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| **Unit Overview** | **Duration** 10 lessons | **Stage** 5.2  **Year** 10 | | **Class** |
| Syllabus Outcomes(s)  PAS5.3.5 Analyses and  describes graphs of  physical phenomena | Key Ideas  Analyse and describe  graphs of physical  phenomena | Student Prior Knowledge  PAS5.2.5 Draws and interprets graphs of physical phenomena | | Notes (including literacy  development, use of ICT,  practical application of  mathematics etc)  Guided instruction, whole-class  Discussion  Procedural practice, work in  pairs, problem solving  Directed instruction, scaffolded  learning, class discussion  Procedural practice, work in  pairs, problem solving  Directed instruction, scaffolded  learning, class discussion |
| Students learn about:  1. Features of right angle triangles  2. Trigonometry identities  3. Application of trigonometry identities  4. Inverse trigonometry identities  5. Conversion of units  6. Angles of elevation and depression  7. Three figure bearings  8. Compass bearings  9. Application of bearings/ commence assessment task  10. Revision / Summative assessment | Students learn to:  1. Revise right angle triangles  2. Recognising right angle triangles. Identifying the hypotenuse.  3. Revise Trigonometry identities.  4. Students use the trigonometric identities to determine angles of right triangles.  5. At the end of the session, the students will be able to use conversion of units to write Decimal Degrees into Degrees, Minutes, Seconds form, and vice versa.  6. Students are able to solve questions involving angles of elevation and depression - some examples where diagram not provided.  7. Students can interpret three-figure bearings (eg 035°, 225°) and compass bearings (eg SSW)  8. Students should be able interpret directions given as bearings and represent them in diagrammatic form.  9. Students need to be able to interpret a variety of phrases involving bearings  10. Revision of unit. Summative assessment of trigonometry unit. | Assessment Opportunities  Pre-test – assess prior and extension knowledge  Observe students  at work  Provide feedback  Exit slip  Assessment task | Resources  Smart board  White board  Worksheets (attached and numbered)  Graphing calculators  Cameras (or students’ mobile devices)  Laptops or computers |
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| **Lesson Number: 1**  MA5.2-13MG  identify, visualise and quantify measures and the attributes of shapes and objects, and explore measurement concepts and geometric relationships, applying formulas, strategies and geometric reasoning in the solution of problems  MA5.2-2WM  interprets mathematical or real-life situations, systematically applying appropriate strategies to solve problems  MA5.2-1WM  selects appropriate notations and conventions to communicate mathematical ideas and solutions | |
| **The Key Idea(s) for this lesson are:** | Recognising right angle triangles. Identifying the hypotenuse. |
| **Time Guide** | 60 minutes |
| **Learning Experiences** | **Intro** (5 minutes)  Introduce unit: Pythagoras story - draw page on board or present though digital slides.  C:\Users\Brendan\AppData\Local\Microsoft\Windows\INetCacheContent.Word\img001.jpg  Students have assigned seats, with no more than 4 at each table. Students are instructed to stay in these groups for the activity.  One student from each group is chosen by the teacher to be the alien. The students chosen are predetermined based on social confidence, providing a chance for some students who lack confidence to be in a position of power. Having a predetermined list also removes any opportunities for arguments amongst students.  The alien in each group is unable to speak English, they can only communicate through noises and gestures. The other students in each group have two minutes to explain everything they know about right angle triangles and trigonometry to the alien. The alien from each group then has up to one minute to explain everything they have learned, using the words and language used by their group  Review of right triangles  Present students with activity 1 on SMART board. Students are required to list the pronumeral of the triangles they believe are right angled.  C:\Users\Brendan\AppData\Local\Microsoft\Windows\INetCacheContent.Word\img002.jpg  Define right angle triangles as a triangle with a right angle (90°). The little square in the corner tells us it is right angled.    *Who can tell me a part of this right triangle?*  Students should answer hypotenuse. Discuss how the hypotenuse is always the longest side, which is found opposite the 90-degree angle.  Show Pythagoras’ theory on the smart board. Ask students if they remember what the letters represent. Lead students to understanding the C (the letter on its own) represents the hypotenuse. And the other letters, usually A and B, represent the other sides, in whichever order they choose.  **Body** (45 minutes)  Students are handed worksheet 1, which requires students to circle the hypotenuse of eight triangles. This activity should be simple for most students. Students are instructed, upon completion of the worksheet they are to begin worksheet 2, which requires students to use a calculator to find the hypotenuse of a series of right angle triangles. Students may choose to work independently or in small groups.  After being given five minutes, construct a group with the students who are struggling with worksheet 1. Draw students’ attention to the two notes at the top of the worksheet: ‘the hypotenuse is always the longest side’ and ‘the hypotenuse is always opposite to the small square’.    Display the above triangle on the board and ask students to think about which of the sides would be the hypotenuse, using the two tips they have been given. Go through each of the sides starting with 3 then 4 and finally 5, checking if the two tips are correct for the chosen side.  Have students continue to circle the hypotenuses on worksheet 1. If students are struggling with worksheet 1, worksheet 2 may be too difficult. If the majority of the class is still working on worksheet 2. Have the guided group start by circling the hypotenuse of each of the triangles, then try to solve at least a few.  Have students return their attention to the front of the classroom. Ask students if there were any triangles in particular which caused them concern. This is referred to as the ‘muddy part’ of the activity, students are familiar with this concept and can recognise ‘muddy’ areas. Solve one or two of these questions on the board with student input.  Skip to next slide, which shows the ladder problem. Explain to students, this image shows the typical exam question students might receive on Pythagoras. A ladder has fallen against a brick wall. The ladder is resting 6 metres above the ground where it connects with the wall and the base of the ladder reaches 8m from the wall. Ask students to find the length of the ladder in metres.    Once students have found the length of the ladder and confirmed their answers, they may progress to worksheet 3, which provides worded Pythagoras problems.  **Conclusion** (10 minutes)    Ask students to attempt to solve the above problem. Students will find they are unable to determine the value when only given one side. Explain, this is where trigonometry comes into play. Pythagoras is effective when we are given two sides of a triangle. However when we are only given one side, we can use angles to determine unknown values. We’ll discuss this next lesson.  Students are familiar with the ‘What did we learn’ song, which takes place at the conclusion of each lesson. Similar to summaries in Playschool or late night television shows, I play backing music on ukulele or guitar, walking around the class, occasionally stopping at students who explain one key idea they have learned that lesson. |
| **Teaching Strategies** | This lesson is a brief revision of previously covered content, ensuring students have developed understanding of stage 4 outcomes: MA4-16MG, MA4-17MG. Intentionally simple lesson, to build students’ self-efficacy in a topic which is generally approached with anxiety (Reference!).  At the start of the lesson, students are encouraged to recall information they have previously learned. Revising the basics serves to refresh the memories of students who are already competent with Pythagoras, whilst also providing a strong foundation for students who require re-teaching of the topic.  The lesson has been designed to build students’ confidence by providing work that students can successfully complete. Not all students will complete all of the given worksheets, but all students will have some achievement and some challenge. It is expected that students will work independently but they are seated in groups and encouraged to have discussions regarding the work. Students are able to discuss answers and collaboratively solve any problems that arise. The teacher moves throughout the classroom as students are working on the given worksheets. The teacher is listening to discussions, asking open questions of students, assessing their understanding (What would happen if? What tells you that? Etc.).  The focus of the lesson is on recognising the hypotenuse of right angle triangles. The hypotenuse is a commonly recurring term in trigonometry which is required for learning the trigonometric identities. The activities were designed so that competent students could continue to extend their learning, whilst students who struggle to grasp the concepts being discussed are provided with opportunities to learn the necessary skills. Whilst Pythagoras’ rule is important, the focus was on ensuring all students could recognise the hypotenuse. |
| **Class Organisation** | Students are seated in small groups, ranging from four to six members. The desks are organised to provide every student with an unobstructed view of the room’s SMART board. The groups are of mixed abilities, with students paired with others they work well with and challenge to improve. The students who generally require extra teacher assistance are seated closer to the front of the classroom, so that small guided lessons can be conducted with minimal relocation of students. |
| **Assessment** | Informal assessment occurs as the teacher manoeuvres about the classroom, providing support and facilitating conversations where required. The small guided group who require more attention, are set small, realistic, attainable goals which solidify the fundamental ideas. The casual conversations which take place with every student on group and individual levels, ensure assistance is always available. Strong relationships have been formed with every student, and the classroom is a comfortable environment where risk taking and question asking are encouraged.  Discussion regarding ‘muddy areas’ provides the teacher with insight as to where students struggled. The teacher takes notes of where the worksheets need to be improved as well as where some or most of the students struggled. The muddy area conversation takes place midway through the lesson, so if students are particularly struggling, the teacher may choose to provide further instruction before moving on.  The worksheets are collected by the teacher to ensure work is completed successfully, and returned at the start of the next class, so students can reflect on prior learning. |
| **Proficiency Strand(s) - How are they developed?** | Fluency is developed within this lesson. Terms previously discussed in Pythagoras are reintroduced to build students confidence as they are met with a new unit. |
| **Identify opportunities for effort, mastery and challenge** | The lesson builds on students’ predeveloped schema. Introducing new concepts within previously covered material. Students should feel confident being challenged. The worksheets provided should not be challenging for the majority of the class. However, some students will require re-teaching of the foundations of the unit before they can continue to be introduced to new concepts. Extension opportunities are available for students who require a greater challenge. |
| **Identify strategies for creating an emotionally safe classroom** | -Ensuring individual contact is made with each student, encourages students to ask for help.  -The musical reflection at the conclusion of the lesson develops students’ sense of belonging and contributing to the classroom community. The music provides a relaxed atmosphere in which students are more confident in taking risks and sharing their ideas. |
| **Identify opportunities for achievable challenges for students of varying abilities and characteristics** | -Worksheets of different ability levels are available, students have used these worksheets in the past and are always excited to move on to the next one. Worksheet 1 covers very basic ideas, so even students who would struggle with Pythagoras are given a sense of achievement. |

