What is Additional Mathematics all about?

Secondary 2 Subject Allocation Exercise

If you choose Pure Sciences, you have to take Additional Mathematics.

O-Level Additional Mathematics (Code – 4049, First Year of Examination – 2021)

Paper	Duration	Description	Marks	Weighting
1	2 h 15 min	There will be 12 – 14 questions of varying marks and lengths, up to 10 marks per question. Candidates are required to answer all questions.	90	50%
2	2 h 15 min	There will be 9 – 11 questions of varying marks and lengths, up to 12 marks per question. Candidates are required to answer all questions.	90	50%

Some of the topics under Algebra:

A4 Polynomials and Partial Fractions

4.1   Multiplication and division of polynomials

4.2   Use of remainder and factor theorems, including factorising polynomials and solving cubic equations

4.3   Use of:
$$a^3 + b^3 = (a + b)(a^2 - ab + b^2)$$
$$a^3 - b^3 = (a - b)(a^2 + ab + b^2)$$

4.4   Partial fractions with cases where the denominator is no more complicated than:
- $(ax + b)(cx + d)$
- $(ax + b)(cx + d)^2$
- $(ax + b)(x^2 + c^2)$

A6 Exponential and Logarithmic Functions

6.1   Exponential and logarithmic functions
$$a^x, \mathrm{e}^x, \log_a x, \ln x$$
and their graphs, including
- laws of logarithms
- equivalence of $y = a^x$ and
$$x = \log_a y$$
- change of base of logarithms

6.2   Simplifying expressions and solving simple equations involving exponential and logarithmic functions

6.3   Using exponential and logarithmic functions as models

Trigonometric functions, identities & equations

1.1	Six trigonometric functions for angles of any magnitude (in degrees or radians)
1.2	Principal values of $\sin^{-1} x$, $\cos^{-1} x$, $\tan^{-1} x$
1.3	Exact values of the trigonometric functions for special angles $(30°, 45°, 60°)$ or $(\frac{\pi}{6}, \frac{\pi}{4}, \frac{\pi}{3})$
1.4	Amplitude, periodicity and symmetries related to sine and cosine functions
1.5	Graphs of $y = a\sin(bx) + c$, $y = a\sin\left(\dfrac{x}{b}\right) + c$, $y = a\cos(bx) + c$, $y = a\cos\left(\dfrac{x}{b}\right) + c$ and $y = a\tan(bx)$, where a is real, b is a positive integer and c is an integer

1.6   Use of:

- $\dfrac{\sin A}{\cos A} = \tan A, \quad \dfrac{\cos A}{\sin A} = \cot A,$

  $\sin^2 A + \cos^2 A = 1,$

  $\sec^2 A = 1 + \tan^2 A,$

  $\csc^2 A = 1 + \cot^2 A$

- the expansions of $\sin(A \pm B)$, $\cos(A \pm B)$ and $\tan(A \pm B)$

- the formulae for $\sin 2A$, $\cos 2A$ and $\tan 2A$

- the expression of $a\cos\theta + b\sin\theta$ in the form $R\cos(\theta \pm \alpha)$ or $R\sin(\theta \pm \alpha)$

50 – 60% of the Syllabus focused on Calculus, i.e. Differentiation and Integration

Calculus deals with the concept of change. It builds on algebra, geometry and trigonometry. It has widespread applications in science, economics, business, engineering and medicine and provides useful tools for analysing and modelling change and behaviour. The interpretation of these phenomena requires the study of the *functions* used in these models.

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In Mathematics, you learn how to solve simultaneous <mark>linear</mark> equations:

Solve the following pair of simultaneous equations.

$$3x - 2y = 1$$

$$x - 2y = 2$$

By elimination, $2x = -1$.

Therefore, $x = -\dfrac{1}{2}$ and $y = -\dfrac{5}{4}$.

In Additional Mathematics, you learn how to solve simultaneous quadratic equations:

Solve the following pair of simultaneous equations.

$$x^2 - 2xy + y^2 = 1 \quad \text{---------equation ①}$$

$$x - 2y = 2 \quad \text{---------equation ②}$$

The answers are $x = 0$, $y = -1$ or $x = -4$, $y = -3$.

Can you solve this? *Try it!*

A little hint: Substitute $x = 2y + 2$ into $x^2 - 2xy + y^2 = 1$.

In Mathematics, you learn how to solve inequalities:

Find the range of values of x such that

$$8x + 9 < 2x + 1.$$
$$6x < -8$$
$$x < -\frac{4}{3}$$

In Additional Mathematics, you learn how to solve quadratic inequalities

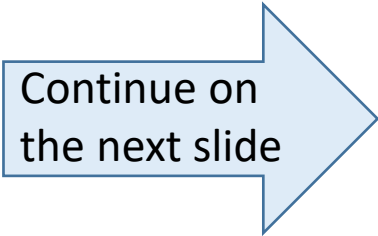Find the range of values of x such that $8x + 9 < (2x+1)^2$.

$$8x + 9 < 4x^2 + 4x + 1$$

$$0 < 4x^2 + 4x + 1 - 8x - 9$$

$$4x^2 - 4x - 8 > 0$$

$$x^2 - x - 2 > 0$$

$$(x-2)(x+1) > 0$$

$$(x-2)(x+1)>0$$

Do you think the answer is (A) or (B)?

(A) $x > 2$ or $x > -1$

(B) $x > 2$ or $x < -1$

In Mathematics, you learn how to combine algebraic fractions:

$$\frac{3}{x+1} + \frac{1}{x-4} = \frac{3(x-4)+1(x+1)}{(x+1)(x-4)}$$

$$= \frac{3x-12+x+1}{x^2-3x-4}$$

$$= \frac{4x-11}{x^2-3x-4}$$

In Additional Mathematics, you learn how to "dismantle" an algebraic fraction:

From the previous slide, we know that

$$\frac{4x-11}{x^2-3x-4} = \frac{3}{x+1} + \frac{1}{x-4}.$$

*Do you know which 2 fractions is* $\dfrac{3x+5}{x^2+3x+2}$ *equal to?*

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Trigonometric functions, identities & equations

$y = 3 \sin 2x$

$y = 2 \cos x$
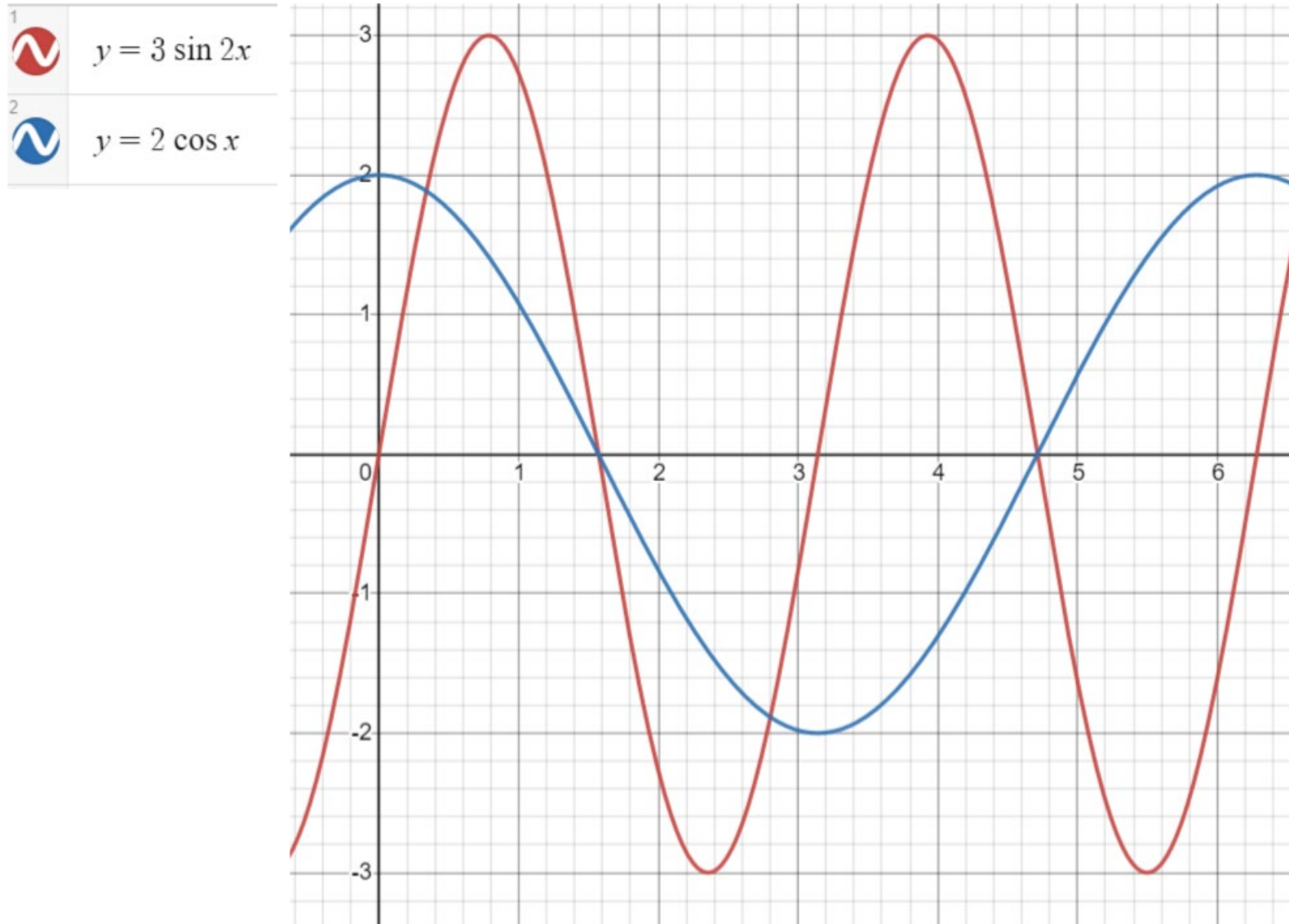
Trigonometric functions, identities & equations

Derivatives of trigonometric functions

If u is a function of x, x is in radians, a, b and n are constants, and n is rational, then

- $\dfrac{d}{dx}(\sin x) = \cos x$

- $\dfrac{d}{dx}(\cos x) = -\sin x$

- $\dfrac{d}{dx}(\tan x) = \sec^2 x$

- $\dfrac{d}{dx}(\sin u) = \cos u \cdot \dfrac{du}{dx}$

- $\dfrac{d}{dx}(\cos u) = -\sin u \cdot \dfrac{du}{dx}$

- $\dfrac{d}{dx}(\tan u) = \sec^2 u \cdot \dfrac{du}{dx}$

- $\dfrac{d}{dx}[\sin (ax + b)] = a \cos (ax + b)$

- $\dfrac{d}{dx}[\cos (ax + b)] = -a \sin (ax + b)$

- $\dfrac{d}{dx}[\tan (ax + b)] = a \sec^2 (ax + b)$

- $\dfrac{d}{dx}(\sin^n x) = n \sin^{n-1} x \cdot \cos x$

- $\dfrac{d}{dx}(\cos^n x) = -n \cos^{n-1} x \cdot \sin x$

- $\dfrac{d}{dx}(\tan^n x) = n \tan^{n-1} x \cdot \sec^2 x$

Trigonometric functions, identities & equations

Prove the identity $\dfrac{\sec A(1+\sin A)}{4(\sin A + \sin^2 A)} = \dfrac{1}{2}\operatorname{cosec} 2A$

Solve the equation $1 + \sin x = \sqrt{3}\cos x$ for $0° < x < 180°$

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The 4 basic calculus rules that you need to memorise & use well:

1. Basic differentiation $\dfrac{d}{dx}ax^n = nax^{n-1}$

2. Chain Rule $\dfrac{dy}{dx} = \dfrac{dy}{dt} \times \dfrac{dt}{dx}$

3. Product Rule $\dfrac{d}{dx}uv = u\dfrac{dv}{dx} + v\dfrac{du}{dx}$ where u and v are functions of x

4. Quotient Rule $\dfrac{d}{dx}\left(\dfrac{u}{v}\right) = \dfrac{v\dfrac{du}{dx} - u\dfrac{dv}{dx}}{v^2}$ where u and v are functions of x

50 – 60% of the Syllabus focused on Calculus, i.e. Differentiation and Integration

Differentiate $y = \dfrac{2x}{\sqrt{3x-1}}$ with respect to x.

$$\frac{d}{dx}\left(\frac{2x}{\sqrt{3x-1}}\right) = \frac{\sqrt{3x-1}\,\dfrac{d}{dx}(2x) - 2x\,\dfrac{d}{dx}\sqrt{3x-1}}{\left(\sqrt{3x-1}\right)^2}$$

$$= \frac{2\sqrt{3x-1} - 2x \cdot \dfrac{3}{2\sqrt{3x-1}}}{\left(\sqrt{3x-1}\right)^2}$$

$$= \frac{3x-2}{(3x-1)\sqrt{3x-1}}$$

To be able to choose Additional Mathematics:

- You must be scoring high marks consistently in Mathematics and Science Overall Combined.

- You must **LOVE ALGEBRA** , have a strong foundation in algebra as there are a lot of algebraic manipulation.

- Also, there are 19 chapters to be completed in 2 years. It is like 4 years of Mathematics compressed into 2 years.

