

A PORTFOLIO ASSESSMENT OF CRITICAL THINKING IN ALGEBRA I

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## TEACHER PACK

### 1. Rationale

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Critical thinking is an essential skill in decision making. It requires skills in acquiring information, and evaluating it to reach a justified conclusion. Everyone makes decisions, and there is a correlation between the quality of decisions and the acceptance of those decisions. The higher the quality of the decision, the more acceptable is the decision. The quality of the decisions is based on the quality of critical thinking put into it. Most exercises in critical thinking are writing in humanities and language courses. However, critical thinking can be highly developed in mathematics courses.

Mathematics is built on critical thinking. Definitions and properties are used to prove theorems and corollaries, which are then used to prove mathematical claims. Though proving in high school algebra courses are not as extensive as higher mathematics courses, the foundations of algebra are built on the properties of real numbers, equalities, inequalities, and the laws of exponents. This unit develops the students' understanding of the foundations of algebra.

Portfolio assessment further develops critical thinking in this unit. The outcomes of this unit will be assessed through portfolios. Again, the students engage in the critical thinking process when they collect, select and write reflections on their own work to include in their portfolio assessments.

The portfolio system is developed only for evaluating students with respect to Benchmarks MA.A1.3.1-2, and MA.A1.10.3. Thus, only I will evaluate the contents of the portfolio, the whole portfolio itself, and if the portfolio gives evidences that the students met

the specified benchmarks. However, parents, faculty and school administrators can request to see the portfolios for their own reasons.

This is the first unit I will teach in the first course of high school algebra. The students have encountered radicals, exponents and order of operations in their previous mathematics course. This unit will explain to them the reasons behind the order of operations, and unify the concept of radicals and exponents. After the students have met the benchmarks in this unit, I will teach them graphs and solutions of linear equations, which will meet Benchmarks 8.1 and 2, and 10.4 and 5.

The working portfolios will be 9" x 12" manila envelopes. Each student will be given an envelope. The working portfolios will be kept in file boxes with lids. Each class will have a file box. The portfolio assessments will be kept in a filing cabinet. It will be arranged alphabetically according to the surname of the student. I will give permission to access portfolio assessments. Generally, the student owns the portfolios. However, working portfolios can only be taken away from the class when I have concluded that portfolio assessments had met the Benchmarks. The portfolio assessments can only be taken away from the classroom when the student is promoted to the next level.

Grading and authenticity of the portfolio assessments are addressed in section 5.

## 2. Standards, Benchmarks and Outcomes

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The standards and benchmarks chosen are unified by the properties of real numbers, equality and inequality, and laws of exponents. These concepts are then used to simplify expressions and eventually to solve linear equations and inequalities.

Standard MA.A1.3: Numbers and Operations: COMPUTATION STRATEGIES: Use computational tools and strategies fluently and, when appropriate, use estimation.

Benchmark MA.A1.3.1. Apply arithmetic properties to operate on and simplify expressions that include radicals and other real numbers.

Outcome: When operating and simplifying expressions that include radicals and other real numbers, the students apply associative, and commutative properties of addition and multiplication, distributive properties of multiplication over addition, additive and multiplicative identities and inverses, and the definitions of subtraction and division.

The Benchmark requires that the students can operate and simplify expressions that include radicals and other real numbers. Furthermore, it specified that students apply the arithmetic properties when operating and simplifying. The arithmetic properties are the properties of real numbers and the definitions of subtraction and division as listed in the outcome above.

Standard MA.A1.3: Numbers and Operations: COMPUTATION STRATEGIES: Use computational tools and strategies fluently and, when appropriate, use estimation.

Benchmark MA.A1.3.2. Apply the laws of exponents to perform operations on expressions with integral exponents.