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| **Lesson Number: 2**  MA5.2-13MG  identify, visualise and quantify measures and the attributes of shapes and objects, and explore measurement concepts and geometric relationships, applying formulas, strategies and geometric reasoning in the solution of problems  MA5.2-1WM  selects appropriate notations and conventions to communicate mathematical ideas and solutions  MA5.2-2WM  interprets mathematical or real-life situations, systematically applying appropriate strategies to solve problems | |
| **The Key Idea(s) for this lesson are:** | Revise Trigonometry identities. |
| **Time Guide** | 60 minutes |
| **Learning Experiences** | **Intro** (5 minutes)  Outline the learning expectations of the lesson for the students.   * We’ll start by going over the basic ideas of trigonometry (and break down the scary word). * By the conclusion of the lesson, SOHCAHTOA will be engrained into your brains. * We’ll work through a couple of examples using the trigonometry ratios. * We’ve got a couple worksheets to get through. * And finally, we’ll end with a little song.   Have the below slide on the SMART board when students enter the classroom.    Tell students ‘This was the problem we attempted to solve at the end of the last lesson. However, because we were only given one side we could not find the length of the hypotenuse. Today we will learn some tricks for finding the length of the hypotenuse even when we only have one side.’    Trigonometry is just the measurement of triangles, using angles and sides.  **Body** (45 minutes)    What information is given by this triangle?  The right angle is indicated by the little box in the corner.  The other angle that we know is 30°, this is usually indicated by θ.  The side opposite the right angle, which is the longest side, is called the hypotenuse.  The side opposite 30° is called the opposite.  The side next to 30° which is not the hypotenuse is called the adjacent.  http://www.cimt.org.uk/projects/mepres/step-up/sect4/chpq2.gif  Using the example on the board, point at features of the triangle and ask students to volunteer what the feature is called (side names, right angle, angle).  Have students complete worksheet 4, which has them name the sides of right angle triangles. If some require extra modelling or advice, work through the first few questions of the worksheet in a small group.  If students have finished the first worksheet early they may begin the second worksheet provided, which is an extension of the first task.  Bring class back together, asking if there were any difficulties before moving on to the next idea.  Ask students if they remember the three trigonometric identities we use when discussing right triangles.  Then show the next slide, which lists the three main identities.  Calculating Sine, Cosine and Tangent  Calculating Sine, Cosine and Tangent (Skillsyouneed.com, 2015).  Discuss what the words opposite and adjacent mean in relation to the angle you are given. Highlight that the hypotenuse will always be the longest side, opposite to the right angle.  To find the sine of the angle, students will need to write the value of the side opposite to the angle over the value of the hypotenuse.  Have three students hold a series of cardboard right triangles of varying shapes and proportions. Spray water from the angle given to demonstrate, the side where the water hits will always be the opposite side. Perform this example three times, allowing students to spray the water as well. Explain that students can simulate this concept using their pencil or rulers. If they line up their pencil starting from the angle it will point to the opposite side.  Explain, students may find it helpful to remember Sine, Cosine and Tangent as SOH CAH TOA.  SOHCAHTOA ninjas:  Students stand up in the centre of the classroom, with plenty of space between them. When the teacher calls out SOH the students call out SOH as they swing their arm vertically, CAH the students swing their arm horizontally and for TOA the students block diagonally. The aim of the game is for the students to call out the identity (SOH, CAH or TOA) as they demonstrate the direction associated with each identity.  Play this game for five minutes, attempting to have the whole class achieve as many consecutive correct responses as possible. Record the highest result so students have a benchmark for the next time they play.    Mathematics higher school certificate examinations by topics (Projectmaths, 2015).  Explain to students, this image is taken straight from a year 12 General Mathematics HSC exam. Tell students by the end of the unit, they will be able to solve problems like these with ease. For now, ask students to draw the triangle in their books, including the dimensions and only the pronumeral B. Ask students to label the hypotenuse, the adjacent, and the opposite side with respect to the angle of B.  **Conclusion** (10 minutes)  Reflect on ‘muddy areas’ with students, addressing and possibly reteaching any concerns that arise.  Perform the ‘what did we learn’ song. If students struggle to provide an answer, the teacher may prompt students to name one of the trigonometry identities, the names of the sides of a right triangle, or even just showing which karate move is associated with SOH, CAH or TOA. |
| **Teaching Strategies** | * Kinaesthetic modelling activity, allows students to see, hear, feel and experience the concept of opposite angles. * The ‘SOHCAHTOA ninjas’ game teaches students the acronym, which is generally taught through written and verbal repetition, in an engaging context. * Use of open questioning, for example ‘What information is given by this triangle?’, allows students’ to demonstrate their prior knowledge and understanding of the topic. * Combination of explicit modelling, open questioning, independent and group work, allows for a diverse range of learners to engage with the content. * The lesson requires students to recall information from previous right angle triangle units, extending their schema. |
| **Class Organisation** | Throughout the lesson students are working in a range of dynamics. The lesson starts with a teacher led whole class discussion. Students who are capable then begin working independently, further instruction is available for students who respond to more explicit modelling. To break up the monotony of the lesson, a whole class game is used to teach students the SOHCAHTOA acronym. The lesson concludes with a whole class discussion on difficulties experienced throughout the lesson. Followed by the whole class musical reflection, which strengthens the community atmosphere of the classroom. |
| **Assessment** | Informal assessment occurs as the teacher manoeuvres about the classroom, providing support and facilitating conversations where required. The small guided group who require more attention, are set small, realistic, attainable goals which solidify the fundamental ideas. The casual conversations which take place with every student on group and individual levels, ensure assistance is always available. Strong relationships have been formed with every student, and the classroom is a comfortable environment where risk taking and question asking are encouraged.  The lesson begins with open non confronting questioning of students’ knowledge of right angle triangles. This style of formative assessment informs the teacher of the general level of understanding within the classroom. If the majority of the class is struggling to recall basic right angle triangles knowledge, the teacher would ensure to fill the gaps in students’ knowledge before continuing the lesson.  The game used to teach the students SOHCAHTOA, is another example of formative assessment. Students are playing as a whole class in a relaxed atmosphere, removing any performance pressure. The teacher would be taking note of which students are struggling to remember the moves associated with the identities, who can be provided with further instruction once students begin working independently.  Discussion regarding ‘muddy areas’ provides the teacher with insight as to where students struggled. The teacher takes notes of where the worksheets need to be improved as well as where some or most of the students struggled. If students’ concerns require significant time to discuss or re-teach, the teacher would seek out an alternative means of teaching the topic and redeliver the concept to the students at the beginning of the next lesson,  The worksheets are collected by the teacher to ensure work is completed successfully, and returned at the start of the next class, so students can reflect on prior learning. |
| **Proficiency Strand(s) - How are they developed?** | Fluency is developed within this lesson. Terms previously discussed in Pythagoras are reintroduced to build on students’ understandings as they are met with a new unit.  Students are applying reasoning within this lesson. The SOHCAHTOA game ensures students remember the trigonometry identities, however it is the application questions which require students to apply their knowledge. The kinaesthetic and verbal aspects of the game, ensure students have a vivid memory associated with each of the identities. |
| **Identify opportunities for effort, mastery and challenge** | Setting learning goals for the lesson is integral to developing a mastery orientated classroom. The informal style used within this lesson, is intended to get students get excited about the activities. The lesson is broken up into many short activities, some of these are going to be significantly more difficult for some students. The whole class activities and reflection questions are integrated throughout the lesson to ensure every student has a sense of achievement. Extra challenge is provided in all aspects of the independent components of the lesson. Students who need to be challenged will be provided with extension tasks and a higher workload, with higher learning expectations.  Meaningful directed explicit positive encouragement is utilised at every opportunity, as opposed to praise. |
| **Identify strategies for creating an emotionally safe classroom** | Ensuring individual contact is made with each student, encourages students to ask for help.  The colloquial language of the goals, has been utilised to create a sense of community within the classroom. Words such as we, ensures students understand they are a part of a community, with similar goals.  The classroom organisation is often changing throughout the lesson. This keeps students engaged and caters for a range of diverse learning styles and attitudes. Students have become accustomed to changing dynamics and are confident in a range of settings within the classroom.  The game being played is a whole class activity with success being a whole class goal. There are no losers or winners. Students who are unsure of their responses will observe students nearby. Social learning is an effective strategy in the classroom, which is encouraged in most facets of the lesson.  The musical reflection at the conclusion of the lesson develops students’ sense of belonging and contributing to the classroom community. The music provides a relaxed atmosphere in which students are more confident in taking risks and sharing their ideas. |
| **Identify opportunities for achievable challenges for students of varying abilities and characteristics** | Achievement expectations are differentiated between students. Some will be expected to complete the extension worksheets, whilst some students will find achievement in simply following along with the example questions. Individual conversations are consistently taking place in the classroom and students are aware of the expectations placed upon them, not only by the teacher but by themselves.  Students are encouraged to develop a growth mindset, in which they believe their own abilities are influenced by effort. Students are grouped with others of similar levels of achievement. Students within each group will challenge each other to achieve the appropriate standard of work. |

