آغا خان یونیورسٹی ایگزامینیشن بورڈ

AGA KHAN UNIVERSITY EXAMINATION BOARD

Pacing Guide for Teachers

Mathematics

Grade IX

Number of weeks: 28

Number of periods per week: 5

Key Textbook: Mathematics for Grade 9 by Caravan Book House, Lahore (and Mathematics 10 by Ilmi Kitab Khana, Karachi as reference)

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Institution(s): Habib Girls' Secondary School, Karachi and Habib Public School, Karachi

Topic	Total Periods
1. Sets and Function	16

Sub-Topic	Range of SLOs	Periods (40 mins)
1.1 Operation on Sets	1.1.1	1
	1.1.2-1.1.3	1
1.2 Properties of Union and Intersection	1.2.1	1
	1.2.2	2
1.3 Venn Diagram	1.3.1,1.3.2	2
	1.3.3	1
1.4 Ordered Pairs and Cartesian Product	1.4.1	1
	1.4.2	1
1.5 Binary Relation	1.5.1	1
	1.5.2	1

1.6 Function	1.6.1,1.6.2	2
	1.6.3,1.6.4	2

Learning Resource

- Mathematics X, Unit 17 (Sindh Textbook Board)

Web Resources

https://www.toppr.com/guides/business-mathematics-and-statistics/sets-relations-and-functions/basic-definitions-and-concepts/
https://www.cuemath.com/algebra/venn-diagram/

Suggested Activities and/or Formative Assessment

Activity 1:

Recap Activity

Each student should write an example of a set and share it with their pair. Discuss and paste one example on the board. Meanwhile teacher will share a few examples and generate discussion why they are not sets.

- If students are already familiar with the concept, consider asking guiding questions to activate prior knowledge:
- Take examples of numbers and expand the set to larger sets as natural numbers to whole numbers, then to integers and finally real numbers
- Give/ write example of a set? [Answers will vary]
- Let's use whole numbers as an example. How would you classify the number 5? [an element of the set of whole numbers]
- Let's think of another set that will have some (but not all) elements in common with whole numbers. What do we call the set of elements they have in common? [intersection]

Activity 2:

Watching Video

https://www.toppr.com/guides/+maths/relations-and-functions/cartesian-product-sets/

Activity 3

Provide the worksheet of different Venn diagrams in a group and let the students identify set operation. Use an online game related to the Venn diagram to revisit the concept of Venn diagram.

Activity 4

In a group, let the students arrange the timetable for a day by giving two sets as Set A = 5 periods of a day and Set B = 5 or 6 subjects, and students will allot the periods of the subjects. After that students will share their possibilities. On the basis of their sharing concept of binary relation, function will be discussed.

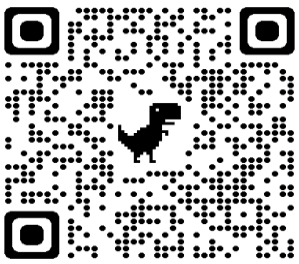
Activity 5

Place the heading of different types of functions on the soft board or on different tables. Give different sets of relations on cards and let the students (in groups/pairs) arrange them under the heading of different functions.

Further Resources

For additional resources related to teaching, learning and formative assessments, please refer to **Learn Smart Classroom by Knowledge Platform:**

https://akueb.knowledgeplatform.com/login



Topic	Total Periods
2. Real and Complex Numbers	15

Sub-Topic	Range of SLOs	Periods (40 mins)
2.1 Real Numbers	2.1.1-2.1.2	2
2.2 Properties of real Numbers	2.2.1	2
2.3 Radicals and Radicands	2.3.1	1
	2.3.2	1
2.4 Laws of Exponents/ Indices	2.4.1	1
	2.4.2	3
2.5 Complex Numbers	2.5.1-2.5.3	1
	2.5.4-2.5.5	1
2.6 Basic Operation on Complex Numbers	2.6.1	3

Learning Resources

- New Count-Down class 8
- Oxford New Syllabus Mathematics Book 3 (Unit 4: Indices)
- Mathematics (Punjab Textbook Board XI) Unit1: Number System

