 Year 11 Mathematics Standard

Unit title: Formulae and Equations

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Duration: 2 weeks

Rationale

Knowledge of algebra enables the modelling of a problem conceptually so that it is simpler to solve, before returning the solution to its more complex practical form. The study of algebra is important in developing students’ reasoning skills and logical thought processes, as well as their ability to represent and solve problems. The ability to interpret and critically evaluate information that is presented in graphical form will provide students with important skills they will use when making decisions in the future.

Topic focus

The principal focus of this subtopic is to provide a solid foundation in algebraic skills, including for example finding solutions to a variety of equations in work-related and everyday contexts. Students develop awareness of the applicability of algebra in their approach to everyday life.

Within this subtopic, schools have the opportunity to identify areas of Stage 5 content which may need to be reviewed to meet the needs of students.

Prior knowledge required

The material in this topic builds on content from the Number and Algebra Strand of the K–10 Mathematics syllabus, including the Stage 5.2 substrands of Equations and Linear Relationships.

Language considerations

There are considerable language considerations in this topic including the use of specific terminology including:

algebraic expression

blood alcohol content (BAC)

changing the subject

Clark’s formula

dosage

dosage strength

equation

evaluate

formulae

Fried’s formula

linear

medication

non-linear

pronumeral

solve

standard drink

stopping distance

subject of a formula

substitution

Young’s formula

Outcomes

A student:

* uses algebraic and graphical techniques to compare alternative solutions to contextual problems MS11-1
* makes predictions about everyday situations based on simple mathematical models MS11-6
* uses appropriate technology to investigate, organize 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 (including formative and summative)

Some strategies for formative assessment could include:

* Reflecting on students’ responses to a class discussion
* Beginning the lesson with a few questions on content from previous lessons before progressing
* Having students write their own questions on a topic or having them write a specific number of questions with the same answer
* [3-2-1 Exit slips](http://www.theteachertoolkit.com/index.php/tool/3-2-1) - http://www.theteachertoolkit.com/index.php/tool/3-2-1
* [Chalk Talk Routine](http://www.santeesd.net/cms/lib/CA01000468/Centricity/Domain/12/VT_ChalkTalk.pdf) - http://www.santeesd.net/cms/lib/CA01000468/Centricity/Domain/12/VT\_ChalkTalk.pdf
* [Red, Yellow, Green Cups](http://www.sstr2.org/Downloads/Cups%20as%20student%20feedback.pdf). Alternatively, students could indicate beside the questions their level of understanding using the letters, R, Y or G. http://www.sstr2.org/Downloads/Cups%20as%20student%20feedback.pdf
* [Mindmaps](https://emedia.rmit.edu.au/learninglab/content/how-create-mind-map) - https://emedia.rmit.edu.au/learninglab/content/how-create-mind-map

Summative Assessment

* MS-A1 Formulae and Equations – Assessment Task

| Content | Teaching and learning strategies and evidence of learning | Resources |
| --- | --- | --- |
| * review substitution of numerical values into linear and non-linear algebraic expressions and equations ◊
	+ review evaluating the subject of a formula, given the value of other pronumerals in the formula
	+ change 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 **AAM** Personal and social capability icon
 | Teaching Strategies* Substitution into expressions should include substitution into expressions containing multiple variables, positive and negative values, powers and square roots. Examples of algebraic expressions for substitution of numerical values should include expressions such as: , , , ,
* When evaluating the subject of a formula through substitution of numerical values, use a wide variety of formulae such as , , , , , , ,
* Changing the subject of a formula should be limited to linear formulae.
* Appropriate formulae should be selected from practical contexts including, but not limited to, formulae students will encounter in other topics, for example, if , find A given , ,
* Stopping distance can be calculated using the formula: stopping distance=reaction-time distance+braking distance

Student Activities* Students use formulae to solve a range of problems related to the safe operation of motor vehicles, e.g. the average speed of a journey or stopping distance. Students can use an online calculator to check their answers for these calculations.
 | * [Calculate your average speed](http://www.countcalculate.com/cars-and-speed/average-speed) - http://www.countcalculate.com/cars-and-speed/average-speed
* [Calculate stopping distance](http://www.countcalculate.com/cars-and-speed/stopping-braking-distance) - http://www.countcalculate.com/cars-and-speed/stopping-braking-distance
* [Convert km/h to metres per second](http://www.countcalculate.com/cars-and-speed/convert-kmh-ms-and-mph) - http://www.countcalculate.com/cars-and-speed/convert-kmh-ms-and-mph
 |
| * 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 **AAM** ◊ Critical and creative thinking icon Literacy icon Personal and social capability icon
 | Teaching strategies* Students may need to revise the following skills prior to developing and solving linear equations.
	+ ­expansion and simplification of expressions such as
	+ ,
	+ multiplication of algebraic terms such as ,