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| **Lesson Number: 3**  MA5.2-13MG  identify, visualise and quantify measures and the attributes of shapes and objects, and explore measurement concepts and geometric relationships, applying formulas, strategies and geometric reasoning in the solution of problems  MA5.2-2WM  interprets mathematical or real-life situations, systematically applying appropriate strategies to solve problems  MA5.2-1WM  selects appropriate notations and conventions to communicate mathematical ideas and solutions | |
| **The Key Idea(s) for this lesson are:** | Students use the trigonometric identities to determine side lengths of right triangles. |
| **Time Guide** | 60 minutes |
| **Learning Experiences** | **Intro** (5 minutes)  Play SOHCAHTOA ninjas. Do not tell students the trigonometry identities, nor the movements associated with each.  Encourage students to attempt to beat last lesson’s high score.  If students are struggling to recall trigonometric identities, the ‘Calculating Sine, Cosine and Tangent’ image can be displayed on the smart board.  Calculating Sine, Cosine and Tangent  Calculating Sine, Cosine and Tangent (Skillsyouneed.com, 2015).  **Body** (45 minutes)    Trigonometric ratios (Farlam, 2010, p.708).  Now that students are familiar with step 1: labelling the sides, trig ratios can be introduced.    Trigonometric ratios (Farlam, 2010, p.708).  With the above triangle displayed on the SMART board, as a class, label the sides.  Work through three examples with the class:  Example 1:  Example 2:  Example 3:  Trigonometric ratios (Farlam, 2010, p.708).  Instruct students to begin work on worksheet 5, which requires students to label the sides of right triangles and use the trigonometry identities. Students who generally struggle to get started will likely struggle with the worksheet, as it may be introducing many new ideas and terms. A small guided group could be used to provide extra modelling for students who would benefit from more explicit prompting.  Students who finish the worksheet early, can begin working independently or collaborativvely, in small groups on worksheet 6. The extension worksheet combines trigenometry identities with pythagoras’ rule to develop students’ problem solving and reasoning abilities.    Tan (a)  Trigonometric ratios (Farlam, 2010, p.712).  Show above image on the SMART board. Explain, trigonometry is an area of mathematics which is integral to many career pathways. Astronomors, civil engineers, acoustic engineers, and financial analysts all use trigonometry on a daily basis. Instruct students to solve the problem in their books. Some discussion is permitted, however this is primarily an independent task. The teacher can use this time to prompt students who struggle to apply their understanding of trigonometry. Open questioning can be used to lead students. Asking ‘Where could we begin?’, ‘What shapes can you identify within the diagram?’, ‘Would redrawing the diagram provide some further insight?’ are all examples of open questioning which will prompt the students to identify the steps required to begin the task.    Trigonometric ratios (Farlam, 2010, p.712).  **Conclusion** (10 minutes)  Provide students with a brief summary of the two step required to solve for trigonometric identities: label and ratios.  Discuss ‘muddy areas’ with students.  Perform ‘what did we learn’ song. |
| **Teaching Strategies** | The lesson begins by connecting to the activities and content taught in the previous lesson. This allows students to begin the lesson with confidence. They are familiar with the game and have a chance to recall the ideas of the previous lesson which they will apply within this lesson.  The lesson has been designed to build students’ confidence by providing work that students can successfully complete. Not all students will complete all of the given worksheets, but all students will have some achievement and some challenge.  It is expected that students will work independently but they are seated in groups and encouraged to have discussions regarding the work. Students are able to discuss answers and collaboratively solve any problems that arise. The teacher moves throughout the classroom as students are working on the given worksheets. The teacher is listening to discussions, asking open questions of students, assessing their understanding (What would happen if? What tells you that? Etc.).  The game used to commence the lesson serves several functions. The game itself, serves as a multisensory experience designed to ensure students remember the trigonometry identities. By beginning the lesson with an activity introduced previously, students are immediately aware of the expectations and goals of the game. This also encourages students to relate prior learning to the new ideas being introduced.  The combination of explicit modelling, open questioning, independent and group work, allows for a diverse range of learners to engage with the content. |
| **Class Organisation** | Throughout the lesson students are working in a range of dynamics. The lesson begins with a whole class game. Students are up and engaging kinaesthetically and orally. The majority of the lesson is focused on independent progression through a range of trigonometry problems. There are challenges available for a diverse range of learners. Collaboration is encouraged within table groups. |
| **Assessment** | Informal assessment occurs as the teacher manoeuvres about the classroom, providing support and facilitating conversations where required. The small guided group who require more attention, are set small, realistic, attainable goals which solidify the fundamental ideas. The casual conversations which take place with every student on group and individual levels, ensure assistance is always available. Strong relationships have been formed with every student, and the classroom is a comfortable environment where risk taking and question asking are encouraged.  The game used to teach the SOHCAHTOA acronym is used as a means of formative assessment. The teacher does not repeat the rules nor the trigonometry identities. The first several rounds of play with identify the students who have remembered the identities. Those who have difficulty recalling the moves and identities will begin to mimic their classmates, who will be eager to assist as achieving in the game is a whole class effort. The teacher will take note of which students struggle to recall the identities and ensure to check their understanding within the lesson.  Discussion regarding ‘muddy areas’ provides the teacher with insight as to where students struggled. The teacher takes notes of where the worksheets need to be improved as well as where some or most of the students struggled.  The worksheets are collected by the teacher to ensure work is completed successfully, and returned at the start of the next class, so students can reflect on prior learning. |
| **Proficiency Strand(s) - How are they developed?** | Fluency is developed within this lesson. Terms previously discussed in trigonometry are being applied to situations which require students to apply their problem solving and reasoning abilities.  Students are demonstrating understanding by transferring their knowledge of trigonometry identities to solve real world problems. |
| **Identify opportunities for effort, mastery and challenge** | Whole class activities and discussions are centred on cooperative achievement. Students who not only recall but adapt previous learning to the challenging questions provided, will have a greater sense of achievement.  Real world problems are introduced in this lesson. Students are tasked with transferring their understanding of abstract concepts to problems which require multiple steps. |
| **Identify strategies for creating an emotionally safe classroom** | -Ensuring individual contact is made with each student, encourages students to ask for help.  The game used to begin the lesson, requires students work cooperatively to achieve. The only competition is with their own personal best, so students are aware of their potential. No students are singled out for being incorrect, so there is no sense of failure associated with learning.  -The musical reflection at the conclusion of the lesson develops students’ sense of belonging and contributing to the classroom community. The music provides a relaxed atmosphere in which students are more confident in taking risks and sharing their ideas. |
| **Identify opportunities for achievable challenges for students of varying abilities and characteristics** | The body of this lesson provides a range of worksheets and problems which cater for a diverse range of abilities. The beginning activity reminds students of prior learning, which demonstrates the relevance of the information being taught.  The skills required for solving trigonometry problems are broken up into steps. Students who struggle with understanding global concepts, will be able to break problems into manageable components.  Extension tasks are provided for students who are capable of working effectively independently. Whilst additional modelling and questioning will be provided for students whom struggle to apply their understandings. |

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| **Lesson Number: 4**  MA5.2-13MG  identify, visualise and quantify measures and the attributes of shapes and objects, and explore measurement concepts and geometric relationships, applying formulas, strategies and geometric reasoning in the solution of problems.  MA5.2-2WM  interprets mathematical or real-life situations, systematically applying appropriate strategies to solve problems  MA5.2-1WM  selects appropriate notations and conventions to communicate mathematical ideas and solutions  MA5.2-3WM:  constructs arguments to prove and justify results. | |
| **The Key Idea(s) for this lesson are:** | Students use the trigonometric identities to determine angles of right triangles. |
| **Time Guide** | 60 minutes |
| **Learning Experiences** | **Intro** (5 minutes)  Begin the lesson with the following link displayed on the SMART board. Allow students to come up to the board and move around the cursor to see the effect the angle has on the values of Sine, Cosine and Tangent.    Introduction to Trigonometry (2014).  Students should be familiar with the unit circle from previous trigonometry units. If students are confused, explain, a unit circle is a circle with a radius of one. The unit circle is used to visually demonstrate the trigonometry relationships, between angles, side lengths and tangents.  What happens as the angle increases?  What happens to the value of cos as sin increases?  What happens to the value of sin as cos increases?  **Body** (45 minutes)  Provide every student with either a laptop or computer. Students are to type in the link which is displayed on the smart board: <http://www.scootle.edu.au/ec/viewing/L9180/index.html>  The link will take students to scootle.edu.au’s trigonometry assessment. Students enter their full name and continue through the assessment. The assessment is ICT based, allowing students to control aspects of a unit circle to answer questions related to trigonometry. Once completed, students will receive a report which they need to print and submit to the teacher.    Trigonometric ratios (Farlam, 2010, p.722).  Work through the above examples as a class. Writing the examples on the board provides a future reference for students to use throughout the lesson. If students need further modelling, bring in a number line which can be highlighted  Explain to students the difference between exressing their answer as sinand actually finding the value of the angle. Ensure all students have access to a calculator. Explain to students, that by the conclusion of the lesson they will be able to use the trigonometry idenitites to find the value of an angle within a right angle triangle.  Write on the white board: To find an angle you use **SHIFT** then enter the ratio.    Trigonometric ratios (Farlam, 2010, p.722).  Have students complete worksheet 7, which requires them to identify the appropriate trigonometric identity for each right triangle. If students complete this activity early have them complete the ‘how many triangles?’ puzzle. The puzzle tests students’ reasoning and problem solving skills, whilst allowing students who require more time to complete the task, the opportunity to develop a strong foundation of the skills which will be required in the following lessons.  https://lawlessguy.files.wordpress.com/2013/02/t0.gif  Bring class back together and discuss any difficulties students are having. If required solve the first question from worksheet 8 as a class. Students can begin working on worksheet 8.    Applications to real life questions (2015).  Once students have completed worksheet 8, they can begin solving the above problem, which is displayed on the SMART board.  Once all students have completed at least part a of the question, solve as a class, with contributions from students.  **Conclusion** (10 minutes)  Have students return to the page where they wrote down the two steps for using trigonometric identities from the last lesson. Have students add a third step: solve. Students may choose to copy the step as it is written on the board (the image below), or they can write it in their own words.    Trigonometric ratios (Farlam, 2010, p.718).  Discuss ‘muddy areas’ with students.  Perform ‘what did we learn’ song. |
| **Teaching Strategies** | The lesson begins with an interactive technology activity. This will immediately draw students’ attentions and provide a new perspective on the unit.  There are several new ideas being introduced within this lesson. Consequently, much of the delivery is group based with teacher modelling. Additional guidance will be provided for students who require further instruction. Students will need to apply their understanding in the provided worksheets, which are primarily skill based questions.  Students are asked to respond to a real world trigonometry problem which requires the use of reasoning and problem solving abilities. Transitioning between guided examples, to independent skills practice, to applying understanding, provides students with a sense of progression and accomplishment. |
| **Class Organisation** | Students are seated in small groups, ranging from four to six members. The desks are organised to provide every student with an unobstructed view of the room’s SMART board. The groups are of mixed abilities, with students paired with others they work well with and challenge to improve. The students who generally require extra teacher assistance are seated closer to the front of the classroom, so that small guided lessons can be conducted with minimal relocation of students.  Much of this lesson relies on teacher based modelling. Students who are capable of working independently are given ample opportunity to progress in such a manner. |
| **Assessment** | Informal assessment occurs as the teacher manoeuvres about the classroom, providing support and facilitating conversations where required. The small guided group who require more attention, are set small, realistic, attainable goals which solidify the fundamental ideas. The casual conversations which take place with every student on group and individual levels, ensure assistance is always available. Strong relationships have been formed with every student, and the classroom is a comfortable environment where risk taking and question asking are encouraged.  Open questioning is used alongside students’ discovery of the unit circle ICT application.  Discussion regarding ‘muddy areas’ provides the teacher with insight as to where students struggled. The teacher takes notes of where the worksheets need to be improved as well as where some or most of the students struggled.  The worksheets are collected by the teacher to ensure work is completed successfully, and returned at the start of the next class, so students can reflect on prior learning. |
| **Proficiency Strand(s) - How are they developed?** | Fluency is developed within this lesson. Terms previously discussed in trigonometry are used as a basis of new concepts and application questions.  Students develop their fluency and skills within the provided worksheets.  The application questions require students to demonstrate their understanding by utilising problem solving and reasoning techniques. Students apply their knowledge of concepts to a real world situation in which trigonometry can be used. |
| **Identify opportunities for effort, mastery and challenge** | There are a large range of questions available to students. Students are aware of their individual learning expectations and encouraged to achieve their personal best. The process of solving trigonometry problems is broken up further, continuing on from the steps provided in the previous lesson. Students are asked to refer to their prior learning to develop upon previously learned concepts. The steps allow students to identify where they are most challenged, whilst providing students with a sense of mastery as they progress through the steps. |
| **Identify strategies for creating an emotionally safe classroom** | -Ensuring individual contact is made with each student, encourages students to ask for help.  -Group discussion is integral to the teacher modelling used in this lesson. Open questioning requires students to apply higher order thinking and reasoning.  -The musical reflection at the conclusion of the lesson develops students’ sense of belonging and contributing to the classroom community. The music provides a relaxed atmosphere in which students are more confident in taking risks and sharing their ideas. |
| **Identify opportunities for achievable challenges for students of varying abilities and characteristics** | Learning expectations and teacher support are catered for students’ individual needs. Extension tasks are provided for students who require extra challenge. Whilst opportunities for group and individual teacher support and consistently provided throughout the lesson.  There are a range of visual, ICT and applicable resources being utilised within this lesson. The tasks provided require students to use a range of skills and thinking styles, allowing for a diverse range of learners to accomplish and demonstrate their understanding. |

