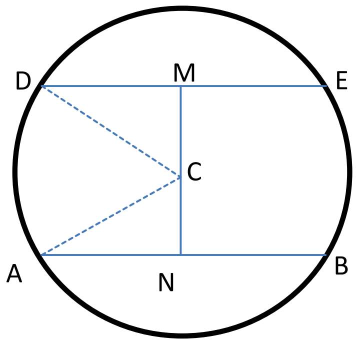
  Given two chords.
- What is the condition?

  Two chords are equal.
- Is the condition sufficient?

  No.
- What information is missing?

  Data is not complete.

Draw a diagram.



Devising a plan

- Find the connection between the data and the unknown

  Given $\overline{DE} = \overline{AB}$

  To show $\overline{CM} = \overline{CN}$

- Examine a simpler problem related to congruence of triangles and see if the same technique can be applied.

- Join DC and AC (dotted lines are drawn).

- Name the triangles thus obtained?

Δ DMC & Δ ANC

Carrying out the plan

- Which are the common measures in Δ DMC & Δ ANC? Why?

  $\overline{DC} = \overline{AC}$ (radii of the same circle)

$\angle CMD = \angle CNA = 90°$ (perpendicular bisector of all chords of a circle passes through the center)

$\overline{DM} = \overline{ME}$

$\overline{AN} = \overline{NB}$ (Perpendicular from the centre of a circle to a chord bisects the Chord)

From that data $\overline{DE} = \overline{AB}$

$\frac{1}{2}\,\overline{DE} = \frac{1}{2}\,\overline{AB}$

- What is the measure of $\frac{1}{2}\,\overline{DE}$ and $\frac{1}{2}\,\overline{AB}$?

$\frac{1}{2}\,\overline{DE} = \frac{1}{2}\,\overline{DM}$

$\frac{1}{2}\,\overline{AB} = \frac{1}{2}\,\overline{AN}$

- What is the peculiarity of Δ DMC & Δ ANC why?

  Using R.H.S theorem Δ DMC $\cong$ Δ ANC

- What can you say about MC & NC? Why?

  They are equal. Corresponding parts of congruent triangles

  Hence the result

Looking back

- Is it reasonable? Yes

- Determine if there is any other method of finding the solution Yes.

- If possible determine other related or more general problems for which the technique will work.

  Two chords of equal length '8' cm is given on either side of the centre of a circle of radius '5' cm find the distance between them.

Lesson Plan 2

Name of the teacher	:	Subject	:	Mathematics
Name of the school	:	Standard	:	IX
		Unit	:	Circles
		Sub Unit	:	Theorem related to Circles

CONCEPT The line joining the centre of a circle to the midpoint of a chord is perpendicular to the chord

OBJECTIVES

- To acquire knowledge about properties of chords of circles
- To understand about the various results related to chords of circles
- To apply the above theorem in relevant situations
- To develop creativity in finding new problems related to it.

Problem

The line joining the centre of a circle to the midpoint of a chord is perpendicular to the chord

Understanding the problem

What is to be proved?

We have to show that the line joining the centre of a circle to the midpoint of the chord is perpendicular.

What are the data?

A line is joined from the centre of a circle to a chord

What is the condition?

The line is joined from the centre of a circle to the midpoint of the chord .

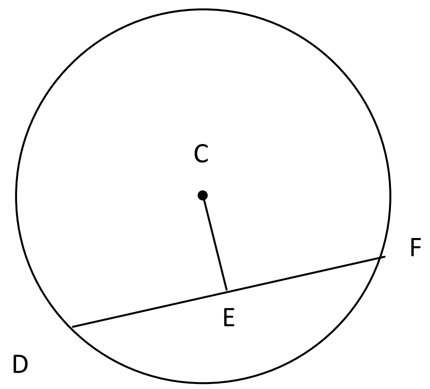
Is the condition sufficient ?

No

What information is missing?

Data is not complete

Draw a Diagram



Devising a Plan

Find the connection between the data and the unknown

Given $\overline{DE} = \overline{FE}$

To show $\angle CED = \angle CEF = 90^o$

Examine a problem related to congruence of triangles and see if the same technique can be applied

Join $\overline{DC}$ & $\overline{FC}$

Name the triangle thus obtained

Δ CDE and Δ CFE

Carrying out the plan

Which are the common measures in Δ CDE and Δ CFE, Why?

$\overline{CD} = \overline{CF}$ (Radii of he same circle are equal)

$\overline{CE} = \overline{CE}$ (Identity congruence)

$\overline{DE} = \overline{FE}$ (Given E is the midpoint of chord DF)

Which theorem is used to prove the congruence of the two triangles?

S.S.S. Theorem

State S.S.S. Theorem

If the three sides of one triangle are equal to the corresponding three sides of another triangle then these triangles are congruent.

What can you say about the measures of $\angle$ CED and $\angle$ CEF? Why?

They are equal. Corresponding angles of congruent triangles

What is the sum of $\angle$ CED and $\angle$ CEF? Why?

$\angle CED + \angle CEF = 180^o$ (linear pair)

$\therefore$ What is the measure of $\angle$ CED and $\angle$ CEF?

$\angle CED = \angle CEF = 90^o$

Hence what can you say about $\overline{CE}$ and the chord $\overline{DF}$?

$\overline{CE}$ is perpendicular to $\overline{DF}$. Hence the result

Looking Back

Is it reasonable ? Yes

Determine if there is any other method of finding the solution. No

If possible determine the related or more general problems for which the technique will work.

What is the distance from the centre of a circle of radius 10 cm to a chord of length 16 cm.

Lesson Plan 3

Name of the teacher	:		Subject	:	Mathematics
Name of the school	:		Standard	:	IX
			Unit	:	Circles
			Sub Unit	:	Problems related to chords of circles

CONCEPT **The perpendicular bisectors of two chords of a circle passes through the centre**

OBJECTIVES

- To acquire knowledge about the problems related to chords of circles
- To develop understanding about the properties of chords of circles
- To apply the above theorems related to circles in new situations
- To develop skill in constructing problems related to the above concept
- To create problems related to chords of circles and solve it

Problem

Draw a triangle with sides 4cm, 5cm and 6 cm and draw its circumcircle

Understanding the Problem

What is to be drawn?

Circumcircle of a triangle

What do you mean by Circumcircle of a triangle

A triangle inscribed in a circle is known as circumcircle of a triangle .

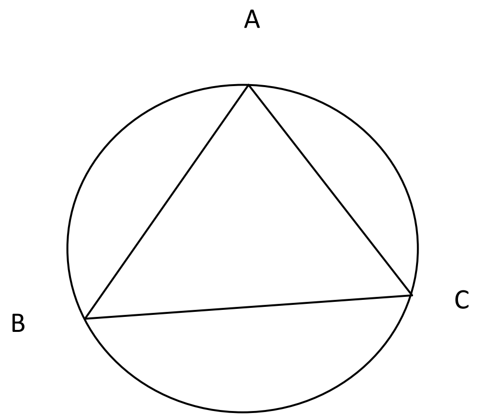
What are the data?

Measures of three sides of a triangle is given

Is the condition sufficient?

No.

Draw a rough figure



Devising a Plan

Find the connection between the data and the unknown?

Given the three sides of a triangle we have to find the circumcircle.

Examine a related problem and see if the same technique can be applied. Which result can we use here?

The perpendicular bisectors of all chords of a circle passes though the centre.

Carrying out the Plan

What is the first step in constructing Δ ABC?

Draw the base BC

What is the measure of BC?

BC = 4cm

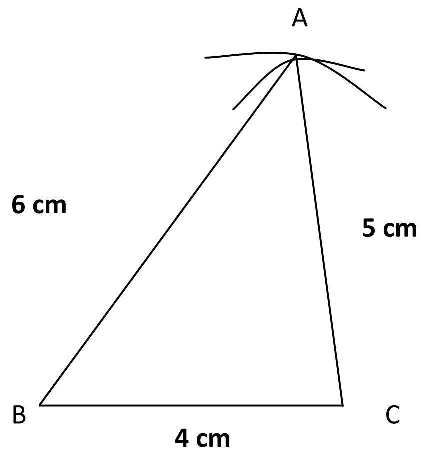
What is the next step?

From B draw an arc of measure 6 cm

From C draw an arc of measure 5 cm

Take the meeting point of the two arcs as A.

Complete the triangle ABC

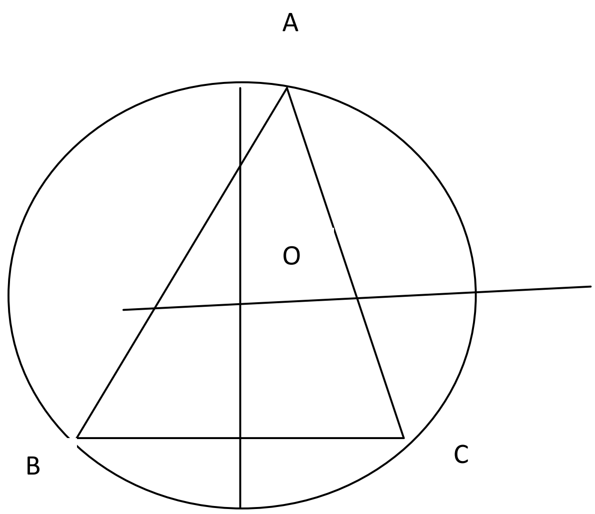


In order to find the centre of the circumcircle what should we do?

Draw the perpendicular bisector of any two sides of the triangle .

The meeting point of he bisectors of BC and AC can be taken as the circumcentre.

What is the radius?



The distance from the meeting point of the perpendicular bisector to any vertex of the triangle gives radius

Thus complete the circumcircle

Looking back

Is it reasonable? Yes

Determine if there is any other method of finding the solution. - Yes

If possible determine other related or more general problems for which the technique will work.

Draw a triangle ABC with measurements as given below and draw the circumcircle of the triangle

AB= 4cm, AC = 5 cm, & $\angle A = 60^o$

LESSON PLAN BASED ON POLYA'S APPROACH

(ARITHMETIC)

Lesson Plan 1

Name of the teacher	:		Subject	:	Mathematics
Name of the school	:		Standard	:	IX
			Unit	:	Irrational Numbers
			Sub Unit	:	$\sqrt{2}$ is an irrational number

CONCEPT

To find out that any expression which cannot be written in the form $\frac{p}{q}$ where p, q, are integers and q $\neq$0 is an irrational number.

OBJECTIVES

- To acquire knowledge about irrational numbers
- To understand the fact that any number which is not rational is irrational
- To apply the above result in new situations
- To develop skill in solving problems related to irrational numbers
- To develop creativity in framing problems related to irrational numbers

Problem: Is the square of any fraction equal to '2'

Understanding the problem

- What is to be proved?

  To prove whether there is any fraction whose square is '2'

- What are the data?

  Given any fraction

- What is the condition?

  Given the square of the fraction.

- Introduce suitable notation.

  Let the fraction be ‘x’/y

Devising a plan

- Find the connection between the data and the unknown

  To show whether $(x/y)^2 = 2$

- Examine a related problem and determine if the same technique can be applied.

  Reduce the fraction ‘x’/y to its lowest term, where ‘x’ and ‘y’ are integers having no common factor and $y \neq 0$

Carrying out the plan

- What does $(x/y)^2 = 2$ imply?

  $X^2 = 2y^2 \longrightarrow \qquad (1)$

- What does this show?

  This shows x^2 is an even number

- What is the peculiarity of ‘x’?

  Since x^2 is an even number ‘x’ is an even number

- How should be the value of y?

  Since ‘x’ and ‘y’ have no common factor ‘y’ cannot be an even number

- What is the peculiarity of ‘y’?

  ‘y’ is an odd number

- In eq. (1) substitute the value of ‘x’

  Let x = 2m (since ‘x’ is an even no.).

  $x^2 \quad = \quad 2y^2$

  $\Rightarrow \quad (2m)^2 = 2y^2$

  $\Rightarrow \quad 4m^2 = 2y^2 \longrightarrow \quad (2)$

- From eq. (2) what is the value of y^2

  $y^2 = 2m^2$

- What does this show?

  Y^2 is an even number

- From eq. (2) what is the peculiarity of y?

  ‘y’ is an even number

- How did this contradiction occur?

  This contradiction occurred because of our assumption that the square of any fraction is equal to ‘2’

- Hence how can you conclude?

  There is no fraction whose square is equal to ‘2’.

- From $(x/y)^2 = 2$ what is the value of x/y?

  $x/y = \sqrt{2}$

  Thus $\sqrt{2}$ is an irrational number

Looking back

- Is it reasonable?

  Yes

- Determine whether there is any other method of finding the solution?

No

- If possible determine other related or more general problems for which the technique will work.

- Prove that $\sqrt{3}$ is an irrational number.

Lesson plan 2

Name of the teacher	:	Subject	:	Mathematics
Name of the school	:	Standard	:	IX
		Unit	:	Irrational Numbers
		Sub Unit	:	Multiplication of Irrational numbers

CONCEPT **Products of two equal irrationals is a rational number and** $\sqrt{x} \times \sqrt{y} = \sqrt{xy}$

OBJECTIVES

- To acquire knowledge about the conversion of irrational fractions
- To understand about the properties of multiplication of Irrational numbers
- To apply the above result in novel situations
- To develop skill in solving problems related to Irrational numbers
- To develop creativity in framing problems related to irrational numbers

Problem :-

Simplifying $\sqrt{7\frac{1}{2}} \times \sqrt{3\frac{1}{3}}$

Understanding the problem: -

What is the unknown?

Product of $\sqrt{7\frac{1}{2}} + \sqrt{3\frac{1}{3}}$

What are the data?

Given two fractional roots.

Is the condition sufficient?

Yes.

Devising a plan :-

Examine a simpler problem and determine if the same technique can be applied.

Simplify $7\frac{1}{2} + 3\frac{1}{3}$

$$7\frac{1}{2} = \frac{7\times 2+1}{2} = \frac{15}{2}$$

$$3\frac{1}{3} = \frac{3\times 3+1}{3} = \frac{10}{3}$$

What is $\sqrt{7\frac{1}{2}} \times \sqrt{3\frac{1}{3}}$?

$$\sqrt{7\frac{1}{2}} \times \sqrt{3\frac{1}{3}} = \sqrt{\frac{15}{2}} \times \sqrt{\frac{10}{3}}$$

Carrying out the plan :-

What is $\sqrt{x} \times \sqrt{y}$?

$$= \sqrt{xy}$$

$$\sqrt{x^2} = x$$

What is $\sqrt{\frac{15}{2}} \times \sqrt{\frac{10}{3}}$?

$$\sqrt{\frac{15}{2}} \times \sqrt{\frac{10}{3}} = \sqrt{\frac{15}{2} \times \frac{10}{3}} = \sqrt{\frac{150}{6}}$$

$= \sqrt{25}$ (using above formula)

$\therefore$ What is $\sqrt{\frac{15}{2}} \times \sqrt{\frac{10}{3}}$?

$$\sqrt{25} = 5$$

Looking Back

Is it reasonable? Yes

Determine if there is any method of finding the solution No

If possible determine other related or more general problems for which the technique will work.

Simplify $\sqrt{4\frac{1}{2}} \times \sqrt{3\frac{1}{3}}$

Lesson Plan 3

Name of the teacher :		Subject	:	Mathematics
Name of the school :		Standard	:	IX
		Unit	:	Irrational Number
		Sub Unit	:	Rationalising an Irrational Number

CONCEPT

OBJECTIVE

- To acquire knowledge about rationalisation of an irrational number
- To understand about the process of rationalization
- To apply the properties of division of irrational numbers in new situations
- To develop skill in dividing an irrational number
- To create problems related to division of Irrational Numbers and find the value

Find the value of $\dfrac{\sqrt{8}\times\sqrt{18}}{2-\sqrt{3}}$ up to two decimal places.

