 MS-A1 formulae and equations, MS-A2 linear relationships

Year 11 mathematics standard (rhombus)

Duration: 4 Weeks

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Rationale

Students will develop skills to justify various types of decisions and make predictions using algebraic techniques, formulae, and linear relationships.

Topic focus

Equations, Formulae and Linear Relationships

Prior knowledge required

MA4-8NA Algebraic Techniques, MA4-10NA Equations, MA4-11NA Linear Relationships, MA5.1-6NA Linear Relationships, MA5.2-5NA Ratios and Rates, MA5.2-8NA Equations, MA5.2-9NA Linear Relationships, MA5.3-4NA Ratios and Rates, MA5.3-5NA Algebraic Techniques

Language considerations

algebraic expression

axis

constant

conversion

direct variation

dependent variable

equation

evaluate

expand

factorise

formulae

gradient

independent variable

intercept

linear

non-linear

origin

pronumeral

relationship

simplify

solution

solve

subject

substitute

variable

y-intercept.

Outcomes

A student:

* Uses algebraic and graphical techniques to compare alternative solutions to contextual problems MS11-1
* Represents information in symbolic, graphical and tabular form MS11-2
* Makes predictions about everyday situations based on simple mathematical models MS11-6
* Uses appropriate technology to investigate, organise and interpret information in a range of contexts MS11-9
* Justifies a response to a given problem using appropriate mathematical terminology and/or calculations MS11-10

Assessment

Formative Assessment

* Begin unit based on diagnostic assessment - Mathematics Stage 4 Diagnostic Tasks (Algebraic Techniques 1 pg 13, Algebraic Techniques 2 pg 14, Equations pg 18-19, Linear Relationships pg. 20-24) - http://numeracyskills.com.au/images/pdfs/Mathematics\_Stage\_4\_Diagnostic\_Tasks.pdf
* Students to complete Tackling the Terminology of Algebra and Modelling

Summative Assessment

* Algebra – Assessment Task

| Outcomes and content | Teaching and learning strategies and evidence of learning | Resources |
| --- | --- | --- |
| Review of algebraic techniques | Students will need to be able to simplify algebraic expressions using addition, subtraction, multiplication and division. These skills may need to be revisited, depending on the pre-test results. Attached is a template to create tailored algebraic techniques question sheets and a ‘find the problem and fix it’ style DIY question sheet.Students will need to be able to solve basic equations. Attached is a series of scaffolded worksheets that practise solving single-step equations, two-step equations, equations with brackets, and equations with pronumerals on both sides.Students will need to have an understanding of Cartesian Coordinates and be able to plot points on a plane. ‘Battleships’ is a cooperative game that can reinforce these concepts. Attached is instructions and a template to practise these skills. Students need to be reminded to put their ships on the points to create a line, rather than in the spaces.Students can creatively practise extrapolating data from a graph with the ‘Describe the Graph’ worksheet. | * [Algebraic Manipulation Skill Drill Number 1](https://drive.google.com/file/d/0Bw3oraSrb8i-RVgzNFN0MFV4aTQ/view?pli=1): https://drive.google.com/file/d/0Bw3oraSrb8i-RVgzNFN0MFV4aTQ/view?pli=1
* [Algebraic Manipulation Bloopers](https://drive.google.com/file/d/0Bw3oraSrb8i-SFROV1lhSG52bkU/view?pli=1): https://drive.google.com/file/d/0Bw3oraSrb8i-SFROV1lhSG52bkU/view?pli=1
* Scaffolded Equations Revision:
	+ [Coordinate Graphing Battleship](https://drive.google.com/file/d/0Bw3oraSrb8i-QUtoc2VuSFd3c2c/view?pli=1): https://drive.google.com/file/d/0Bw3oraSrb8i-QUtoc2VuSFd3c2c/view?pli=1
	+ [Describe the Graph](http://illuminations.nctm.org/uploadedFiles/Content/Lessons/Resources/3-5/DescribeTheGraphAS.pdf): http://illuminations.nctm.org/uploadedFiles/Content/Lessons/Resources/3-5/DescribeTheGraphAS.pdf
* More Coordinates activities:
	+ [General coordinates game](http://www.shodor.org/interactivate/activities/GeneralCoordinates/) http://www.shodor.org/interactivate/activities/GeneralCoordinates/
	+ [Maze game](http://www.shodor.org/interactivate/activities/MazeGame/) http://www.shodor.org/interactivate/activities/MazeGame/
	+ [Hit the coordinate](http://www.mathsisfun.com/data/click-coordinate.html) http://www.mathsisfun.com/data/click-coordinate.html
	+ [Billy Bug](http://www.oswego.org/ocsd-web/games/BillyBug2/bug2.html) http://www.oswego.org/ocsd-web/games/BillyBug2/bug2.html
	+ [Homer’s donuts](http://www.xpmath.com/forums/arcade.php?do=play&gameid=59) http://www.xpmath.com/forums/arcade.php?do=play&gameid=59
 |
| * review substitution of numerical values into linear and non-linear algebraic expressions and equations (ACMGM010) ◊
	+ review evaluating the subject of a formula, given the value of other pronumerals in the formula
	+ review changing the subject of a linear formula
	+ solve problems involving formulae, including but not limited to calculating distance, speed and time (with change of units of measurement as required) or calculating stopping distances of vehicles using a suitable formula (ACMGM011) AAM Personal and social capability icon
 | SubstitutionSubstitution is when an unknown (pronumeral, variable) is replaced by a number.The following types of examples could be considered:* Find the value of the following expressions given that , , ,
* Find the value of  if , and .
* Find the value of  if  and .