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| **Lesson Number: 5**  MA5.2-13MG  identify, visualise and quantify measures and the attributes of shapes and objects, and explore measurement concepts and geometric relationships, applying formulas, strategies and geometric reasoning in the solution of problems  MA5.2-2WM  interprets mathematical or real-life situations, systematically applying appropriate strategies to solve problems  MA5.2-1WM  selects appropriate notations and conventions to communicate mathematical ideas and solutions  MA5.2-3WM:  constructs arguments to prove and justify results. | |
| **The Key Idea(s) for this lesson are:** | At the end of the session, the students will be able to use conversion of units to write Decimal Degrees into Degrees, Minutes, Seconds form, and vice versa. |
| **Time Guide** | 60 minutes |
| **Learning Experiences** | **Intro** (5 minutes)  Have the following questions on the board when students arrive. Instruct students to begin answering the questions as soon as they are settled.    Explain to students, in today’s lesson we want to learn how to convert decimal degrees into degrees/minutes/seconds form and vice versa.  Show students ‘Pre-Calculus - Converting between decimals and degrees minutes and seconds’ by MySecretMathTutor on Youtube. Which provides a simple overview of converting between decimals, degrees, minutes and seconds.  **Body** (45 minutes)    Go through the example as a class, answering students’ questions as they arise. Give students several minutes after the example, to work on the guided practice questions. The teacher manoeuvres around the classroom providing assistance to small groups at a time.    Again, go through the example as a class, leaving the steps on the board for students to return to. Students have several minutes to attempt the guided practice questions.  Students work in pairs to convert decimal degrees into degrees/minutes/seconds form, and vice versa. One student works through the convert into degrees/minutes/seconds list, and the other student works through the convert into decimal degrees list. The students then swap and compare answers.  Pairs who finish early can begin working on worksheet 9, which reinforces the skills they have developed over the past couple of lessons.  **Conclusion** (10 minutes)  Have students write the steps which were left up on the board, in their own words.  Discuss ‘muddy areas’ with students, and revisit any ideas that are causing major concerns for students.  Perform ‘What did we learn’ song with students. |
| **Teaching Strategies** | A variation of the Think/Pair/Share cooperative learning strategy has been used within this lesson.  Whole class discussion and teacher modelling are used to introduce students to the new concepts being taught.  Students work independently through the worksheets provided, so the teacher may spend time consolidating the basic concepts with students who require further modelling and prompting. |
| **Class Organisation** | Students are seated in small groups, ranging from four to six members. The desks are organised to provide every student with an unobstructed view of the room’s SMART board. The groups are of mixed abilities, with students paired with others they work well with and challenge to improve. The students who generally require extra teacher assistance are seated closer to the front of the classroom, so that small guided lessons can be conducted with minimal relocation of students. |
| **Assessment** | Students assess their learning cooperatively through the think/pair/share activity. Students who find discrepancies between their results will work collaboratively to find a solution.  Informal assessment occurs as the teacher manoeuvres about the classroom, providing support and facilitating conversations where required. The small guided group who require more attention, are set small, realistic, attainable goals which solidify the fundamental ideas. The casual conversations which take place with every student on group and individual levels, ensure assistance is always available. Strong relationships have been formed with every student, and the classroom is a comfortable environment where risk taking and question asking are encouraged.  Discussion regarding ‘muddy areas’ provides the teacher with insight as to where students struggled. The teacher takes notes of where the worksheets need to be improved as well as where some or most of the students struggled.  The worksheets are collected by the teacher to ensure work is completed successfully, and returned at the start of the next class, so students can reflect on prior learning. |
| **Proficiency Strand(s) - How are they developed?** | New terms are likely introduced within this lesson. Ensuring the language used is relevant and associated with prior learning in this unit, develops students’ mathematical fluency.  Students are required to communicate with their partner in written and oral forms to formulate and express mathematical ideas. |
| **Identify opportunities for effort, mastery and challenge** | Worksheets and examples provided are catered for a diverse range of learners. The lesson introduces the new concepts using familiar language and terms. Skills are gradually built upon as the lesson progresses. The worksheets progressively build students’ understanding from the most basic interpretation of the concepts. Students who seek further challenge will be provided an extension worksheet. Some students will find challenge in developing their understanding of the most basic foundations of the new concepts. Mastering the foundations will set students up for success as they are exposed to application problems. |
| **Identify strategies for creating an emotionally safe classroom** | -Cooperative learning is utilised within this lesson. Some students will be working with a more knowledgeable other, while some students will benefit from teaching their peers.  Open discussion regarding difficult areas of the lesson develops students’ growth mindset. Knowing other students struggled with similar experiences will restore the confidence of students who are feeling overwhelmed by the new topic. |
| **Identify opportunities for achievable challenges for students of varying abilities and characteristics** | Achievement expectations are differentiated between students. Some will be expected to complete the extension worksheets, whilst some students will find achievement in simply following along with the example questions. Individual conversations are consistently taking place in the classroom and students are aware of the expectations placed upon them, not only by the teacher but by themselves.  The pairs allocated for the cooperative activity will depend on the students within the class. If applicable a capable student would be paired with a special needs student who would benefit from peer modelling. Other pairs will be closer in ability level, allowing for a shared sense of challenge. If some pairs complete the activity too easily, more advanced problems may be provided. |

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| **Lesson Number: 6**  MA5.2-13MG  identify, visualise and quantify measures and the attributes of shapes and objects, and explore measurement concepts and geometric relationships, applying formulas, strategies and geometric reasoning in the solution of problems  MA5.2-2WM  interprets mathematical or real-life situations, systematically applying appropriate strategies to solve problems  MA5.2-1WM  selects appropriate notations and conventions to communicate mathematical ideas and solutions  MA5.2-3WM:  constructs arguments to prove and justify results. | |
| **The Key Idea(s) for this lesson are:** | Angles of elevation and depression - some examples where diagram not provided. |
| **Time Guide** | 60 minutes |
| **Learning Experiences** | **Intro** (5 minutes)  Explain to students, by the conclusion of today’s lesson, they will be able to   * apply sine, cosine and tangent ratios to find angles of elevation and depression. * Students will be able to measure lengths and use measurements to determine angle measures.   Explain that trigonometric ratios have many practical real world applications. Angles of elevation and depressions are based on a person’s line of sight with an object. If you are looking up, the angle is an elevation angle. C:\Users\Brendan\AppData\Local\Microsoft\Windows\INetCacheContent.Word\20160909_101316_HDR.JPG  Refer to the diagram displayed on the smart board.  If you are looking down, the angle is a depression angle.  Refer to the diagram on the smart board.  Example: Alex (A) is standing outside when he sees Superman (S) hovering in the sky.     1. What is the angle of elevation from Alex to Superman? (1) 2. What is the angle of depression from Superman to Alex? (3)   **Body** (45 minutes)  20160908_151722_HDR  Have students work in their allocated table groups (approximately 4 per group). Explain that each group will be given a helium balloon, 2 pieces of string and a camera. Students are to tie the two pieces of strings to the balloon before they leave the classroom.  Show students the diagram on the board. Students are to find an open area outside and allow the balloon to float, whilst two students hold the two attached strings as shown. The other student(s) in the group are to use the provided camera to photograph the students and the balloon.  Students are given five minutes to obtain a photograph, before coming inside to work on the computers. Students copy the picture to ensure every member of the group has their own. Students then upload their pictures into Adobe Photoshop. Where, students will use the line tool to draw right angle triangles over their photographs. Students then use the paint brush tool to draw the angles of elevation and depression, labelling these using the text tool. The teacher will be available to assist students with any ICT or mathematics concerns.  The steps will be written on the board to ensure students understand the lesson expectations.  When students have completed the task, they are to print the image, which will be displayed on the classroom wall.  Once students have printed their image they will begin work on worksheet 10, which provides further examples of angles of elevation and depression.  **Conclusion** (10 minutes)    Trigonometric ratios (Farlam, 2010, p.729).  Work through the above example as a class. Have students write the steps out in their books, using their own words.  Discuss ‘muddy areas’ with the class.  Perform ‘What did we learn’ song. |
| **Teaching Strategies** | Clear learning objectives are indicated at the beginning of the lesson.  A mixture of hand drawn and computer generated diagrams are utilised within the lesson. Within my experience, some students respond obvious effort from their teachers, a hand drawn diagram shows students the teacher’s understanding and passion for the subject.  An investigative activity forms the basis of this lesson. Angles of elevation and depression are used in answering application questions within the trigonometry unit. Naturally the explanation of these concepts should be in a real world context as well. The activity combines kinaesthetic, visual, oral, ICT, cooperative and independent aspects to cater for a diverse range of learners and learning styles. Students who complete the task will have produced a piece of work, which they can refer to throughout the rest of the unit.  Clear steps are provided for solving trigonometry problems. |
| **Class Organisation** | The class begins with teacher led whole class discussion. Students are organised into groups to undertake the investigative activity. Cooperation is necessary for students to meet the requirements of the task.  The worksheet provided allows for students to solidify their understanding independently. |
| **Assessment** | Informal assessment occurs as the teacher manoeuvres about the classroom, providing support and facilitating conversations where required. The small guided group who require more attention, are set small, realistic, attainable goals which solidify the fundamental ideas. The casual conversations which take place with every student on group and individual levels, ensure assistance is always available. Strong relationships have been formed with every student, and the classroom is a comfortable environment where risk taking and question asking are encouraged.  The investigative activity requires students to produce a piece of work. This style of formative assessment demonstrates whether students have understood the concepts being introduced. Students will have access to their projects throughout the unit, essentially creating their own learning tools.  Discussion regarding ‘muddy areas’ provides the teacher with insight as to where students struggled. The teacher takes notes of where the worksheets need to be improved as well as where some or most of the students struggled. The muddy area conversation takes place midway through the lesson, so if students are particularly struggling, the teacher may choose to provide further instruction before moving on.  The worksheets are collected by the teacher to ensure work is completed successfully, and returned at the start of the next class, so students can reflect on prior learning. |
| **Proficiency Strand(s) - How are they developed?** | Fluency is developed within this lesson. New terms are being introduced in conjunction with trigonometry problems and terms students have previously been exposed to.  Students are required to communicate their understanding in oral, visual, written forms. Students are representing the concept in their own unique ways. |
| **Identify opportunities for effort, mastery and challenge** | Collaborative group work in which students are exploring real world concepts encourages students to persist and produce a solution. Students can see through group discussions and activities how effort correlates with success. |
| **Identify strategies for creating an emotionally safe classroom** | -Ensuring individual contact is made with each student, encourages students to ask for help.  Students work in groups to produce their projects. Group work allows students to cooperatively explore new concepts, developing their understanding as a community. The focus of the group is on producing a solution which demonstrates their understanding.  -The musical reflection at the conclusion of the lesson develops students’ sense of belonging and contributing to the classroom community. The music provides a relaxed atmosphere in which students are more confident in taking risks and sharing their ideas. |
| **Identify opportunities for achievable challenges for students of varying abilities and characteristics** | The groups will consist of a range of abilities and learning styles. Students can learn from more knowledgeable others. There are a range of mediums required within the assessment, students can share responsibilities and utilise their unique abilities. |

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| **Lesson Number: 7**  MA5.2-13MG  identify, visualise and quantify measures and the attributes of shapes and objects, and explore measurement concepts and geometric relationships, applying formulas, strategies and geometric reasoning in the solution of problems  MA5.2-2WM  interprets mathematical or real-life situations, systematically applying appropriate strategies to solve problems  MA5.2-1WM  selects appropriate notations and conventions to communicate mathematical ideas and solutions | |
| **The Key Idea(s) for this lesson are:** | Students can interpret three-figure bearings (eg 035°, 225°) and compass bearings (eg SSW) |
| **Time Guide** | 60 minutes |
| **Learning Experiences** | **Intro** (5 minutes)  Explain to students the objectives of the lesson:   * Students should be able to interpret three-figure bearings (eg 035°, 225°) * Students should be able to interpret compass bearings (eg SSW) * Students can interpret bearings in trigonometry problems   Begin with ‘Trigonometry Lesson 1 Bearings’ by Irrational Mathematician on YouTube, which provides a simple, short overview of true bearings.  https://www.youtube.com/watch?v=4axB8cntDfQ  **Body** (45 minutes)  Explain to students, calculation of bearings uses the values shown in the video (0/360, 90, 180, 270) and either addition or subtraction. Show the below examples on the smart board.    Trigonometric ratios (Farlam, 2010, p.733).  Students can now begin worksheet 11, which uses circles labelled with pronumerals to provide students with multiple opportunities to demonstrate their understanding.  Students who require further modelling will work in small guided group with the teacher. The group can work through problems 1-16 together if required, and attempt 17 onwards either individually or with the help of their peers.  Students who finish early can begin work on worksheet 12, which provides extension questions for true bearings.  **Conclusion** (10 minutes)  C:\Users\Brendan\AppData\Local\Microsoft\Windows\INetCacheContent.Word\Calculator bearings.jpg  Calculator bearings part 2  Bearings on the TI-Nspire CAS – a geometric approach (Jones & Lipson, 2005)  All students have access to a graphics calculator and follow along as the teacher explains the example on the smart board.  Discuss ‘muddy areas’ with students.  Perform ‘What did we learn’ song. |
| **Teaching Strategies** | The lesson begins with a short video clip, providing an overview of the topic.  Teacher led modelling, facilitates whole class discussions.  Graphing calculators are used to provide an alternate means of demonstrating students understanding. |
| **Class Organisation** | Students are seated in small groups, ranging from four to six members. The desks are organised to provide every student with an unobstructed view of the room’s SMART board. The groups are of mixed abilities, with students paired with others they work well with and challenge to improve. The students who generally require extra teacher assistance are seated closer to the front of the classroom, so that small guided lessons can be conducted with minimal relocation of students. |
| **Assessment** | Informal assessment occurs as the teacher manoeuvres about the classroom, providing support and facilitating conversations where required. The small guided group who require more attention, are set small, realistic, attainable goals which solidify the fundamental ideas. The casual conversations which take place with every student on group and individual levels, ensure assistance is always available. Strong relationships have been formed with every student, and the classroom is a comfortable environment where risk taking and question asking are encouraged.  Discussion regarding ‘muddy areas’ provides the teacher with insight as to where students struggled. The teacher takes notes of where the worksheets need to be improved as well as where some or most of the students struggled. The muddy area conversation takes place midway through the lesson, so if students are particularly struggling, the teacher may choose to provide further instruction before moving on.  The worksheets are collected by the teacher to ensure work is completed successfully, and returned at the start of the next class, so students can reflect on prior learning. |
| **Proficiency Strand(s) - How are they developed?** | Fluency is developed within this lesson. Bearings and trigonometry terms form the foundations of new learning. |
| **Identify opportunities for effort, mastery and challenge** | Worksheets and examples provided are catered for a diverse range of learners. The lesson introduces the new concepts using familiar language and terms. Skills are gradually built upon as the lesson progresses. The worksheets progressively build students’ understanding from the most basic interpretation of the concepts. Students who seek further challenge will be provided an extension worksheet.  Using the graphing calculators provides students an alternate means of viewing and understanding the concept. |
| **Identify strategies for creating an emotionally safe classroom** | -Ensuring individual contact is made with each student, encourages students to ask for help.  -The musical reflection at the conclusion of the lesson develops students’ sense of belonging and contributing to the classroom community. The music provides a relaxed atmosphere in which students are more confident in taking risks and sharing their ideas. |
| **Identify opportunities for achievable challenges for students of varying abilities and characteristics** | Achievement expectations are differentiated between students. Some will be expected to complete the extension worksheets, whilst some students will find achievement in simply following along with the example questions. Individual conversations are consistently taking place in the classroom and students are aware of the expectations placed upon them, not only by the teacher but by themselves.  Students who are visual learners have the opportunity to experience the topic through the graphing calculator. |