Web Resources

https://davenport.libguides.com/math-skills-overview/exponents/definition#:~:text=Radical%20%2D%20The%20%E2%88%9A%20symbol%20that,with%20variables%20in%20the%20radicands.
https://www.youtube.com/watch?v=bmsapLZM2Uo&list=PLmdFyQYShrjfgDBFTTXYfFumKEY3mcpz1&index=3
https://www.youtube.com/watch?v=C9a_sRlW2LU
https://www.youtube.com/watch?v=hqr1DtXXHpY&list=PLmdFyQYShrjfgDBFTTXYfFumKEY3mcpz1
https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:complex/x2ec2f6f830c9fb89:complex-num/a/intro-to-complex-numbers

Suggested Activities and/or Formative Assessment

Activity 1

In a classroom activity on real numbers, the students in pairs have to pick a number card from a pile and frame clue questions on it. Play a quiz with the rest of the class to identify the number.

Activity 2

Support material can be provided prior to the students and students will prepare their presentation.

Activity 3

The teacher will facilitate a discussion by recalling the sets of numbers. Starting with the smallest set of numbers and progressing to the largest set known to their grade level. The teacher will write the examples on the board. Then move the discussion that would there be a larger set of numbers.

Here, the teacher will show the video:

Complex Numbers – Why We Need Them –

http://www.youtube.com/watch?feature=endscreen&NR=1&v=BDIv7r-X2kk

Assessment: One-line summary to assess students' understanding by asking

Why do we need complex numbers?

Share the video to develop student perspectives on the role of complex numbers in the number system.

Classwork: Ask students to develop their own examples of imaginary numbers. The teacher will move around randomly and check students learning. Conclude with general feedback.

Activity 4

Matching exercise where students match expressions or stepwise solutions with their corresponding properties. Distribute a handout with two columns: Column A contains the expressions, and Column B has the names of properties. Instruct students to draw lines connecting the correct matches. Review the answers as a class to reinforce understanding.

Activity 5

Students will have fun playing Bingo with their classmates as they review the properties of exponents.

Example: There are 30 task cards that require the exponent rules to simplify. Pass out a Bingo sheet to each student. Then project all of the possible answers (there are 30). Students will need to pick any 24 answers and put them in any order on their Bingo sheet.

Once every student has their selected answers on their Bingo sheet, you can begin the game! Randomly pick the task cards and project them for the students. The students will need to simplify each expression and if that answer appears on their Bingo sheet, they will put the task card letter next to that answer and cross out that box. Repeat until someone calls out 'Bingo!

Activity 6

Find-n-Fix

The teacher prepares several slides of incorrect problems for viewing. One by one the teacher places the problem on the overhead and allows each group to work for 2-3 minutes on the problem; time depending on the level of difficulty. The teacher begins the activity by telling the students that the following problems contain mistakes (there is no limit to how many mistakes there can be). It is up to the students to find and correct the mistakes in order to receive the points. The groups will go in their numbered order (delegated at the start of the game).

Activity 7

https://www.liveworksheets.com/pt2872995ql

https://study.com/academy/practice/quiz-worksheet-radical-expressions.html

https://www.baschools.org/vimages/shared/vnews/stories/50a3074c837f0/Properties%20Practice%20A.pdf

https://www.mathsisfun.com/sets/real-number-properties.html

Further Resources

For additional resources related to teaching, learning and formative assessments, please refer to **Learn Smart Classroom by Knowledge Platform:**

https://akueb.knowledgeplatform.com/login

Topic	Total Periods
3. Logarithm	10

Sub-Topic	Range of SLOs	Periods (40 mins)
3.1 Scientific Notation	3.1.1	1
3.2 Logarithm	3.2.1	1
	3.2.2	2
	3.2.3	1
	3.2.4	1
3.3 Laws of Logarithms	3.3.1	2
3.4 Application of Logarithms	3.4.1	2

Learning Resource

- New Additional Mathematics, Ho Soo Thong, Khor Nyak Hiong (Unit 3: Indices, Surds, and Logarithms)

Web Resources

https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:logs/x2ec2f6f830c9fb89:log-intro/a/intro-to-logarithms

https://www.youtube.com/watch?v=GJJUsvDOksQ

https://www.youtube.com/watch?v=1reblXFlM6I

Suggested Activities and/or Formative Assessment

Activity 1

Show/ Give the worksheet in which different examples of exponential and logarithmic form will be given. Ask students to go through each example and pay attention to each of the equivalent forms. Show the definition of a logarithm without actually telling students the pattern; ask them to make observations and predictions to help them understand and state the definition. Also, point out that each exponential form is true.

