Stage 2 General Mathematics

Open Topic 6: Applied Geometry

This topic will replace Topic 2: Modelling with Matrices

Geometry is everywhere — in the structure of the natural environment, in the way people navigate and communicate, in what they construct, and in their artistic and sporting endeavours.

This topic should be approached by posing problems, preferably with an encompassing theme or context. The most common areas of application are navigation, building construction, surveying, and manufacture and design. There may be others, however, that would provide a suitable medium through which to learn this topic. The problems chosen should allow for a practical approach in which the solutions found by students can be tested or verified by an alternative method. It is also suggested that the problems cover the more global as well as local aspects of the context.

Once a problem has been posed, students consider what needs to be measured to provide data for the geometric model they will use in its solution. Implicit in this process is the consideration of which implement will best do the job and what limitations there will be to the accuracy of the measurement it gives.

The geometric models that students apply to the solution of the problems posed require skills in solving triangles of all types, as well as the calculation of length, area, and volume for a variety of two-dimensional and three-dimensional shapes. Students quantify the level of error implicit in their answers, and interpret the appropriateness of these answers in the original context of the problem.

Subtopic 6.1: Right and Non-right Triangle Geometry

| Key Questions and Key Ideas | Considerations for Developing Teaching and Learning Strategies |
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| What mathematics is needed in calculations from measurement? | Finding solutions to the problems posed in the scenarios at the beginning of the topic is the driving force for learning the techniques in this subtopic. |
| Review of right-angled triangle geometry   * Pythagoras’ theorem * Sine, cosine, and tangent | Right-angled triangles are most commonly encountered in construction problems such as roof designs and trusses and the tree protector. Problems are presented in 2D and 3D contexts and with practical activities where appropriate. |
| Non-right-angled trigonometry   * Sine rule * Cosine rule | Triangles that are not right-angled occur somewhere in most of the problems. |

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| Solving problems involving direction and bearings | Students understand bearings and how to interpret them so that practical problems involving navigation and angles of elevation and depression can be solved by applying trigonometry. |
| What are the effects of absolute and relative errors?   * Discussion of accuracy of measurements * Calculation of absolute and relative errors * Effect of errors on the calculations | Students calculate the tolerance of their result with either an absolute error or a relative error (i.e. ) and discuss the implications of errors. The effect of a small error in an angle measurement is magnified by distance (as in search-and-rescue problems). Students consider the reliability of their answers in the context of the problem. |

| **Subtopic 6.2: Area and Volume** | |
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| Key Questions and Key Ideas | Considerations for Developing Teaching and Learning Strategies |
| Area and volume   * Area of compound shapes * Volume of compound solids * Area of irregular shapes using * Simpson’s rule * an approximation using simple mathematical shapes (e.g. circles, rectangles, triangles) * Volume of irregular solids | Students calculate areas and volumes of plane shapes. The focus is on solving practical problems set in familiar contexts, with increasing complexity of the shapes involved. The problems involving tendering and finding the capacity of a dam or lake require students to find the area and/or volume of irregular shapes or solids. The problems involving a beach umbrella, a tree protector, roof designs, the search area for a ship, and a layout of a car park or playground require students to find areas of simpler shapes. The dam problems provide the most challenging calculations of volume; however, the volume of materials such as grass clippings for compost and pine bark for a playground also needs to be worked out.  The area of irregular shapes like kidney-shaped garden beds or golfing greens can be calculated by finding an average radius and then applying, where *r* is the average radius. The average radius can be calculated by selecting a central point and measuring to the edge of the shape at 10° intervals. The sum of the measurements is then divided by the number of measurements.  Calculations of the area of irregular shapes could also be done using Pick’s rule or the Monte Carlo method. |
| What are the effects of absolute and relative errors?   * Discussion of accuracy of measurements * Calculation of absolute and relative errors * Effect of errors on the calculations | Students calculate the tolerance of their result with either an absolute error or a relative error (i.e. ) and discuss the implications of errors. |