Understanding the problem

What is the unknown?

Simplified form of the above expression

Is the condition sufficient ? Yes

Devising a Plan

Examine a simpler problem and see if the same techniques can be applied

What is $\sqrt{x} \times \sqrt{y}$?

$$\sqrt{x} \times \sqrt{y} = \sqrt{xy}$$

What is the value of $\sqrt{\frac{1}{2}}$?

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

Carrying out the Problem

What is $\sqrt{8} \times \sqrt{18}$

$$\sqrt{8} = \sqrt{4 \times 2} = \sqrt{4} \text{ x } \sqrt{2} = 2\sqrt{2}$$

$$\sqrt{18} = \sqrt{9 \times 2} = \sqrt{9} \text{ x } \sqrt{2} = 3\sqrt{2}$$

What is $\dfrac{2\sqrt{2} \times 3\sqrt{2}}{2 - \sqrt{3}}$?

What is the conjugate of $\left(2 - \sqrt{3}\right)$? $= 2 + \sqrt{3}$

What will you get if you multiply the numerator ands denominator of $\left(\dfrac{2\sqrt{2} \times 3\sqrt{2}}{2 - \sqrt{3}}\right)$

using $\left(2-\sqrt{3}\right)$

$$\frac{(2\sqrt{2}\times 3\sqrt{2})(2+\sqrt{3})}{(2-\sqrt{3})(2+\sqrt{3})}$$

What is (a+b) (a-b)?

a^2 - b^2

What is $(2+\sqrt{3})(2-\sqrt{3}) \quad = 4-\left(\sqrt{3}\right)^2$ = 4-3 = 1

What is $(2\sqrt{2}\times 3\sqrt{2}) \quad = 6\times\sqrt{2}\times\sqrt{2}$ = 6 x $\sqrt{4}$ = 6x2 = 12

What is the value of 12 $\left(2+\sqrt{3}\right)$?

12 $\left(2+\sqrt{3}\right)$ = 12 x 2 + 12 x $\sqrt{3}$ = 24 + 12 x $\sqrt{3}$

What is the value of $\sqrt{3}$? = $\sqrt{3}$ = 1.732

What is the sum of 24 and 20.76

24 + 20.76 = 44.76

Looking Back

Is it reasonable ?

Yes

Determine if there is any other method of finding the solution - No

If possible determine other related or more general problems for which the technique will work

a) $\frac{5}{2\sqrt{7}-3\sqrt{5}}$ b) $\frac{3}{2\sqrt{3}-\sqrt{2}}$

LESSON PLAN BASED ON POLYA'S APPROACH –III
(ALGEBRA)

Lesson Plan 1

Name of the teacher	:		Subject	:	Mathematics
Name of the school	:		Standard	:	IX
			Unit	:	Pairs of Equations
			Sub Unit	:	Solving Equations

CONCEPT **To frame simultaneous Equations and to find the value of variables given an algebraic problem**

OBJECTIVES

- To acquire knowledge about the various terms as Variables , equations in one variable, equations in two variables and value of variable
- To understand the fact that any unknown can be expressed using a variable, and the principle that given two variables the value of one variable can be obtained by proper substitution .
- To apply the above principle in new problematic situations
- To develop skill in solving problems related to the above

concept

- To develop creativity in framing problems related to the above concept

Problem: The price of '3' pencils and 4 pens is 26 rupees. The price of 6 pencils and 3 pens is 27 rupees. What is the price of each?

Understanding the problem

- What is the unknown?

  Price of pencil & pen.
- What are the data?

  Given price of '3' pencils and 4 pens and price of '6' pencils and '3' pens.
- Is the data sufficient?

  Yes
- Introduce suitable notation

  Let the price of a pencil be 'x' and pen be 'y'

Devising a plan

- Find the connection between the data and the unknown.

  Given $3x + 4y = 26 \longrightarrow (1)$

  $6x + 3y = 27 \longrightarrow (2)$
- Examine a related problem and see if the same technique can be applied.

  Make the value of any one variable equal in the two equations.
- Multiplying eq. (1) by (2) what do you get?

  $6x + 8y = 52 \longrightarrow (3)$

Carrying out the plan

- From eq. (2) and eq. (3) how will you find the value of y

i.e., $6x + 3y = 27 \longrightarrow$ (2)

$6x + 8y = 52 \longrightarrow$ (3)

- Subtract eq (2) from eq (3)

  $\Longrightarrow$ $5y = 52 - 27 = 25$
- What is the value of y?

  $Y = 25/5 = 5$
- What does y denote?

  Price of a pen
- Substitute the value of y in eq (1) and find the value of 'x'

  i.e., $3x + 4 \times 5 = 26$ i.e., $3x = 26\text{-}20 = 6$
- What is the value of x?

  $x = 6/3 = 2$
- What does 'x' denote?

  Price of a pencil

Looking back

- Substitute the values of 'x' and 'y' in the above equation and check whether it is correct.

  $3x + 4y = 26$ (1)

  $\Longrightarrow$ $3 \times 2 + 4 \times 5 = 26$

  $\Longrightarrow$ $6 + 20 = 26$ true
- Determine if there is any other method of finding the solution.

  Yes
- If possible determine other related or more general problem for which the technique will work

The price of two pens and three note books is 29 rupees, for two pens and five note books it is 43. What is the price of each?

Lesson Plan 2

Name of the teacher	:	Subject	:	Mathematics
Name of the school	:	Standard	:	IX
		Unit	:	Pairs of Equations
		Sub Unit	:	Framing equations and finding the value of variables

CONCEPT **To translate a verbal statement into an algebraic form**

OBJECTIVES

- To acquire knowledge about conversion of verbal statements to algebraic form
- To understand about the translation of verbal form to variable form
- To apply the method of substitution and elimination to find the value of variable
- To develop skill in solving problems related to equations in one variable and two variables
- To develop creativity in framing and solving problems of the above form

Problem

The sum of the digits of a two digit number is 11. If the digits of the number are interchanged, we get a number which is 27 more than the original number. What is the number?

Understanding the Problem

What is the unknown?

To find the two digit number

What are the data?

Given the sum of the digits of the two digit number is 11 and digits of the number are interchanged to get a number 27 more than original number.

Is the condition sufficient?

Yes

Introduce suitable notation.

Let the digit in the ten's place of the number be 'x' and the digit in the one's place of the number be 'y'.

Devising a Plan

Find the connection between the data and the unknown

Given $x + y = 11$ ………(1)

Let the unknown two digit number be $10x + y$

Also $10y + x = 10x+y+27$ ……….(2)

From eq (2) we get

$9y - 9x = 27$

i.e. $9 (y-x) = 27$

or $y - x = \frac{27}{9} = 3$ ……(3)

Carrying out the Plan

How will you find the value of 'x' and 'y' form eq (1) and eq (3)

$x + y = 11$ ie. $x + y = 11$

and $y - x = 3$ and $-x + y = 3$

Add the two equations

What is the value of y?

$2y = 14 \quad y = \frac{14}{2} = 7$

What is the value of x?

$x = y - 3 = 7 - 3 = 4$

What is the original number?

Original number $= 10x + y$

$= 10x4+7 = 47$

What is the interchanged number?

Interchanged number $= 10y + x$

$= 10 \text{ x } 7 + 4 = 74$

Looking Back

Is it reasonable? Yes

Substitute the values of ‘x’ and ‘y’ in the above equations and check whether it is correct.

$x + y = 11$ i.e. $4 + 7 = 11$

& $y - x = 3$ & $7 - 4 = 3$

Determine if there is any other method of finding the solution.

Yes

If possible determine other related or more general problems for which the technique will work.