FormulaeFormulae are special types of equations. A formula represents a relationship between physical quantities. A formula is different from an equation in that it will always have more than one pronumeral. However, to find the value of a pronumeral in a formula we must be told the values of every other pronumeral in the formula. Students should be exposed to formulae that they will be using in other aspects of the course, for example:* The simple interest formula states that . Use the formula to calculate  when ,  and .
* The volume of a pyramid is given by the formula . What is the volume of a pyramid when  and ?
* Given that  and , calculate  when

Changing the Subject of a FormulaLooking at  , the subject of both of these formulae is s because it is the sole pronumeral on the left hand side. Sometimes the value of the subject is known and the task is to find the value of one of the other pronumerals. To find the value of another pronumeral, substitute any known values and then solve an equation. Students should be exposed to formulae that they will be using in other aspects of the course. The following types of examples could be considered:* Given that , calculate  when  and .
* If , evaluate  correct to 1 decimal place when ,  and
* If , calculate  hen  and

Literal EquationsThis is when a formula is rearranged so that one of the other pronumerals is the subject, without substituting values for the other pronumerals. To do this, the same procedures as for solving equations are used. Students should be exposed to formulae that they will be using in other aspects of the course. The following types of examples could be considered:* Make  the subject of the formula
* Make  the subject of
* Change the subject of  to

