

Materials to support revised internal assessment requirements and HSC examination specifications for Mathematics, Mathematics Extension 1 and Mathematics Extension 2

The Board of Studies has revised the internal assessment requirements and HSC examination specifications for all Stage 6 Mathematics courses (see [Official Notice BOS 17/11](#)). The revisions take effect with the 2012 HSC cohort.

The following materials have been developed to assist teachers implementing the revisions for Mathematics, Mathematics Extension 1 and Mathematics Extension 2:

- advice on internal assessment
- advice on programming the Mathematics Extension 1 course
- a set of five sample objective-response questions for each HSC examination
- a mapping grid for each set of sample questions
- a sample cover page for each HSC examination.

The revised internal assessment requirements and HSC examination specifications are contained in the *Assessment and Reporting in Mathematics, Mathematics Extension 1 and Mathematics Extension 2 Stage 6* document, located at www.boardofstudies.nsw.edu.au in the HSC Syllabuses section.

Advice on internal assessment

Internal assessment components

The mandatory components and weightings for each of the Mathematics, Mathematics Extension 1 and Mathematics Extension 2 HSC courses are set out below. These components and weightings are suggested for use in each Preliminary course.

Component	Description	Weighting
Concepts, skills and techniques	Use of concepts, skills and techniques to solve mathematical problems in a wide range of theoretical and practical contexts	50
Reasoning and communication	Application of reasoning and communication in appropriate forms to construct mathematical arguments and proofs and to interpret and use mathematical models	50
		100

Teachers may use their discretion in determining the manner in which they allocate tasks within the course content.

Up to 20% of the internal assessment mark submitted to the Board of Studies for the Mathematics course may be based on the Preliminary course.

The Board considers that 3 to 5 tasks are sufficient to assess the components of each course.

Measuring attainment of the assessment components will involve assessing a student's ability in relation to aspects of the Mathematics, Mathematics Extension 1 and Mathematics Extension 2 courses such as:

Concepts, skills and techniques

- recalling mathematical terminology and concepts
- identifying the nature of mathematical problems from theoretical and practical contexts, and appropriate techniques for solution
- applying appropriate techniques to solve routine problems.

Reasoning and communication

- interpreting information from theoretical and practical contexts given in written, diagrammatic or graphical form, and representing given information in other ways
- explaining terminology, concepts, techniques for solution or aspects of a solution, using written and/or spoken language and diagrams
- interpreting and using mathematical models, and constructing mathematical arguments and proofs to solve familiar and unfamiliar problems
- evaluating methods of solution in terms of efficiency and breadth of application, and recognising limitations to the validity of solutions.

The two components are weighted equally to:

- reflect their equal importance in mathematics learning
- recognise the benefits to student learning associated with a focus on reasoning and communication at a level appropriate to the respective course objectives, outcomes and syllabus content.

Each HSC examination measures attainment relevant to both components and any one internal assessment task may also contribute to measuring attainment of both components.

Advice on programming the Mathematics Extension 1 course

Schools can be flexible when programming the Mathematics Extension 1 course in order to meet the needs of their students. Topics from the Mathematics Extension 1 HSC course may be taught before all the topics of the Preliminary course have been taught.

Submitting internal HSC assessment marks to the Board of Studies

Course/s studied	Mark/s submitted
Mathematics only	A single mark out of 100
Mathematics Mathematics Extension 1	A single mark for Mathematics out of 100 A single mark for Mathematics Extension 1 out of 50
Mathematics Mathematics Extension 1 Mathematics Extension 2	No mark required A single mark for Mathematics Extension 1 out of 100 A single mark for Mathematics Extension 2 out of 100

Recognising the cumulative nature of mathematical knowledge and the reinforcement of knowledge, skills and understanding that arise from application and use over a period of time, greater weighting should be attached to internal assessment tasks undertaken towards the end of the respective HSC course/s.

Internal assessment for the Mathematics Extension 1 HSC course can be based on the entire Mathematics Extension 1 course (both Preliminary and HSC courses). However, HSC assessment for the Mathematics Extension 1 course should not begin until the school program of HSC assessments for other subjects begins (usually no earlier than Term 4 of Year 11).

A student who wishes to discontinue the study of Mathematics Extension 2, and complete the Mathematics and Mathematics Extension 1 HSC courses only, is permitted to do so provided the school can submit a valid internal assessment mark for the Mathematics HSC course for that student. Such changes are permitted up until the due date for submission of internal assessment marks (see the HSC Events Timetable).

