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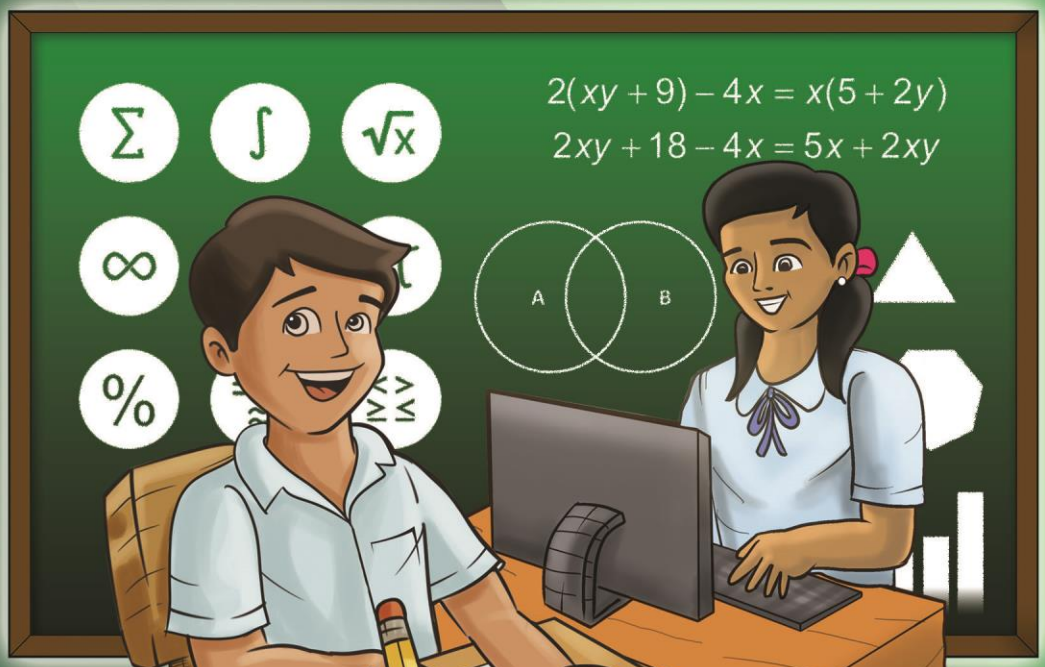
NATIONAL LEARNING CAMP

DepED DEPARTMENT OF EDUCATION

Mathematics

Enhancement Learning Camp

Lesson Plans



Enhancement Learning Camp
Lesson Plans Booklet

Mathematics Grade 9

Weeks 1 to 3

Contents

Dear Reader,

Every care has been taken to ensure the accuracy of the information provided in this Booklet. Nevertheless, if you identify a mistake, error, or issue, or wish to provide a comment, we would appreciate you informing the **Office of the Director of the Bureau of Learning Delivery** via telephone numbers (02) 8637-4346 and 8637-4347 or by email at bld.od@deped.gov.ph

Thank you for your support.

National Learning Camp Overview

The Learning Camp offers grade-level review lessons that are directed by the teacher and designed to be highly interactive among:

(i) students with their teacher and
(ii) students with their peers.

A strength of the design is the focus on both student and teacher learning. The intentions and expectations of the Learning Camp are for:

- students to consolidate and enhance their thinking in topics covered;
- teachers to enhance their pedagogical practices by focusing on selected skills that include 21st -century skills; and
- teachers to update, strengthen, and expand their subject knowledge in ways that encourage students to be involved in learning activities at different levels including those considered higher order.

Teachers are afforded resources, time, and opportunity to use deliberate practice to further extend their skills, knowledge, and understanding of teaching and how students learn. As the lessons are designed to apply subject content already encountered by students, they do not contain repetitive and routine questions of a particular subject aspect.

One important purpose of the subject content review by teachers at the beginning of each lesson is to determine learners' subject background knowledge and skills and to enable teachers to build on this. This activity also reminds students of what they have already encountered. This approach is different to 'teaching' students anew as if they have not been taught previously.

Under an integrated banner of 'Science of Learning', research-evidence advances in applying disciplines to education practice such as the learning brain, cognition, teacher and teaching growth, and learning development is adding to our knowledge of teaching and learning. This Project draws on information in this field that has highlighted the need to go beyond what might be considered current practice in the Philippines and incorporate ideas and approaches, including the 21st Century skills, to enhance teaching and learning for all.

Review lessons

The review lessons are based on content related to the students' current grades. All lessons **involve the exploration of ideas, concepts, and content** already encountered by students. The purpose of the lessons is two-fold:

(i) to establish in students a stronger basis for future learning development (prior to enrolling in a new grade after the summer break) and
(ii) to enable teachers to strengthen their teaching practice in a research-based professional development program (prior to a new academic year).

The primary focus of the lessons is on students revising and then applying previously taught subject content to support problem-solving and/or comprehension activities focused on applying knowledge, skills, and understanding to real-world problems.

Lesson Overview

All lessons in each of the three subjects, English, Mathematics, and Science, contain five components. Approximate time for the components is indicated as timing advice to guide the teacher in pacing the lessons. Time management involves moving through components at a pace that is appropriate to the learners while still ensuring that the components are completed in a timely, efficient, and constructive manner. Ultimately, however, the pace will be determined by the learners' needs and strengths.

Nevertheless, there needs to be practical limits on the duration of the components to prevent major disruption of lessons. When times are allocated appropriately, and students become familiar with the approach and teacher expectations, concept development and student skill levels are improved.

Research findings related to student learning quality and 'time' are related to student 'time-on-task'. Time-on-task refers to the time students are actively involved (engaged) in some aspects of the learning process in class. The suggested timing for each component is intended to maximize the time available for student involvement. This will encourage the students to work efficiently, timewise, through the lesson without jeopardizing the importance of such activities as students:

- answering routine and non-routine questions
- responding to verbal questions and explanations
- interpreting and using appropriate terminology
- discussing aspects with their peers
- explaining or justifying their approaches and thinking
- working productively on their own
- listening carefully to their teacher or peers.

Care needs to be exercised in determining what engagement means. Engagement is more evident when students are **doing the learning** through answering questions, writing, discussing, and reading.

Establishing on-task time is more problematic when the teacher talks and students passively listen, such as in didactic teaching. With such an approach it is difficult to determine whether students are listening or paying attention. Often in lessons requiring problem-solving or intense reading and comprehension, student activity is more subtle and cerebral as students work.

Critical aspects of the National Learning Camp for the teacher include questions related to learning areas, based around a key idea. The questions are offered at different levels of difficulty involving lower- to higher-order thinking, starting with questions of modest complexity up to those that require more developed reasoning. Students are provided with opportunities to practice solving non-routine questions to help improve their conceptual understanding by applying known content to subject-related problems.

Teacher reflection on the lessons presented can offer important insights to stimulate teachers to enhance their own practice and the learning of their students. This includes:

- new teaching approaches encouraged by lesson components that can contribute in different ways to student learning and lesson success;
- the use of review lessons that help review learnt material and extend student abilities in problem-solving by utilizing known information;
- a focus on student concept and skill acquisition, pedagogical approaches, student errors, time-on-task, deliberate practice, and working memory demands.

Enhancement and Consolidation Camp

The Consolidation Camp offers students the chance to review their subject background knowledge by consolidating previously taught material. The intention is for students to have opportunities to practice applying their knowledge of concepts and ideas through grade-related sets of questions of developing difficulty.

In the case of lessons for students in the Consolidation Camp, the materials including the lesson plans are the same as offered to students attending the Enhancement Camp. There are important reasons for both Camps sharing the same content. However, there are differences between the Camps associated with the teaching focus related to the breadth and depth of conceptual knowledge of the students.

In all learning, lower-order thinking is a prerequisite for higher-order skill and knowledge development. Many students are disadvantaged in their attempts to move forward in their learning through a lack of practice and conceptual development of needed lower-order skills, knowledge, and understanding. Hence, all students benefit from a stock-take on relevant lower-order skills with previously addressed content. This helps establish a basis upon which student learning should built.

In both the Consolidation and Enhancement Camps important lower-order content skills, knowledge, and understanding are re-visited at the beginning of each lesson. This helps ensure that potential learning obstacles are made visible to the student and the teacher. It also means that errors in understanding or misconceptions are identified. This information is important in helping all students move forward regardless of their achievement levels.

Small sets of questions asked in the lessons are also the same. These questions range from those of modest difficulty to those that require more insight and knowledge. Exploring and answering these question sets has value to all students, albeit in different ways. It enables students to work through a range of ideas on their own before hearing from their peers and teacher concerning the same questions – a very rich learning environment.

As the questions posed are about applying content already encountered to a new problem, students have the opportunity to use or apply their current knowledge, skills, and understanding in a practical way at their level, further developing their conceptualization and understanding of the content.

This Consolidation Camp offers students the opportunity to improve their learning and conceptual development through a stepped approach:

(i) reminding students of relevant lower-order skills through practice,
(ii) having students apply and discuss their knowledge in sets of graded questions with an emphasis on earlier questions,
(iii) expecting students to apply their knowledge leading to more breadth in learning,
(iv) beginning an initial focused practice on higher-order skill development.

The approach advocated to solve problems or comprehend passages extends student learning beyond simple repetitive exercise sets. For these students, the teaching part of the lesson requires teachers reviewing closely student solution attempts through student explanation, discussion, and questioning of fundamental aspects of topics that are typically found in the earlier questions. Teachers should be sensitive to students' self-perceptions here as the students may meet the ideas presented in the lessons, maybe after many failures with these concepts in the past.

Nevertheless, these students should become aware of the more difficult questions as they allow them to consider links or connections between concepts previously taught. There is value in a problem for students to read the question and be able to say what it is about in their own words.

It is important that students in the Intervention Camp become aware of where their learning is at and where it is progressing. Teachers need to be nurturing and supportive of this development and continually look for evidence of success and growth. Teachers also need to encourage students to persist, continue to practice individual aspects, and use any mistakes they make as an opportunity to learn more. These are important features of a successful learning journey.

Lesson Components: Short Overview

Lesson Component 1 (Lesson Short Review)

Component 1 offers teachers the chance to:

- settle the class quickly;
- review or preview previously encountered information;
- address previous content in the form of a few targeted questions that are **relevant to the current lesson;**
- note what students already know;
- elicit answers from the class to reinforce the important content needed for the lesson; and
- address briefly issues that may arise.

The questions set for the Short Review section of a lesson are designed to remind students of knowledge and skills developed when first studying the topic area, which is relevant to the lesson.

Lesson Component 2 (Lesson Purpose/Intention)

This component offers teachers a chance to acquaint students with the purpose/intention of the lesson. It is valuable if students see a link here with their prior knowledge or experience, especially if the teacher can connect it to the responses and levels of student understanding evident in Component 1.

In addition, this component is an appropriate time to address what students might expect/aim to achieve, i.e., their lesson goal(s). Teachers should clarify, in clear language, the learning intention for the students as well as what success will look like. (Note**:** The degree of success or partial success of student learning in the lesson should occur as part of Component 5.)

Lesson Component 3 (Lesson Language Practice)

Component 3 concerns language use – speaking, hearing, listening, and comprehending. The focus is on words or phrases that are to be used.

The language practice suggested has been identified by considering the whole lesson and identifying those words/phrases that have the potential to cause difficulties for students through speech, listening, or understanding. Typically, the language identified is restricted to less than 6 words/phrases so that there is enough time to use a variety of approaches in practice within the time available.

Lesson Component 4 (Lesson Activity)

Component 4 has three aspects, 4A, 4B, and 4C.

In the case of the Learning Camp activity, Component 4 addresses the key idea for the lesson. It is about students applying known content to solve real-world problems. This requires students to correctly interpret/understand the meaning of the 'stem', a stimulus, (passage/text or diagram or the first part of the problem or story) correctly before answering questions of varying degrees of complexity related to the stem.

Students are first presented with the stem in 4A and are given the time/chance to understand it. Then in 4B and 4C, two separate sets of questions related to the same stem are asked.

4A Reading and Understanding the Stem

4A involves understanding the language of the stem.

The purposes here are for the teacher to model fluent reading of the stem (first) and to identify any unfamiliar language (possibly addressed in Component 3). On the other hand, the students' purposes are to read the passage or describe the figure, the likes, and to hear and experience fluency in reading the stem.

4B Solving the First Set of Questions

4B involves a set of questions associated with the stem. Students will need to refer to the stem as they prepare to answer the set of questions. Students write down responses or attempts at each question. It is important that every student in the class is expected to have a response to each question. It is expected and acceptable that students would make errors, which provide teachers with important information about students' learning needs. A critical procedural action here for teachers is the importance of all students starting on the same set of questions at the same time.

When the students have finished, or sufficient time has passed, the teacher marks the questions. This can be achieved by students providing answers to the questions and by explaining or justifying their reasons. Time should be allocated to student discussion, explanation, reasoning, etc., about the answers.

4C Solving the Second Set of Questions

4C offers a new start for students regardless of how they performed in Component 4B. The structure is similar to Component 4B, i.e., undertaking a new set of questions related to the same stem. The lesson structure allows a refresh for the student's brain processing as 4C represents, for the student, a new starting point. This structure also allows all students in the class to become centered around starting a new activity.

This approach serves two purposes for teachers. First, it enables the teacher to bring all students back together to proceed as a group with issues able to be directed to and considered by every student at the same time. Second, it offers the teacher to practice offering their students extended problems where different sets of questions can be used with a single Stem, enabling an efficient way to incorporate more problem-solving or comprehension practice on specific content into a lesson.

Lesson Component 5 (Lesson Conclusion)

Component 5 has a high metacognitive aspect for students – students thinking about their own thinking – which can be further enhanced by teacher modeling. Component 5 is designed to offer a student-focused overview of the main intentions of the lesson. In particular, the focus is about helping students reflect on their progress and achievements (or partial achievements) of the lesson intention as well as their understanding development during the lesson.

It builds on comments from Component 2 about teacher expectations. There is the chance here to confirm student progress during the lesson. A teacher may use a diagram, picture, or some aspect of the lesson as a catalyst to stimulate student discussion and reflection.

NOTE: A fuller description of the Components and features of the lessons is provided in the Learning Camp – Notes to Teachers Booklet. It is recommended that these notes are read and discussed by teachers as they provide a further basis for understanding the structure of lessons and the pedagogy recommended.

Mathematics Grade 9 Lesson Plan 1

Quadratic Equations

Key Idea

Solving quadratic equations

Component 1: Short Review

Time: 10 minutes

- Ask students to answer the following questions on their worksheet
  1. If $x^2 = 16$, is $x = 4$ the only answer? Why?
  2. Solve $6y^2 = 0$
  3. Solve $x(x + 3) = 0$
  4. Solve $(x - 1)(x - 2) = 0$
  5. Solve $4x^2 - 20 = 0$
  6. Solve $2x^2 + 16 = 34$
  7. Solve $h^2 = -9$

- Ask students to volunteer answers, giving positive feedback. Read out a sample answer for all students to listen to and write down. (This may come from one of the students or from the answers below.

Answers:

1. *There is another answer x = -4 because* $(-4)^2 = 16$
2. $y = 0$
3. $x = -3 \; or \; 0$
4. $x = 1 \; or \; 2$
5. $x = \pm\sqrt{5}$
6. $x = \pm 3$
7. *There is no solution. The answer is imaginary since the square root of -9 is 3i.*

Component 2: **Lesson Purpose/Intention**

Time: 3 minutes

This lesson is about factorizing to solve quadratic equations. This is an important process that helps us understand more about equations which will eventually assist in solving problems that rely on the solution to a quadratic equation.

Component 3: Lesson Language Practice

Time: 5 minutes

Product - the result of two or more numbers when multiplied together
Factor - numbers or terms that divide exactly into another number or expression.
Squares – a number that is multiplied by itself
square root - is a number that when multiplied by itself gives the number required

Expand – to expand brackets, or multiply out, involves multiplying every term inside the bracket by the term on the outside and then collecting like terms with the aim of removing the set of brackets.
Factorizing – find what can be multiplied to get a given expression.

- Read out difficult or unfamiliar words or phrases and ask the students to read them to themselves and then out loud as a class.
- Ask the students to practice saying the words in a sentence.

Component 4*:* Lesson Activity
Time: 25 minutes

Component 4A

- Refer students to the main lesson stimulus
- Read out the written text.

Factorize (if necessary) and then solve the following equations:

- Ask the students if there are any words that they are not familiar with (or suggest) and give descriptions of any words that may be problematic.

Component 4B

i) Factorize if necessary
ii) Find the answer

1. $x^2 + 4x = 0$
2. $3x^2 - 15 = 0$
3. $(x + 3)(x - 7) = 0$
4. $(3x + 5)(x - 8) = 0$
5. $-3(x + 4)(x - 1) = 0$
6. $y^2 - 4y - 21 = 0$
7. $m^2 - m - 30 = 0$
8. $x^2 + 5x = 6$
9. $2n^2 + 8n - 64 = 0$
10. $(x + 2)^2 = 5$

Sample answers:

1. $x = 0, -4$
2. $x = \pm\sqrt{5}$
3. $x = -3, 7$
4. $x = \frac{-5}{3}, 8$
5. $x = -4, 1$
6. $y = 7, -3$
7. $m = 6, -5$
8. $x = -6, 1$
9. $n = -8, 4$
10. $x = -2 \pm \sqrt{5}$

Component 4C

- Read out the following questions

Sandra is twice as old as Russell. Eight years ago, the product of their ages was 10. Find their current ages.

Q1. Write expressions to show the information in the problem

Q2. Form a trinomial using your expressions from Q1)

Q3. Factorize to solve the problem

Q4. Why is one of the solutions not useable?

Q5. What are the ages of Sandra and Russell?

- Observe students' answers. Ask the students to volunteer their answers, giving positive feedback.

Answers:

Russell is 9 years old and Sandra is 18 years old.

Component 5: Lesson Conclusion
Time: 5 minutes

In this component, the teacher initiates and leads a student-focused wrap-up to the main objectives of the lesson. The focus is on the whole lesson experience, including how well what students feel that they take from the lesson relates to what their expectations were for the lesson, as outlined in Component 2 ('Purpose/focus' of the lesson).

The teacher should facilitate student reflection and discussion, that addresses such questions as:

- What do you think were the key mathematical concepts addressed in this lesson?
- Would you rate your level of understanding of the material covered in this lesson as high, moderate, or low?
- Has the lesson helped you to gain further insight into aspects of the material covered that represent strengths or weaknesses?
- What would you describe as the main barriers, if any, to your ongoing progress and achievement in relation to the topic area addressed in this lesson?
- What do you think would best assist your ongoing progress and achievement in relation to the topic area?

REMINDER: Collect student worksheets to review and analyze student's learning.

Mathematics Grade 9 Lesson Plan 2

The Discriminant

Key Idea

Using the discriminant to determine the nature of the roots of a quadratic equation

Component 1: Short Review

Time: 5 minutes

- Ask students to answer the following questions.

For the quadratic $ax^2 + bx + c = 0$, the formula to solve for x *is* $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$

1. Use the formula to solve:
   Q1. $x^2 + 2x - 5 = 0$
   Q2. $x^2 - 3x - 18 = 0$
   Q3. $x^2 - 9x + 14 = 0$
   Q4. $4x^2 - 9 = 0$
2. Solve $7x^2 + 42x - 112 = 0$ by:
   a) Factoring first and then solve
   b) Using the formula.
   c) Which one was easier? Why?
3. Determine the discriminant $\Delta = b^2 - 4ac$ for Q1.-Q4.

- Ask students to volunteer answers, giving positive feedback. Read out answers for all students to listen to and write down. (This may come from one of the students or the answers below).

Sample answers:

1. *Q1.* $x = -1 \pm \sqrt{6}$

   Q2. $x = 6\ or\ -3$

   Q3. $x = 2\ or\ 7$

   Q4. $x = \pm\frac{3}{2}$

2. *a)* $7(x^2 + 6x - 16) = 0$
   $7(x + 8)(x - 2) = 0$
   $x = -8\ or\ 2$
   b) $x = \frac{-42 \pm \sqrt{42^2-4\times7\times(-112)}}{2\times7}$ $x = -8\ or\ 2$
   Factorizing is much easier because the numbers are cumbersome in the formula.

3. *Q1* $\Delta = 24$

   Q2. $\Delta = 81$

   Q3. $\Delta = 25$

   Q4. $\Delta = 144$

Component 2: **Lesson Purpose/Intention**
Time: 3 minutes

The lesson is about using the discriminant to determine the nature of the roots of quadratic equations. The discriminant allows us to determine if there are no solutions to a quadratic equation, only one solution, two solutions and whether those two solutions are unequal and rational or not.

Component 3: Lesson Language Practice
Time: 5 minutes

- Read out difficult or unfamiliar words or phrases and ask the students to read them to themselves and then out loud as a class.
  Discriminant *- the expression under the square root symbol,* $b^2 - 4ac$
  Rational *- is a number that can be expressed as the fraction of two integers, a numerator p and a non-zero denominator q*
  Roots *- the values of the unknowns that satisfy the equation*
  Quadratic - *is an equation that contains at least one squared unknown.*
  Radical *- The √ symbol that is used to denote square root or nth roots*

- What is the difference between the words ***'square'*** and ***'square root'***?

- Ask the students to practice saying the words in a sentence.

Component 4*:* Lesson Activity
Time: 25 minutes

Component 4A
- Refer students to the main lesson stimulus

- Read out the written text.

- Ask the students if there are any words that they are not familiar with and give descriptions of any words that may be problematic.

Q1. Determine the nature of the roots by investigating the discriminant for each of the equations below:

1. $2x^2 + x - 7 = 0$
2. $x^2 + 10x + 25 = 0$
3. $2x^2 + 3x + 3 = 0$

Component 4B
- Read out the following questions and ask students to answer
  Q2. Find the values of k so that $3x^2 - 6x + k = 0$ has:

  a) Equal roots
  b) No real roots
  c) 2 real and unequal roots

Q3. If $mx^2 - 5x = -6$ has equal roots, find the value of m.

Q4. Use the discriminant to determine the nature of the roots for

a) $3x^2 + 7x + 2 = 0$
b) $x^2 - 3x + 11 = 0$

- Observe students' answers. Ask the students to volunteer their answers, giving positive feedback.
- Select a good answer for all students to write down. This may come from one of the students or from the following answer.

Sample answers:
Q1.
1. $\Delta > 0, roots\ are\ real\ and\ unequal$
2. $\Delta = 0, roots\ are\ real\ and\ equal$
3. $\Delta < 0, no\ real\ roots$

Q2.
a) $\Delta = 0$, k=3
b) $\Delta < 0, k > 3$
c) $\Delta > 0, k < 3$

Q3. $\Delta = 0, m = \frac{25}{24}$
Q4.
a) $\Delta = 25, 2\ real\ rational\ roots$
b) $\Delta < 0$*, no real roots*

Component 4C (O)
- Read out the following questions and ask students to answer

Q1. Use the discriminant to prove $rx^2 + 2rx + r = 0$ has equal roots for any value of r.

- Observe students' answers
- Ask the students to volunteer their answers, giving positive feedback.
- Select a good sample answer for all students to write down. This may come from one of the students or from the following sample answer.

Sample answers:
Q1. $\Delta = (2r)^2 - 4(r)(r) = 0$
The roots are real and equal, since $\Delta = 0$.

Component 5: Lesson Conclusion

Time: 5 minutes

In this component, the teacher initiates and leads a student-focused wrap-up to the main objectives of the lesson. The focus is on the whole lesson experience, including how well what students feel that they take from the lesson relates to what their expectations were for the lesson, as outlined in Component 2 ('Purpose/focus' of the lesson).

The teacher should facilitate student reflection and discussion, that addresses such questions as:

- What do you think were the key mathematical concepts addressed in this lesson?
- Would you rate your level of understanding of the material covered in this lesson as high, moderate, or low?
- Has the lesson helped you to gain further insight into aspects of the material covered that represent strengths or weaknesses?
- What would you describe as the main barriers, if any, to your ongoing progress and achievement in relation to the topic area addressed in this lesson?
- What do you think would best assist your ongoing progress and achievement in relation to the topic area?

REMINDER: Collect student worksheets to review and analyze student's learning.

Mathematics Grade 9 Lesson Plan 3

Solves quadratic inequalities

Key Idea

Using knowledge of quadratic inequalities to illustrate solutions graphically

Component 1: Short Review

Time: 5 minutes

- Ask students to answer the following questions.

  Solve

  Q1. $x^2 = 64$

  Q2. $x^2 > 64$

  Q3. $x^2 < 64$

  Q4. $x^2 \geq 64$

  Q5. $x^2 < -64$

  Q6. $2x^2 > 18$

  Q7. $x^2 - 2x - 3 < 0$

- Ask students to volunteer answers, giving positive feedback.

Sample answers:

Q1. $x = \pm 8$

Q2. $x > 8, x < -8$

Q3. $x > -8, x < 8, or -8 < x < 8$

Q4. $x \geq 8, x \leq -8$

Q5. No solution. No real number can be satisfied by the inequality.

Q6. $x > 3, x < -3$

Q7. $-1 < x < 3$

Component 2: **Lesson Purpose/Intention**

Time: 3 minutes

The lesson is about using quadratic inequalities to illustrate solutions to quadratic inequalities both algebraically and graphically. This skill will assist in solving problems with quadratic inequalities.

Component 3: Lesson Language Practice
Time: 5 minutes

- Read out difficult or unfamiliar words or phrases and ask the students to read them to themselves and then out loud as a class.

Discriminant *- the expression under the square root symbol,* $b^2 - 4ac$
Rational *- is a number that can be expressed as the fraction of two integers, a numerator p and a non-zero denominator q*
Roots *- the values of the unknowns that satisfy the equation*
Quadratic- *is an equation that contains at least one squared unknown.*
Radical - *the √ symbol that is used to denote square root or nth roots*
Inequalities - *the mathematical expressions in which both sides are not equal. In inequality, unlike in equations, we compare two values. The equal sign in between is replaced by less than (or less than or equal to), greater than (or greater than or equal to), or not equal to sign.*

- Explain the difference between the roots of an equation and the solution of an equation.
- Ask the students to practice saying the words in a sentence.

Component 4*:* Lesson Activity
Time: 25 minutes

Component 4A

- Refer students to the main lesson stimulus
- Read out the written text.
- Ask the students if there are any words that they are not familiar with (and give descriptions of any words that may be problematic.

Solve the inequality $x^2 + 5x \geq -4$

Component 4B

Q1. Rearrange the inequality to have 0 on the right-hand side of the inequality sign

Q2. Factorize the quadratic expression

Q3. Sketch the parabola

Q4. Test the values inside and outside the parabola

Q5. Write the solution

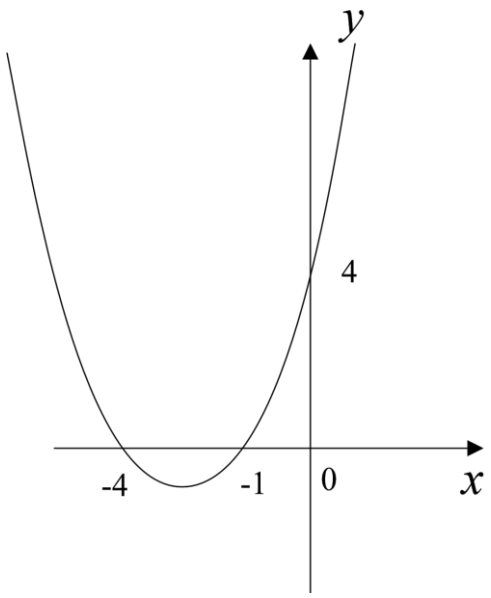
- Observe students' answers. Ask the students to volunteer their answers, giving positive feedback.
- Select an answer for all students to write down. This may come from one of the students or from the following sample answer.