Find the two digit number such that if either one is added to 8 times the sum of the digits or if 2 is added to 13 times the difference of the digits the number itself is obtained.

Lesson Plan 3

Name of the teacher	:		Subject	:	Mathematics
Name of the school	:		Standard	:	IX
			Unit	:	Pairs of Equations
			Sub Unit	:	Translating Word problems to equations and finding the value of variables

CONCEPT **To translate a word problem into an algebraic form**

OBJECTIVE

- To acquire knowledge about framing equations
- To develop understanding about finding the value of variables
- To apply the given data and connect the unknown with the known
- To develop skill in framing equations and solving the problem
- To develop creativity in framing problems of the above form

Problem

If the length of a rectangle is increased by 2 cm and the breadth is increased by 2 cm, then the area decreases by 28cm^2. If the length is decreased by 1 cm and the breadth is increased by 2 cm, then the area increases by 33 sq cm. Find the area of the original rectangle.

Understanding the problem

What is the unknown?

Area of the original rectangle

What are the data?

Length and breadth of a rectangle is given

What is the condition?

Given when the length is increased by 2 cm and the breadth is decreased by 2 cm , area decreases by 28 cm^2 and if length is decreased by 2 cm and the breadth is increased by 2 cm area increases by 33 cm^2

Is the condition sufficient?

Yes

Introduce suitable notation

Let the length be represented by ‘x’ and breadth by ‘y’.

Devising a Plan

Find the connection between the data and the unknown

Given $(x + 2) (y -2) = xy – 28$ …..(1)

And $(x – 1) (y+2) = xy + 33$ ……..(2)

Expand the LHS of equation (1)

ie. $xy - 2x + 2y - 4 = xy - 28$

ie. $-2x + 2y = -28 + 4 = -24$ …… ..(3)

Expand the L.H.S. of eq (2)

ie. $xy + 2x - y - 2 = xy + 33$

i.e $2x - y = 35$ ……..(4)

Carrying out the Plan

How will you find the value of 'y' from eq (3) and eq (4)

Add (3) and (4)

i.e. $-2x + 2y + 2x - y = -24 + 35$

i.e. $y = 11$

Substitute the value of 'y' in any equation and find the value of 'x'

$2x - y = 35 \rightarrow 2x - 11 = 35$

$\rightarrow 2x = 46 \quad x = \frac{46}{2} = 23$

Looking back

Substitute the values of 'x' and 'y' in eq (1) and (2) . Check whether it is correct.

$(x+2)(y-2) = xy - 28$

→ (23 + 2) (11 – 2) = 23 x 11 – 28

i.e. 25 x 9 = 253 – 28 = 225

i.e. 225 = 225

Determine if there is any other method of finding the solution

Yes

If possible determine other related or more general problems for which the technique will work.

If the length of a rectangle is increased by 5 meters and the breath is decreased by 3 meters, then its area decreases by 5 sq. meters. If the length is increased by 3 meters and the breath is increased by 2 meters , then its area increased by 50 sq. meters . Find the dimensions of the rectangle.

Appendix-V

School of Pedagogical Sciences
Mahatma Gandhi University

LESSON PLAN-ACTIVITY ORIENTED METHOD

Prepared by

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(Research Scholar)
School of Pedagogical Sciences
Mahatma Gandhi University

&

Guided by

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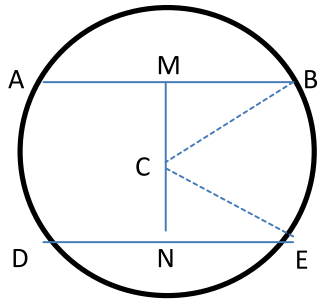
(Professor)
School of Pedagogical Sciences
Mahatma Gandhi University

LESSON PLAN-ACTIVITY ORIENTED METHOD

(GEOMETRY)

Problem: If two chords are at equal distances from the centre, prove that they are equal.

Process / activity	Response/ Evaluation
Activity No. (1) Teacher gives cut out of circles. Teacher checks the previous knowledge of the students and asks them to draw chords of circles.	Chords are line segments joining any two points on the circle.
Activity No. (2) Teacher asks students to draw the diagram by giving activity card and complete the figure by framing two triangles ΔCMB and ΔCNE	
Activity No. (3) Teachers tells that the triangles are congruent using the S.S.S congruency theorem	If three sides of a triangle are equal to the three isdes of another tirangle then they are congruent.
Activity No. (4) Teacher consolidates the results using activity card by explaining that the perpendicular from the centre of a circle to a chord bisects the chord, radii of a circle are equal and the chords are at equal distances from the centre.	Recalls the result
Activity No. (5)(Extension Activity) Teacher gives a problem regarding the above result. Two chords of equal length ‘8’ cm is given on either side of the centre of a circle of radius 5cm. find the distance between them.	

LESSON PLAN-ACTIVITY ORIENTED METHOD

(ARITHMETIC)

Problem: Is the square of any fraction equal to 2

Process / activity	Response/ Evaluation
Activity No. (1) Teacher checks the previous knowledge of the students regarding fractions.	An expression of the form P/q, where $q \neq 0$ & p, q are integers
Activity No. (2) Teacher asks students to square a fraction of the form (x/y) = 2 and find the value of $(x/y)^2$. Teacher gives the idea that x & y do not have any common factors.	$(x/y)^2 = 2$
Activity No. (3) Teacher consolidates that using the above result we arrive at a contradiction that x^2 is an even number. Using the value x = 2 m, teacher asks students to find the value of y. Again a contradictory statement is obtained that both 'x' & 'y' are even numbers.	$x^2 = 2y^2$ implies x is even $(4m^2) = 2y^2$ $Y^2 = 2m^2$
Activity No. (4) Teacher asks students the reason for this contradiction and tells that this is due to the wrong assumption that the square of a fraction is 2. Hence the students arrive at the result that there is no fraction whose square is equal to 2.	Recalls the result
Activity No. (5) (Extension activity) Prove that $\sqrt{3}$ is an irrational number.	

LESSON PLAN-ACTIVITY ORIENTED METHOD

(ALGEBRA)

Problem: The price of 3 pencils and 4 pens is 26 rupees. The price of 6 pencils and 3 pens is 27 rupees. What is the price of each?

Process / activity	Response/ Evaluation
Activity No. (1) Teacher asks students about algebraic expression.	Expressions of the form ax + b, where a≠0 a & b are constants
Activity No. (2) Activity sheets containing various expressions are given and the students are asked to identify algebraic expression.	3y + 9 4z + 12
Activity No. (3) Teachers says that pencils can be represented using the variable ‘x’ and pen by the variable ‘y’ thus the first statement of the above problem. Is 3x + 4y Teachers asks students to write the above problem in symbolic form	$3x + 4y = 26 \rightarrow (1)$ $6x + 3y = 27 \rightarrow (2)$
Activity No. (4) Teacher asks students to eliminate the variable ‘x’ by multiplying first equation with (6) and second equation with (3)	18x + 24y = 156 <u>18 x + 9y = 81</u> 15y = 75 Y=5
Activity No. (5) Teacher asks students to substitute the values of ‘x’ & ‘y’ in the above equation and check whether it is true thus she consolidated the result if the value is true for one equation then it is true for the second equation.	
Activity No. (6) (Extension Activity) The price of two pens and three note books is 29 rupees, for two pens and five note books it is 43. What is the price of each?	Price of a Pen = Rs.4.00 Price of a note book =Rs. 7.00

Appendix-VI

School of Pedagogical Sciences
Mahatma Gandhi University

Problem Solving Ability Test

(Draft)

Name of the school: Max. Marks: 50
Class: Time: 90 Minutes

General Instructions

i. Carefully read the questions given below.

ii. Write the necessary steps for solving each problem.

iii. You can follow the pattern given at the end of the test while answering the question

iv. Use additional sheets to answer the questions.

PROBLEM NO. 1

In a circle of radius 1.7 cm a chord of length 3 cm is to be drawn. How far from the centre is it?