Sample objective-response questions and mapping grids

The following sample questions are provided to illustrate how objective-response questions could appear in the HSC examination for each of the Mathematics, Mathematics Extension 1 and Mathematics Extension 2 courses.

Objective-response questions will follow the same format as those for other HSC examinations, ie multiple-choice with four options, only one of which is correct. Objective-response questions in each HSC examination may address content from any area of the respective syllabus and at different levels of difficulty.

The sample questions are intended to illustrate the type of question that may be asked. They are not intended to be the most difficult questions that may be asked, neither are they intended to be the easiest. They are not designed to represent coverage of the relevant knowledge, skills and understanding in any of the Mathematics, Mathematics Extension 1 and Mathematics Extension 2 courses.

Sample HSC examination cover pages

The sample cover pages are provided to illustrate the revised HSC examination specifications for each of Mathematics, Mathematics Extension 1 and Mathematics Extension 2.

Sample Questions – Mathematics

- 1 A bag contains seven yellow balls and three white balls. Trish selects three balls at random from the bag.

What is the probability that all three balls are yellow?

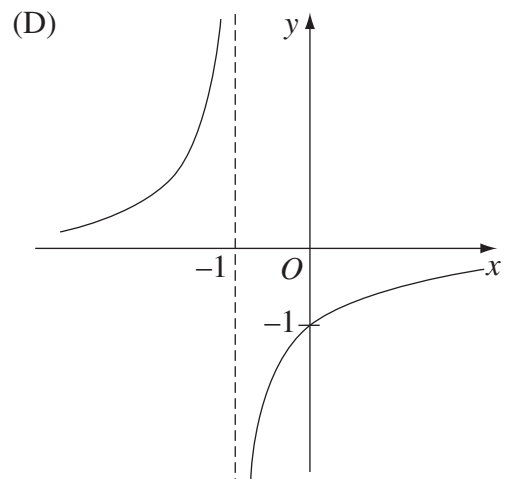
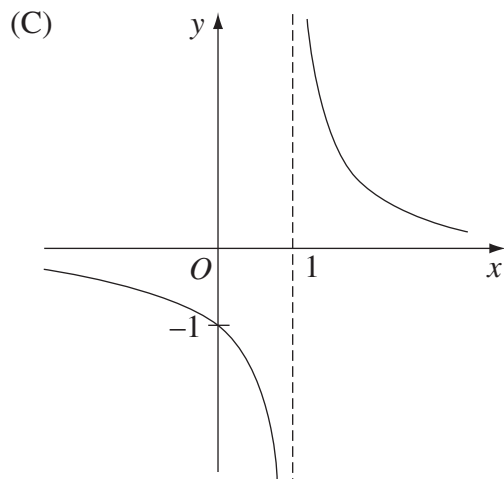
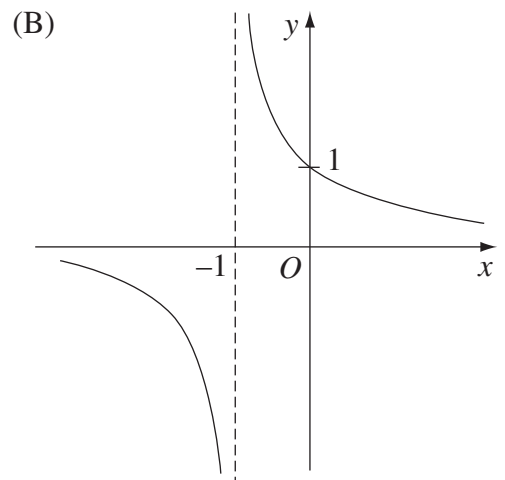
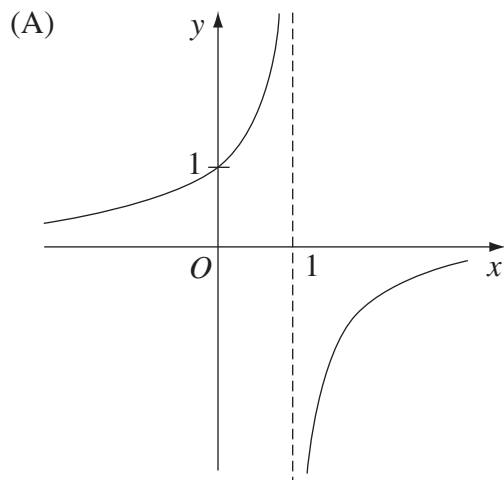
- (A) $\frac{1}{180}$
- (B) $\frac{7}{24}$
- (C) $\frac{343}{1000}$
- (D) $\frac{7}{10}$
- 2 If $f''(x) > 0$ and $f'(x) < 0$ for all x over a given domain, which of the following describes the graph of $y = f(x)$?
- (A) Increasing and concave up
- (B) Increasing and concave down
- (C) Decreasing and concave up
- (D) Decreasing and concave down

- 3 A parabola has its focus at $(0, 4)$. The equation of its directrix is $x = -4$.