Outcome: When given expressions with integral exponents, the students apply the following laws of exponents:

- $b^m \cdot b^n = b^{m+n}$
- $\frac{b^m}{b^n} = b^{m-n}$
- $(b^m)^n = b^{mn}$
- $(ab)^m = a^m b^m$

To further operate and simplify expressions as required by the previous benchmark, the applications of the laws of exponents are necessary. However for this course, the state only requires the application of integral exponents. Thus, only the laws of integral exponents were placed in the outcome.

Standard MA.A1.10: Patterns, Functions, and Algebra: SYMBOLIC REPRESENTATION:

Use symbolic forms to represent, model, and analyze mathematical situations.

Benchmark MA.A1.10.3. Justify the steps used in simplifying expressions and solving linear equations and inequalities.

Outcome: When simplifying expressions and solving linear equations and inequalities with one variable, the students:

- apply the properties of real numbers, and the laws of exponents (only applicable in simplifying expressions) (see Benchmark MA.A1.3.1 and 2)
- apply reflexive, symmetric, transitive, substitution, additive and multiplicative properties of equality
- apply trichotomy, transitive, additive and multiplicative properties of inequality
- state the properties and laws they have used for each change they made in the expressions, equations and inequalities

In this benchmark, simplifying expressions and solving linear equations and inequalities were connected. Furthermore, the benchmark identified that the students justify the steps they used when simplifying and solving. They can efficiently do so by referring to the properties of real numbers, equalities and inequalities, and the laws of exponents in each step. Thus, the outcome lists the properties of equalities and inequalities, and referenced the previous benchmarks for the list of properties of real numbers, and the laws of exponents. Furthermore, the outcome limits the solutions to linear equalities and inequalities to one variable because solving linear equalities and inequalities in multiple variables, and then justifying each step require the skills, understanding and experience beyond the first course in Algebra, which is this course.

### 3. Lessons (HTS.6.1)

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#### 3.1. Properties of real numbers

Replacements for  $\times$  as multiplication symbol will be reviewed. Definitions of natural numbers, integers, rational numbers, irrational numbers and real numbers will be reviewed, which the students have learned from their previous mathematics courses. A Venn diagram will be shown to summarize the definitions. Properties of real numbers will be discussed by giving examples first. I will ask why the following are true:

- $\sqrt{2} + 3 = 3 + \sqrt{2}$  (Commutative law of addition)
- $\sqrt{2} \times 3 = 3 \times \sqrt{2}$  (Commutative law of multiplication)
- $(\sqrt{2} + 3) + 4 = \sqrt{2} + (3 + 4)$  (Associative law of addition)
- $(\sqrt{2} \times 3) \times 4 = \sqrt{2} \times (3 \times 4)$  (Associative law of multiplication)
- $\sqrt{2} + 0 = 0 + \sqrt{2} = \sqrt{2}$  (Additive identity or existence of zero)
- $\sqrt{2} \times 1 = 1 \times \sqrt{2} = \sqrt{2}$  (Multiplicative identity or existence of 1)
- $\sqrt{2} + (-\sqrt{2}) = (-\sqrt{2}) + \sqrt{2} = 0$  (Additive inverse of existence or existence of a negative)
- $\sqrt{2} - 3 = \sqrt{2} + (-3)$  (Definition of subtraction)
- $2 \cdot \frac{1}{2} = \left(\frac{1}{2}\right)2 = 1$  (Multiplicative inverse or existence of a reciprocal)
- $4 \div 2 = \frac{4}{2} = 4\left(\frac{1}{2}\right)$  (Definition of division)
- $\sqrt{2}(3 + 4) = \sqrt{2} \cdot 3 + \sqrt{2} \cdot 4$  (Distributive law over addition)
- $(\sqrt{2} + 3) \times 4 = \sqrt{2} \cdot 4 + 3 \cdot 4$  (Distributive law over addition)

After giving several examples of real numbers, variables will be defined for the class and properties of real numbers will be defined abstractly. Using the above properties, the class will discuss simplification of algebraic expressions. Homework on simplification of expressions will be given (HTS.7.6).