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| **Lesson Number: 8**  MA5.2-13MG  identify, visualise and quantify measures and the attributes of shapes and objects, and explore measurement concepts and geometric relationships, applying formulas, strategies and geometric reasoning in the solution of problems  MA5.2-2WM  interprets mathematical or real-life situations, systematically applying appropriate strategies to solve problems  MA5.2-1WM  selects appropriate notations and conventions to communicate mathematical ideas and solutions | |
| **The Key Idea(s) for this lesson are:** | Students should be able interpret directions given as bearings and represent them in diagrammatic form. |
| **Time Guide** | 60 minutes |
| **Learning Experiences** | **Intro** (5 minutes)  On board as students enter the classroom:  Akmal is driving North at 40 km/h. Cindy is driving East at 54 km/h. If they left from the same place at the same time:   1. How far, in kilometres, has Akmal travelled after 6 hours? 2. How far, in kilometres, has Cindy travelled after 6 hours? 3. What is the distance, in kilometres (call it *d* km) between Akmal and Cindy after 6 hours? Give your answer in km correct to one decimal place.   Instruct students to begin solving the problem immediately. Students who struggle to begin can work collaboratively with students at their table. If a table is generally struggling, the teacher can work with the table to prompt students to begin. If lots of students are struggling, the teacher may provide prompts for the entire class.  **Body** (45 minutes)  Compass bearings measure the bearing from North, when above the East-West line. Or South when below the East-West line.  To give the compass bearing, you use two directions. Firstly, North or South, then the direction in which the angle is heading, either East or West. If the angle isn’t given from North or South, a calculation is performed to change it.    Trigonometric ratios (Farlam, 2010, p.740).  Begin worksheet 13, which continues the format of worksheet 11. Students use the circles given to identify compass bearings.  Present students with a sheet with the following questions printed with space for working.   1. A deranged deer was spooked by a menacing looking flower. He ran west for 150 metres and then went south for 220 metres. Find the deer’s bearing from its initial position to 2 decimal places. 2. A silly squirrel fell asleep sunbaking on the back of a parked car. He awoke to the vehicle travelling at a very high speed. Naturally, the squirrels only choice was to hold on, tight. The squirrel held on to the car as it travelled 305 metres North then 130 metres East.   When students have completed the two questions they may begin working through worksheet 14, which has students interpret directional bearings through graphical representation.  Work through the below example as a class, using the whiteboard to draw out the diagram.        Application of bearings (Jones & Lipson, 2005)  **Conclusion** (10 minutes)  Students are to complete an exit slip prior to exiting the class.  Exit slip:   1. Give the bearing for each of these directions. 2. N 3. NE 4. E 5. SE 6. NW 7. Find the bearing, correct to the nearest degree, of: 8. Point A from O 9. Point O from A 10. A ship travels due south for 3km, then on a bearing of 130 11. Find how far east the ship is from its starting point, correct to 2 decimal places. 12. Find how far south the ship is from its starting point, correct to 2 decimal places. |
| **Teaching Strategies** | The lesson begins with a real world application of trigonometry problem. Beginning the lesson with a problem immediately, will catch students’ attention and have them instantly working mathematically.  Students work through the provided worksheets, which have students learn the concept of compass bearings through repetition and visual representation.  A real world problem is provided to measure students’ understanding and reasoning with bearings as an aspect of trigonometry.  An exit slip is provided to students to complete before they leave. The exit slip allows students to demonstrate their understanding of the topic and allows the teacher to identify areas for further instruction. |
| **Class Organisation** | The lesson consists of whole class discussion, teacher modelling and independent study.  Students are seated in small groups, ranging from four to six members. The desks are organised to provide every student with an unobstructed view of the room’s SMART board. The groups are of mixed abilities, with students paired with others they work well with and challenge to improve. The students who generally require extra teacher assistance are seated closer to the front of the classroom, so that small guided lessons can be conducted with minimal relocation of students. |
| **Assessment** | In answering bearings questions, students read the question, then draw a diagram then solve. The teacher can assess students’ understanding by observing these steps within students’ working.  Students should be able interpret directions given as bearings and represent them in diagrammatic form. If students are struggling to translate the information given in the question to diagrammatic form, further modelling will be required.  Informal assessment occurs as the teacher manoeuvres about the classroom, providing support and facilitating conversations where required. The small guided group who require more attention, are set small, realistic, attainable goals which solidify the fundamental ideas. The casual conversations which take place with every student on group and individual levels, ensure assistance is always available. Strong relationships have been formed with every student, and the classroom is a comfortable environment where risk taking and question asking are encouraged.  The worksheets are collected by the teacher to ensure work is completed successfully, and returned at the start of the next class, so students can reflect on prior learning. |
| **Proficiency Strand(s) - How are they developed?** | Communicating and reasoning  This lesson is predominantly structured to provide students time to independently develop their understanding of bearings questions in trigonometry. The teacher will be having conversations with small groups and individual students where necessary. Students are required to communicate their understanding of problems to the teacher. Students must be able to explain their reasoning and problem solving strategies in order to demonstrate concrete understanding. |
| **Identify opportunities for effort, mastery and challenge** | All of the problems provided to students have been broken up into achievable steps. The challenge of these questions increases as the lesson progresses. More aspects of trigonometry and right angle triangle geometry are introduced into the bearings questions as students progress.  The exit slip provides students an opportunity for meaningful reflection. Students can either demonstrate their understanding of the unit, or, recognise areas in which they can improve. It is explicitly stated that the exit slip is not a test. The slip is being used as a means of formative assessment to inform future teaching. |
| **Identify strategies for creating an emotionally safe classroom** | -Ensuring individual contact is made with each student, encourages students to ask for help.  - Students understand the exit slip provided is not a test. Students will not be reprimanded for their failures. The exit slip results are indicative of areas the lessons need to cover prior to the conclusion of the unit. |
| **Identify opportunities for achievable challenges for students of varying abilities and characteristics** | The lesson consists of whole class discussion, teacher modelling and independent study. Students who require an extra challenge may be provided with an extension worksheet, further solidifying concepts taught within this lesson. Students who require further modelling can work in a small guided group alongside the teacher. Questions are broken up into steps to ensure students attain a sense of achievement in some aspects of every problem. |

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| **Lesson Number: 9**  MA5.2-13MG  identify, visualise and quantify measures and the attributes of shapes and objects, and explore measurement concepts and geometric relationships, applying formulas, strategies and geometric reasoning in the solution of problems  MA5.2-2WM  interprets mathematical or real-life situations, systematically applying appropriate strategies to solve problems  MA5.2-1WM  selects appropriate notations and conventions to communicate mathematical ideas and solutions  MA5.2-3WM:  constructs arguments to prove and justify results. | |
| **The Key Idea(s) for this lesson are:** | Students need to be able to interpret a variety of phrases involving bearings, such as:   * 'The bearing of Melbourne from Sydney is 230°' * 'A plane flies to Melbourne on a bearing of 230° from Sydney' * 'A plane flies from Sydney to Melbourne on a bearing of 230°' * 'A plane leaves from Sydney and flies on a bearing of 230° to Melbourne'. |
| **Time Guide** | 60 minutes |
| **Learning Experiences** | **Intro** (5 minutes)  Using the exit slips handed out at the conclusion of the last lesson, go over students’ misunderstandings through open questioning and modelling.  Provide students with an outline of this lesson’s learning expectations. By the lesson’s conclusion, students will be able to interpret a variety of phrases involving bearings, as well as solve worded bearings and trigonometry questions.  Students begin working in groups before  **Body** (40 minutes)  The first activity requires students to work in their table groups. Students are given an A1 sheet of paper and colour markers.  ‘The bearing of Melbourne from Sydney is 230°’ is written atop the classroom whiteboard. Explain that students are to begin by illustrating the problem using a diagram.  Students then surround the diagram by writing the prompt on the board in as many different ways as possible. For example:   * 'A plane flies to Melbourne on a bearing of 230° from Sydney' * 'A plane flies from Sydney to Melbourne on a bearing of 230°' * 'A plane leaves from Sydney and flies on a bearing of 230° to Melbourne'.   Have each table volunteer a statement, writing all the unique responses on the board underneath the original prompt.  Explain to students, often worded questions will change vocabulary, however, the meaning stays the same. When approaching application questions in trigonometry, ensure you unpack the important information.  Explain to students, there will be an assessment task to formally assess their understanding of the unit. The assessment is in two parts. Part A requires students to create one trigonometry questios, suitable to form part of the trigonometry topic quiz. Part B requires students to sit a quiz, made up predominantly of the questions provided in part A.   * Students’ questions must be related to trigonometric ratios (sin, cos, tan), angles of elevation or depression and/or bearings. * A diagram must be included for each question * Correct units must be provided * All questions must be based on practical, real life scenarios where trigonometry would be applicable.   In order to prepare students for the assessment, they will have the opportunity to work through two worksheets which review the entire trigonometry unit. Students may choose to complete the worksheets in class and create the questions as homework or vice-versa, either option is acceptable. Students may use questions from the worksheet as a beginning point for their problem, but the final result must be students’ original work.  Students should predominantly work on this independently, but support can be sought within table groups. If there are many students who require extra help with the review, a guided group, with more explicit modelling and prompting may be beneficial. Otherwise, support can be given on an individual or small group basis.  The questions must be completed and submitted electronically (using either email or the school’s submission system) prior to the commencement of the next lesson. Using the snipping tool program, collate the questions into a word document to form the quiz, which will be assessment part B.  **Conclusion** (15 minutes)  Bring the class together earlier than other lessons. This extra time allows for the teacher to further explore any ‘muddy areas’ students might have come across within the unit review. Having ten minutes to go over specific problems within the unit review will allow for the students to solidify their undrestandings prior to formal assessment.  Conclude the lesson with the ‘what did we learn’ song. Explain to students, the emphasis for today’s song is on recalling the important concepts from the trigonometry unit. |
| **Teaching Strategies** | Reflecting on exit slips completed at the conclusion of the previous lesson links to prior learning and allows students to amend concerns within the unit.  The poster activity allows for collaboration within the classroom. Students are listing as many solutions as they can. Students will value cooperation, as other students will likely have suggestions different from their own. The think and share cooperative learning strategy forms the basis of the activity. Groups develop their own resource, which is shared with the class. Student learn from each other in groups and as a whole class.  Providing choice allows students to complete the assessment at their own pace. If students feel they need to further revise any specific areas, they might focus on that aspect of the worksheet before constructing their question.  The questions students write allow for demonstration of understanding outside of the traditional test environment. |
| **Class organisation** | Students are seated in small groups, ranging from four to six members. The desks are organised to provide every student with an unobstructed view of the room’s SMART board. The groups are of mixed abilities, with students paired with others they work well with and challenge to improve. The students who generally require extra teacher assistance are seated closer to the front of the classroom, so that small guided lessons can be conducted with minimal relocation of students.  The group activity provides students with the opportunity to work collaboratively. |
| **Assessment** | Informal assessment occurs as the teacher manoeuvres about the classroom, providing support and facilitating conversations where required. The small guided group who require more attention, are set small, realistic, attainable goals which solidify the fundamental ideas. The casual conversations which take place with every student on group and individual levels, ensure assistance is always available. Strong relationships have been formed with every student, and the classroom is a comfortable environment where risk taking and question asking are encouraged.  Having assessed students’ exit slip results, the teacher is aware of any significant gaps in students’ understanding. These concerns can be addressed at the beginning of the lesson.  Discussion regarding ‘muddy areas’ provides the teacher with insight as to where students struggled. The teacher takes notes of where the worksheets need to be improved as well as where some or most of the students struggled. The muddy area conversation takes place midway through the lesson, so if students are particularly struggling, the teacher may choose to provide further instruction before moving on.  The worksheets are collected by the teacher to ensure work is completed successfully, and returned at the start of the next class, so students can reflect on prior learning. |
| **Proficiency Strand(s) - How are they developed?** | Students need to communicate their understanding of the topic using oral and written forms.  The assessment item will assess students’ reasoning, problem, solving, fluency and understanding of the unit. |
| **Identify opportunities for effort, mastery and challenge** | Students are given the opportunity to create a question based on a topic of their choice. Students will likely choose the topic they are most confident in. By developing a question using a topic they understand, students can extend their problem solving and reasoning capabilities to develop a question which demonstrates the extent of their understanding. |
| **Identify strategies for creating an emotionally safe classroom** | In reflecting on students’ exit slip performance, the teacher explains, there are no failures, only areas for further development. Students are encouraged to ask questions.  The group activity allows students to work in their table groups. Students should generally be comfortable sharing their ideas with these groups. The task is intentionally open to interpretation, so a large variety of responses could be provided.  Students are given choice within the lesson. If they believe they would benefit from further revision before commencing the assessment task, that option is available. Students are given responsibility for their own learning. |
| **Identify opportunities for achievable challenges for students of varying abilities and characteristics** | An answer must be provided for each question so students will develop questions that are relevant to their level of understanding. Students understand that the quiz will be taken by the entire class and will want to challenge both themselves and their peers. |