(1 Mark)

PROBLEM NO. 2

Find ‘x’ & ‘y’ $x/4 = 2$, $3x + 5y = 55$

(1 Mark)

PROBLEM NO. 3

Simplify $1/\sqrt{5} + \sqrt{3}$

(1 Mark)

PROBLEM NO. 4

Simplify $\sqrt{125} - \sqrt{45}$

(1 Mark

PROBLEM NO. 5

Find the length of a chord which is at a distance of 6 cm from the centre of a circle of radius 10 cm.

(1 Mark)

PROBLEM NO. 6

x+ $\frac{x}{x-1}$

(1 Mark)

PROBLEM NO. 7

Find ‘x’ & ‘y’ x:y =2:1. 6x-2y = 50

(1 Mark)

PROBLEM NO. 8

Simplify √80 - √20

(1 Mark)

PROBLEM NO. 9

The distance between two points A and B is 9 cm. What is the radius of the smallest circle through these points?

(1 Mark)

PROBLEM NO. 10

Find the value of x. (3x/2)+4=2x-3

(1 Mark)

PROBLEM NO. 11

Two persons divided Rs.100 between them and one got Rs. 10 more than the other. How much did each get?

(1 Mark)

PROBLEM NO. 12

Find ‘x’ & ‘y’ y = x+1, 9x+y=1

(1 Mark)

PROBLEM NO. 13

Renu's age is three times that of her brother Rajan. After two years, Renu's age would be two times that of Rajan. How old are they now?

(1 Mark)

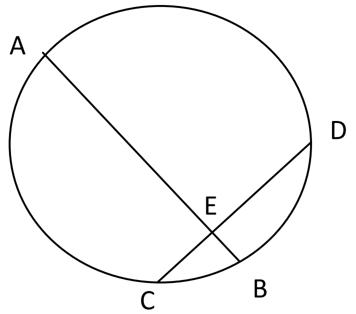
PROBLEM NO. 14

Find 'x' & 'y' y/2 = 5. x-y = 30

(1 Mark)

PROBLEM NO. 15

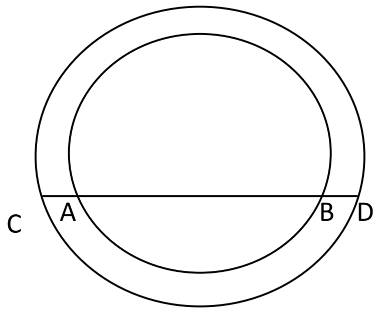
In the figure below CD is a chord and AB is the diameter perpendicular to it. Prove that Δ ADC is an isosceles triangle.



(1 .5Marks)

PROBLEM NO. 16

The two circles in the picture have the same centre. Prove that AC = BD.



(1.5 Marks)

PROBLEM NO. 17

A hundred rupee note was changed to ten rupee notes and twenty rupee notes. Eight notes in all. How many ten rupee notes and how many twenty rupee notes?

(1.5 Mark)

PROBLEM NO. 18

Simplify $\sqrt{80} + \sqrt{125} - \sqrt{45}$

(1.5 Marks)

PROBLEM NO. 19

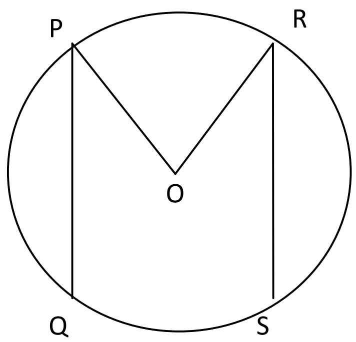
Simplify $\dfrac{4}{2\sqrt{3} - \sqrt{2}}$

(1.5 Marks)

PROBLEM NO. 20

In the figure below 'O' is the centre of the circle and PQ & RS are chords with <OPQ = < ORS. Prove that PQ = RS

(1.5 Mark)



PROBLEM NO. 21

Five years back my age was three times the age of my son. After ten years my age will be double that of my son. What is my present age?

(2Marks)

PROBLEM NO. 22

Sum of two numbers is 25 and the difference of the numbers is 9. Find the numbers?

(2 Marks)

PROBLEM NO. 23

Two parallel chords in a circle of diameter 30cm have lengths 24 cm and 18cm. If the chords are on the same side of the centre, what is the distance between them?

(2 Marks)

PROBLEM NO. 24

Which is the largest $2\sqrt{6}$, $3\sqrt{3}$, $4\sqrt{2}$

(2 Marks

PROBLEM NO. 25

The sides of a square are '4' cm long. The mid points of the sides are joined to form another square, what is the perimeter of the smaller square?

(2 Marks)

PROBLEM NO. 26

In a class thrice the number of boys is equal to twice the number of girls. The total number of students in the class is 25. How many boys and girls are there in the class?

(2 Marks)

PROBLEM NO. 27

If $\left(\frac{\sqrt{7}-1}{\sqrt{7}+1}\right)-\left(\frac{\sqrt{7}+1}{\sqrt{7}-1}\right) = a+b\sqrt{7}$ find 'a' & 'b'

(3Marks)

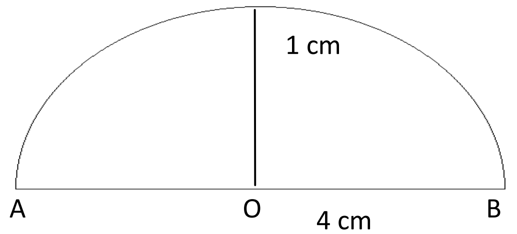
PROBLEM NO. 28

A, B, C are three points such that AB= $\sqrt{50}$ cm, BC = $\sqrt{98}$ cm, AC = $\sqrt{288}$ cm. Do they lie in a straight line?

(2 Marks)

PROBLEM NO. 29

In a circle of radius 1.7 cm a chord of length 3 cm is to be drawn. How far from the centre is it?



(2Marks)

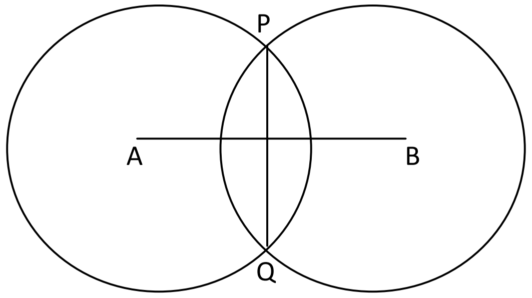
PROBLEM NO. 30

Represent $\sqrt{3}$ on the number line.

(3 Marks)

PROBLEM NO. 31

In the picture below circles centered at 'A' and 'B' intersect at P and Q. Show that AB is the perpendicular bisector of PQ.



(3 Marks)

PROBLEM NO. 32

Draw a rectangle of side 4cms and 5cms and draw its circumcircle

(3 Marks)

Appendix-VII

School of Pedagogical Sciences
Mahatma Gandhi University
Problem Solving Ability Test

(Final)

Name of the school: Max. Marks: 25

Class: Time: 45 Minutes

General Instructions

i. Carefully read the questions given below.

ii. Write the necessary steps for solving each problem.

iii. You can follow the pattern given at the end of the test while answering the question

iv. Use additional sheets to answer the questions.

PROBLEM NO. 1

In a circle of radius 1.7 cm a chord of length 3 cm is to be drawn. How far from the centre is it?

(1 Mark)

PROBLEM NO. 2

Find ‘x’ & ‘y’ $x/4 = 2$, $3x + 5y = 55$

(1 Mark)

PROBLEM NO. 3

Simplify $\sqrt{125} - \sqrt{45}$

(1 Mark)

PROBLEM NO. 4

Find the length of a chord which is at a distance of 6 cm from the center of a circle of radius 10 cm. (1 Mark)

PROBLEM NO. 5

Find ‘x’ & ‘y’ x:y =2:1. 6x-2y = 50

(1 Mark)

PROBLEM NO. 6

Simplify $\sqrt{80} - \sqrt{20}$

(1 Mark)

PROBLEM NO. 7

Find the value of x. (3x/2)+4=2x-3

(1 Mark)

PROBLEM NO. 8

Two persons divided Rs.100 between them and one got Rs. 10 more than the other. How much did each get?

(1 Mark)

PROBLEM NO. 9

Find ‘x’ & ‘y’ y = x+1, 9x+y=1

(1 Mark)

PROBLEM NO. 10

Renu’s age is three times that of her brother Rajan. After two years, Renu’s age would be two times that of Rajan. How old are they now?

(1 Mark)

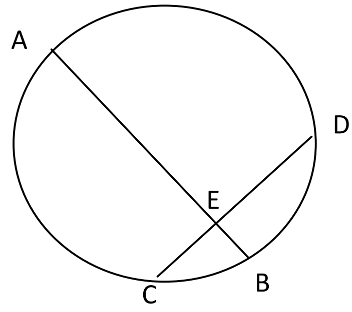
PROBLEM NO. 11

Find ‘x’ & ‘y’ y/2 = 5. x-y = 30

(1 Mark)

PROBLEM NO. 12

In the figure below CD is a chord and AB is the diameter perpendicular to it. Prove that Δ ADC is an isosceles triangle.



(1.5 Marks)

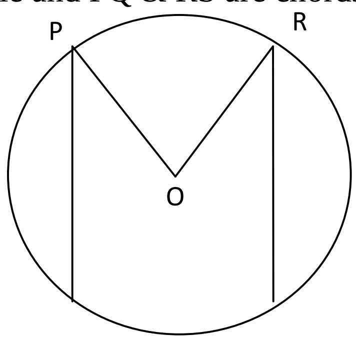
PROBLEM NO. 13

A hundred rupee note was changed to ten rupee notes and twenty rupee notes. Eight notes in all. How many ten rupee notes and how many twenty rupee notes?

(1.5 Marks)

PROBLEM NO. 14

In the figure below 'O' is the centre of the circle and PQ & RS are chords with <OPQ = < ORS. Prove that PQ = RS



(1.5 Mark)

PROBLEM NO. 15

Two parallel chords in a circle of diameter 30cm have lengths 24 cm and 18cm. If the chords are on the same side of the centre, what is the distance between them?

(2 Mark)

PROBLEM NO. 16

The sides of a square are '4' cm long. The mid points of the sides are joined to form another square, what is the perimeter of the smaller square

(2 Mark)

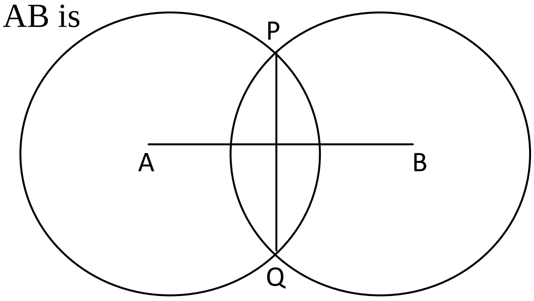
PROBLEM NO. 17

A, B, C are three points such that AB= $\sqrt{50}$ cm, BC = $\sqrt{98}$ cm, AC = $\sqrt{288}$ cm. Do they lie in a straight line?

(2.5 Mark)

PROBLEM NO. 18

In the picture below circles centered at 'A' and B' intersect at P and Q. Show that AB is the perpendicular bisector of PQ.



(3 Mark)

Question Pattern

Stage-I

1. What is the unknown?
2. What are the data?
3. Is the condition sufficient?

Stage-II

1. Find the connection between the data and the unknown.
2. Examine a simpler problem and see if the same technique can be applied.

Stage-III

1. Carry out the steps in stage II and make necessary computation.
2. Check each step as you proceed.

Stage-IV

1. Check the answer.
2. Is there any other method of finding the solution?
3. If possible determine other related or more general problem for which the technique will work.

Appendix-VII

School of Pedagogical Sciences
Mahatma Gandhi University

Problem Creating Ability Test

(Draft)

Name of the School:
Class: Time: 60 Minutes

General Instructions

i. Carefully read the questions given below.
ii. Write the necessary steps for creating each problem.
iii. Write the problems for test items in the separate sheets provided to you.

Appeal

Prepare as many sums or problems as you can with the given data. You may add some more data which you feel relevant to create a problem. Both quantity and quality are under consideration. You need not solve any of the problems you create.

Test items

Whatever problems you create see that

TEST ITEM No. 1

The circle is having radius 6 cm

TEST ITEM No. 2

Distance from the center to a point on the circle is 4 cm.

TEST ITEM No. 3

The circle is having diameter 10 cm

TEST ITEM No. 4

Distance from the center to the chord is 4 cm.

TEST ITEM No. 5

Length of a chord is 12 cm

TEST ITEM No. 6

The solution is a multiple of $\sqrt{8}$

TEST ITEM No. 7

One of the angles of a triangle is 90^0

TEST ITEM No. 8

The solution is a multiple of $\sqrt{10}$

TEST ITEM No. 9

Frame an equation involving one variable so that the solution is an even number

TEST ITEM No. 10

Two sides of a triangle is 12 cm

TEST ITEM No. 11

The solution is a multiple of $\sqrt{50}$

TEST ITEM No. 12

Frame an equation involving one variable so that the solution is an odd number.

TEST ITEM No. 13

One of the angles of a triangle is 100^0

TEST ITEM No. 14

The solution is a multiple of $\sqrt{2}$

TEST ITEM No. 15

Base of a triangle is 8 cm

TEST ITEM No. 16

One of the angles of a triangle is 45^0

TEST ITEM No. 17

The solution is a multiple of $\sqrt{3}$

TEST ITEM No. 18

Frame an equation involving two variables so that the solution is an even number.

TEST ITEM No. 19

One of the sides of a triangle is 13 cm

TEST ITEM No. 20

One of the angles of a triangle is 60^0

Appendix- IX

School of Pedagogical Sciences
Mahatma Gandhi University

Problem Creating Ability Test

(Final)

Name of the School: Class:
Time: 60 Minutes

General Instructions

i. Carefully read the questions given below.

ii. Write the necessary steps for creating each problem.

iii. Write the problems for test items in the separate sheets provided to you.

Appeal

Prepare as many sums or problems as you can with the given data. You may add some more data which you feel relevant to create a problem. Both quantity and quality are under consideration. You need not solve any of the problems you create.

]Test items

Whatever problems you create see that

TEST ITEM No. 1

The circle is having radius 6 cm

TEST ITEM No. 2

The circle is having diameter 10 cm

TEST ITEM No. 3

Length of a chord is 12 cm

TEST ITEM No. 4

One of the angles of a triangle is 90^0

TEST ITEM No. 5

Frame an equation involving one variable so that the solution is an even number.

TEST ITEM No. 6

The solution is a multiple of $\sqrt{2}$

TEST ITEM No. 7

One of the sides of a triangle is 13 cm

TEST ITEM No. 8

The solution is a multiple of $\sqrt{3}$

TEST ITEM No. 9

One of the angles of a triangle is 45^0

TEST ITEM No. 10

Frame an equation involving one variable so that the solution is an odd number.