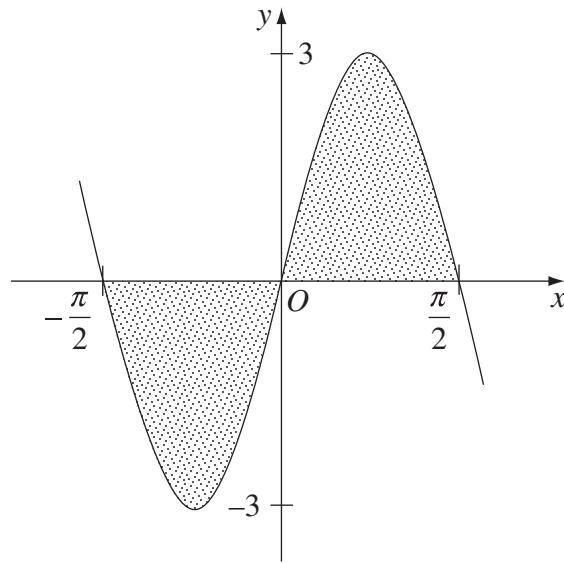
Which of the following is the equation of the parabola?

- (A) $x^2 = 16y$
- (B) $(x + 2)^2 = 8(y - 4)$
- (C) $(y + 2)^2 = 8(x - 4)$
- (D) $(y - 4)^2 = 8(x + 2)$

4 Which of the following graphs represents $y = \frac{1}{1-x}$?



- 5 The diagram below shows the graph of the function $f(x) = 3 \sin 2x$.



Which expression gives the total shaded area?

(A) $3 \int_{-3}^3 \sin 2x \, dx$

(B) $6 \int_0^3 \sin 2x \, dx$

(C) $3 \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \sin 2x \, dx$

(D) $6 \int_0^{\frac{\pi}{2}} \sin 2x \, dx$

Mapping Grid – Mathematics

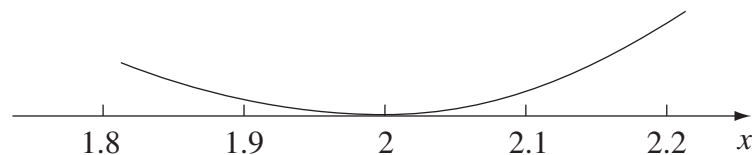
Sample Question	Marks	Answer	Content	Syllabus Outcomes
1	1	B	3.3	H5
2	1	C	10.1, 10.4	H6
3	1	D	9.5	P4, P5
4	1	A	4.2	P5
5	1	D	11.2, 11.4	H8

Sample Questions – Mathematics Extension 1

- 1 The velocity, v metres per second, of a particle moving in simple harmonic motion along the x -axis is given by the equation $v^2 = 36 - 9x^2$.

What is the amplitude, in metres, of the motion of the particle?

- (A) 2
(B) 3
(C) 6
(D) 18
- 2 Part of the graph of $y = P(x)$, where $P(x)$ is a polynomial of degree four, is shown below.



Which of the following could be the polynomial $P(x)$?

- (A) $P(x) = x^2(x + 2)^2$
(B) $P(x) = (x + 2)^4$
(C) $P(x) = x(x - 2)^3$
(D) $P(x) = (x - 1)^2(x - 2)^2$
- 3 The radius of a sphere is increasing at the rate of 6 centimetres per minute.
- What is the rate of increase of the volume of the sphere, in cubic centimetres per minute, when the radius is 3 centimetres?
- (A) 36π
(B) 144π
(C) 216π
(D) 864π