JAE Booklet (JAE: Joint Admission Exercise)

- **https://www.moe.gov.sg/-/media/files/post-secondary/2022-jae-information-booklet.pdf**

Page 102 of booklet details the cut-off points of JC

1 Junior Colleges & Millennia Institute

1.1 Previous Year's Aggregate Scores of Junior Colleges

Table D-1 shows the **L1R5 net aggregate of the lowest ranked students (course cut-off point)** who were admitted to the junior college (JC) course through the previous year's (2021) Joint Admissions Exercise (JAE). These aggregate scores are meant as a reference for applicants applying to the JCs and do not constitute the admission scores for subsequent admission exercises. The L1R5 net aggregate scores for the courses are not pre-determined by MOE or schools before posting. The eventual course aggregate scores for 2022 JAE may vary from previous years, depending on students' GCE O-Level examination results and their course choices during the JAE.

Table D-1 : L1R5 Aggregate Scores (with Bonus Points) of Students Admitted to JCs in the Previous Year's (2021) JAE

S/No	JC Name	Arts		Science/IB	
		Course Code	Previous (2021) JAE Net L1R5	Course Code	Previous (2021) JAE Net L1R5
1	Anderson Serangoon Junior College	39A	11	39S	11
2	Anglo-Chinese Junior College	22A	9	22S	8
3	Anglo-Chinese School (Independent)	-	-	51I	5
4	Catholic Junior College	23A	13	23S	13

Junior Colleges & Millennia Institute

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4	Catholic Junior College	23A	13	23S	13
5	Dunman High School	44A	9	44S	8
6	Eunoia Junior College	38A	8	38S	7
7	Hwa Chong Institution	24A	5	24S	4
8	Jurong Pioneer Junior College	40A	16	40S	15
9	Nanyang Junior College	26A	6	26S	6
10	National Junior College	27A	8	27S	7
11	Raffles Institution	28A	5	28S	4
12	River Valley High School	45A	9	45S	8
13	St. Andrew's Junior College	30A	11	30S	10
14	St. Joseph's Institution	-	-	52I	8
15	Tampines Meridian Junior College	41A	13	41S	13
16	Temasek Junior College	32A	9	32S	9
17	Victoria Junior College	33A	8	33S	7
18	Yishun Innova Junior College	42A	19	42S	20

Combination 1:
Pure Sciences + Additional Mathematics caters mainly to students who aspires to go to a JC.

![NGEE ANN POLYTECHNIC logo]

To be eligible for consideration for admission to the various courses in Ngee Ann Polytechnic, applicants must obtain **26 points or better for the net ELR2B2 aggregate score** (i.e. English Language, 2 relevant subjects and best 2 other subjects, **including CCA Bonus Points**) and meet the minimum entry requirements as shown in the table of courses in this section. CCA cannot be used to meet the minimum entry requirements. For Aggregate Types Computation Criteria (for polytechnic courses), please refer to Table 6 under Section 5 – Aggregate Types Computation Criteria.

The "**Net ELR2B2 Range for Previous (2021) JAE**" in the table below shows the **net ELR2B2 aggregate of the highest to lowest ranked students who were admitted to these courses in the 2021 Joint Admissions Exercise (JAE)**. These aggregate scores are meant as a reference for applicants applying to these courses, and **do not** constitute the admission scores for subsequent admission exercises. The net ELR2B2 aggregate scores for the courses are not pre-determined by MOE or polytechnics before posting. The eventual course aggregate scores for the 2022 JAE may vary from previous years, depending on students' GCE O-Level examination results and their course choices during the JAE.

Courses	Course Code	Aggregate Type	Net ELR2B2 Range for Previous (2021) JAE	Minimum Entry Requirements
APPLIED SCIENCES				
Biomedical Science	N59	ELR2B2-C	4 to 8	<table><tr><td></td><td>Subject</td><td>Grade</td></tr><tr><td>a)</td><td>English Language</td><td>1-7</td></tr><tr><td>b)</td><td>Mathematics (Elementary/Additional)</td><td>1-6</td></tr><tr><td>c)</td><td>Any one of the following subjects:</td><td>1-6</td></tr></table> • Biology • Biotechnology • Chemistry • Combined Science • Design & Technology • Food & Nutrition • Electronics / Fundamentals of Electronics • Physics / Engineering Science • Science (Chemistry, Biology) • Science (Physics, Biology) • Science (Physics, Chemistry) / Physical Science
Pharmaceutical Science ①	N73	ELR2B2-C	5 to 9	

Polytechnic courses are very competitive.

Although the minimum entry requirements are:
(a) English Language   A1 – D7
(b) Mathematics OR   A1 – C6
     Additional Mathematics
do you think you can get into this course if you only obtained passed to EL & Maths?

What would your EL + R2 + B2 score?