Appendix-X

School of Pedagogical Sciences
Mahatma Gandhi University

(Final)

Marking Scheme of Problem Solving Ability Test

Marking Scheme

PROBLEM NO. 1

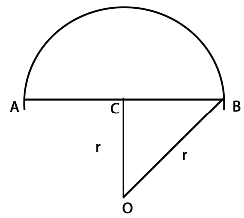
In a circle of radius 1.7 cm a chord of length 3 cm is to be drawn. How far from the centre is it. (1 Mark)

OC = 9

CB = 3/2 = 1.5 cm (1/4)

OC = $\sqrt{(1.7)^2 - (1.5)^2}$ = $\sqrt{(1.7+1.5)\ (1.7 - 1.5)}$ (1/2)

= $\sqrt{3.2 \times .2}$ = $\sqrt{.64}$ = .8 cm (1/4)



PROBLEM NO. 2

Find ‘x’ & ‘y’ x/4 = 2, 3x + 5y = 55 (1 Mark)

y =? x =? x/4 = 2, 3x + 5y = 55

3 x 8 + 5y = 55 (1/4)

5y = 55 – 24 = 31 (1/4)

y = 31/5 = 6.2 (1/2)

PROBLEM NO. 3

Simplify $\sqrt{125} - \sqrt{45}$ (1 Mark)

$\sqrt{125}$ + $\sqrt{45}$ = $\sqrt{25 \times 5}$ + $\sqrt{9 \times 5}$ (1/4)

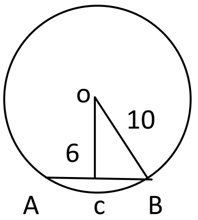
= $5\sqrt{5}$ + $3\sqrt{5}$ (1/4)

= $8\sqrt{5}$ (1/2)

PROBLEM NO. 4

Find the length of a chord which is at a distance of 6 cm from the center of a circle of radius 10 cm. (1 Mark)

CB = $\sqrt{(10)^2 - (6)^2}$ (1/4)



= $\sqrt{(10+6)\ (10 - 6)}$ (1/4)

= $\sqrt{16 \times 4}$ = $\sqrt{64}$ = 8 cm

AB = 2 x 8 =16 cm (1/2)

PROBLEM NO. 5

Find ‘x’ & ‘y’ x:y =2:1. 6x-2y = 50 (1 Mark)

x/y=2/1

x=2y (1/4)

(6 x 2y)-2y=50 (1/4)

‘y=50/10=5 (1/4)

‘x=2x y=10 (1/4)

PROBLEM NO. 6

Simplify $\sqrt{80} - \sqrt{20}$ (1 Mark)

= $\sqrt{16 \times 5}$ - $\sqrt{4 \times 5}$ (1/4)

= $4\sqrt{5} - 2\sqrt{5}$ (1/4)

= $2\sqrt{5}$ (1/2)

PROBLEM NO. 7

Find the value of x. (3x/2)+4=2x-3 (1 Mark)

(3x/2)+4=2x-3

7=2x-(3x/2) (1/4)

7=(4x-3x)/2 (1/4)

14=x (1/2)

PROBLEM NO. 8

Two persons divided Rs.100 between them and one got Rs. 10 more than the other. How much did each get? (1 Mark)

'x+x+10=100 (1/2)

2x=90 (1/4)

'x=45 & the other person got x+10=55 (1/4)

PROBLEM NO. 9

Find 'x' & 'y' y = x+1, 9x+y=1 (1 Mark)

9x+x+1=1 (1/4)

10x=0 (1/4)

'x=0 (1/4)

'y=1 (1/4)

PROBLEM NO. 10

Renu's age is three times that of her brother Rajan. After two years, Renu's age would be two times that of Rajan. How old are they now? (1 Mark)

Rajan's Age = x

Renu's Age = 3x (1/4)

After 3 years Renu's age = 3x+2

Given 3 x + 2=2(x + 2)

3x =2 x =4-2 (1/4)

x= 4-2 = 2 (1/4)

Rajan's Age = 2

Renu's Age = 3x2=6 (1/4)

PROBLEM NO. 11

Find 'x' & 'y' y/2 = 5. x-y = 30 (1 Mark)

x – 10 = 30 (1/2)

x = 10 +30 =40 (1/2)

PROBLEM NO. 12

A hundred rupee note was changed to ten rupee notes and twenty rupee notes. Eight notes in all. How many ten rupee notes and how many twenty rupee notes?

(1.5 Marks)

Let ten rupee notes be 'x' and twenty rupee notes be 'y'.

$x + y = 8 \longrightarrow$ (1) (1/4)

$\underline{10x + 20y = 100} \longrightarrow$ (2) (1/2)

(1) By (10) $10x + 10y = 80$ (1/4)

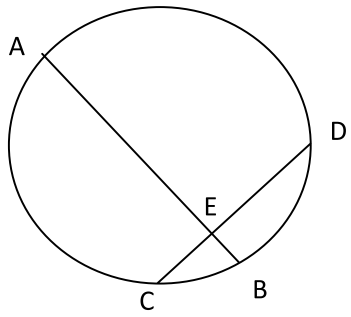
$\underline{10x + 20y = 100}$

$-10y = -20 \quad \therefore y = 2$ (1/4)

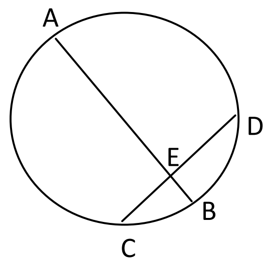
$\therefore x = 8 - y = 8 - 2 = 6$ (1/4)

PROBLEM NO. 13

In the figure below CD is a chord and AB is the diameter perpendicular to it. Prove that Δ ADC is an isosceles triangle.



(1.5 Marks)



D E = CE (perpendicular to CD bisects the chord) (1/4)

Consider Δ AEC & Δ AED

$\overline{AE} = \overline{AE}$ (common side) (1/4)

$\angle AEC = \angle AED = 90^0$ (given) (1/4)

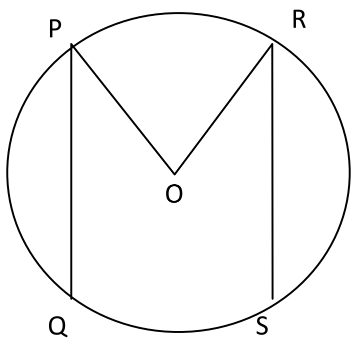
$\Delta AEC \cong \Delta AED$ (Using SAS theorem) (1/4)

$\therefore \overline{AC} \cong \overline{AD}$ (C.P.C.T) (1/4)

$\therefore \Delta$ ADC is an isosceles triangle. (1/4)

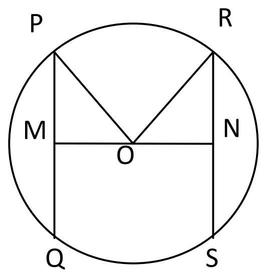
PROBLEM NO. 14

In the figure below 'O' is the centre of the circle and PQ & RS are chords with <OPQ = < ORS. Prove that PQ = RS



(1.5 Marks)

$\angle PMO = \angle RNO = 90^0$ ($\perp^r$ bisector theorem) (1/4)



$\angle MPO = \angle ORN$ (given)

$\therefore \angle POM = \angle RON$ (Using above result) (1/4)

$\overline{OP} = \overline{OR}$ (Radii of the same circle) (1/4)

$\therefore \Delta POM \cong \Delta RON$ (Using ASA theorem) (1/4)

$\therefore \overline{PM} = \overline{RN}$ (C PCT) (1/4)

$\therefore \overline{PM} = \overline{MQ}$ & $\overline{RN} = \overline{NS}$ ($\perp^r$ from the centre bisects the chord)

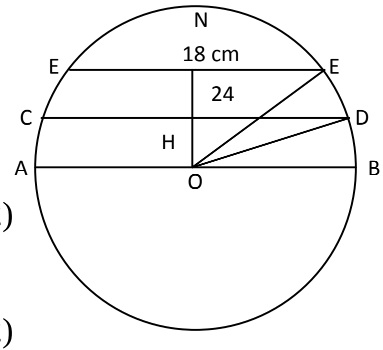
$\therefore \overline{PQ} = \overline{RS}$ (1/4)

PROBLEM NO. 15

Two parallel chords in a circle of diameter 30cm have lengths 24 cm and 18cm. If the chords are on the same side of the centre, what is the distance between them?