4 Which of the following represents the inverse function of $f(x) = \frac{2}{3x+6} - 1$?

(A) $f^{-1}(x) = \frac{2}{x+1} - 2$

(B) $f^{-1}(x) = 3 - \frac{2}{3x+3}$

(C) $f^{-1}(x) = 2 - \frac{1}{x+1}$

(D) $f^{-1}(x) = \frac{2}{3x+3} - 2$

5 How many solutions does the equation $\cos 2\theta = \sin \theta$ have in the domain $0 \leq \theta \leq 2\pi$?

(A) 2

(B) 3

(C) 4

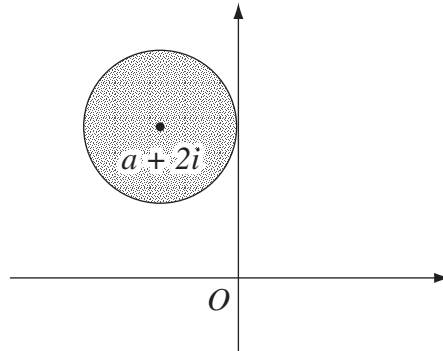
(D) 5

Mapping Grid – Mathematics Extension 1

Sample Question	Marks	Answer	Content	Syllabus Outcomes
1	1	A	14.4E	HE3
2	1	D	16.3E	PE3
3	1	C	14.1E	HE5
4	1	D	15.1E	HE4
5	1	B	13.3	H5

Sample Questions – Mathematics Extension 2

1 Consider the Argand diagram below.



Which inequality could define the shaded area?

- (A) $|z - (a + 2i)| \geq 1$
(B) $|z - (a + 2i)| \leq 1$
(C) $|z + a - 2i| \leq 1$
(D) $|z + a - 2i| \geq 1$
- 2 Which of the following is an expression for $\int xe^{2x} dx$?

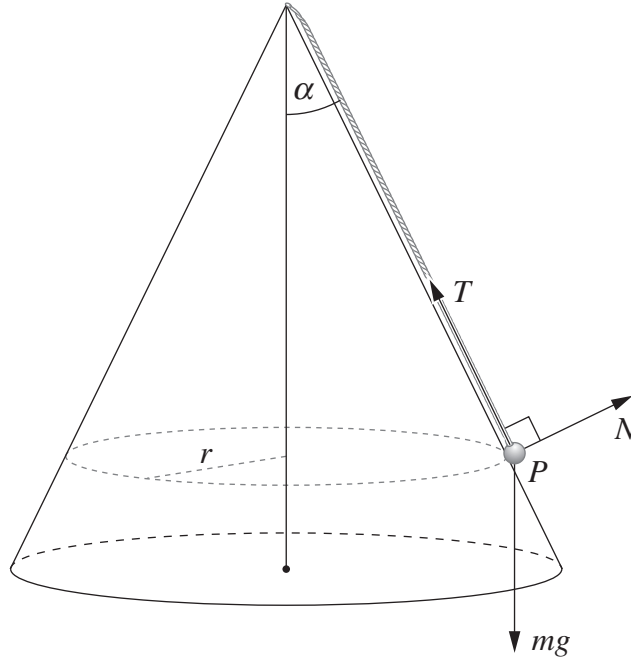
- (A) $e^{2x} \left(\frac{x}{2} - \frac{1}{4} \right) + C$
(B) $e^{2x} \left(\frac{x}{2} - 1 \right) + C$
(C) $e^{2x} \left(x - \frac{1}{4} \right) + C$
(D) $e^{2x} (2x - 1) + C$

3 The polynomial $P(z)$ has real coefficients. The roots of $P(z) = 0$ include $z = 1 - i$ and $z = 2$.

What is the lowest possible degree of $P(z)$?

- (A) One
(B) Two
(C) Three
(D) Four

- 4 A light string is attached to the vertex of a smooth vertical cone. A particle P of mass m is attached to the string as shown in the diagram. The particle remains in contact with the cone and rotates with constant angular velocity ω on a circle of radius r . The string and the surface of the cone make an angle of α with the vertical, as shown.

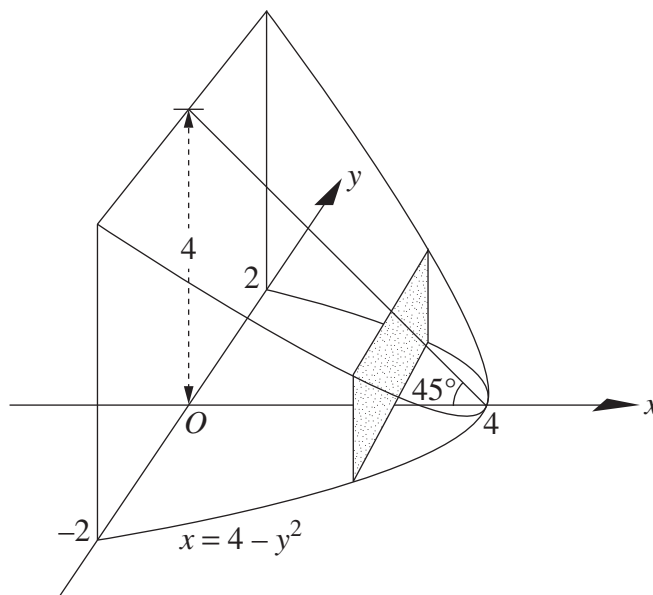


The forces acting on the particle are the tension, T , in the string, the normal reaction, N , to the cone and the gravitational force mg .