Activity 2

https://www.chilimath.com/lessons/advanced-algebra/log-rules-practice-problems-with-answers/

https://math.colorado.edu/math1300/resources/Exercises_LogarithmicFunction.pdf

Further Resources

For additional resources related to teaching, learning and formative assessments, please refer to **Learn Smart Classroom by Knowledge Platform:**

https://akueb.knowledgeplatform.com/login

Topic	Total Periods
4. Algebraic Expressions and Algebraic Formulas	22

Sub-Topic	Range of SLOs	Periods (40 mins)
4.1 Algebraic Expression	4.1.1-4.1.2	1
	4.1.3-4.1.4	3
	4.1.5	1
4.2 Algebraic Formulae	4.2.1	1
	4.2.2	2
	4.2.3-4.2.4	2
	4.2.5	1
	4.2.6-4.2.7	2
	4.2.8-4.2.9	2

4.3 Surds of Second Order and their Applications	4.3.1	1
	4.3.2	2
4.4 Rationalisation	4.4.1	1
	4.4.2	3

Learning Resources

- Syllabus D2 Unit 3: Expansion and Factorization of Algebraic Expression
- Syllabus D2 Unit 4: Further Expansion and Factorization of Algebraic Expression
- New Additional Mathematics, Ho Soo Thong, Khor Nyak Hiong (Unit 3: Indices, Surds, and Logarithms)

Web Resource

https://mmerevise.co.uk/gcse-maths-revision/surds-gcse-maths-revision-worksheets/

Suggested Activities and/or Formative Assessment

Activity 1

Each group of students will prepare Presentation for the proof of algebraic identities. (Each group will be assigned one identity)

Activity 2

Puzzles like MAZE Challenge can be created to assess students' learning. For example, check the given link: https://www.teachingexpertise.com/classroom-ideas/evaluating-expressions-activity/

Further Resources

For additional resources related to teaching, learning and formative assessments, please refer to **Learn Smart Classroom by Knowledge Platform:** https://akueb.knowledgeplatform.com/login

Topic	Total Periods
5. Factorisation	16

Sub-Topic	Range of SLOs	Periods (40 mins)
5.1 Basic Factorisation	5.1.1 (a - d)	1
	5.1.1 (e)	2
5.2 Factorisation	5.2.1 (a)	2
	5.2.1 (b)	1
	5.2.1 (c)	1
	5.2.1 (d)	1
	5.2.1 (e)	1
5.3 Remainder Theorem and Factor Theorem	5.3.1	1
	5.3.2	2
	5.3.3	2

5.4 Factorisation of Cubic Polynomial	5.4.1	2

Learning Resources

- Syllabus D2 Unit 4: Further Expansion and Factorization of Algebraic Expression
- New Secondary Mathematics VIII (By Mohsin Ali) Unit 6: Formulae and Factors
- New Additional Mathematics, Ho Soo Thong, Khor Nyak Hiong
  (Unit 5: Remainder and Factor Theorems)

Suggested Activities and/or Formative Assessment

Activity 1

Factoring Algebraic Expressions - Scavenger Hunt Activity

Teams solve algebraic expressions to uncover clues or pieces of a puzzle hidden around the area. Prompts can be taken from the given link:

Factorization Of Algebraic Expressions Quiz Questions & Answers - ProProfs Quiz

Further Resources

For additional resources related to teaching, learning and formative assessments, please refer to **Learn Smart Classroom by Knowledge Platform:**

https://akueb.knowledgeplatform.com/login

Topic	Total Periods
6. Variation	13

Sub-Topic	Range of SLOs	Periods (40 mins)
6.1 Ratio and Proportion	6.1.1	1
	6.1.2	2
6.2 Theorems on Proportions	6.2.1	4
6.3 Direct, Inverse and Joint Variation	6.3.1	1
	6.3.2	2
6.4 K-Method	6.4.1	3