Sample answers:

Q1. $x^2 + 5x + 4 \geq 0$

Q2. $(x + 1)(x + 4) \geq 0$

Q3.



Q4. For graph to be above the x-axis, $x < -4$ *or* $x > -1$

Q5. The solution for $x^2 + 5x \geq -4$ *is* $-4 > x > -1$

Component 4C

- Read out the following questions and ask students to answer

a). Solve the inequality $x^2 - 3x > 0$

b) Solve the inequality x^2*-5x+24*$< 5x + 8$

- Observe students' answers.
- Ask the students to volunteer their answers, giving positive feedback.
- Select an answer for all students to write down. This may come from one of the students or from the following sample answer.

Sample answers:

Q1. $x < 0$ *or* $x > 3$

Q2. $2 < x < 8$

Component 5: Lesson Conclusion
Time: 5 minutes

In this component, the teacher initiates and leads a student-focused wrap-up to the main objectives of the lesson. The focus is on the whole lesson experience, including how well what students feel that they take from the lesson relates to what their expectations were for the lesson, as outlined in Component 2 ('Purpose/focus' of the lesson).

The teacher should facilitate student reflection and discussion, that addresses such questions as:

- What do you think were the key mathematical concepts addressed in this lesson?
- Would you rate your level of understanding of the material covered in this lesson as high, moderate, or low?
- Has the lesson helped you to gain further insight into aspects of the material covered that represent strengths or weaknesses?
- What would you describe as the main barriers, if any, to your ongoing progress and achievement in relation to the topic area addressed in this lesson?
- What do you think would best assist your ongoing progress and achievement in relation to the topic area?

REMINDER: Collect student worksheets to review and analyze student's learning.

Mathematics Grade 9 Lesson Plan 4

Solving Problems with Quadratic Inequalities

Key Idea

Students use their skills with quadratic inequalities to solve problems

Component 1: Short Review

Time: 5 minutes

- Ask students to answer the following questions.

Solve the following inequalities.

Q1. $x^2 + 2x - 15 > 0$

Q2. $x^2 - 2x - 3 \leq 0$

Q3. $x^2 - 8x + 12 < 0$

Q4. $x^2 - 5x \geq 0$

Q5. $9x > 2x^2 - 18$

- Ask students to volunteer answers, giving positive feedback.

Answers:

Q1. $x < -5, x > 3$

Q2. $-1 \leq x \leq 3$

Q3. $2 < x < 6$

Q4. $x < 0, x > 5$

Q5. $x < 6, x > -\frac{3}{2}$ *or* $-\frac{3}{2} < x < 6$

Component 2: **Lesson Purpose/Intention**

Time: 3 minutes

The lesson is about solving quadratic inequalities in order to find the answer to real problems.

Component 3: Lesson Language Practice

Time: 5 minutes

- Read out difficult or unfamiliar words or phrases and ask the students to read them to themselves and then out loud as a class.
- Ask the students to practice saying the words in a sentence.
  Ask students to volunteer their answers, giving positive feedback and discussing.

Discriminant *- the expression under the square root symbol,* $b^2 - 4ac$
Rational *- is a number that can be expressed as the fraction of two integers, a numerator p and a non-zero denominator q*
Roots *- the values of the unknowns that satisfy the equation*

Quadratic *- is an equation that contains at least one squared unknown*
Radical *- the √ symbol that is used to denote square root or nth roots*
Inequalities *- the mathematical expressions in which both sides are not equal. In inequality, unlike in equations, we compare two values. The equal sign in between is replaced by less than (or less than or equal to), greater than (or greater than or equal to), or not equal to sign.*

- Ask the students to practice saying the words in a sentence.

Component 4*:* Lesson Activity
Time: 25 minutes

Component 4A

- Refer students to the main lesson stimulus
- Read out the written text.
- Ask the students if there are any words that they are not familiar with and give descriptions of any words that may be problematic.

A rocket is launched from ground level directly upward at a rate of 48m/sec. The equation for the rocket's height is $y = -16x^2 + 48x$.

Component 4B

- Read out the following questions and ask students to answer in the space on their worksheet.

  Q1. What values of x is the rocket at or above 32m?

  Q2 How long is the rocket at or above this height?

- Observe students' answers.
- Select an answer for all students to write down. This may come from one of the students or from the following sample answer.

Sample answers

Q1. $1 < x < 2$

Q2. 1 second

Component 4C

- Read out the following questions and ask students to answer in the space on their worksheet.

The area of this rectangle is greater than 40 sq. cm. What are all the possible values of x?

(2x - 1) cm

(x + 3) cm

- Observe students' answers.
- Ask the students to volunteer their answers, giving positive feedback.

- Select an answer for all students to write down. This may come from one of the students or the following sample answer.

Sample answers

When inequation is solved, there is also a negative answer that is not possible, so $x > 3.55$

Component 5: Lesson Conclusion

Time: 5 minutes

In this component, the teacher initiates and leads a student-focused wrap-up to the main objectives of the lesson. The focus is on the whole lesson experience, including how well what students feel that they take from the lesson relates to what their expectations were for the lesson, as outlined in Component 2 ('Purpose/focus' of the lesson).

The teacher should facilitate student reflection and discussion, that addresses such questions as:

- What do you think were the key mathematical concepts addressed in this lesson?
- Would you rate your level of understanding of the material covered in this lesson as high, moderate, or low?
- Has the lesson helped you to gain further insight into aspects of the material covered that represent strengths or weaknesses?
- What would you describe as the main barriers, if any, to your ongoing progress and achievement in relation to the topic area addressed in this lesson?
- What do you think would best assist your ongoing progress and achievement in relation to the topic area?

REMINDER: Collect student worksheets to review and analyze student's learning.

Mathematics Grade 9 Lesson Plan 5

Graphs of Quadratic Functions

Key Idea

Uses the key features of a parabola to sketch its graph

Component 1: Short Review

Time: 10 minutes

Follow the steps below to graph $f(x) = x^2 - 6x + 8$

a) Decide whether the parabola is concave up or concave down. Give reasons.
b) Find the axis of symmetry
c) Find the vertex
d) Find the y-intercept
e) Find the x-intercept
f) Use these points to sketch the graph of the function

- Ask students to volunteer answers, giving positive feedback.

Sample answers:

a) $a > 0$, the parabola is concave up
b) The axis of symmetry is x=3
c) The vertex is (3, -1)
d) The y-intercept is y=8
e) The x-intercept/s: x = 4, 2
f) Sketch of the parabola including the above points

Component 2: **Lesson Purpose/Intention**

Time: 25 minutes

The lesson is about using the number plane to determine the position or location of a parabola on a number plane. Being able to draw accurate sketches of parabola is a tool that is used to solve Mathematical problems. Confidence in using a Number Plane to sketch graphs will assist in many other aspects of Mathematics

Component 3: Lesson Language Practice

Time: 5 minutes

- Read out difficult or unfamiliar words or phrases and ask the students to read them to themselves and then out loud as a class.
- Ask the students to practice saying the words in a sentence

Coordinates – two numbers which locate a specific point on a coordinate plane.
Variable – is a quantity that can be changed and is not fixed
Dependent – is the variable that depends on the value of some other number
Independent – is the variable that refers to the cause or reason for an outcome
Vertex – is a point at which the parabola makes its sharpest turn
Concave – A parabola is concave upward if the curve opens upward. A parabola is concave downward if the curve opens downward.

Axis of symmetry – the line that will divide a parabola into two equal halves which are mirror images of each other

Intercepts – the points at which the parabola crosses the x -axis and the y-axis

Component 4*:* Lesson Activity

Time: 25 minutes

Component 4A

- Refer students to the main lesson stimulus
- Read out the written text.
- Ask the students if there are any words that they are not familiar with and give descriptions of any words that may be problematic.

> Graph the function $f(x) = 3(x-1)^2 + 2$.

Component 4B

- Read out the following questions and ask students to answer

1) Expand the equation
2) Determine whether the parabola faces up or down
3) Find the axis of symmetry
4) Determine the vertex
5) Determine x and y intercepts (there may not be any x intercepts)
6) Draw your sketch

- Observe students' answers. Ask the students to volunteer their answers, giving positive feedback.
- Select an answer for all students to write down. This may come from one of the students or from the following sample answer.

Sample answers:

Q1 $f(x) = 3x^2 - 6x + 5$

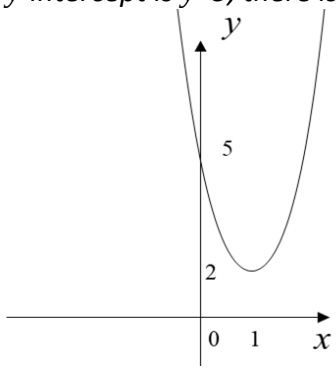
Q2. Concave up

Q3. axis of symmetry is $x = 1$

Q4. vertex is (1,2)

Q5. y-intercept is y=5, there is no x-intercept

Q6.



Component 4C

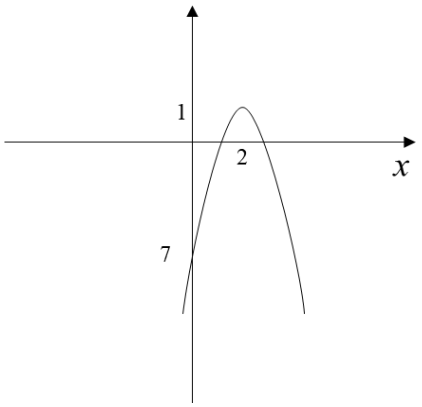
- Read out the following questions and ask students to answer

> Graph the parabola
>
> $$f(x) = -2(x-2)^2 + 1$$
>
> Use the steps from the previous question as a guide

- Observe students' answers.
- Ask the students to volunteer their answers, giving positive feedback.
- Select an answer for all students to write down. This may come from one of the students or from the following sample answer.

Sample answers:

- Concave down
- Axis of symmetry $x = 2$
- Vertex (2,1)
- y-intercept y=-7, x -intercept x=1.29 and x=2.71



Component 5: Lesson Conclusion

Time: 5 minutes

In this component, the teacher initiates and leads a student-focused wrap-up to the main objectives of the lesson. The focus is on the whole lesson experience, including how well what students feel that they take from the lesson relates to what their expectations were for the lesson, as outlined in Component 2 ('Purpose/focus' of the lesson).

The teacher should facilitate student reflection and discussion, that addresses such questions as:

- What do you think were the key mathematical concepts addressed in this lesson?
- Would you rate your level of understanding of the material covered in this lesson as high, moderate, or low?
- Has the lesson helped you to gain further insight into aspects of the material covered that represent strengths or weaknesses?
- What would you describe as the main barriers, if any, to your ongoing progress and achievement in relation to the topic area addressed in this lesson?
- What do you think would best assist your ongoing progress and achievement in relation to the topic area?

REMINDER: Collect student worksheets to review and analyze student's learning.

Mathematics Grade 9 Lesson Plan 6 Deliberate Practice

Review Patterns and Algebra

Key Ideas

Review Patterns and Algebra

Component 1. Short Review

Solve:

Q1. $x^2 - x = 30$

Q2. $x^2 + 7x + 10$=0

Q3. $6x^2 + 8x - 5 = 0$

Q4. $16x^2 - 25 < 0$

Q5. $y^2 - y - 20 \geq 0$

Sample Answers

Q1. x= 6,-5
Q2. x= -2,-5
Q3. $x = \frac{-4 \pm \sqrt{46}}{6}$
Q4. $x > \frac{-5}{4}, x < \frac{5}{4}$
Q5. $y \geq 5, y \leq -4$

Component 2: **Lesson Purpose/Intention**

Time: 5 minutes

The lesson is about ensuring the skills learned during the week will be consolidated in this review lesson

Component 3: Language Practice

Time: 5 minutes

Select 6 to 8 of the most important words encountered during the week.

product, factor, squares, square root, expand, factorizing, discriminant, rational, roots, quadratic, radical, inequalities, co-ordinate, variable, dependent, independent, vertex, concave, axis of symmetry, intercepts

Component 4*:* Lesson Activity

Time: 30 minutes

Component 4A

- Have the students read out the question aloud. Ask the students what the word equation and the equal sign mean.
- Ask the students what features stand out in $2x^2 - 18 = 16x$

Component 4B

For the equation $2x^2 - 18 = 16x$:

1. Rearrange the equation into the form $ax^2 + bx + c = 0$
2. Use the discriminant to determine the nature of the roots
3. Using the equation $y = 2x^2 - 16x - 18$, determine the axis of symmetry
4. Determine the vertex of the equation in (3)
5. What are the *x* and *y* intercepts of the equation in (3)
6. Sketch the graph of the equation in (3).

Sample answers:

1. $2x^2 - 16x - 18 = 0$

2. The nature of the roots is real since the computed discriminant is greater than 0 which is 400.

3. $\Delta = 400$

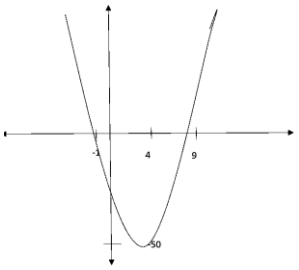
4. $x = 4, y = -50$

5. *x*-intercepts:

x = 9, -1

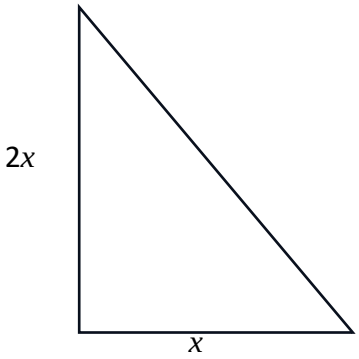
y-intercept:
y = -18

6.