(2 Marks)

Fig. (1/2)



$OM = \sqrt{(OD)^2 - (MD)^2}$

$= \sqrt{(15)^2 - (12)^2}$

$= \sqrt{225 - 144} = \sqrt{81} = 9$ (1/2)

$ON = \sqrt{(OE)^2 - (ME)^2} = \sqrt{(15)^2 - (9)^2}$

$= \sqrt{225 - 81} = \sqrt{144} = 12$ (1/2)

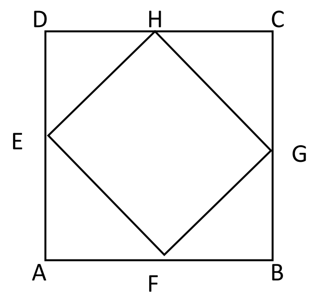
$\therefore MN = ON - OM = 12 - 9 = 3$ (1/2)

PROBLEM NO. 16

The sides of a square are '4' cm long. The mid points of the sides are joined to form another square, what is the perimeter of the smaller square. (2 Marks)

$FG = \sqrt{(2)^2 + (2)^2}$ (1/4)

$= \sqrt{8} = \sqrt{4 \times 2} = 2\sqrt{2}$ (1/2)



Area of the square $= a^2$ (1/4)

$= 2\sqrt{2} \times 2\sqrt{2}$ (1/2)

$= 4 \times 2 = 8\ cm^2$ (1/2)

PROBLEM NO. 17

A, B, C are three points such that AB= $\sqrt{50}$ cm, BC $= \sqrt{98}$ cm, AC $= \sqrt{288}$ cm. Do they lie in a straight line? (2.5 Marks)

A, B, C are three points such that AB= $\sqrt{150}$ cm, BC $= \sqrt{98}$ cm, AC $= \sqrt{288}$ cm do they lie in a straight line.

$AB = \sqrt{50} = \sqrt{25 \times 2} = 5\sqrt{2}$ (1/2)

$BC = \sqrt{98} = \sqrt{49 \times 2} = 7\sqrt{2}$ (1/2)

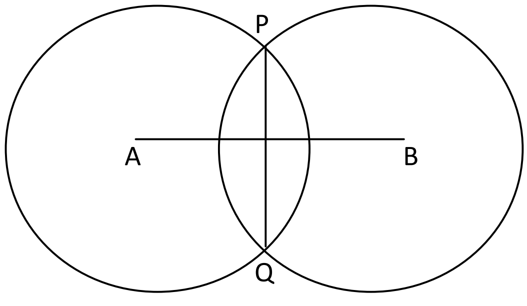
$AC = \sqrt{288} = \sqrt{144 \times 2} = 12\sqrt{2}$ (1/2)

If AB+BC = AC then they are collinear (1/2)

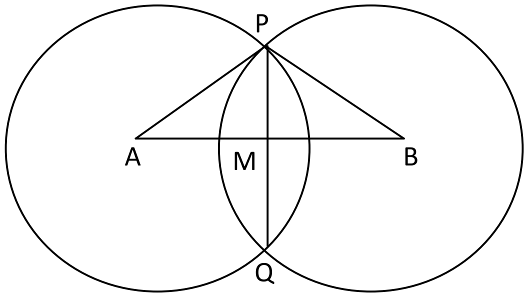
$AB + BC = \sqrt{2}\ (5+7) = 12\sqrt{2} = AC$ (1/2)

PROBLEM NO. 18

In the picture below circles centered at ‘A’ and ‘B’ intersect at P and Q. Show that AB is the perpendicular bisector of PQ.



(3 Marks)



Consider $\triangle$ APB and $\triangle$AQB

$\overline{AP} = \overline{AQ}$ (Radii of the same circle) (1/4)

$\overline{BP} = \overline{BQ}$ (Radii of the same circle) (1/4)

$\overline{AB} = \overline{AB}$ (Identity Congruence) (1/4)

$\therefore \triangle APB = \triangle AQB \cong$ (S.S.S Theorem) (1/4)

<PBM = <QBM (Corresponding parts of Congruent triangles) (1/4)

Consider $\triangle$PBM and $\triangle$ QBM

$\overline{BP} = \overline{BQ}$

$\overline{BM} = \overline{BM}$ (1/4)

<PBM = <QBM

$\therefore \triangle$ PBM = $\triangle$ QBM {S.A.S postulate} (1/4)

$\overline{PM} = \overline{QM}$ (1/4)

<PMB = <QMB (C.P.C.t) (1/4)

<PMB + <QMB = 180^0 (Linear Pair) (1/4)

$\therefore$<PMB = 90^0= <QMB (1/4)

$\therefore \overline{BM}$ is the perpendicular bisector of $\overline{PQ}$

i.e. $\overline{AB}$ is the perpendicular bisector of PQ (1/4)

Appendix-XI

Item Analysis of the Draft of Problem Solving Ability Test for 9th Standard

Sl. No.	Difficulty Index DI = (U+L)/2N	Discriminating Power DP = (U-L)/N
1.	0.41	0.61
2.	0.46	0.63
3.	0.22	0.25
4.	0.40	0.50
5.	0.41	0.62
6.	0.25	0.30
7.	0.40	0.35
8.	0.40	0.50
9.	0.71	0.72
10.	0.35	0.40
11.	0.41	0.40
12.	0.45	0.50
13.	0.30	0.37
14.	0.44	0.51
15.	0.44	0.61
16.	0.70	0.72
17.	0.35	0.40
18.	0.10	0.20
19.	0.20	0.20
20.	0.44	0.59
21.	0.25	0.27
22.	0.65	0.70
23.	0.30	0.40
24.	0.13	0.26
25.	0.45	0.62

26.	0.25	0.26
27.	0.15	0.20
28.	0.30	0.40
29.	0.24	0.40
30.	0.15	0.29
31	0.32	0.37
32	0.25	0.12

Appendix-XII

Item Analysis of the Draft of Problem Creating Ability Test for 9th Standard

Sl. No.	Difficulty Index DI = (U+L)/2N	Discriminating Power DP = (U-L)/N
1.	0.5	0.33
2.	0.22	0.23
3.	0.44	0.44
4.	0.1	0.22
5.	0.33	0.52
6.	0.25	0.15
7.	0.48	0.52
8.	0.15	0.22
9.	0.44	0.59
10.	0.22	0.24
11.	0.11	0.22
12.	0.43	0.63
13.	0.26	0.23
14.	0.5	0.56
15.	0.28	0.41
16.	0.46	0.55
17.	0.43	0.56
18.	0.15	0.22
19.	0.35	0.56
20.	0.28	0.21

Appendix-XIII

DIVERGENT MATHEMATICAL TEST

(Prepared by Mr. Yogesh Sharma, 2011)

1. Tell as many solutions as you can if

   ? + ? = 5

   ? + ? = 9

2. Given the numbers 1, 2, 3 and 4 , relate them in different ways to get an answer six.
3. Express three with the help of three 3's.
4. Write down as many solutions as you can of the following problem

   $3x \pm - = -$

5. Formulate as many questions as you can by using the numbers 2, 3 and 5

Appendix-XIV
LIST OF EXPERTS

- Cliffin Aruja- Senior Assistant, St. Mary’s HSS, Fort Kochi
- Dafni P. V. - Teacher, St. Mary’s HSS, Fort Kochi
- Mavis C. - Teacher, St. Mary’s HSS, Fort Kochi
- Mary Elizabeth - Senior Assistant, Britto HSS, Fort Kochi
- Terry Jesteena D’souza – Teacher, Britto HSS, Fort Kochi
- George Mathew – DRG, St. Augustine’s HSS, Aroor
- Sheffin K. Mohan, Lecturer in Mathematics, University of Oman
- Susan Thomas, Teacher, Holy Angels Higher Secondary School, Edathua
- Aba Antony, Teacher Vidyodaya Higher Secondary School, Ernakulam
- Dibin A.M., Teacher, Govt. high School, Mundamvelil
- Preetha Gopalakrishnan, Lecturer in Mathematics, M.E.S. College, Aluva