Web Resources

https://www.allmathtricks.com/ratio-proportion-variation-problems-solutions/

https://testbook.com/objective-questions/mcq-on-componendo-or-dividendo--5eea6a1039140f30f369e804

https://www.math-only-math.com/practice-test-on-direct-variation-and-inverse-variation.html

Suggested Activities and/or Formative Assessment

Activity 1

Scale Drawings

Provide students with a scale drawing of a room or building and ask them to use ratios and proportions to determine the actual dimensions of the space. Students can then compare their calculations to actual measurements to see how accurate their estimations were.

Further Resources

For additional resources related to teaching, learning and formative assessments, please refer to **Learn Smart Classroom by Knowledge Platform:**

https://akueb.knowledgeplatform.com/login

Topic	Total Periods
7. Matrices and Determinants	24

Sub-Topic	Range of SLOs	Periods (40 mins)
7.1 Introduction to Matrices	7.1.1-7.1.2	2
7.2 Types of Matrices	7.2.1	1
	7.2.2	1
7.3 Addition and Subtraction of Matrices (up to order 3 x 3)	7.3.1-7.3.2	1
	7.3.3	2
	7.3.4-7.3.5	1
7.4 Multiplication of Matrices (up to order 2 x 2)	7.4.1	1
	7.4.2-7.4.3	2
	7.4.4	1
	7.4.5	1

	7.4.6	1
	7.4.7	1
7.5 Multiplicative Inverse of Matrices (up to order 2 x 2)	7.5.1-7.5.3	1
	7.5.4	1
	7.5.5-7.5.7, 7.5.9	2
	7.5.8	1
	7.5.10	1
7.6 Solution of Matrix Equation	7.6.1	1
	7.6.2	2

Learning Resource

- New Additional Mathematics, Ho Soo Thong, Khor Nyak Hiong (Unit 6: Matrices)

Web Resources

How to organize, add and multiply matrices - Bill Shillito - YouTube

https://www.google.com/search?q=matrices+and+determinants&source=lnms&tbm=vid&sa=X&ved=2ahUKEwiJ1aeFoM79AhWS_7sIHcawAewQ_AUoAnoECAEQBA&biw=713&bih=437&dpr=1.5#fpstate=ive&vld=cid:975ed4dd,vid:YFGTpSkfT40

Suggested Activities and/or Formative Assessment

Activity 1

Rainforest and Jungle Themed Homework Grid: This is an engaging practice on multiplying matrices with carefully chosen problems, some with nice answers.

- Task 1. Given a matrix A (2x2). Students have to determine f(A) which is a quadratic function of A (two problems here)
- Task 2. is proving that two matrices (2x2) are commuting (two problems included)
- Task 3. is finding AB-BA (two problems here)
- Task 4. is performing indicated operations AB+CD.
- Task 5. Given matrices A, B and C. Students have to prove that A(BC)=(AB)C

Activity 2

Secret code: This can be done in pairs or groups. Ask students to imagine that they are soldiers during WW2. Ask them to write encrypted codes along with 'encryption key' for their partner/ fellow group members. The partners will find the coded numbers/ messages using the encryption key and matrixes. See How to organize, add and multiply matrices - Bill Shillito - YouTube (3 50 – 4 15) for more details.

Activity 3

Solve different worksheets for practice: https://www.math-aids.com/Algebra/Algebra_2/Matrices/

Further Resources

For additional resources related to teaching, learning and formative assessments, please refer to **Learn Smart Classroom by Knowledge Platform:** https://akueb.knowledgeplatform.com/login

Topic	Total Periods
8. Practical Geometry	5

Sub-Topic	Range of SLOs	Periods (40 mins)
8.1.1 Construction of Triangles (cases)	8.1.1	2
	8.1.2-8.1.3	3

Web Resources

https://flexbooks.ck12.org/cbook/ck-12-cbse-math-class-9/section/11.4/primary/lesson/construction-of-triangles/

https://www.mathopenref.com/constbisectangle.html

Suggested Activities and/or Formative Assessment

Activity 1

Students will watch the video and do construction according to the given task.

https://www.youtube.com/watch?v=NzcTKGxwCCE

Activity 2

Give students incomplete geometric designs and ask them to complete to complete the design using construction techniques learnt in this topic.