Student activities* Students complete a matching activity where they have to match a word description to the correct linear equation. Half the students are given a word description and the other half is given the matching equations – they have to move around the classroom to find their partner.
 | * [Two-Step Equations Basketball Game](http://www.math-play.com/two-step-equations-basketball-game/two-step-equations-basketball-game_html5.html): http://www.math-play.com/two-step-equations-basketball-game/two-step-equations-basketball-game\_html5.html
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| * calculate and interpret blood alcohol content (BAC) based on drink consumption and body weight **AAM** Ethical understanding icon Civics and citizenship icon
	+ use formulae, both in word form and algebraic form, to calculate an estimate for blood alcohol content $(BAC)$, including $BAC\_{Male}=\frac{10N-7.5H}{6.8M}$ and $BAC\_{Female}=\frac{10N-7.5H}{5.5M}$ where $N$ is the number of standard drinks consumed, $H$ is the number of hours of drinking, and $M$ is the person’s weight in kilograms
	+ determine the number of hours required for a person to stop consuming alcohol in order to reach zero BAC, eg using the formula $time=\frac{BAC}{0.015}$
	+ describe limitations of methods estimating BAC
 | Teaching strategies* Blood Alcohol Content (BAC) is the measure of alcohol concentration in the bloodstream. It is measured in grams of alcohol per 100 millilitres of blood. Discuss why blood alcohol content (BAC) is a function of body weight and other factors (or variables) that affect BAC including gender, fitness, health and liver function.
* Investigate the meaning of a ‘standard drink’. Note that different countries have different definitions for a standard drink. In Australia and New Zealand a standard drink is one that contains 10g of alcohol. In the UK and Iceland it is 8g of alcohol and in Austria it is 20g of alcohol.
* Discuss the limitations to the estimation of BAC, including that the formulae are based on average values and will not apply equally to everyone. Zero BAC is an important consideration for young drivers in NSW, as the state’s laws require a zero BAC limit for all learner and provisional drivers.

Student activities* Students could order a series of images for alcoholic drinks (taken from the Australian Department of Health – Standard Drinks Guide) base on the number of standard drinks per volume. Students could then check against the guide.
* Students to investigate in groups the effect of weight and alcohol consumption to calculate and interpret the BAC levels of both males and females.
* Students could use a BAC calculator that allows for cross-country comparison to compare and contrast the different definitions of a standard drink.
 | * [The Australian Standard Drink](http://www.alcohol.gov.au/internet/alcohol/publishing.nsf/Content/standard) (Australian Department of Health) - http://www.alcohol.gov.au/internet/alcohol/publishing.nsf/Content/standard
* [Standard Drinks Calculator](https://drinkwise.org.au/standard-drinks-calculator/) (DrinkWise) - https://drinkwise.org.au/standard-drinks-calculator/#
* [Blood Alcohol Calculator](http://www.bloodalcoholcalculator.com.au/) (set to Australian standard drink) - http://www.bloodalcoholcalculator.com.au/
* Australian Department of Health – [Standard Drinks Guide](http://www.alcohol.gov.au/internet/alcohol/publishing.nsf/content/E9E12B0E00E94FD5CA25718E0081F1DC/%24File/std0910.pdf) http://www.alcohol.gov.au/internet/alcohol/publishing.nsf/content/E9E12B0E00E94FD5CA25718E0081F1DC/$File/std0910.pdf
* [Blood Alcohol Calculator](http://www.alcoholhelpcenter.net/program/BAC_Standalone.aspx) (Alcohol Help Centre) - http://www.alcoholhelpcenter.net/program/BAC\_Standalone.aspx
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| * calculate required medication dosages for children and adults from packets, given age or weight, using Fried’s, Young’s or Clark’s formula as appropriate **AAM** Literacy icon
	+ Fried’s formula: $Dosage for children 1-2 years=\frac{age (in months) × adult dosage}{150}$
	+ Young’s formula: $Dosage for children 1-12 years=\frac{age of child (in years) × adult dosage}{age of child (in years) + 12}$
	+ Clark’s formula: $Dosage= \frac{weight in kg × adult dosage}{70}$
 | Teaching strategies* Use formulae in a range of calculations related to child and adult medication and apply various formulae in the solution of practical problems.
* Examples of dosage panels from over-the - counter medications should be examined.
* Students should develop a clear understanding of formulae used to calculate required dosages for children and the variables included in Fried’s Formula, Young’s Formula and Clark’s Formula

Student activities* Students could calculate medication dosage for the same context using each of the formulae and compare the answers. They could discuss which might be the more reliable calculation of dosage (i.e. formulae that uses weight maybe more reliable since age is not necessarily a predictor of weight).
 | * Students could research medication on a website for a chemist or a manufacturer.
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Reflection and evaluation: