 Year 12 Mathematics Standard 1

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Unit title

MS-M5 Scale Drawings

Duration

2 weeks

Rationale

Measurement involves the application of knowledge, skills and understanding of numbers and geometry to quantify and solve problems in practical situations.

Topic focus

The principal focus of this subtopic is to interpret and use scale drawings and use similarity in solutions to practical problems involving measurement.

Students develop their ability to interpret and use house plans, designs and maps in the calculation of a range of measurements and solve related problems.

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

* Review the use of different metric units of measurement including units of area, take measurements, and calculate conversions between common units of measurement, for example kilometres to metres or litres to millilitres (ACMEM090, ACMEM092)
* Calculate the absolute error of a reported measurement and state the corresponding limits of accuracy
* Investigate types of errors, for example, human error or device limitations
* Calculate the percentage error of a reported measurement
* Use standard form and standard metric prefixes in the context of measurement, with and without a required number of significant figures
* MS11-3 Solves problems involving quantity measurement, including accuracy and the choice of relevant units
* MS11-4 Performs calculations in relation to two-dimensional figures
* MS11-9 Uses appropriate technology to investigate, organise and interpret information in a range of contexts
* MS11-10 Justifies a response to a given problem using appropriate mathematical terminology and/or calculations

Language considerations

If students abbreviate geometrical reasons that they use in deductive geometry, they must take care not to abbreviate the reasons to such an extent that the meaning is lost.

Outcomes

A student:

* MS1-12-3 Interprets the results of measurements and calculations and makes judgements about their reasonableness
* MS1-12-4 Analyses simple two-dimensional and three-dimensional models to solve practical problems
* MS1-12-9 Chooses and uses appropriate technology effectively and recognises appropriate times for such use
* MS1-12-10 Uses mathematical argument and reasoning to evaluate conclusions, communicating a position clearly to others

Assessment

Informal assessment

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)
* [Chalk Talk Routine](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); students could also indicate beside the questions their level of understanding using the letters, R, Y or G.
* [Mindmaps](https://emedia.rmit.edu.au/learninglab/content/how-create-mind-map)

Formal assessment

An investigative task based on students using the knowledge, understanding and skills they have developed in this topic to analyse and create a scaled project.

| Content | Teaching and learning strategies and evidence of learning | Resources |
| --- | --- | --- |
| * Solve practical problems involving ratio, for example, map scales, mixtures for building materials or cost per item AAM
	+ Work with ratio to express a ratio in simplest form, to find the ratio of two quantities and to divide a quantity in a given ratio
	+ Use ratio to describe map scales
 | Teaching strategies:A ratio is the quantitative relation between two amounts showing the number of times one value contains or is contained within the other. If ‘a’ and ‘b’ are two quantities, they can be expressed as ‘a:b’. Here, ‘a’ is called ‘antecedent’ and ‘b’ is called ‘consequent’.Teachers note:* A ratio has no units, such that $10 to $15 is written as 10:15.
* It can be expressed as a fraction. For example, 2:3 can be expressed as 2/3.
* The two quantities that are compared should be of the same kind. For example, litres and grams cannot be compared.
* The ratio must be expressed in the simplest form. 3:9 can be expressed as 1:3.

A practical application of ratios is scale drawings. The scale determines the size of an object in a drawing or in real life. The closer the terms in the scale ratio are together, the closer the drawing is to the real size. So a 1:10 scale drawing would be bigger than a 1:100 scale drawing of the same object. Scale diagrams could include house plans and maps. Students should be aware that millimetre is the standard unit of lengths on building plans. Sample problems could include:* The dimensions of the room and the width of the carpet should be considered when deciding in which direction to lay the carpet in order to minimise wastage and the number of joins.

Students should be able to:* Recognise ratios written in different forms, such as 6/4, 6:4 or 6 to 4
* Write a ratio in simplest form. Sample problems could include:
	+ 4:6
	+ 5mm to 1 metre
	+ $1.50 to $3.75
	+
	+ Note – Ratios do not contain units. $10 to $15 is okay, but not $10:$15 (should be 10:15)
* Calculate amounts from a ratio. Sample problems could include: Concrete is formed by mixing cement, sand and gravel in the ratio 1:2:6. What volume of sand is needed to make 1.6m3 of concrete?
* Use scales to determine the dimensions of an object in a drawing and in real life.
* Divide a quantity into a given ratio. Sample problems could include:
	+ Divide $300 in the ratio 2:3.
	+ A sum of money is divided in the ratio 2:3. The smaller sum is $3.60. Find the sum that was divided.
 | [Ratio and scale](https://sites.google.com/site/letmesolveyourmathproblems/ratio-and-scale)[Scale drawings](http://www.mathsteacher.com.au/year8/ch06_ratios/06_scale/draw.htm)[Constructing scale drawings](https://www.khanacademy.org/math/cc-seventh-grade-math/cc-7th-geometry/cc-7th-scale-drawings/e/constructing-scale-drawings)[Scale drawings toolbox](https://www.dlsweb.rmit.edu.au/toolbox/furnishindustry/toolbox/shared/resources_dr/techniques/conventions/scale.htm)[Ratios](http://www.math-only-math.com/ratios.html)[Dividing a quantity in a given ratio](http://www.mathsteacher.com.au/year10/ch17_variation/03_dividing/25div.htm) |
| * Use the conditions for similarity of two-dimensional figures, including similar triangles, to solve related problems
* Use the linear scale factor for two similar figures to solve problems (ACMGM022)
 | Possible problems that students could investigate are:* By measuring the shadow thrown by a metre-rule, students use similarity and shadow lengths to find the height of tall objects, such as a tree or flag pole.
* A sewer is required to have a fall of 1 in 40. How much deeper should one end be compared to the other in a 160-metre long trench?
 | [Measuring heights of tall objects](http://www.learner.org/courses/learningmath/measurement/session5/part_b/index.html)[Similar figures](http://www.mathsteacher.com.au/year10/ch06_geometry/05_similar/figures.htm) |
| * Obtain measurements from scale drawings, including but not limited to maps (including cultural mappings or models) or building plans, to solve problems AAM
 | * Students use online mapping applications (such as Google Earth or SIX maps) to search locations and use the scale to find the actual distance between two points on the map.
 | [Google Earth Ruler Tool](https://www.youtube.com/watch?v=x8hzpMn-nNs) |
| * + Interpret commonly used symbols and abbreviations on building plans and elevation views
 | * Students accurately construct a scaled model of their classroom or another room using a building plan and/or elevation view.
 | [How to draw a floor to scale](https://www.wikihow.com/Draw-a-Floor-Plan-to-Scale)[How to measure and draw a floor plan to scale](https://www.smartdraw.com/floor-plan/measure-draw-floor-plan-scale.htm) |
| * Estimate and compare quantities, materials and costs using actual measurements from scale drawings, for example using measurements for packaging, clothing, cooking, painting, bricklaying and landscaping including sustainability issues AAM
 | Students could investigate the following:* Use house plans to cost carpeting, tiling, and painting rooms using a building plan.
* The actual area and volume of objects based on scale drawings. The calculation of area and volume based on information on a plan needs to include, for example:
	+ Finding the area of a house to be carpeted and the cost of purchasing the carpet.
	+ Calculating the area to be painted and the cost of painting a room in a house.
	+ Calculating the volume of the rooms in a house and using a table to determine the appropriate-sized air conditioner for the house.
 | N/A |

Reflection and evaluation