Further Resources

For additional resources related to teaching, learning and formative assessments, please refer to **Learn Smart Classroom by Knowledge Platform:**

https://akueb.knowledgeplatform.com/login

Topic	Total Periods
9. Congruent Triangles	3

Sub-Topic	Range of SLOs	Periods (40 mins)
9.1 Congruent Triangle	9.1.1 (a)	1
	9.1.1 (b, c)	1
	9.1.1 (d, e)	1

Learning Resources

- Syllabus D2 (Unit 8; Congruence and Similarity)

Suggested Activities and/or Formative Assessment

Activity 1

Congruent triangles can be integrated with the construction of triangles. For this activity, students can cut the triangle of a given measurement and find their partner who has the same one.

Further Resources

For additional resources related to teaching, learning and formative assessments, please refer to **Learn Smart Classroom by Knowledge Platform:**

https://akueb.knowledgeplatform.com/login

Topic	Total Periods
10. Parallelogram and Triangles	5

Sub-Topic	Range of SLOs	Periods (40 mins)
10.1 Parallelogram and Triangles	10.1.1 (a, b)	1
	10.1.1 (c)	1
	10.1.1 (d)	1
	10.1.1 (e)	2

Web Resources

https://www.youtube.com/watch?v=J0ubIoe1fMU

https://www.youtube.com/watch?v=t42sLuns4Qs

https://www.youtube.com/watch?v=1mS4NDGE2oI

https://www.toppr.com/ask/en-pk/question/quadrilateral-abcd-is-a-parallelogram-find-the-value-of-x-and-measure-of-all-the/

https://www.youtube.com/watch?v=59wiwrcNMuo

Suggested Activities and/or Formative Assessment

Activity 1

Parallelogram Properties Investigation: Divide the students into small groups and provide each group with a set of construction materials (rulers, protractors, compasses, etc.). Give each group a chart paper or a whiteboard to work on. Ask the groups to draw a parallelogram of their choice on the paper or whiteboard. Have the students measure the opposite sides and opposite angles of their parallelograms and

record their findings. Next, instruct the groups to draw the diagonals of their parallelograms and observe if they bisect each other. After completing their investigations, gather the groups to share their results with the class. Facilitate a discussion about the properties of parallelograms, focusing on the theorems mentioned in the learning outcome.

Activity 2

Parallelogram Classification Challenge: Provide each student or small group with a set of quadrilateral cards (prepared in advance) that have different properties, such as "Opposite sides congruent and parallel." Instruct the students to analyse each quadrilateral card and determine if the given properties make it a parallelogram or not. Have the students sort the cards into two categories: "Parallelogram" and "Not a Parallelogram." After they have completed the sorting, discuss the reasoning behind their decisions as a class. Introduce the theorem mentioned in learning outcome: "If two opposite sides of a quadrilateral are congruent and parallel, it is a parallelogram." Ask the students to revisit their sorting and check if their decisions align with the theorem.

Activity 3

Transversals and Parallel Lines: Draw three parallel lines on the board or provide students with a worksheet showing three parallel lines. Instruct the students to draw a transversal line intersecting the three parallel lines. Ask them to measure and compare the lengths of the intercepts made by the transversal on each parallel line. Have the students analyse if the intercepts are congruent on each parallel line. Engage the students in a discussion about the theorem related to parallel lines and congruent intercepts on transversals. Provide additional examples for practice to reinforce the concept further.

Further Resources

For additional resources related to teaching, learning and formative assessments, please refer to **Learn Smart Classroom by Knowledge Platform:**

https://akueb.knowledgeplatform.com/login

Topic	Total Periods
11. Line Bisectors and Angle Bisectors	3

Sub-Topic	Range of SLOs	Periods (40 mins)
11.1 Line Bisectors and Angle Bisectors	11.1.1 (a, b)	1
	11.1.1 (d, e)	1
	11.1.1 (c, f)	1

Web Resource

https://calcworkshop.com/congruent-triangles/bisector-theorems/#:~:text=Perpendicular%20bisector%20theorem%20deals%20with,the%20side%20of%20the%20triangle.