Component 4C

- Read out the following questions and ask students to answer.
  Here is a rectangle and a right-angled triangle.



All measurements are in cm. The area of the rectangle is greater than the area of the triangle. What are all the possible values of x?

Sample answers:
$x > 2$

Component 5: Lesson Conclusion
Time: 5 minutes

In this component, the teacher initiates and leads a student-focused wrap-up to the main objectives of the lesson. The focus is on the whole lesson experience, including how well what students feel that they take from the lesson relates to what their expectations were for the lesson, as outlined in Component 2 ('Purpose/focus' of the lesson).

The teacher should facilitate student reflection and discussion, that addresses such questions as:

- What do you think were the key mathematical concepts addressed in this lesson?
- Would you rate your level of understanding of the material covered in this lesson as high, moderate, or low?
- Has the lesson helped you to gain further insight into aspects of the material covered that represent strengths or weaknesses?
- What would you describe as the main barriers, if any, to your ongoing progress and achievement in relation to the topic area addressed in this lesson?
- What do you think would best assist your ongoing progress and achievement in relation to the topic area?

NOTE: Remember to collect student worksheets to review and analyze student's learning.

Mathematics Grade 9 Lesson Plan 7

Determines the Equation of a quadratic Function

Key Idea

Uses the graph of a quadratic function to determine its equation

Component 1: Short Review

Time: 5 minutes

- Ask students to answer the following questions.

Q1. Complete the square for the expressions below:

a). $x^2 + 4x + 1$

b). $x^2 - 6x + 16$

c). $-3x^2 - 6x + 18$

Q2 Solve for *x* in the following:

a). $(x + 2)^2 = 5$

b). $3(x - 7)^2 = 8$

Q3. Complete the square and then solve for *x*.

a). $x^2 + 6x + 2 = 0$

b). $x^2 - 10x + 15 = 0$

- Ask students to volunteer answers, giving positive feedback.

Sample answers:

Q1.

a). $(x - 2)^2 - 3$

b).$(x - 3)^2 + 7$

c).$-3[(x - 1)^2 + 5]$

Q2.

a).$x = -2 + \sqrt{5},\ x = -2 - \sqrt{5}$

b). $x = 7 + \sqrt{\frac{8}{3}}\ \ x = 7 - \sqrt{\frac{8}{3}}$

Q3.

a). $x = \pm\sqrt{7} - 3$

b).$x = \pm\sqrt{10} + 5$

Component 2: **Lesson Purpose/Intention**

Time: 5 minutes

The lesson is about using a graph and knowledge of completing the square to find the equation of a parabola.

Component 3: Lesson Language Practice
Time: 5 minutes

- Read out difficult or unfamiliar words or phrases and ask the students to read them to themselves and then out loud as a class.
- Ask the students to practice saying the words in a sentence.
- Ask students to volunteer their answers, giving positive feedback and discussing.

Intercept - is the point where the line crosses the x-axis, called the x-intercept, and the point where the line crosses the y-axis, or the y-intercept.

Vertex - is a point at which the parabola makes its sharpest turn
Concave - A parabola is concave upward if the curve opens upward. A parabola is concave downward if the curve opens downward.
Axis of symmetry -the line that will divide a parabola into two equal halves which are mirror images of each other

Component 4*:* Lesson Activity
Time: 25 minutes

Component 4A
- Refer students to the main lesson stimulus
- Read out the written text.
- Ask the students if there are any words that they are not familiar with (or suggest examples such as and give descriptions of any words that may be problematic.

For a quadratic equation of the form $y = k(x - a)^2 + b$, the following properties are true:
- *The axis of symmetry is $x = a$*
- *The vertex is the point (a,b)*
- *If $k > 0$, then the parabola is concave up*
- *If $k < 0$, then the parabola is concave down*

Component 4B

- Read out the following questions and ask students to answer

1. For the equation $y = x^2 - 6x + 11$

   Q1. Rewrite the equation in the form $y = (x - a)^2 + b$ by completing the square

   Q2. Use the properties to determine significant points

   Q3. Sketch the parabola

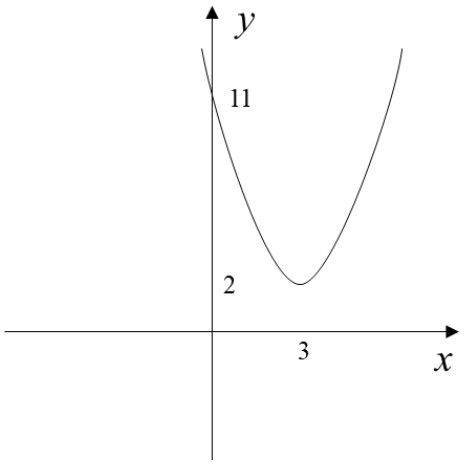
2. Use the same strategy to graph $y = x^2 + 10x + 7$

Observe students' answers. Ask the students to volunteer their answers, giving positive feedback.

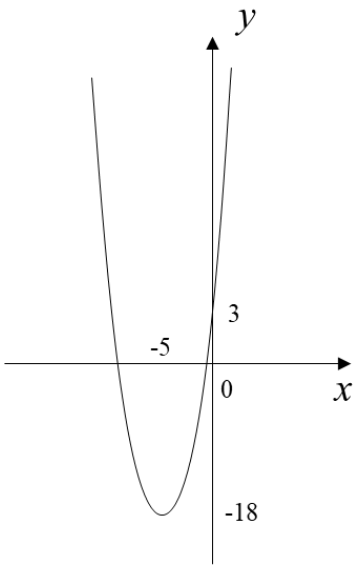
Sample answers:

Q1. $y = (x-3)^2 + 2$

Q2. Axis of symmetry is $x = 3$
Vertex is (3,2)
Concave up
y-intercept is y=11



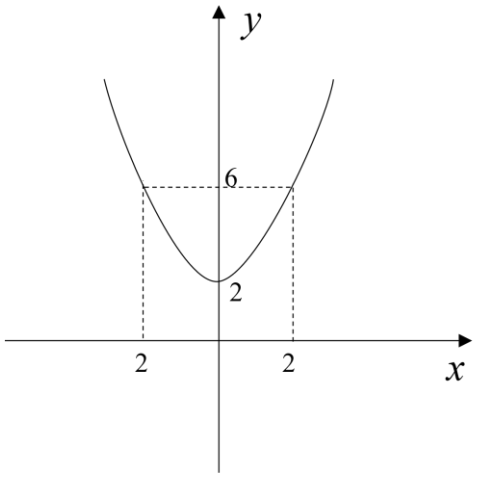
Q3.
y-intercept is y=7
vertex is (-5,-18)
Axis of symmetry is x=-5



Component 4C

- Read out the following questions and ask students to answer

From the graph below determine the equation of the parabola



- Observe students' answers.
- Ask the students to volunteer their answers, giving positive feedback.

Sample answers:
Axis is Symmetry is $x = 0$, therefore $x = a$=0
Vertex is (0,2), therefore b=2
k=1
Equation is $y = x^2 + 2$

Component 5: Lesson Conclusion
Time: 5 minutes

In this component, the teacher initiates and leads a student-focused wrap-up to the main objectives of the lesson. The focus is on the whole lesson experience, including how well what students feel that they take from the lesson relates to what their expectations were for the lesson, as outlined in Component 2 ('Purpose/focus' of the lesson).

The teacher should facilitate student reflection and discussion, that addresses such questions as:

- What do you think were the key mathematical concepts addressed in this lesson?
- Would you rate your level of understanding of the material covered in this lesson as high, moderate, or low?
- Has the lesson helped you to gain further insight into aspects of the material covered that represent strengths or weaknesses?
- What would you describe as the main barriers, if any, to your ongoing progress and achievement in relation to the topic area addressed in this lesson?
- What do you think would best assist your ongoing progress and achievement in relation to the topic area?

REMINDER: Collect student worksheets to review and analyze student's learning.

Mathematics Grade 9 Lesson Plan 8

Simplifying Expressions with Rational Components

Key Idea

The learner applies knowledge of index laws to simplify algebraic expressions

Component 1: Short Review

Time: 5 minutes

- Ask students to answer the following questions on their worksheet.

Simplify the following expressions

Q1. $(a^3)^2$
Q2. $(b^5)(b^7)$
Q3.$(x^{12}) \div (x^7)$
Q4. $\left(2x^{\frac{3}{2}}\right)\left(x^{\frac{4}{5}}\right)$
Q5. $(x^4)^{\frac{3}{2}}$
Q6. $27^{\frac{2}{3}}$
Q7. 2^{-3}

- Ask students to volunteer answers, giving positive feedback. Read out a sample answer for all students to listen to and write down. (This may come from one of the students or from the sample answers below).

Sample answers:
Q1. a^6
Q2. b^{12}
Q3. x^5
Q4. $2x^{\frac{23}{10}}$
Q5. x^6
Q6. 9
Q7.$\frac{1}{8}$

Component 2: **Lesson Purpose/Intention**

Time: 5 minutes

The lesson is about applying the understanding of index laws to simplify algebraic expressions that include radicals.

Component 3: Lesson Language Practice

Time: 5 minutes

- Read out difficult or unfamiliar words or phrases and ask the students to read them to themselves and then out loud as a class.
- Ask the students to practice saying the words in a sentence.
- Ask students to volunteer their answers, giving positive feedback and discussing.

index laws **-** the rules for simplifying expressions involving powers to the same base number
surd **-** the roots of numbers that cannot be simplified into a whole or rational number

Component 4*:* Lesson Activity
Time: 25 minutes

Component 4A

- Refer students to the main lesson stimulus
- Read out the written text.
- Ask the students if there are any words that they are not familiar with and give descriptions of any words that may be problematic.

> The lesson is about applying the understanding of index laws to simplify algebraic expressions that include radicals.

Component 4B

- Read out the following questions and ask students to answer in the space on their workbook

Q1. $(8p^4)(4p^8)$

Q2. $(7r^6)(8s^5)(9r^4)$

Q3. $(5^5)(a^3)(3)(5^5)(3a^5)$

Q4. $(x^2y^3) \div (xy^2)$

Q5. $(16f^7g^2) \div (4f^3g)$

Q6. $(21j^8k^3m^3) \div (3k^2m)$

Q7. $(8^9)^3$

Q8. $(h^4)^6$

Q9. $(c^2d^3)^5$

- Observe students' answers. Ask the students to volunteer their answers, giving positive feedback.
- Select a good sample answer for all students to write down. This may come from one of the students or from the following sample answer.

Sample answers:

Q1. $32p^{12}$
Q2. $504r^{10}s^5$
Q3. $(5^{10})(9a^8)$
Q4. xy
Q5. $4f^4g$
Q6. $7j^8km^2$

Q7. 8^{27}
Q8. h^{24}
Q9. $c^{10}d^{15}$

Component 4C

- Read out the following questions and ask students to answer in the space on their worksheet.
- Observe students' answers. Ask the students to volunteer their answers, giving positive feedback.

These questions are more challenging for your skills of manipulating expressions using index laws.

Q1. $(27p^6)^{\frac{5}{3}}$
Q2. $(25b^6)^{\frac{-3}{2}}$
Q3. $\frac{4x^2}{2x^{\frac{1}{2}}}$

- Select a good sample answer for all students to write down. This may come from one of the students or from the following sample answer.

Sample answers:
Q1. 3^5p^{10}
Q2. $5^{-3}b^{-9}$
Q3.$2x^{\frac{3}{2}}$

Component 5: Lesson Conclusion
Time: 5 minutes

In this component, the teacher initiates and leads a student-focused wrap-up to the main objectives of the lesson. The focus is on the whole lesson experience, including how well what students feel that they take from the lesson relates to what their expectations were for the lesson, as outlined in Component 2 ('Purpose/focus' of the lesson).

The teacher should facilitate student reflection and discussion, that addresses such questions as:

- What do you think were the key mathematical concepts addressed in this lesson?
- Would you rate your level of understanding of the material covered in this lesson as high, moderate, or low?
- Has the lesson helped you to gain further insight into aspects of the material covered that represent strengths or weaknesses?
- What would you describe as the main barriers, if any, to your ongoing progress and achievement in relation to the topic area addressed in this lesson?
- What do you think would best assist your ongoing progress and achievement in relation to the topic area?

REMINDER: Collect student worksheets to review and analyze student's learning.

Mathematics Grade 9 Lesson Plan 9

Radical Expressions

Key Idea

Performs Operations on Radical Expressions

Component 1: Short Review

Time: 8 mins

Simplify:

1. $\sqrt{98}$
2. $\sqrt{80}$
3. $\sqrt{99}$
4. $3\sqrt{2} + 5\sqrt{2}$
5. $\sqrt{3} - \sqrt{48}$
6. $4\sqrt{3}+\sqrt{2} - \sqrt{3}$
7. $(\sqrt{3})(\sqrt{6})$
8. $\sqrt{\frac{75}{3}}$

- Teacher provides answers to questions and highlights particular concepts, as well as issues that may have arisen in student answers (issues not addressed to be noted at end of lesson).

- Ask students to volunteer their answers, giving positive feedback. Read out a sample answer for all students to listen to and write down. This may come from one of the students or from the sample answers below.

Sample answers:

1. $7\sqrt{2}$
2. $4\sqrt{5}$
3. $3\sqrt{11}$
4. $8\sqrt{2}$
5. $-3\sqrt{3}$
6. $3\sqrt{3} + \sqrt{2}$
7. $\sqrt{18} = 3\sqrt{2}$
8. ± 5

Component 2: **Lesson Purpose/Intention**

Time: 2 mins

The purpose of this lesson is to simplify radical expressions.

Component 3: Lesson Language Practice

Time: 5 mins

- Read out difficult or unfamiliar words or phrases and ask the students to read them to themselves and then out loud as a class.

index laws **-** the rules for simplifying expressions involving powers to the same base number
surd **-** the roots of numbers that cannot be simplified into a whole or rational number
radical **-** is the square root or cubed root etc.