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| **Lesson Number: 10**  MA5.2-13MG  identify, visualise and quantify measures and the attributes of shapes and objects, and explore measurement concepts and geometric relationships, applying formulas, strategies and geometric reasoning in the solution of problems  MA5.2-2WM  interprets mathematical or real-life situations, systematically applying appropriate strategies to solve problems  MA5.2-1WM  selects appropriate notations and conventions to communicate mathematical ideas and solutions  MA5.2-3WM:  constructs arguments to prove and justify results. | |
| **The Key Idea(s) for this lesson are:** | Revision of unit. Summative assessment of trigonometry unit. |
| **Time Guide** | 60 minutes |
| **Learning Experiences** | **Intro** (5 minutes)  If any students are yet to submit their questions for the quiz, allow five minutes for these to be completed and submitted, either electronically or hand written. If time permits, add these questions to the quiz before printing. Students who have completed assessment part A, may use this time for revision, referring to the summary worksheet they received in the previous lesson.  **Body** (50 minutes)  Students are to independently complete the quiz under test conditions. There may be some humorous questions provided by students, consequently some laughter is to be expected, however it is made clear to students that conversations are inappropriate. Students are strongly encouraged to read through their answers when they believe they are finished, as papers will not be collected until the time has been used.  **Conclusion** (5 minutes)  Students naturally want to discuss quiz questions after taking a quiz. Allowing five minutes of discussion between students and the teacher allows for consolidation of understanding for some, as well as correcting students’ understanding for others. Ask students if there are any questions in particular they struggled with. Why did they struggle? Did the diagram help them understand? How did they/ could they have approached the problem? |
| **Teaching Strategies** | This lesson is a brief revision of previously covered content, ensuring students have developed understanding of stage 4 outcomes: MA4-16MG, MA4-17MG. Intentionally simple lesson, to build students’ self-efficacy in a topic which is generally approached with anxiety (Reference!).  At the start of the lesson, students are encouraged to recall information they have previously learned. Revising the basics serves to refresh the memories of students who are already competent with Pythagoras, whilst also providing a strong foundation for students who require re-teaching of the topic.  The lesson has been designed to build students’ confidence by providing work that students can successfully complete. Not all students will complete all of the given worksheets, but all students will have some achievement and some challenge. It is expected that students will work independently but they are seated in groups and encouraged to have discussions regarding the work. Students are able to discuss answers and collaboratively solve any problems that arise. The teacher moves throughout the classroom as students are working on the given worksheets. The teacher is listening to discussions, asking open questions of students, assessing their understanding (What would happen if? What tells you that? Etc.).  The focus of the lesson is on recognising the hypotenuse of right angle triangles. The hypotenuse is a commonly recurring term in trigonometry which is required for learning the trigonometric identities. The activities were designed so that competent students could continue to extend their learning, whilst students who struggle to grasp the concepts being discussed are provided with opportunities to learn the necessary skills. Whilst Pythagoras’ rule is important, the focus was on ensuring all students could recognise the hypotenuse. |
| **Class Organisation** | Students are seated in small groups, ranging from four to six members. The desks are organised to provide every student with an unobstructed view of the room’s SMART board. The groups are of mixed abilities, with students paired with others they work well with and challenge to improve. The students who generally require extra teacher assistance are seated closer to the front of the classroom, so that small guided lessons can be conducted with minimal relocation of students. |
| **Assessment** | The completed quiz papers are collected at the conclusion of the lesson to be marked by the teacher. Only positive marks are awarded, no crosses are written on the paper. Where students have gone wrong, the teacher has written short prompts to explain the question. Final marks are given as +21, for example. As opposed to 21/33. This emphasises students’ successes rather than their failures. The marked quizzes will be returned to students at the beginning of the next lesson. With five minutes allocated to going through the quiz as a class, identifying any general areas of concern.  Informal assessment occurs as the teacher manoeuvres about the classroom, providing support and facilitating conversations where required. The small guided group who require more attention, are set small, realistic, attainable goals which solidify the fundamental ideas. The casual conversations which take place with every student on group and individual levels, ensure assistance is always available. Strong relationships have been formed with every student, and the classroom is a comfortable environment where risk taking and question asking are encouraged.  Discussion regarding ‘muddy areas’ provides the teacher with insight as to where students struggled. The teacher takes notes of where the worksheets need to be improved as well as where some or most of the students struggled. The muddy area conversation takes place midway through the lesson, so if students are particularly struggling, the teacher may choose to provide further instruction before moving on.  The worksheets are collected by the teacher to ensure work is completed successfully, and returned at the start of the next class, so students can reflect on prior learning. |
| **Proficiency Strand(s) - How are they developed?** | Fluency is developed within this lesson. Terms previously discussed in Pythagoras are reintroduced to builds students confidence as they are met with a new unit. |
| **Identify opportunities for effort, mastery and challenge** |  |
| **Identify strategies for creating an emotionally safe classroom** | -Ensuring individual contact is made with each student, encourages students to ask for help.  -The musical reflection at the conclusion of the lesson develops students’ sense of belonging and contributing to the classroom community. The music provides a relaxed atmosphere in which students are more confident in taking risks and sharing their ideas. |
| **Identify opportunities for achievable challenges for students of varying abilities and characteristics** | -Worksheets of different ability levels are available, students have used these worksheets in the past and are always excited to move on to the next one. Worksheet 1 covers very basic ideas, so even students who would struggle with Pythagoras are given a sense of achievement. |

References:

Applications to real life questions. (2015). Retrieved from [https://mathspace.co/learn/login/?next=/learn/world-of-maths/trigonometry/applications- to-real-life-6610/questions/](https://mathspace.co/learn/login/?next=/learn/world-of-maths/trigonometry/applications-%09to-real-life-6610/questions/)

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Introduction to trigonometry (2014). Retrieved from <https://www.mathsisfun.com/algebra/trigonometry.html>

Jones, P. & Lipson, K. (2005). *Essential Further Mathematics*. Cambridge University Press.

Projectmaths. (2015). *Mathematics higher school certificate examinations by topics*.

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Worksheets:

(A rough guide to assist in sorting)

1. Hippo

2. calculating hypotenuse

3. Hypote-nose

4. freefall name sides

5. Freefall trig identities

6. Trig identities 2

7. Trig angles 2

8. Trig angles

9. Minutes and degrees

10. Angles elevation

11. True bearings worksheet

12. Bearings sheet 2

13. compass bearings

14. compass bearings 2

15. Trig review

16. Trig review 2

All worksheets are either hand drawn or taken from Freefall mathematics velocity 10 (Farlam, 2010).



