Further Resources

For additional resources related to teaching, learning and formative assessments, please refer to **Learn Smart Classroom by Knowledge Platform:**

https://akueb.knowledgeplatform.com/login

Topic	Total Periods
12. Sides and Angle of Triangle	3

Sub-Topic	Range of SLOs	Periods (40 mins)
12.1 Sides and Angle of Triangle	12.1.1 (a, b)	1
	12.1.1 (c)	1
	2.1.1 (d)	1

Suggested Activities and/or Formative Assessment

Activity 1

Assign one sub-SLO to each group and let them explore by using geometric software like GeoGebra and make a chart with examples. Then each group will display their work and also explain their findings to other fellows.

Further Resources

For additional resources related to teaching, learning and formative assessments, please refer to **Learn Smart Classroom by Knowledge Platform:**

https://akueb.knowledgeplatform.com/login

Topic	Total Periods
13. Application of Ratio and Proportion in Geometrical Theorems	5

Sub-Topic	Range of SLOs	Periods (40 mins)
13.1 Application of Ratio and Proportion in Geometrical Theorems	13.1.1 (a, b)	1
	13.1.1 (c)	1
	13.1.1 (d)	3

Learning Resource

Cambridge IGCSE Mathematics, Second Edition (Unit 5: Geometry)

Web Resources

https://www.youtube.com/watch?v=kS6B5nmJ9K0

https://www.youtube.com/watch?v=3T_iym-TsMk

https://www.youtube.com/watch?v=MKgflO9qo4E

Suggested Activities and/or Formative Assessment

Activity 1: Triangle Side-Angle Relationship

Learning Outcome: Apply the theorems related to side-angle relationships in triangles.

Objective: Students will explore the connection between side lengths and angle measures in triangles.

Instructions:

1. Provide each student with a set of triangle cutouts made of paper or cardboard.
2. Instruct the students to create several triangles with varying side lengths and angle measures.
3. Have the students measure the side lengths and angle measures of each triangle using rulers and protractors.
4. Ask them to identify the longer side and the corresponding angle with greater measure for each triangle.
5. Engage the students in a discussion about their observations and conclusions, emphasizing the theorems mentioned in the SLO (parts a and b).

Activity 2: Triangle Inequality Exploration

Learning Outcome: Apply the theorem related to the sum of the lengths of any two sides of a triangle.

Objective: Students will investigate the triangle inequality theorem.

Instructions:

1. Divide the students into small groups and provide each group with a set of three straws or sticks of varying lengths.
2. Instruct the groups to arrange the straws to form triangles and record the lengths of the three sides for each triangle.
3. Have the students check if the sum of the lengths of any two sides is greater than the length of the third side for each triangle.
4. Discuss their findings as a class, emphasizing the triangle inequality theorem (c).

Activity 3: Perpendicular Shortest Distance Challenge

Learning Outcome: Apply the theorem related to the shortest distance from a point to a line.

Objective: Students will explore the concept of perpendicularity and shortest distances.

Instructions:

1. Draw a line on the board or provide students with a visual representation of a line.
2. Randomly select points in the classroom or on the paper and ask the students to determine the shortest distance from each point to the line.
3. Have the students draw a perpendicular line from each point to the given line using rulers or straight edges.
4. Ask the students to measure the lengths of the perpendiculars and compare them.
5. Engage the students in a discussion about their findings, emphasizing that perpendicular lines are the shortest distance from a point to a line (d).

Further Resources

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Note: This teacher-led pacing guide has been developed for AKU-EB affiliated schools to facilitate them by

- ensuring smooth transition of a school's academic year.
- ensuring curricular continuity in schools.
- predicting the time and pace of syllabi implementation.

This document also contains **suggested activities and/or formative assessments** that may enhance the learning experience. Please note that these activities are meant to serve as suggestions. As educators, you have the flexibility and autonomy to adapt and modify them to best suit the needs of your students and the dynamics of your classroom.

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