- Ask students what the difference is between the words**.**

Component 4*:* Lesson Activity

Time: 25 mins

Component 4A

- Refer students to the main lesson stimulus and **orient them to the text**

Simplify the following expressions. Some may require rationalizing the denominator.

Component 4B

- Read out the following questions and ask students to answer in the space on their worksheet.

Q1. $3\sqrt{7} - 2\sqrt{8} + \sqrt{63}$
Q2. $(3\sqrt{3} - 2\sqrt{2})^2$
Q3. $2\sqrt{5} + \sqrt{12} - \sqrt{27}$
Q4. $(2 - 2\sqrt{2})^2$
Q5. $\sqrt{15} \times \sqrt{5}$
Q6. $5\sqrt{5}(2 - 5\sqrt{6})$
Q7. $(5 - 4\sqrt{5})(5 + 3\sqrt{5})$
Q8. $(-5\sqrt{3} + 2)(-2\sqrt{3} - 4)$
Q9. $\frac{\sqrt{5}}{\sqrt{2}}$
Q10. $\frac{4}{\sqrt{3}}$

- Observe students' answers. Ask the students to volunteer their answers, giving positive feedback. Select good sample answers for all students to write down. These may come from the students or from the following sample answers.

Sample Answers:
Q1. $6\sqrt{7} - 4\sqrt{2}$
Q2. $35 - 12\sqrt{6}$
Q3. $2\sqrt{5} - \sqrt{3}$
Q4. $12 - 8\sqrt{2}$
Q5. $3\sqrt{5}$
Q6. $10\sqrt{5} - 25\sqrt{30}$
Q7. $-35 - 5\sqrt{5}$
Q8. $22 + 16\sqrt{3}$
Q9. $\frac{\sqrt{10}}{2}$
Q10. $\frac{4\sqrt{3}}{3}$

Component 4C

- Read out the following questions and ask students to answer in the space on their worksheet.

Simplify these radical expressions. These questions may require you to simplify more than once.

Q1. $\frac{\sqrt{6}}{\sqrt{3}}$

Q2. $\frac{3\sqrt{3}}{5\sqrt{75}}$

Q3. $\left(\sqrt{2}-4\sqrt{3}\right)\left(\sqrt{2}+4\sqrt{3}\right)$

Q4. $\frac{\sqrt{8}}{-2\sqrt{24}}$

Q5. $\frac{\sqrt{15xy}}{3\sqrt{10xy^3}}$

- Observe students' responses, giving encouragement. Ask the students to volunteer their answers, giving positive feedback. Select good sample answers for all students to write down. These may come from the students or from the following sample answer.

Sample Answer:

Q1. $\sqrt{2}$

Q2. $\frac{3}{25}$

Q3. -46

Q4. $\frac{\sqrt{3}}{-6}$

Q5. $\frac{\sqrt{6}}{6y}$

Lesson Component 5: Reflection

Time: 5 minutes

In this component, the teacher initiates and leads a student-focused wrap-up to the main objectives of the lesson. The focus is on the whole lesson experience, including how well what students feel that they take from the lesson relates to what their expectations were for the lesson, as outlined in Component 2 ('Purpose/focus' of the lesson).

The teacher should facilitate student reflection and discussion, that addresses such questions as:

- What do you think were the key mathematical concepts addressed in this lesson?
- Would you rate your level of understanding of the material covered in this lesson as high, moderate, or low?
- Has the lesson helped you to gain further insight into aspects of the material covered that represent strengths or weaknesses?
- What would you describe as the main barriers, if any, to your ongoing progress and achievement in relation to the topic area addressed in this lesson?
- What do you think would best assist your ongoing progress and achievement in relation to the topic area?

NOTE: Remember to collect student worksheets to review and analyze student's learning.

Mathematics Grade 9 Lesson Plan 10

Parallelograms

Key Idea

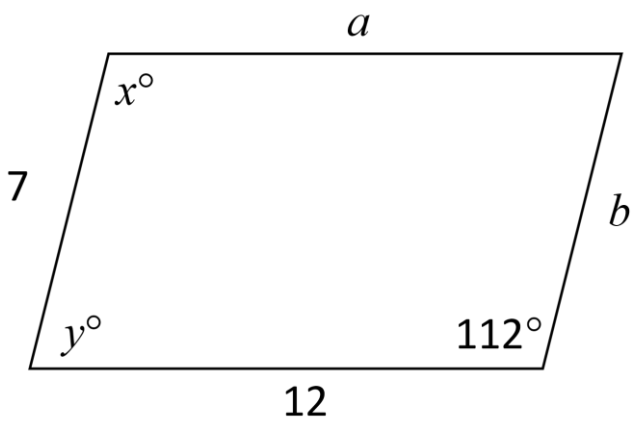
Uses the properties of parallelograms to solve problems

Component 1: Short Review

Time: 8 mins

- Review the properties of parallelograms:
  1. Opposite sides are parallel and equal in length
  2. Diagonally opposite angles are equal
  3. Adjacent (consecutive) angles are supplementary
  4. The two diagonals bisect each other

- For the parallelogram below find the values of the unknowns and give reasons.



- Teacher provides answers to questions and highlights particular concepts, as well as issues that may have arisen in student answers (issues not addressed to be noted at end of lesson).

- Ask students to volunteer their answers, giving positive feedback. Read out a sample answer for all students to listen to and write down. This may come from one of the students or from the sample answers below.

Sample answers:

$a = 12$ *because opposite sides of a parallelogram are equal*
$b = 7$ *because opposite sides of a parallelogram are equal*
$x° = 112°$ *because diagonally opposite angles are equal*
$y° = 68°$ *because adjacent (consecutive) angles are supplementary*

Component 2: **Lesson Purpose/Intention**

Time: 2 mins

The purpose of this lesson is to use the properties of parallelograms to find unknown length values and unknown angles. This skill will be useful when proving geometric facts and solving problems.

Component 3: Lesson Language Practice

Time: 5 mins

- Read out difficult or unfamiliar words or phrases and ask the students to read them to themselves and then out loud as a class.

Complementary angles are two angles whose sum is 90 degrees.

Supplementary angles are two angles whose sum is 180 degrees**.**

Adjacent angles *are* pair of angles that share a common vertex and a common side that do not overlap.

Alternate angles are equal angles formed by two parallel lines crossed by a transversal.

Transversal *is a line that intersects two or more lines at different points.*

Vertically opposite angles/vertical angles *are* the angles formed on opposite sides of the vertex of intersecting lines.

- Ask students the difference between the words '***complementary' and 'supplementary'*.**

Component 4*:* Lesson Activity

Time: 25 mins

Component 4A

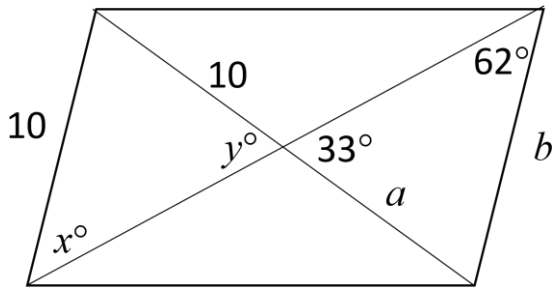
- Refer students to the main lesson stimulus and **orient them to the text**

  Find the indicated values on each of the diagrams below. Give reasons for your answers.

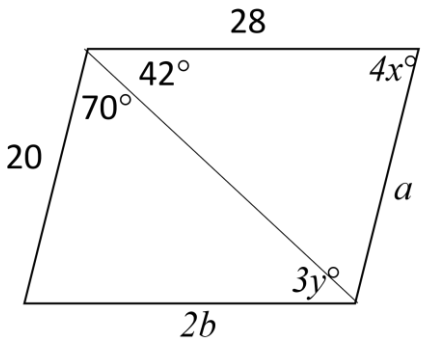
Component 4B

- Read out the following questions and ask students to answer in the space on their worksheet.

1.



2.



- Observe students' answers. Ask the students to volunteer their answers, giving positive feedback. Select good sample answers for all students to write down. These may come from the students or from the following sample answers.

Sample answers:

1. a=10 because the two diagonals bisect each other
   b=10 because opposite sides of a parallelogram are equal
   $x° = 62°$ because $x°$ and $62°$ are alternate angles when a transversal crosses two parallel lines
   $y° = 33°$ because the two angles are vertically opposite each other and are equal

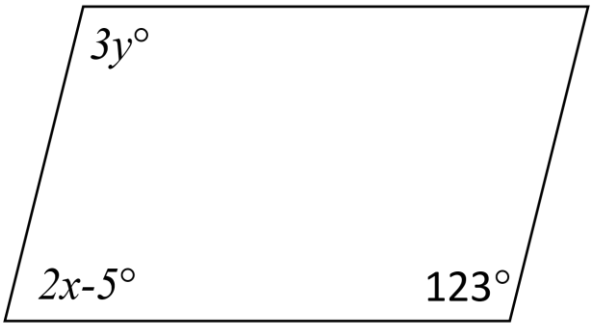
2. a = 20 because opposite sides of a parallelogram are equal
   b = 14 because opposite sides of a parallelogram are equal
   $x° = 17°$ because 4x=68° adjacent angles are supplementary
   $y° = 14°$ because $3y° \; and \; 42°$ are alternate angles

Component 4C

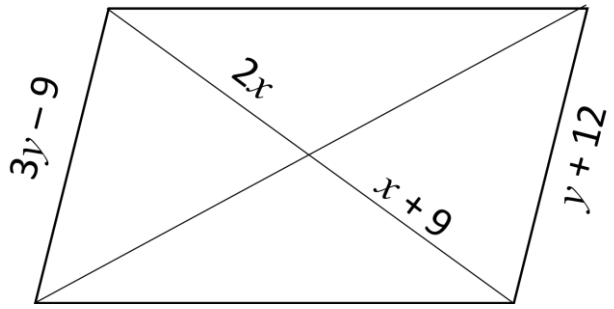
- Read out the following questions and ask students to answer in the space on their worksheet.

For the parallelograms below find the indicated values.

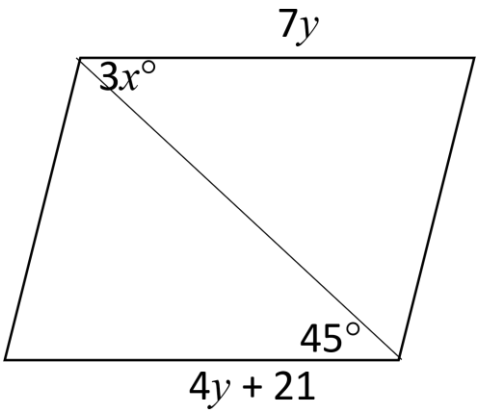
Q1.



Q2.



Q3.



- Observe students' responses, giving encouragement. Ask the students to volunteer their answers, giving positive feedback. Select good sample answers for all students to write down. These may come from the students or from the following sample answer.

Sample Answer:

1. $x° = 31°$
2. $x = 9, y = 10.5$
3. $x = 15, y = 7$

Lesson Component 5: Reflection

Time: 5 minutes

In this component, the teacher initiates and leads a student-focused wrap-up to the main objectives of the lesson. The focus is on the whole lesson experience, including how well what students feel that they take from the lesson relates to what their expectations were for the lesson, as outlined in Component 2 ('Purpose/focus' of the lesson).

The teacher should facilitate student reflection and discussion, that addresses such questions as:

- What do you think were the key mathematical concepts addressed in this lesson?
- Would you rate your level of understanding of the material covered in this lesson as high, moderate, or low?
- Has the lesson helped you to gain further insight into aspects of the material covered that represent strengths or weaknesses?
- What would you describe as the main barriers, if any, to your ongoing progress and achievement in relation to the topic area addressed in this lesson?
- What do you think would best assist your ongoing progress and achievement in relation to the topic area?

NOTE: Remember to collect student worksheets to review and analyze student's learning.

Mathematics Grade 9 Lesson Plan 11

Parallelograms, Trapezoids and Kites

Key Idea

To solves problems involving Parallelograms, Trapezoids and Kites

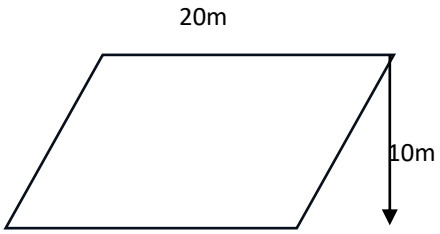
Component 1: Short Review

Time: 8 mins

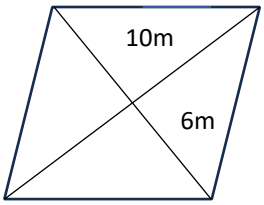
1. Write down 3 things you know about:
   a) Parallelogram
   b) Trapezoid
   c) Kite

2. Calculate the area of each of the shapes below:

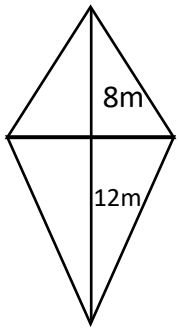
a).



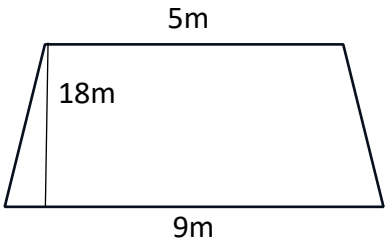
b).



c).



d).



- Teacher provides answers to questions and highlights particular concepts, as well as issues that may have arisen in student answers (issues not addressed to be noted at end of lesson).

- Ask students to volunteer their answers, giving positive feedback. Read out a sample answer for all students to listen to and write down. This may come from one of the students or from the sample answers below.

Sample answers:

1. Check that what students have written is correct for each shape.
2. a).$200m^2$
   b). $30m^2$
   c). $48m^2$
   d). $126m^2$

Component 2: **Lesson Purpose/Intention**
Time: 2 mins

The purpose of this lesson is to have the knowledge and understanding to solve problems that involve parallelograms, trapezoids and kites.

Component 3: Lesson Language Practice
Time: 5 mins

- Read out difficult or unfamiliar words or phrases and ask the students to read them to themselves and then out loud as a class.

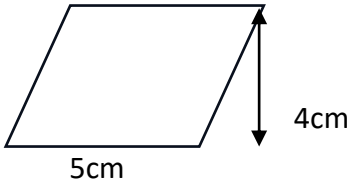
  Parallelogram - is a simple quadrilateral with two pairs of parallel side
  Trapezoid - is a quadrilateral that has at least one pair of parallel sides
  Kite - a quadrilateral in which 2 pairs of adjacent sides are equal
  Perpendicular - two lines are perpendicular if they form a right angle at the point of intersection
  Rhombus- a quadrilateral whose 4 sides all have the same length

- Ask students the difference between the words '***kite'*** and **'*trapezoid'*.**

Component 4*:* Lesson Activity
Time: 25 mins
Component 4A

- Refer students to the main lesson stimulus and **orient them to the text**

John is tiling the floor of a rectangular room that is 4m wide and 3 m long. The tiles are in the shape of a parallelogram.



Component 4B

- Read out the following questions and ask students to answer in the space on their worksheet.

1. a). Calculate the area of the floor to be tiled.
   b). Calculate the area of a tile.
   c). How many whole tiles will be required to cover the floor with tiles? Ignore the number of tiles that may have to be cut to fit next to the walls.

- Observe students' answers. Ask the students to volunteer their answers, giving positive feedback. Select good sample answers for all students to write down. These may come from the students or from the following sample answers.

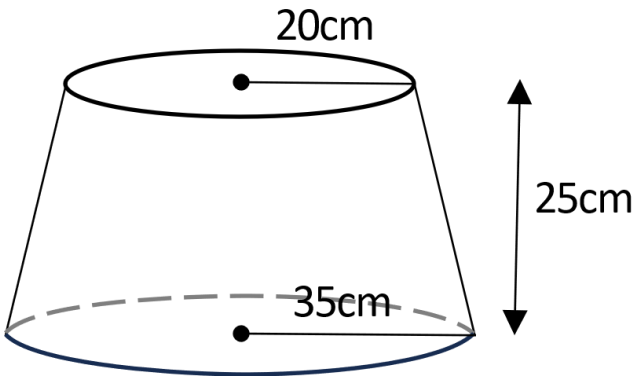
Sample answers:

1. a). $12m^2$ or 120 000cm^2
   b). $20cm^2$
   c). 6000

Component 4C

- Read out the following questions and ask students to answer in the space on their worksheet.

Jane wants to make a lampshade from a piece of material that is 1m by 1m. The lampshade has a radius of 20cm at the top and the bottom has a radius of 35cm.



Will Jane have enough material to make the lampshade?

- Observe students' responses, giving encouragement. Ask the students to volunteer their answers, giving positive feedback. Select good sample answers for all students to write down. These may come from the students or from the following sample answer.

Sample Answer:

The shape of the lampshade is a trapezium when it is opened out. The calculated area of the shade is $4317.5cm^2 = 0.43175m^2$
Jane will have enough material.

Lesson Component 5: Reflection

Time: 5 minutes

In this component, the teacher initiates and leads a student-focused wrap-up to the main objectives of the lesson. The focus is on the whole lesson experience, including how well what students feel that they take from the lesson relates to what their expectations were for the lesson, as outlined in Component 2 ('Purpose/focus' of the lesson).

The teacher should facilitate student reflection and discussion, that addresses such questions as:

- What do you think were the key mathematical concepts addressed in this lesson?
- Would you rate your level of understanding of the material covered in this lesson as high, moderate, or low?
- Has the lesson helped you to gain further insight into aspects of the material covered that represent strengths or weaknesses?
- What would you describe as the main barriers, if any, to your ongoing progress and achievement in relation to the topic area addressed in this lesson?
- What do you think would best assist your ongoing progress and achievement in relation to the topic area?

NOTE: Remember to collect student worksheets to review and analyze student's learning.

Mathematics Grade 9 Lesson Plan 12 Deliberate Practice

Patterns and Algebra, Quadratic equations, Indices, Radical Expressions, Parallelograms, Trapezoids and Kites

Key Idea

Review the learning in the lessons in Week 2

Component 1: **Short Review**

Time: 10 minutes

- Ask students to answer the following questions.

1. Rewrite $y = x^2 - 6x + 8$ in the form $y = (x - a)^2 + b$
2. What is the difference between concave up and concave down?
3. Simplify:
   i)$(a^5)^6$
   ii) $(x^8)(x^9)$
   iii) $m^5 \div m^4$
   iv) $\sqrt{\frac{125}{5}}$
   v) $\sqrt{72}$
   vi) $5\sqrt{2}(3 - 2\sqrt{5})$
   vii)$\frac{2}{\sqrt{3}}$
4. Find the value of x in degrees

- Ask students to volunteer answers, giving positive feedback.

Sample Answers

1. $y = (x - 3)^2 - 1$

2. Concave up means a parabola faces upwards and has a minimum value and concave down means the parabola faces downwards and has a maximum value

3.

i) a^{30}

ii) x^{17}

iii) m

iv) 5

v) $6\sqrt{2}$

vi) $15\sqrt{2} - 10\sqrt{10}$

vii) $\frac{2\sqrt{3}}{3}$

4. $x = 16°$

Component 2: **Lesson Purpose/Intention**

Time: 3 minutes

The lesson is about ensuring the skills learnt during the week will be consolidated in this review lesson

Component 3: Lesson Language Practice
Time: 5 minutes

- Read out difficult or unfamiliar words or phrases and ask the students to read them to themselves and then out loud as a class.
- Ask the students to practice saying the words in a sentence.

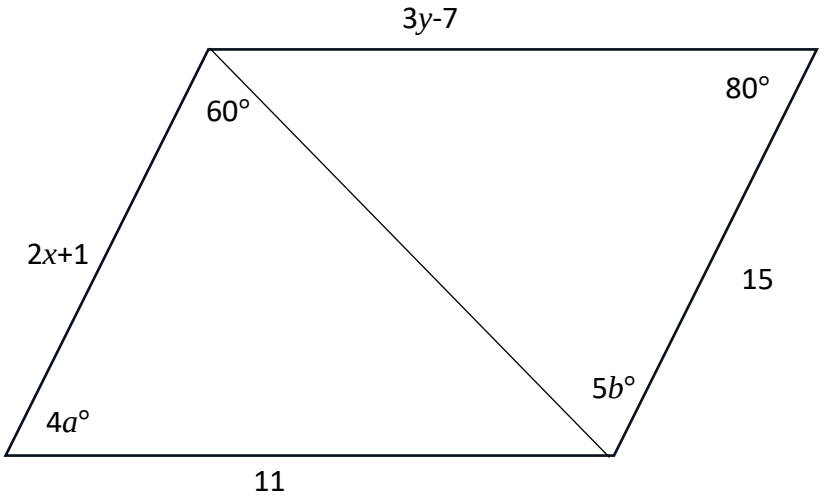
Ask students to volunteer their answers, giving positive feedback and discussing.

intercept, vertex, concave, axis of symmetry, index laws, surd, radical, complementary, supplementary, corresponding, adjacent, alternate, vertically opposite, parallelogram, trapezoid, kite, perpendicular

Component 4*:* Lesson Activity
Time: 25 minutes

Component 4A

- Refer students to the main lesson stimulus
- Read out the written text.
- Ask the students if there are any words that they are not familiar with and give descriptions of any words that may be problematic.



Component 4B
Find the values of the unknowns in the diagram in **4A**. All angles are in degrees and all measurements are in cm

- Observe students' answers. Ask the students to volunteer their answers, giving positive feedback.

Sample answers:

$a = 20°, b = 12°, x = 7cm, y = 6cm$

Component 4C

Simplify:

1. $(5\sqrt{2} - 3\sqrt{3})(6\sqrt{3} + 2\sqrt{2})$
2. $(5\sqrt{5} + 8)(5\sqrt{5} - 8)$
3. $(2\sqrt{3} - 6)^2$
4. $\frac{5\sqrt{5}}{6\sqrt{3}}$
5. $\frac{\sqrt{3}}{1+\sqrt{6}}$

Sample Answer:

1. $24\sqrt{6} - 34$
2. 61
3. $48 - 24\sqrt{3}$
4. $\frac{5\sqrt{15}}{18}$
5. $\frac{\sqrt{3}-3\sqrt{2}}{-5}$

Component 5: Lesson Conclusion

Time: 5 minutes

In this component, the teacher initiates and leads a student-focused wrap-up to the main objectives of the lesson. The focus is on the whole lesson experience, including how well what students feel that they take from the lesson relates to what their expectations were for the lesson, as outlined in Component 2 ('Purpose/focus' of the lesson).

The teacher should facilitate student reflection and discussion, that addresses such questions as:

- What do you think were the key mathematical concepts addressed in this lesson?
- Would you rate your level of understanding of the material covered in this lesson as high, moderate, or low?
- Has the lesson helped you to gain further insight into aspects of the material covered that represent strengths or weaknesses?
- What would you describe as the main barriers, if any, to your ongoing progress and achievement in relation to the topic area addressed in this lesson?
- What do you think would best assist your ongoing progress and achievement in relation to the topic area?

NOTE: Remember to collect student worksheets to review and analyze student's learning.

Mathematics Grade 9 Lesson Plan 13

Pythagorean Theorem

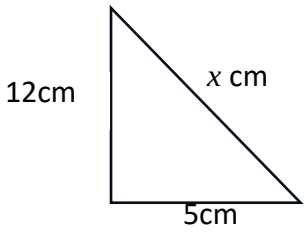
Key Idea

Investigates problems using the Pythagorean Theorem

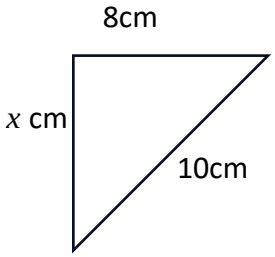
Component 1: Short Review

Time: 8 mins

1. State Pythagorean Theorem
2. Draw a diagram, including measurements, that illustrates the Pythagorean Theorem.
3. Find the length of the unknown side:
   a).



b).



- Teacher provides answers to questions and highlights particular concepts, as well as issues that may have arisen in student answers (issues not addressed to be noted at end of lesson).

- Ask students to volunteer their answers, giving positive feedback. Read out a sample answer for all students to listen to and write down. This may come from one of the students or from the sample answers below.

Sample answers:

1. *The square on the hypotenuse is equal to the sum of the squares on the other two sides.*

2. *There will be a variety of answers. Check that they are correct*
3. *a)* $x = 13cm$
   b)$x = 6cm$

Component 2: **Lesson Purpose/Intention**

Time: 2 mins

The purpose of this lesson is to understand the application of the Pythagorean Theorem in real life problems.

Component 3: Lesson Language Practice

Time: 5 mins

- Read out difficult or unfamiliar words or phrases and ask the students to read them to themselves and then out loud as a class.

  Pythagorean Theorem - The square on the hypotenuse is equal to the sum of the squares on the other two sides

  Hypotenuse - the side opposite the right angle in a right- angled triangle

- Ask students the difference between the words '***hypotenuse'*** and **'*adjacent'*** in terms of right angled triangles**.**

Component 4*:* Lesson Activity

Time: 25 mins

Component 4A

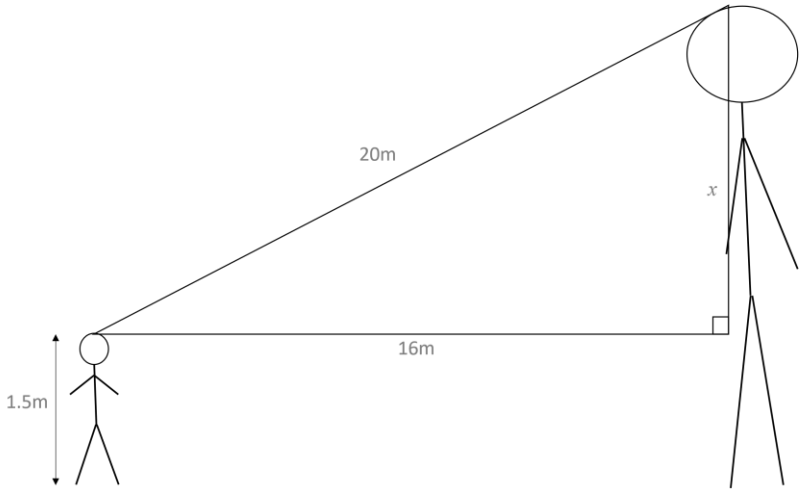
- Refer students to the main lesson stimulus and **orient them to the text**

Millie is standing 16m away from a statue in the park. Millie is 1.5m tall. The distance from the top of the statue to the top of Millie's head is 20m. How tall is the statue?

Component 4B

- Read out the following questions and ask students to answer in the space on their worksheet.

  i) Please add all of the information to the diagram.
  ii) In the picture mark the unknown value with an x
  iii) Use the Pythagorean Theorem to calculate the required distance.



- Observe students' answers. Ask the students to volunteer their answers, giving positive feedback. Select good sample answers for all students to write down. These may come from the students or from the following sample answers.

Sample answers:

i) *Check the diagrams to ensure they are correct*
ii) *Check the diagrams to ensure they are correct*
iii) The statue is 13.5 m tall

Component 4C

- Read out the following questions and ask students to answer in the space on their worksheet.

Mark and his family lived by the side of a river. There was a tall tree right next to the river. Mark would cross the 12m bridge to the other side of the river to fly his kite. One day his kite got stuck in the tree. He knew the string attached to his kite was 20m long. A storm raged and the bridge got washed away. If Mark chopped down the tree from the ground, would it be a way to cross the river?

- Observe students' responses, giving encouragement. Ask the students to volunteer their answers, giving positive feedback. Select good sample answers for all students to write down. These may come from the students or from the following sample answer.

Sample Answer:

The tree's height is 16 m so it is long enough to go across the river.

Lesson Component 5: Reflection

Time: 5 minutes

In this component, the teacher initiates and leads a student-focused wrap-up to the main objectives of the lesson. The focus is on the whole lesson experience, including how well what students feel that they take from the lesson relates to what their expectations were for the lesson, as outlined in Component 2 ('Purpose/focus' of the lesson).

The teacher should facilitate student reflection and discussion, that addresses such questions as:

- What do you think were the key mathematical concepts addressed in this lesson?
- Would you rate your level of understanding of the material covered in this lesson as high, moderate, or low?
- Has the lesson helped you to gain further insight into aspects of the material covered that represent strengths or weaknesses?
- What would you describe as the main barriers, if any, to your ongoing progress and achievement in relation to the topic area addressed in this lesson?
- What do you think would best assist your ongoing progress and achievement in relation to the topic area?

NOTE: Remember to collect student worksheets to review and analyse student's learning.

Mathematics Grade 9 Lesson Plan 14

Trigonometric Ratios

Key Idea

Uses trigonometric ratios

Component 1: Short Review

Time: 10 minutes

- Ask students to answer the following questions on their worksheet.
    1. Use an electronic device to find (to 3 decimal places) the value of:
        a. $sin\ 31°$
        b. $cos\ 43°$
        c. $tan\ 73°$
    2. Use an electronic device to find the angle (to the nearest degree) when:
        a. $sin\ \emptyset = 0.34$
        b. $cos\ cos\ \emptyset = 0.72$
    3. Explain why $sin\ 45° = cos\ 45°$.

- Ask students to volunteer answers, giving positive feedback. Read out a sample answer for all students to listen to and write down. (This may come from one of the students or from the sample answers below).

Sample answers:

1. *a. 0.515*
   b. 0.731
   c. 3.271
2. *a.* $20°$
   b. $44°$

3. In a right-angled triangle, if one of the angles is $45°$*, then the other angle must also be* $45°$*, as the three angles have a sum of* $180°$*. Therefore, the triangle is isosceles and 2 the 2 sides other than the hypotenuse are equal. So, the 'opposite' side and the 'adjacent' side are equal and so* $sin\ 45° = cos\ 45°$.

- If students get the earlier Short Review questions incorrect, then time should be devoted to looking at their knowledge of the skills of using an electronic device to calculate using trigonometric ratios, or they may need to revise the trigonometric ratios. Perhaps, give them more similar questions after some basic skills have been reviewed before moving on to the more difficult questions in Component

Component 2: **Lesson Purpose/Intention**

Time: 3 minutes

This lesson is about using the trigonometric functions to solve problems, expanding on previous lessons on mastering the trigonometric ratios. This is an important process that helps us understand more about the use of trigonometry. Trigonometry and its functions have a large number of uses in our daily life. For instance, it is used in building and construction, in GPS to measure the distance between places, in astronomy to measure the distance of nearby stars and also in the satellite navigation system.

Students will find this skill invaluable as they student the later topics in the review of the Mathematics in Year 9. As students become more confident in their use of the trigonometric ratios, their ability to engage with more challenging problems will become less daunting.

Component 3: Lesson Language Practice

Time: 5 minutes

- The following words would be those used most often in this section. It is necessary for students to really understand the meaning of all of these words as they are the directions teachers give to inform students of what is required of them to do.

Cosecant - *the reciprocal of the sine function.*
Cosine - *a trigonometric ratio equal to the adjacent side divided by the hypotenuse.*
Cotangent - *the reciprocal of the tangent function*
Secant - *the reciprocal of the cosine function.*
Sine - *a trigonometric ratio equal to the opposite side divided by the hypotenuse*
Tangent - *a trigonometric ratio equal to the opposite side divided by the adjacent side.*
trigonometric ratios - *the ratios of the length of two side of a right triangle.*

- Read out difficult or unfamiliar words or phrases and ask the students to read them to themselves and then out loud as a class.
- Ask the students to practice saying the words in a sentence.

Component 4*:* Lesson Activity

Time: 25 minutes

Component 4A

- Refer students to the main lesson stimulus.
- Read out the written text.
- Ask the students if there are any words that they are not familiar with (or suggest and give descriptions of any words that may be problematic.

A rope is stretched from a window in the side of a building to a point on the ground, 6m from the base of the building. The angle between the rope and the side of the building is $19°$.

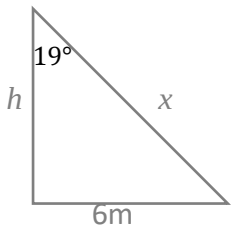
a. How long is the rope?
b. How high is the window?

- Students should say out loud what the question requires them to do. They could also explain to each other how they will start the problem.

Component 4B

Q1. Draw a diagram to show the information in the problem.
Q2. Determine which trigonometric ratios you will need to use to solve the problem.

Sample answers:



a. $sin19° = \frac{6}{x}$

$x = \frac{6}{sin19°}$

$x = 18.43$

Therefore, the rope is 18.43m long

b. $tan\ 19° = \frac{6}{h}$

$h = \frac{6}{tan19°}$

$h = 17.43m$

Therefore, the window is 17.43m high.

Component 4C

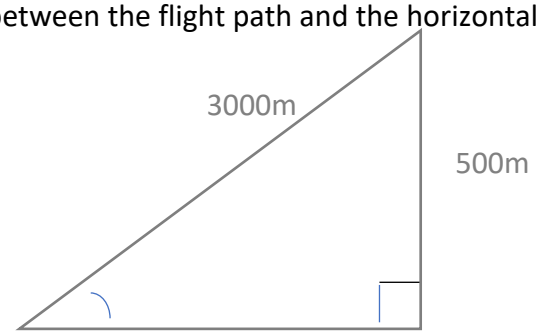
- Read out the following question and ask students to answer.

  As an airplane travels 3000m along a straight flight path, it rises 500m.
  Calculate the angle between the flight path of the airplane and the horizontal. Give your answer to an appropriate level of accuracy.

- Observe students' answers.
- Ask the students to volunteer their answers, giving positive feedback.
- Select a good sample answer for all students to write down. This may come from one of the students or from the following sample answer.

Sample answers:

Let Ø be the angle between the flight path and the horizontal.



$$sin\ Ø = \frac{500}{3000}$$
$$= 0.16666666$$
$$Ø = 9.6°$$

Therefore, the angle between the ground and the flight path is $9.6°$.
The teacher should discuss whether this is an appropriate answer.

Component 5: Lesson Conclusion

Time: 5 minutes

In this component, the teacher initiates and leads a student-focused wrap-up to the main objectives of the lesson. The focus is on the whole lesson experience, including how well what students feel that they take from the lesson relates to what their expectations were for the lesson, as outlined in Component 2 ('Purpose/focus' of the lesson).

The teacher should facilitate student reflection and discussion, that addresses such questions as:

- What do you think were the key mathematical concepts addressed in this lesson?
- Would you rate your level of understanding of the material covered in this lesson as high, moderate, or low?
- Has the lesson helped you to gain further insight into aspects of the material covered that represent strengths or weaknesses?
- What would you describe as the main barriers, if any, to your ongoing progress and achievement in relation to the topic area addressed in this lesson?
- What do you think would best assist your ongoing progress and achievement in relation to the topic area?

NOTE: Remember to collect student worksheets to review and analyze student's learning.

Mathematics Grade 9 Lesson Plan 15

Similar Triangles

Key Idea

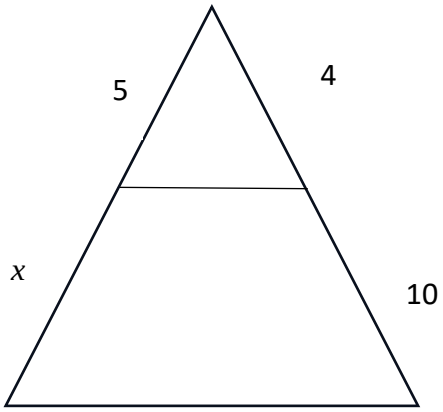
Solves problems involving similar triangles

Component 1: Short Review

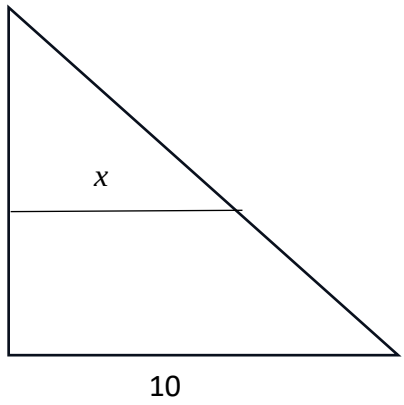
Time: 8 mins

1. Find the value of x in the triangles below. All measurements are in cm

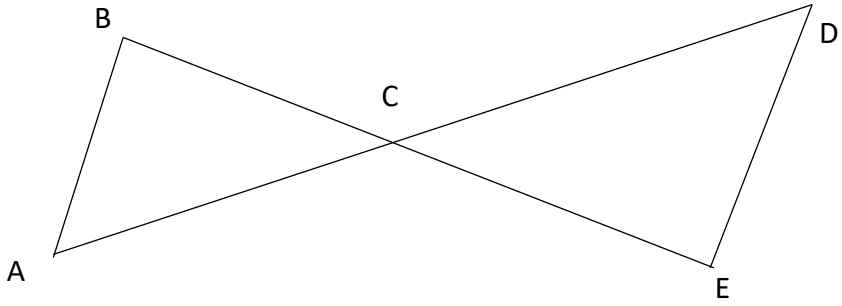
a).



b).



2. What Similarity test would you use to show that $\Delta ABC \sim \Delta CDE$ if $BC:CE = AC:CD$? Justify your answer.



- Teacher provides answers to questions and highlights particular concepts, as well as issues that may have arisen in student answers (issues not addressed to be noted at end of lesson).
- Ask students to volunteer their answers, giving positive feedback. Read out a sample answer for all students to listen to and write down. This may come from one of the students or from the sample answers below.

Sample answers:

1. $a)\ 12.5$
   b) x=5

2. *SAS*

Component 2: **Lesson Purpose/Intention**
Time: 2 mins

The purpose of this lesson is to apply your knowledge of similar triangles to solve problems

Component 3: Lesson Language Practice
Time: 5 mins

- Read out difficult or unfamiliar words or phrases and ask the students to read them to themselves and then out loud as a class.

***Congruent triangles* -** have the same corresponding angle measures and side lengths
Similar triangles - have the same shape but not the same size
***Proportional* -** the relationship between two unknowns where the ratios are equivalent

- Ask students the difference between the words '***congruent'*** and **'*similar'*.**

Component 4*:* Lesson Activity
Time: 25 mins
Component 4A

- Refer students to the main lesson stimulus and **orient them to the text**

An electricity pole is 10m high and casts a shadow of 8m. At the same time, a palm tree casts a shadow of 14m. How high is the palm tree?

Component 4B

- Read out the following questions and ask students to answer in the space on their worksheet.

1. *Draw a sketch of the electricity pole and palm tree.*
2. *Convert the picture into a diagram with the relevant measurements.*
3. *Determine the height of the palm tree.*

- Observe students' answers. Ask the students to volunteer their answers, giving positive feedback. Select good sample answers for all students to write down. These may come from the students or from the following sample answers.

Sample answers:
Check the diagrams to see if they are correct.
The height of the palm tree is 11.2 meters.

Component 4C

- Read out the following questions and ask students to answer in the space on their worksheet.

Bindi is walking through the jungle and comes to a river. She wants to know how wide the river is. Bindi locates a tree at point A on the other side of the river. She marks the spot and then walks 28 paces to point C where she hammers in a marker. She then walks another 10 paces in the same direction to the point D and turns until she is at right angles to the river and walks 14 paces until point E. What is the width of the river in paces? Bindi measures her pace to be 0.8m. What is the measurement of the width of the river?

- Observe students' responses, giving encouragement. Ask the students to volunteer their answers, giving positive feedback. Select good sample answers for all students to write down. These may come from the students or from the following sample answer.

Sample Answer:

The river is 39.2 paces wide, which is 31.36m wide.

Lesson Component 5: Reflection

Time: 5 minutes

In this component, the teacher initiates and leads a student-focused wrap-up to the main objectives of the lesson. The focus is on the whole lesson experience, including how well what students feel that they take from the lesson relates to what their expectations were for the lesson, as outlined in Component 2 ('Purpose/focus' of the lesson).

The teacher should facilitate student reflection and discussion, that addresses such questions as:

- What do you think were the key mathematical concepts addressed in this lesson?
- Would you rate your level of understanding of the material covered in this lesson as high, moderate, or low?
- Has the lesson helped you to gain further insight into aspects of the material covered that represent strengths or weaknesses?
- What would you describe as the main barriers, if any, to your ongoing progress and achievement in relation to the topic area addressed in this lesson?
- What do you think would best assist your ongoing progress and achievement in relation to the topic area?

NOTE: Remember to collect student worksheets to review and analyze student's learning.

Mathematics Grade 9 Lesson Plan 16

Angles of Elevation and Depression

Key Idea

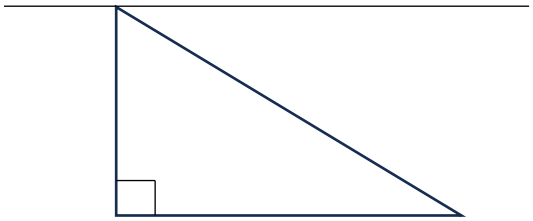
Apply knowledge of trigonometry and angles of elevation and depression to solve problems.

Component 1: Short Review

Time: 8 mins

- Teacher asks students questions (designed to remind them of relevant content completed).

1. For the diagram below, mark the angle of elevation with an a, the angle of depression with an x, and the line of sight. Why is the angle of depression and the angle of elevation equal?