### 3.2. Properties of Equality

I will collect the homework from the previous lesson, and then the class will discuss some of the answers from the homework to review concepts from the previous lesson (HTS.1.3). The following examples with real numbers will be given (and others if necessary) to illustrate the properties of equality:

- $\sqrt{2} = \sqrt{2}$  (Reflexive property)
- If  $2 + 3 = 4 + 1$ , then  $4 + 1 = 2 + 3$  (Symmetric property)
- If  $2 + 3 = 5$  and  $5 = 4 + 1$ , then  $2 + 3 = 4 + 1$  (Transitive property of equality)

More practice and drills will be given to check if the concepts of the properties above have been understood. An abstract definition of the properties above will be given after the class has understood the concepts of those properties. The substitution property will be defined and this example will be given to illustrate it: If  $3(a + 2) = 3a + 6$ , and  $a = b$ , then  $3(b + 2) = 3b +$

6. The class will engage in proving this theorem:

If  $a$ ,  $b$ , and  $c$  are real numbers, then

- $a + c = b + c$  if and only if  $a = b$
- $ac = bc$  if and only if  $a = b$

Several other theorems will be given as exercises in proving. Theorems to be proven will be assigned for homework (HTS.2.4, 7.3, 7.6).

### 3.3. Introduction of the portfolio assessment (HTS.1.1, 7.1, 8.4)

I will collect the homework from the previous lesson, return evaluated homework, and then the class will discuss some of the answers from the homework to review concepts from the previous lesson (HTS.1.3). I will return evaluated homework. I will then introduce the assessment portfolio. I will give them the instructions in the section 4.1. I will teach them the collection procedures for their working portfolio. I will also teach them the format for the reflection sheet, which is:

- Recreation of solutions
- Explanation of growth and goal achievement
- Explanation of weaknesses and strengths (self-assessment/reflection)
- Goal setting

I will demonstrate with a mock evaluated homework and reflection sheet how I would have written a reflection. I will discuss with them the rubrics for goal setting, explanation of weaknesses and strengths, growth and goal achievement, and self-assessment/reflection (HTS.8.1, 8.4). With their evaluated homework, the class will write a reflection sheet in class. I will walk around and answer questions on writing the reflection (HTS.1.3). We will go through the submission procedures, and I will distribute their manila envelopes.

### 3.4. Simplification and linear equations in one variable

I will comment on the class' performance on their reflection sheet. I will re-emphasize instructions they seem to have not understood, and those part of the rubric they have not met (HTS.1.3). I will return the homework from the previous lesson. We will review the concepts from the previous lessons by placing exercises on properties of real numbers and equalities on the board (HTS.1.3). The class will divide into groups of three to

work on the exercises (HTS.2.1). They will present their work on the board, and the whole class will critique their work (HTS.4.3).

I will demonstrate simplifying expressions and solving linear equations with one variable, and justifying each step I took with the properties of real numbers and equalities. I will give the class exercise sheets and they will answer the exercise sheets in their groups (HTS.2.1). Again, they will present their work on the board, and the whole class will critique their work (HTS.4.2). I will assign homework for them to do (HTS.7.6).

### 3.5. Properties of inequalities

Homework will be collected and evaluated homework will be returned. I will write on the board an exercise that reviews the concepts previously learned. The class will answer the exercise in groups (HTS.2.1), they will present their work on the board, and the whole class will critique their work (HTS.4.3). The following properties will be defined and explained:

Let  $a$ ,  $b$ , and  $c$  be real numbers.

- One and only one of the following relations hold.

$$a < b, a > b, a = b \text{ (Trichotomy property)}$$

- If  $a < b$  and  $b < c$ , then  $a < c$ . (Transitive property)
- If  $a < b$ , then  $a + c < b + c$  (Additive property of inequality)
- If  $a < b$ , and  $c > 0$ , then  $ac < bc$  (Multiplicative property when multiplied by a positive number)
- If  $a < b$ , and  $c < 0$ , then  $ac > bc$  (Multiplicative property when multiplied by a negative number)

Exercises will be given to students where they apply the properties on inequalities and real numbers in solving linear inequalities in one variable. They will answer the exercises in

groups (HTS.2.1), present their work on the board, and the whole class will critique their work (HTS.4.3). Homework will be assigned solving linear inequalities and equalities, simplifying, justifying each step they made with the properties of real numbers, equalities and inequalities (HTS.7.6).