Which of the following gives the correct resolution of forces on P in the horizontal and vertical directions?

- (A) $T \sin \alpha - N \cos \alpha = mr\omega^2$
 $T \cos \alpha + N \sin \alpha = mg$
- (B) $T \sin \alpha - N \cos \alpha = mr\omega^2$
 $T \sin \alpha + N \cos \alpha = mg$
- (C) $T \sin \alpha + mr\omega^2 = N \cos \alpha$
 $T \cos \alpha + N \sin \alpha = mg$
- (D) $T \sin \alpha - N \sin \alpha = mr\omega^2$
 $T \cos \alpha + N \sin \alpha = mg$

- 5 The base of a solid is the region enclosed by the parabola $x = 4 - y^2$ and the y -axis. The top of the solid is formed by a plane inclined at 45° to the xy -plane. Each vertical cross-section of the solid parallel to the y -axis is a rectangle. A typical cross-section is shown shaded in the diagram.

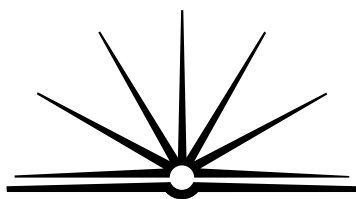


Which of the following expressions gives a correct representation of the volume of the solid, V ?

- (A) $V = \int_0^4 x\sqrt{4-x} \, dx$
- (B) $V = 2 \int_0^4 x\sqrt{4-x} \, dx$
- (C) $V = \int_0^4 (4-x)\sqrt{4-x} \, dx$
- (D) $V = 2 \int_0^4 (4-x)\sqrt{4-x} \, dx$

Mapping Grid – Mathematics Extension 2

Sample Question	Marks	Answer	Content	Syllabus Outcomes
1	1	B	2.5	E3
2	1	A	4.1	E8
3	1	C	7.5	E4
4	1	A	6.3.3	E5
5	1	D	5.1	E7



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**HIGHER SCHOOL CERTIFICATE
EXAMINATION**

Mathematics

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
Black pen is preferred
- Board-approved calculators may be used
- A table of standard integrals is provided at the back of this paper
- Show all necessary working in Questions 11–16

Total marks – 100

Section I Pages x–x

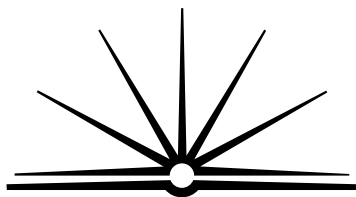
10 marks

- Attempt Questions 1–10
- Allow about 15 minutes for this section

Section II Pages x–xx

90 marks

- Attempt Questions 11–16
- Allow about 2 hours 45 minutes for this section



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**HIGHER SCHOOL CERTIFICATE
EXAMINATION**

Mathematics Extension I

General Instructions

- Reading time – 5 minutes
- Working time – 2 hours
- Write using black or blue pen
Black pen is preferred
- Board-approved calculators may be used
- A table of standard integrals is provided at the back of this paper
- Show all necessary working in Questions 11–14

Total marks – 70

Section I Pages x–x

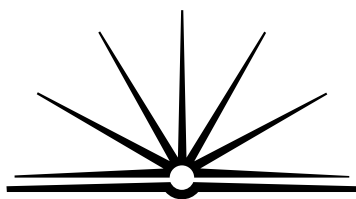
10 marks

- Attempt Questions 1–10
- Allow about 15 minutes for this section

Section II Pages x–xx

60 marks

- Attempt Questions 11–14
- Allow about 1 hours 45 minutes for this section



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**HIGHER SCHOOL CERTIFICATE
EXAMINATION**

Mathematics Extension 2

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
Black pen is preferred
- Board-approved calculators may be used
- A table of standard integrals is provided at the back of this paper
- Show all necessary working in Questions 11–16

Total marks – 100

Section I Pages x–x

10 marks

- Attempt Questions 1–10
- Allow about 15 minutes for this section

Section II Pages x–xx

90 marks

- Attempt Questions 11–16
- Allow about 2 hours 45 minutes for this section