.

2. Gerry is flying a kite in the park. The string from Gerry's hand to the kite is 65m. The angle of elevation from Gerry's hand to the kite is $70°$

   a). Draw a picture to illustrate this information

   b). Draw a diagram to represent the picture with the relevant measurements included.

   c). What is the vertical height of the kite above Gerry's hand?

- Teacher provides answers to questions and highlights particular concepts, as well as issues that may have arisen in student answers (issues not addressed to be noted at end of lesson).

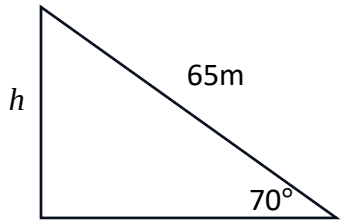
- Ask students to volunteer their answers, giving positive feedback. Read out a sample answer for all students to listen to and write down. This may come from one of the students or from the sample answers below.

Sample answers:

1. *Check markings on the diagram.*
   Line of sight is the hypotenuse of the right-angled triangle.
   The angle of depressions and elevation are alternate angles formed when a transversal cross a pair of parallel lines. The horizontal line where the angle of depression is formed is parallel to the base of the triangle.

2a). Check the pictures to ensure they represent the information correctly.

2b).



2c). $Height\ is\ 61\ m$

Component 2: **Lesson Purpose/Intention**
Time: 2 mins

The lesson is about learning how to trigonometry to solve real life problems involving angels of elevation and depression.

Component 3: Lesson Language Practice
Time: 5 mins

- Read out difficult or unfamiliar words or phrases and ask the students to read them to themselves and then out loud as a class.

  Angle of depression*-the angle between the horizontal line and the line of sight to the object below*
  Angle of elevation*-is the angle between the base and the line of sight to the object above*
  Line of sight*- is the imaginary line between an observer and an object*

- Ask students the difference between the words '***elevation'*** and **'*depression'*.**

Component 4*:* Lesson Activity
Time: 25 mins
Component 4A

- Refer students to the main lesson stimulus and **orient them to the text**

From an airplane at an altitude of 1200m, the angle of depression to a building on the ground measures $28°$*.*

Component 4B

- Read out the following questions and ask students to answer in the space on their worksheet.

  1. Draw a picture to illustrate the information.
  2. Transfer that picture into a diagram with the measurements included.
  3. Find the distance from the plane to the building.

- Observe students' answers. Ask the students to volunteer their answers, giving positive feedback. Select good sample answers for all students to write down. These may come from the students or from the following sample answers.

Sample answers:

1. *Check the pictures to show the angle of depression in the correct position.*
2. *Check that the diagram is correct. The student could use* $28°$*or* $62°$ *as long as they are in the correct position*
3. *2556m*

Component 4C (O)

- Read out the following questions and ask students to answer in the space on their worksheet.

Standing on top of a harbour light house 380m above sea level, Locky sees an approaching ship into the harbour and *measures an angle of depression of* $9°$*. How far from the tower is the ship? Locky then sights a second ship beyond the first. The angle of depression of the second ship is* $5°$*. How far apart are the ships?*

- Observe students' responses, giving encouragement. Ask the students to volunteer their answers, giving positive feedback. Select good sample answers for all students to write down. These may come from the students or from the following sample answer.

Sample answers:

The diagrams drawn here must include the correct information in the correct position. The students may use complementary angles with the correct trigonometric ratio.

The ships are approximately 1944m apart.

Lesson Component 5: Reflection

Time: 5 minutes

In this component, the teacher initiates and leads a student-focused wrap-up to the main objectives of the lesson. The focus is on the whole lesson experience, including how well what students feel that they take from the lesson relates to what their expectations were for the lesson, as outlined in Component 2 ('Purpose/focus' of the lesson).

The teacher should facilitate student reflection and discussion, that addresses such questions as:

- What do you think were the key mathematical concepts addressed in this lesson?
- Would you rate your level of understanding of the material covered in this lesson as high, moderate, or low?
- Has the lesson helped you to gain further insight into aspects of the material covered that represent strengths or weaknesses?
- What would you describe as the main barriers, if any, to your ongoing progress and achievement in relation to the topic area addressed in this lesson?
- What do you think would best assist your ongoing progress and achievement in relation to the topic area?

NOTE: Remember to collect student worksheets to review and analyze student's learning.

Mathematics Grade 9 Lesson Plan 17

Solves problems involving Trigonometric Ratios

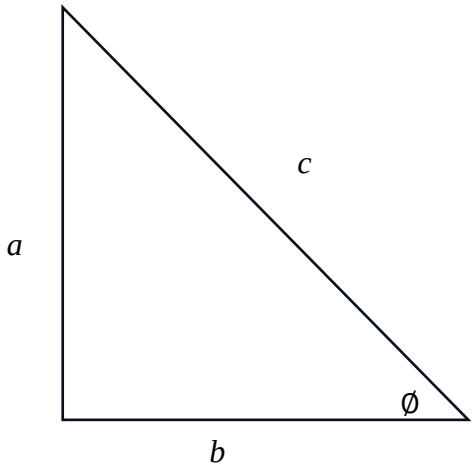
Key Idea

Demonstrates knowledge and understanding of trigonometry to apply skills to solve real world problems

Component 1: Short Review

Time: 8 mins

1. For this triangle, write down the expression for sin, cos and tan of Ø.



2. AB is a 3m ladder making an angle of $70°$ with the ground.

i) Draw a diagram to represent the information
ii) Find h, the height of B above the ground to 2 decimal places.

- Ask students to volunteer their answers, giving positive feedback. Read out a sample answer for all students to listen to and write down. This may come from one of the students or from the sample answers below.

Sample answers:

1. $sin\emptyset = \frac{a}{c}$
   $cos\emptyset = \frac{b}{c}$
   $tan\emptyset = \frac{a}{b}$

2. *h=2.82m*

Component 2: **Lesson Purpose/Intention**

Time: 2 mins

In this lesson, students will apply their knowledge of trigonometry to solve real world problems.

Component 3: Lesson Language Practice

Time: 5 mins

- Read out difficult or unfamiliar words or phrases and ask the students to read them to themselves and then out loud as a class.

Cosecant - *the reciprocal of the sine function.*
Cosine - *a trigonometric ratio equal to the adjacent side divided by the hypotenuse.*
Cotangent - *the reciprocal of the tangent function*
Secant - *the reciprocal of the cosine function.*
Sine - *a trigonometric ratio equal to the opposite side divided by the hypotenuse*
Tangent - *a trigonometric ratio equal to the opposite side divided by the adjacent side.*
trigonometric ratios - *the ratios of the length of two side of a right triangle.*

- Ask students the difference between the words '*tangent*' and '*cosine*'.
  Ask students to volunteer their answers, giving positive feedback and discussing.

- Ask the students to practice saying the words in a sentence.

Component 4*:* Lesson Activity

Time: 25 mins

Component 4A

- Refer students to the main lesson stimulus and **orient them to the text**
- Ask the students if there are any words that they are not familiar with

Q1. A block of land slopes at $5°$*. Find the depth of excavation needed to provide a level base 20m long (to 2 decimal places).*

Q2. The steepest slope a tractor can climb is $35°$*. Find the shortest length of road required for a rise of 20m.*

Component 4B

- Read out the following questions and ask students to answer in the space on their worksheet.

Q1. a). Draw a diagram to represent the information in the question

b) Determine which trigonometric ratio to use.

c) Calculate the depth.

Q2. a) Draw a diagram to represent the information in the question

b) Determine which trigonometric ratio to use.

c) Calculate the length of road.

- Observe students' answers. Ask the students to volunteer their answers, giving positive feedback. Select good sample answers for all students to write down. These may come from the students or from the following sample answers.

Sample answers:

Q1.

a) *Diagrams could be varied. Check to ensure the information is in the correct position.*
b) Most students will use the tan ratio.
c) 1.75 m

Q2.

a) *Diagrams could be varied. Check to ensure the information is in the correct position.*
b) Sine ratio
c) 34.87m

Component 4C (O)

- Read out the following questions and ask students to answer in the space on their worksheet.

Two wires supporting a 20m flag pole are each anchored with wire 3m from the base of the flag pole. Fine the angles (to the nearest degree) between the wire and the ground.

- Observe students' responses, giving encouragement. Ask the students to volunteer their answers, giving positive feedback. Select good sample answers for all students to write down. These may come from the students or from the following sample answer.

Sample answers:

81°

Component 5: Lesson Conclusion

Time: 5 mins

In this component, the teacher initiates and leads a student-focused wrap-up to the main objectives of the lesson. The focus is on the whole lesson experience, including how well what students feel that they take from the lesson relates to what their expectations were for the lesson, as outlined in Component 2 ('Purpose/focus' of the lesson).

The teacher should facilitate student reflection and discussion, that addresses such questions as:

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NOTE: Remember to collect student worksheets to review and analyze student's learning.

Mathematics Grade 9 Lesson Plan 18 Deliberate Practice

Using Pythagoras, trigonometry and triangles to solve problems

Key Idea

Review the learning from the third week

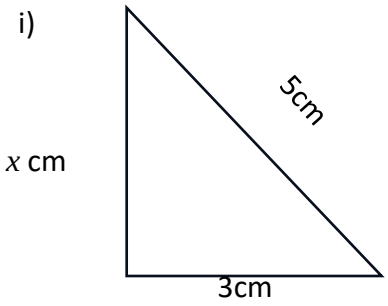
Component 1: **Short Review**

Time: 10 minutes

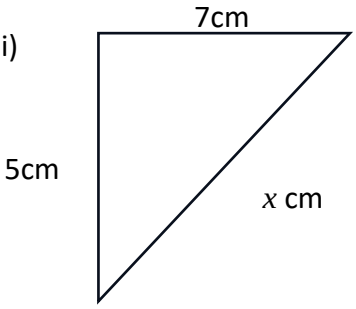
- Ask students to answer the following questions.

1. State the Pythagorean Theorem.
2. Find the value of the unknown sides:

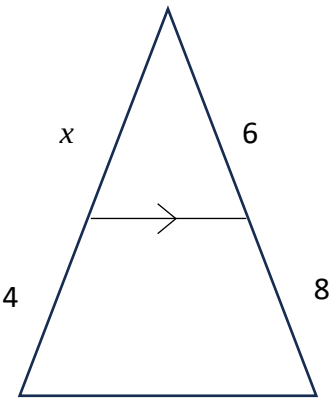
i)



ii)

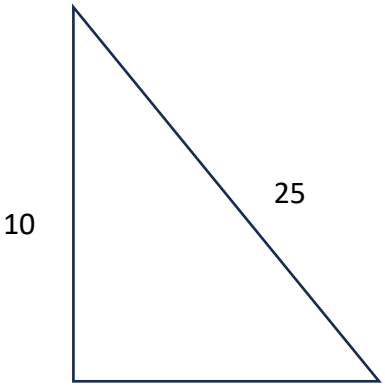


3. Find the value of x. All measurements are in mm

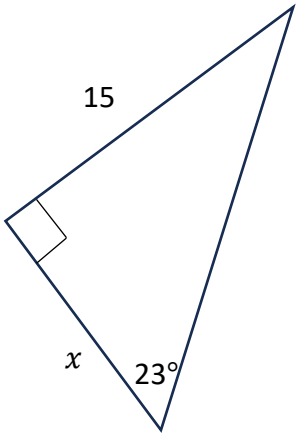


4. Determine the value of the unknowns (Measurements in cm or degrees)

i)



ii)



- Ask students to volunteer answers, giving positive feedback.

Suggested Answers:
1. The square on the hypotenuse is equal to the sum of the squares on the other two sides
2. i) 4cm ii) $\sqrt{74} \approx 8.6$ *cm*
3. x = 3
4. i) 24° ii) 35.34

Component 2: **Lesson Purpose/Intention**
Time: 3 minutes

Review the learning for the last week of the camp.

Component 3: Lesson Language Practice
Time: 5 minutes

- Read out difficult or unfamiliar words or phrases and ask the students to read them to themselves and then out loud as a class.
- Ask the students to practice saying the words in a sentence.
  Ask students to volunteer their answers, giving positive feedback and discussing.

Pythagorean Theorem, hypotenuse, sine, cosine, tangent trigonometry, congruence, similar triangles, proportional, angles of elevation, angles of depression, line of sight,

- Choose 5 words from the above list and use them in a sentence

Component 4*:* Lesson Activity
Time: 25 minutes

Component 4A

From the tops of a 40m high vertical cliff, the angle of depression of an object that is level with the base of the cliff is 34°. How far is the object from the base of the cliff?

Component 4B

1. Draw a diagram to represent the information.
2. Complete the calculations
3. Answer the questions

Answers:
Diagram
59.3 m

Component 4C
A surveyor wants to know the height of a skyscraper. He places his inclinometer on a tripod 1m from the ground. At a distance of 50m from the skyscraper, he records an angle of elevation of 82°.

Sample Answer:
356.8m

Component 5: Lesson Conclusion
Time: 5 minutes

In this component, the teacher initiates and leads a student-focused wrap-up to the main objectives of the lesson. The focus is on the whole lesson experience, including how well what students feel that they take from the lesson relates to what their expectations were for the lesson, as outlined in Component 2 ('Purpose/focus' of the lesson).

The teacher should facilitate student reflection and discussion, that addresses such questions as:

· What do you think were the key mathematical concepts addressed in this lesson?

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· Has the lesson helped you to gain further insight into aspects of the material covered that represent strengths or weaknesses?

· What would you describe as the main barriers, if any, to your ongoing progress and achievement in relation to the topic area addressed in this lesson?

· What do you think would best assist your ongoing progress and achievement in relation to the topic area?

REMINDER: Collect student worksheets to review and analyze student's learning.

For inquiries or feedback, please write or call:

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Contact Numbers: 8637-4366; 8637-4347; 8633-9347

Department of Education - Bureau of Learning Resources (DepEd-BLR)
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