### 3.6. Laws of exponents

Homework will be collected. If the class has any questions on the homework, the item will be brought up and written on the board, and the whole class will work on it for review.

The class will also review of the definition of exponents and  $a^0 = 1$ .

I will discuss and explain the following laws of exponents:

- $b^m \cdot b^n = b^{m+n}$
- $\frac{b^m}{b^n} = b^{m-n}$
- $(b^m)^n = b^{mn}$
- $(ab)^m = a^m b^m$

I will ask the class to form groups (HTS.2.1.), and use the rules of exponents and the properties of equalities to prove that  $a^0 = 1$  (HTS.2.4, 7.3). The groups will present their work on the board, and the whole class will critique their work (HTS.4.3).

I will give homework in simplifying expressions, solving equalities and inequalities, and justifying each step in simplification and solution using the properties of real numbers, equalities and inequalities, and laws of exponents to the class (HTS.7.6).

### 3.7. Continuation of instruction on the portfolio assessment (HTS.1.1, 7.1)

I will collect homework and return previous homework. If the class has any questions on the homework, then the class will discuss it in the procedure as before.

I will discuss the instructions on portfolio assessment in section 4.2. I will thoroughly discuss grading, authenticity and decisions in section 5 including the checklists and rubrics (HTS.8.1).

## STUDENT PACK

### 4. Portfolio Assessment (GLO.4.1.-3)

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#### 4.1. Instructions on the working portfolio

Please collect assignments that show how you applied your understanding of the properties of real numbers, equalities and inequalities, and the laws of exponents in simplifying expressions and solving linear equations and inequalities with one variable. An understanding of these concepts is fundamental in Algebra. Therefore, demonstrating this understanding is important, and there will be many opportunities for you to demonstrate your understanding of these concepts.

When I show you an evaluated assignment, and you believe that it shows your understanding of the concepts listed in the previous paragraph, then you must write on 8.5" x 11" white unlined papers how the assignment or parts of it show this understanding. You may recreate solutions, and state the properties of real numbers, equalities and inequalities, and the laws of exponents you have used to justify each step (Benchmarks MA.A1.3.1-2 and MA.A1.10.3). Identify and briefly explain weaknesses that you have on a concept and improvements on your understanding of a concept. Briefly explain how the assignment fulfills goals you have previously made (GLO.5.4). Write your goals for improvement. You may bring the evaluated assignment home, and write your reflection there. You must return the evaluated assignment to me with your reflection stapled behind it. I will sign and date your reflection before you can put the reflection and assignment in your working portfolio. I will provide you each with a 9" x 12" manila envelope. You cannot take your envelopes outside the class without my permission.

You may stop collecting your work after all work has been corrected previous to the unit on linear inequalities. It is my hope that when we discuss graphing and solutions systems of linear equations, you have learned the properties of real numbers, equalities and inequalities, and the laws of exponents. Otherwise, it will be difficult for you to understand graphing and solutions systems of linear equations, and you can easily fail that unit.

#### 4.2. Instructions on the assessment portfolio (GLO.1.1-3)

You will assemble an assessment portfolio before instruction on graphing and solutions systems of linear equations begins. From your working portfolio, you must select your best works in justifying simplification of expressions, and solving linear equations and inequalities (GLO.3.1.). Ensure that you show the use of ALL the properties of real numbers, equalities and inequalities, and the laws of exponents in your justifications and in your solutions.