Problem Solving‘Word sentences’ or problems can be translated into number sentences. When solving problems we have to be able to translate the words into equations. The following types of examples could be considered:* A rectangle is three times longer than it is wide. If it has a perimeter of 192m, what are its dimensions?
* My father was 28 years old when I was born. If he is now three times as old as I am, what are our present ages?
* Use the formula dry braking distance  to calculate the braking distance of a car that is travelling at 87 km/h on a dry road (to the nearest metre).
 | * [Substitution Differentiated Worksheet](http://justmaths.co.uk/Worksheets/Algebra/Substitution%20-%20Differentiated%20Worksheet.pdf): http://justmaths.co.uk/Worksheets/Algebra/Substitution%20-%20Differentiated%20Worksheet.pdf
* [Substituting into an expression](https://drive.google.com/file/d/0BwaMIFwXzq3sNEVsSnVBOXVXLUk/view?pli=1): https://drive.google.com/file/d/0BwaMIFwXzq3sNEVsSnVBOXVXLUk/view?pli=1
* [Algebraic expression](http://www.bbc.co.uk/bitesize/ks3/maths/algebra/formulae1/activity/) http://www.bbc.co.uk/bitesize/ks3/maths/algebra/formulae1/activity/
* [Rearranging and Understanding Formulas – Independent Practice Worksheet](http://www.mathworksheetsland.com/algebra/21underform/ip.pdf): http://www.mathworksheetsland.com/algebra/21underform/ip.pdf
* [Rearranging and Understanding Formulas – Matching Worksheet](http://www.mathworksheetsland.com/algebra/21underform/matching.pdf): http://www.mathworksheetsland.com/algebra/21underform/matching.pdf
* [Literal Equations Calculator:](http://www.mathcelebrity.com/literalequation.php) http://www.mathcelebrity.com/literalequation.php
* [Solving Literal Equations:](http://www.wolframalpha.com/widgets/view.jsp?id=7cd5a1d4664804885ed5092f68ff1842) http://www.wolframalpha.com/widgets/view.jsp?id=7cd5a1d4664804885ed5092f68ff1842
* [Solving Problems using Equations](https://drive.google.com/file/d/0BwaMIFwXzq3sUzE4RzR3dEtzWGc/view?pli=1): https://drive.google.com/file/d/0BwaMIFwXzq3sUzE4RzR3dEtzWGc/view?pli=1
* [How does speeding increase the chances and severity of a crash?:](http://www.rms.nsw.gov.au/saferroadsnsw/speeding_and_crashes.pdf) http://www.rms.nsw.gov.au/saferroadsnsw/speeding\_and\_crashes.pdf
* [Stopping Distance:](http://www.sdt.com.au/safedrive-directory-STOPPINGDISTANCE.htm) http://www.sdt.com.au/safedrive-directory-STOPPINGDISTANCE.htm
* [Highway Code on Braking Distances and Speed:](https://www.youtube.com/watch?v=lWmEbbPlQ_c) https://www.youtube.com/watch?v=lWmEbbPlQ\_c
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| * develop and solve linear equations, including but not limited to those derived from substituting values into a formula, or those developed from a word description (ACMGM038, ACMGM039) AAM ◊ Critical and creative thinking icon Literacy icon Personal and social capability icon
 | Students develop linear equations from a word description by developing a pattern, completing a table of values and determining a rule. | * Linear Modelling Example 1: [Money Box](https://drive.google.com/open?id=0Bw3oraSrb8i-ZGlITnZNWmY0a2M)
* Linear Modelling Example 2: [Beach](https://drive.google.com/open?id=0Bw3oraSrb8i-MnNJRlQ4U2VlRE0)
* Linear Modelling Example 3: [Surfboards](https://drive.google.com/open?id=0Bw3oraSrb8i-bG9kRXlkVHMwZDA)
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| * model, analyse and solve problems involving linear relationships, including constructing a straight-line graph and interpreting features of a straight-line graph, including the gradient and intercepts (ACMMM002, ACMMM003) AAM ◊ Sustainability icon Critical and creative thinking icon
	+ recognise that a direct variation relationship produces a straight-line graph
	+ determine a direct variation relationship from a written description, a straight-line graph passing through the origin, or a linear function in the form  Critical and creative thinking icon Literacy icon
	+ review the linear function  and understand the geometrical significance of  and  (ACMGM041, ACMGM042)
	+ recognise the gradient of a direct variation graph as the constant of variation (ACMGM042) AAM Critical and creative thinking icon  Information and communication technology capability icon Literacy icon
	+ construct straight-line graphs both with and without the aid of digital technology (ACMGM040)  Information and communication technology capability icon
 | Use [Desmos](http://www.desmos.com/calculator) (www.desmos.com/calculator) or [Geogebra](http://geogebra.org/) (http://geogebra.org/) to generate linear graphs. It is also capable of applying ‘sliders’ to variables. This is very useful for demonstrating the effects of changing  and  in .  | * [How to Create Desmos Graphs with Sliders in 3 Steps:](http://mathandmultimedia.com/2014/10/11/desmos-graphs-sliders/) http://mathandmultimedia.com/2014/10/11/desmos-graphs-sliders/
* [Geogebra Tutorial 2 – Slider Basics](https://www.youtube.com/watch?v=p1xeRhgEB2U&feature=youtu.be): https://www.youtube.com/watch?v=p1xeRhgEB2U&feature=youtu.be
 |
| * construct and analyse a linear model, graphically or algebraically, to solve practical direct variation problems, including but not limited to the cost of filling a car with fuel or a currency conversion graph (ACMGM043) AAM ◊ Sustainability icon Personal and social capability icon
* identify and evaluate the limitations of a linear model in a practical context
 | Students to use the following steps to solve a direct variation problem:1. Write the correct equation
2. Use the information in the question to find the value of
3. Rewrite the equation, substituting your value for
4. Use the equation to answer the question
 | * [Steps required for solving direct variation problems](http://www.mesacc.edu/~scotz47781/mat120/notes/): http://www.mesacc.edu/~scotz47781/mat120/notes/variation/direct/direct.html
 |

Reflection and evaluation: