



DESIGNING AN ASSESSMENT PROGRAM IN GENERAL MATHEMATICS

Before designing an assessment program, teachers need to be familiar with Board of Studies requirements regarding General Mathematics and school policies and procedures.

The following steps may assist teachers in developing an internal assessment program for the HSC General Mathematics course.

Step 1: Map the HSC course outcomes to the areas of study.

The specific course outcomes to be addressed are included at the start of each unit of work in the syllabus. As part of the process of developing an assessment program for General Mathematics, it is useful to map the outcomes of the HSC course against the areas of study. Table 1 below shows a completed example of this process.

The information contained in this table assists the development of the assessment program. For example, it is important to consider the number of times an outcome is addressed within the assessment program.

Outcomes P1 (*A student develops a positive attitude to mathematics and appreciates its capacity to provide enjoyment and recreation*) and H1 (*A student appreciates the importance of mathematics in his/her own life and its usefulness in contributing to society*) relate to the affective domain. These outcomes relating to students' values and attitudes should be addressed and monitored when teaching the course. However, there is no expectation that these outcomes will be assessed in an independent way when determining final assessment marks.

Teachers will need to ensure that their teaching program provides ample opportunity for students to work towards achieving all of the outcomes. Additionally, the teacher will need to gather and record

evidence for each student to be able to provide feedback to students relating to achievement of the outcomes.

Step 2: Brainstorm and research the range of tasks that could be used in mathematics.

This will assist you in selecting the tasks for your assessment program. Tasks refer to anything students are given to do from which assessment information can be gathered, e.g. practical tests or assignments, written tests or reports, projects, investigations, oral reports or explanations. Some examples of types of tasks are outlined in the *Mathematics Years 9-10 Stage 5 Support Document for Advanced, Intermediate and Standard Courses* (Board of Studies, 1996). They include:

- mini-projects
- student explanation and demonstration to others
- samples of students' work
- student-produced overviews or summaries of topics
- investigations
- students' oral and written reports
- short quizzes
- pen-and-paper tests involving multiple-choice, short-answer questions and questions requiring longer responses, including interdependent questions (where one part depends on the answer obtained in the preceding part)
- open-book tests
- comprehension and interpretation exercises
- student-produced worked examples
- teacher/student discussion or interviews
- observation of students during learning activities, including listening to students' use of language
- observation of students' participation in a group activity
- consideration of students' portfolios
- students' plans for and records of their solutions to problems
- students' journals and comments on the process to their solutions
- practical tasks such as measurement activities.

Students should be given clear guidelines for these tasks, including the outcomes that will be assessed and the criteria to be used in marking.



Table 1: General Mathematics: HSC outcomes

AREA OF STUDY \ OUTCOMES	H1 Values & attitudes	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11
Financial mathematics											
• Credit and borrowing		◆			◆			◆			◆
• Annuities and loan repayments		◆			◆			◆			◆
• Depreciation		◆			◆			◆			◆
Data analysis											
• Interpreting sets of data		◆		◆	◆				◆		◆
• The normal distribution		◆		◆	◆				◆		◆
• Correlation		◆		◆	◆				◆		◆
Measurement											
• Further applications of area and volume		◆	◆			◆	◆				◆
• Applications of trigonometry		◆				◆	◆				◆
• Spherical geometry		◆				◆	◆				◆
Probability											
• Multi-stage events		◆	◆	◆						◆	◆
• Applications of probability		◆		◆						◆	◆
Algebraic modelling											
• Algebraic skills and techniques		◆	◆				◆				◆
• Modelling linear and non-linear relationships		◆	◆		◆						◆

Step 3: List the assessment components, weightings and tasks

Using *Assessment Components, Weightings and Tasks* (see page 84 of the General Mathematics syllabus), list the components and mandatory weightings in the assessment schedule. List the outcomes which relate to each *Area of study* using the map of outcomes for the HSC course (table 1).

Step 4: Develop effective assessment tasks

Students indicate their level of understanding and skill development in what they do, say and write.

Therefore there are a number of ways of gathering information in mathematics for assessment purposes. Each will provide important information to the assessment process. Each assessment task should be appropriate for the outcomes it is designed to measure. Outcomes related to students' values and attitudes (such as H1) are not part of the formal assessment program.

It is the teacher's responsibility to ensure that the assessment procedures accurately reflect students' knowledge, understanding and skills in the course. The following are points to consider when developing



effective assessment tasks to measure student achievement of syllabus outcomes. These are outlined in *Mathematics Years 9-10 Stage 5 Support Document for Advanced, Intermediate and Standard Courses* (Board of Studies, 1996).

- Which syllabus objectives are to be assessed?
- What are the associated syllabus outcomes?
- What type of task will be used?
- What should be considered when designing the task?
 - The requirements of the task need to be clear to students.
 - The task needs to allow students to demonstrate achievement of the appropriate outcomes.
 - The language used needs to be clear to students.
 - Any stimulus material or practical materials need to be appropriate to the task.
 - Students need to have the appropriate tools to complete the task.
 - The task needs to be accessible to students.
- Does the task measure what is intended?
 - It should assess the appropriate balance of knowledge, understanding and skills.
 - It should allow for valid judgements to be made of students' achievements.
- How will the task be designed to produce consistent results?

Step 5: Consider the types of tasks

Decide on the most appropriate type of task to be used. The outcomes to be assessed influence the type of assessment task to be used. For example, what type of task would need to be designed to allow H3 (*A student develops and tests a general mathematical relationship from observed patterns*) to be assessed?

Ask the following questions when completing this step:

- What type of task will best assess student achievement of these outcomes?
- Is a range of tasks used to allow students to demonstrate achievement of outcomes in a variety of ways?
- Does the task fit the overall teaching and learning program?

Step 6: Design the assessment tasks

When designing a task ensure that:

- a manageable number of outcomes is being assessed

- the task chosen will enable the outcomes to be assessed effectively
- the task will measure what you want it to assess
- students have the best opportunity to demonstrate what they know and can do.

More information on task design can be found in

Office of the Board of Studies, *The New Higher School Certificate: Assessment Support Document* and in the New HSC cross-sectoral bulletin, *Internal Assessment in the New Higher School Certificate*.

Step 7: Decide on the timing of each task

Consider:

- the school calendar of events
- the scope and sequence of the teaching program
- the amount of time needed to ensure that students have had access to content necessary for the outcomes being assessed.

Using a schedule assists teachers to judge whether the assessment program is meeting all requirements. In Table 3, *Suggested internal assessment program* on page 13, the following features are evident:

- It clearly identifies the outcomes addressed in each *Area of study*.
- It clearly identifies the outcomes to be assessed in each task.
- Each task assesses a manageable number of outcomes.
- Some outcomes are linked to more than one assessment task and component.
- It uses a range of tasks.
- It uses weightings which are in accordance with syllabus specifications.
- It has an appropriate timing for tasks.

This method of designing an assessment program is not specific to the General Mathematics course. Using the specific weightings for component A and component B in the Mathematics, Mathematics Extension 1 and Extension 2 courses, together with the course outcomes, a complete set of assessment programs can be devised. The revised outcomes for these courses can be obtained from the Board of Studies web site www.boardofstudies.nsw.edu.au/syllabus99/maths_ext12_outcomes.html. A sample mapping of the HSC outcomes to the course content has been provided for the Mathematics course (previously called 2 Unit Mathematics) in Table 2.



Table 2: Mathematics (2 unit) HSC Outcomes

AREA OF STUDY \ OUTCOMES	H1 Values & attitudes	H2	H3	H4	H5	H6	H7	H8	H9
Coordinate methods in geometry (6.8)		◆			◆				◆
Applications of geometrical properties (2.5)		◆			◆				◆
Geometrical applications of differentiation (10.1-10.8)		◆			◆	◆			◆
Integration (11.1-11.4)		◆		◆	◆			◆	◆
Trigonometric functions (including applications of trigonometric ratios 13.1-13.6, 13.7)		◆		◆	◆	◆		◆	◆
Logarithmic and exponential functions (12.1-12.5)		◆	◆		◆	◆	◆	◆	◆
Applications of calculus to the physical world (14.1-14.3)		◆	◆	◆	◆	◆	◆		◆
Probability (3.1-3.3)		◆		◆	◆				◆
Series (7.1-7.3) and series applications (7.5)		◆		◆	◆				◆



Table 3: Suggested internal assessment program
General Mathematics

PRELIMINARY

Outcomes which relate to the areas of study	Components	Weightings (Syllabus) %	Task 1	Task 2	Task 3	Task 4	Task 5
			Financial mathematics assignment	Measurement: Practical task	Half-yearly	Basic algebraic skills topic test	Yearly
P1, P3, P4, P6, P7, P8, P11	Knowledge and skills	40%	5%	5%	10%	10%	10%
P2, P4, P5, P6, P9, P10, P11	Applications	60%	5%	5%	15%	5%	30%
	MARKS	100%	10%	10%	25%	15%	40%
OUTCOMES ASSESSED BY THE TASK			P2, P7, P8, P11	P2, P6, P7	P2, P6, P7, P11	P3, P4, P5, P7	P2, P4, P6, P7, P9, P10, P11

HSC

Outcomes which relate to the areas of study	Components	Weightings (Syllabus) %	Task 1	Task 2	Task 3	Task 4
			Practical measurement task	Data analysis topic test	Half-yearly	Trial
H1, H2, H3, H4, H5, H6, H7, H9, H11	Knowledge and skills	40%	10%	10%	10%	10%
H1, H2, H6, H7, H8, H10, H11	Applications	60%	10%		20%	30%
	MARKS	100%	20%	10%	30%	40%
OUTCOMES ASSESSED BY THE TASK			H2, H6, H7	H2, H4, H5, H9, H11	H2, H3, H6, H7, H8, H11	H2, H3, H4, H5, H6, H7, H8, H9, H10, H11



Possible assessment tasks

The following outlines could be used with practical assessment tasks or modified for assignments in the General Mathematics course.

Teachers could provide the following information to the students up to two weeks before the task is to occur so that students can see in advance what outcomes will be assessed.

Please refer to the relevant parts of Table 4 for the following task. Alternatively, adapt this task by generating your own questions after obtaining copies of a few digital mobile phone plans. These are readily available from mobile phone dealers. It will be necessary to explain how the plans work, and terms such as *peak*, *off-peak*, *digital to digital*, *digital to fixed lines*, *monthly access*, and *call charges*.

ASSESSMENT TASK: PRELIMINARY COURSE, 2000

Task number:

Date due:

Topic: Financial Mathematics

Weighting: 10%

Outcomes to be assessed:

- P2: A student applies mathematical knowledge and skills to solving problems within familiar contexts.
- P7: A student determines the degree of accuracy of measurements and calculations.
- P8: A student models financial situations using appropriate tools.
- P11: A student justifies his/her response to a given problem using appropriate mathematical terminology.

Task:

Your parents have offered to buy you a mobile phone on the condition that you select a plan which costs no more than \$30 per month.

- Compare and contrast two mobile phone deals (2 marks)
- Recommend a particular plan and explain how you will make the best use of the mobile phone (2 marks)
- Devise a list which includes phone calls to at least twenty different people in one month. For each phone call, list the time you rang, whether you were ringing a mobile phone or a fixed line, the duration of each phone call, and indicate whether the call was made during peak or off-peak time. Ensure that your list includes a balance of calls made during peak and off-peak times and that calls are made to both fixed lines and to mobile phones. Find the total of your calls. This total should be as close as possible to the \$30 limit, but it must not exceed it. Match each phone call to the plan to find how much it costs, and calculate the difference in cost to peak rates. (5 marks)
- List the advantages and disadvantages of using a mobile phone compared to a fixed line (1 mark)

Marking guidelines:

Your task will be assessed according to your ability to:

- match lists of all calls with associated costs
- interpret your findings and make judgements about the reasonableness of your chosen plan.



ASSESSMENT TASK: HSC COURSE, 2001

Task number:

Date due:

Topic: Measurement

Weighting: 20 %

Outcomes to be assessed:

- H2: A student integrates mathematical knowledge and skills from different content areas in exploring new situations
- H6: A student analyses two-dimensional and three-dimensional models to solve practical and mathematical problems
- H7: A student interprets the results of measurements and calculations and makes judgements about reasonableness

Task:

Practical measurement activity

When providing students with information pertaining to the assessment task, it is sufficient to provide them with a general statement regarding the task, rather than the actual question.

Marking guidelines:

Your task will be assessed according to your ability to:

- Represent a 3D object in a 2D drawing
- Use a scale diagram to calculate the area and perimeter of a figure
- Apply information to another situation.

Teachers should consider providing students with the marks that will be allocated to each component in the marking guidelines.



TABLE 4

An Optus plan

\$0 effective access fee

Yes Time: free Optus Mobile digital to Optus mobile digital calls 8pm to midnight every night

Yes weekend: Optus mobile digital to fixed line: local calls midnight Friday to midnight Sunday

Peak: 7 a.m. – 8 p.m. Mon – Sat Off-peak: all other times

Monthly access	Included monthly calls	Call charges per 30 seconds					
		PEAK		OFF-PEAK			
		National, local, Optus mobile digital to all other mobile calls	Optus mobile digital to Optus mobile digital	Yes time weekend	Yes Optus Mobile	National local, Optus mobile digital to all other mobile calls	Optus mobile digital to Optus mobile digital
\$25	\$25	48c	33c	Free for the first 20 min per call then off-peak rate	25c for the first 5 min then standard local call rates	18c	10c
\$15	\$10	65c	55c	Free for the first 20 min per call then off-peak rate	25c for the first 5 min then standard local call rates	33c	10c

A Vodaphone plan

Connection fee: \$65 for 1-Sec 20, 30

Flag fall applies on all calls

Peak: 7 am to 7 pm Monday to Saturday Off-peak: All other times

1 – Sec 20	Access fee per month: \$20		CALL RATES (per sec)		FLAG FALL		FREE MINUTES INCLUDED: 20 mins per month
			PEAK	OFF-PEAK	PEAK	OFF-PEAK	
		Local and long-distance	2.3c	0.4c	30c	5c	
		Vodafone to Vodafone	2.3c	0.08c	30c	5c	
		Vodafone to other mobile networks	2.3c	0.8c	30c	5c	

1 – Sec 30	Access fee per month: \$30		CALL RATES (per sec)		FLAG FALL		FREE MINUTES INCLUDED: 30 mins per month
			PEAK	OFF-PEAK	PEAK	OFF-PEAK	
		Local and long-distance	1.2c	0.4c	30c	5c	
		Vodafone to Vodafone	1.2c	0.08c	30c	5c	
		Vodafone to other mobile networks	1.2c	0.8c	30c	5c	