You may take your selection home to write an introduction on your assessment portfolio. Your introduction should be written on 8.5” x 11” unlined white papers. Write how your selection shows your growth and achievement of your goals, how goal setting has helped you improve, and how the reflections helped you learn.

Include a table of contents. Organize your portfolio according to this order:

- A title page with your name and the schedule of the class you belong in.
- Table of contents
- Introduction
- Assignments on justifying simplification of expressions each accompanied by a reflection sheet

- Assignments on solving linear equations and inequalities in one variable each accompanied by a reflection sheet

Submit the assessment portfolio in a slide folder to me a week after we have started instruction on graphing and solutions systems of linear equations.

#### 5. Grading, Decisions and Authenticity

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The assessment portfolio will replace the summative assessment for this unit. Thus, it is important that you thoughtfully select the contents of your assessment portfolio. If you lack any work that demonstrates your learning of the outcome, you will need to produce that work and resubmit your assessment portfolio. Otherwise you have not met the intended benchmarks for this unit.

Please ensure that you know and understand every part of your assessment portfolio. After I have collected your assessment portfolio, you will schedule with me a personal conference to discuss the contents of your assessment portfolio. During that personal conference, I shall randomly select a part of your assessment portfolio and I will ask you to recreate the part of your reflection where you recreated your solution and justified each step. My assumption is if you have learned all the concepts in this unit and have reflected on them, then you can recreate any part of your assessment portfolio. If for any reason you were not able to recreate that part of your assessment portfolio, then I will reject that part because to me you did not learn what you told me you have learned. You will need to select another work from your working portfolio to replace your work which was rejected. The replacement must address the same outcomes as the rejected work. You will need to write another reflection on the whole portfolio incorporating the replacement. You will then resubmit to me your assessment portfolio, and reschedule a personal conference where I will randomly select

a part of your assessment portfolio for you to recreate just like the previous conference. If you fail this second authentication, you will repeat the process of replacing your work with another work from your working portfolio, and going through a conference with me and your parents in attendance where you present your portfolio. Hopefully, you won't fail the authentication then.

Aside from the authentication during the personal conference, I will be evaluating your assessment portfolio according to these rubrics.

You must get at least a "1" in each item in the rubric and the checklist below to be competent.

Were the following properties and laws present and correctly applied in either the reflection or the assignment?	There were more instances when it wasn't correctly applied than when it was (0)	There were more instances when it was correctly applied than when it wasn't (1)	It was always correctly applied (2)
Real numbers			
Commutative law of addition Commutative law of multiplication Associative law of addition Associative law of multiplication Additive identity Multiplicative identity Additive inverse Multiplicative inverse Distributive law Definition of subtraction Definition of division			
Equalities			
Symmetric Transitive Substitution Additive Multiplicative			
Inequalities			

Inequalities Transitive Additive Multiplicative when multiplied by a positive number Multiplicative when multiplied by a negative number			
Exponents			
$b^m \cdot b^n = b^{m+n}$ $\frac{b^m}{b^n} = b^{m-n}$ $(b^m)^n = b^{mn}$ $(ab)^m = a^m b^m$			

Were the following properties correctly explained during the personal conference?	No (0)	Yes (1)
Closure property of addition of real numbers Closure property of multiplication of real numbers Reflexive property of equalities Trichotomy property of inequalities		

If you receive a “0” in any of the items in the rubric above, you will follow the same procedure above for failing the authentication. If you receive a “No” in any of the items in the checklist above, you will only need to reschedule another personal conference where you must correctly explain to me the properties you have received a “No” for.

The next rubrics will improve your grade only after you have demonstrated competency.

	No (0)	Yes, but I can think of at least one suggestion for improvement (1)	Yes, and I can't think of any suggestions for improvement (2)
Goal setting			
Goals are standards, benchmarks and outcome-oriented			
Goals are measurable and quantifiable			
Goals are challenging yet			

attainable			
Implementation has specific steps			
Implementation has a clear time-frame			

Growth and Achievement	Goals were not achieved most of the time (0)	Goals were achieved most of the time (1)	Consistent excellence and/or improvement in achieving all goals (2)
Student shows improvement by achieving goals			

Reflection/Self Assessment	No (0)	Yes, but I can think of at least one suggestion (1)	Yes, and I can't think of any suggestions (2)
Student identifies and explains strengths and weaknesses			
Weaknesses and goals match			

Completeness and organization of the assessment portfolio	No (0)	Yes (1)
Is the portfolio comprehensible?		
Is the portfolio organized?		
Does the portfolio have a title page, a table of contents, and an introduction aside from the works selected and reflections attached to each work?		
Are all the reflections dated?		
Are all pieces clearly labeled?		
Do I like the overall quality of the portfolio?		
Is it submitted in a sliding folder?		

## Appendix

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### 1. General Learner Outcomes

GLO.1.1. Sets priorities and establishes achievable goals and personal plans for learning.

GLO.1.2. Plans and manages time and resources to achieve goals.

GLO.1.3. Monitors progress and evaluates learning experiences.

In this portfolio assessment, the students select what to include in their portfolios, and then write reflections about what they learned. They make a goal to collect evidence of their learning, reflect on their progress, and set goals for growth. To collect enough evidence, the students must plan and manage their time and resources. Thus, these learner outcomes will be met in the portfolio assessment.

GLO.2.2. Cooperates with and helps and encourages others in group situations.

During instruction, the students work in groups, present their work in front of the whole class, and then critique their peers' works.

GLO.3.1. Applies prior learning experiences to new situations.

Students select pieces of work that best display their learning of a certain concept even though the pieces of work were not assigned while they are being instruction on that certain concept. Students will most probably select pieces of work that build upon previous learning as proof of their mastery of that previous learning.

GLO.4.1. Recognizes and understands what quality performances and products are.

GLO.4.2. Understands and sets criteria to meet or exceed Hawaii Content and Performance Standards.

GLO.4.3. Produces evidence that meets or exceeds Hawaii Content and Performance Standards.

The students will be instructed on how their portfolio will be evaluated. With that understanding, it is hope that they will produce the level of quality necessary to meet or exceed Hawaii Content and Performance Standards. The students' portfolios will give their evidence that they have met or exceeded Hawaii Content and Performance Standards.

GLO.5.4. Communicates effectively and clearly through writing, using appropriate forms, conventions, and styles to convey ideas and information for a variety of audiences and purposes.

Students write in their reflection how their selected pieces of work produce evidence of their learning of a certain concept.

## 2. Teacher Standards

HTS.1.1. Provides opportunities for students to assume responsibility for their own learning, shaping tasks and pursuing their own goals and aspirations.

Through the portfolio assessment, the students set goals for learning and courses of action to improve their learning. Thus, with the portfolio assessment, I provide them opportunities to be responsible for their own learning.

HTS.1.3. Demonstrates concern and interest by taking time to listen and respond to students.

At the beginning of each class, I review with my students the concepts they have previously learned, and re-teach those concepts if necessary. This is the time I listen and respond to my students to meet their learning needs. During instruction on writing reflections, I will move around, answer students' questions, and clarify instruction that they have misunderstood.

HTS.2.1. Promotes empathy, compassion, and mutual respect among students.

I promote empathy, compassion and mutual respect every time I ask students to group up for review.

HTS.2.4. Promotes students' intrinsic motivation by providing meaningful and progressively challenging developmentally appropriate learning experiences that enable student success.

Students using the concepts to mathematically prove theorems is progressively challenging and developmentally appropriate. Furthermore, it improves their intrinsic motivation because they are engaged in an activity where they directly apply what they have learned. Each lesson is aimed at producing student success.

HTS.4.3. Encourages self-expression, reflection and evaluation.

Aside from the portfolio assessment that achieves this standard, I also encourage self-expression, reflection and evaluation every time I ask students to present their work, and their peers to critique.

HTS.6.1. Plans and implements logical, sequenced instruction and continually adjusts plans based on learner needs.

The lesson plans for this unit are sequenced logically, and every time I review the students, I adjust plans based on the review.

HTS.7.1. Involves students in setting goals and standards, selecting tasks, planning, implementing and evaluating to produce quality performance and quality products.

Through the portfolio assessment, I accomplish this standard.

HTS.7.3. Provides challenging learning experiences which develop higher order thinking skills.

Proving theorems is challenging and develops students' critical thinking process.

HTS.7.6. Provides opportunities for students to apply and practice what is learned.

Every time I assign homework, I demonstrate this standard.

HTS.8.1. Evaluates students' performances and products objectively and fairly.

My use of rubrics in evaluating students' portfolios demonstrates this standard.

HTS.8.4. Engages students in self-assessment activities and encourages them to set personal achievement goals.

I engage students in self-assessment activities and goal-setting through the portfolio assessment.

HTS.10.1. Consistently seeks opportunities to build strong partnerships with parents and community members.

Parents can see their children's portfolios whenever they want to. They just need to set up an appointment with me to see the portfolios.

3. Matrix of Organization

Topics (see outline below)	1.1-1.5	2.1-2.3, & 3.1-3.2	2.1-2.3 & 3.2-3.4	4.1 & 4.2	2.4 & 2.5	5.1 & 5.2	5.3-5.5	6.1	6.2 & 6.3	6.4	6.5 & 6.6	
Benchmarks	24-Aug-07	27-Sep-07	8-Nov-07	17-Dec-07	17-Jan-08	5-Feb-08	28-Feb-08	21-Mar-08	8-Apr-08	7-May-08	27-May-08	
MA.AI.	Assessment Dates											
1.1												
2.0				There are no benchmarks for standard 2								
3.1												
3.2												
3.3												
4.1												
5.0	There are no benchmarks for standard 5											
6.0	There are no benchmarks for standard 6											
7.0	There are no benchmarks for standard 7											
8.1												
8.2												
9.1												
9.2												
9.3												
9.4												
10.1												
10.2												
10.3												
10.4												
10.5												
10.6												
10.7												
10.8												
10.9												
11.0	There are no benchmarks for standard 11											
12.1												
12.2												
13.0	There are no benchmarks for standard 13											
14.0	There are no benchmarks for standard 14											

## Unit 1 Foundations of Algebra.

- 1.1. *The real number system and line*
- 1.2. *Introduction to algebraic expression and polynomials*
- 1.3. *Review of radicals*
- 1.4. *Integer and rational exponents*
- 1.5. *Solutions to linear equations and inequalities in one variable*

## Unit 2 Functions.

- 2.1. *Review of rectangular coordinate systems*
- 2.2. *Function and function notations*
- 2.3. *Graphs of linear functions*
- 2.4. *Exponential functions and their graphs*
- 2.5. *Direct and inverse variation*

## Unit 3 Systems of linear equalities and inequalities.

- 3.1. *Systems of linear equations*
- 3.2. *Solving by elimination*
- 3.3. *Applications*
- 3.4. *Systems of linear inequalities in two variables*

## Unit 4 Matrices.

- 1.1. *Matrices and linear systems*
- 1.2. *Matrix operations*

## Unit 5 Roots of Polynomials.

- 5.1. *Review of algebraic expressions and polynomials, properties of real numbers, equalities and inequalities, and laws of integral and rational exponents*
- 5.2. *Factoring*
- 5.3. *Polynomial division and synthetic division*
- 5.4. *The remainder and factor theorems*
- 5.5. *Factors and roots*

## Unit 6 Probability and Statistics

- 6.1. *Measures of central tendency*
- 6.2. *Standard deviation*
- 6.3. *Range*
- 6.4. *Stem-and-leaf plots and box-and-whisker graphs*
- 6.5. *Scatter plots and correlation*
- 6.6. *Finding lines of best fit*