

DATE: MAY 24, 2024

It is expected that all students have extensive previous mathematical experiences and that they are familiar with the following topics before they enter the IB Diploma Programme.

Therefore, the following table lists the topics covered by the entrance exam in Mathematics.

Topic	Content
Number	<ul style="list-style-type: none"> - Estimation, including using appropriate forms of rounding to estimate results, decimal approximations and significant figures - Writing numbers in a standard form (scientific notation) - Prime numbers and factors (divisors), including greatest common divisors and least common multiples - Simple applications of ratio, percentage and proportion (direct and inverse proportion), linked to similarity - Definition and elementary treatment of absolute value (modulus) - Number systems: natural numbers, integers, rationals, and irrationals; real numbers - Intervals on the real number line using set notation and using inequalities. Expressing the solution set of a linear inequality on the number line and in set notation
Algebra	<ul style="list-style-type: none"> - Polynomials (operations with polynomials, the remainder theorem and factor theorem)

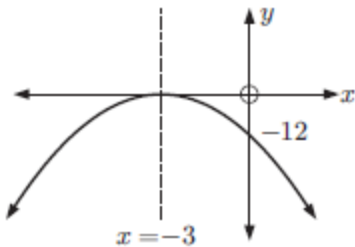
	<ul style="list-style-type: none"> - Algebra of expressions : manipulate with algebraic expressions (including simplifying algebraic fractions with indices and surds) - Solving different types of equations (linear, quadratic, cubic, rational, irrational, exponential, logarithmic, modulus) - Solving different types of inequalities (linear, quadratic, cubic, rational, irrational, exponential, logarithmic, modulus) - Simultaneous equations (where functions meet) - Different methods of solving different types (e.g. two linear, one linear one quadratic, etc) of simultaneous equations
<p>Functions</p>	<ul style="list-style-type: none"> - Concept of a function, Domain and range of a function, Inverse function, Composite function - Linear functions, their graphs, and properties (increase/decrease, sign) - Quadratic function (factorised, completed square, and general form; Different methods of solving quadratic equation; Vieta's formulas; Quadratic inequalities - Exponential function; Exponential equations and inequalities - Logarithmic function; Laws of logarithms; Logarithmic equations and inequalities

Coordinate geometry	<ul style="list-style-type: none"> - Distance between two points - Mid-point of line segment - Slope/Gradient of a line - Equation of a line (parallel and perpendicular lines) - Equation of a perpendicular bisector - Distance from a point to a line
Geometry	<ul style="list-style-type: none"> - The circle, its centre and radius, area and circumference. The terms “arc”, “sector”, “chord”, “tangent” and “segment” - Perimeter and area of plane figures. Properties of triangles and quadrilaterals, including parallelograms, rhombuses, rectangles, squares, kites and trapeziums (trapezoids); compound shapes - Volumes of cuboids, pyramids, spheres, cylinders and cones - Classification of prisms and pyramids, including tetrahedra
Trigonometry	<ul style="list-style-type: none"> - Right-angled triangle trigonometry - Trigonometric identities - Unit circle and radian measure

Please find below some questions for practice as well as some samples of entrance exams.

- Find the equation of a line (in *gradient – intercept form* $y = kx + n$) which is parallel to a line with equation $x - 3y + 4 = 0$ and passes through the point A(1,5). Hence, graph the line and determine its sign, and increase/decrease.
- Find the equation of the quadratic in the form $y = ax^2 + bx + c$ with graph given below:
- Solve exponential inequality: $2^{x+1} + 7 \cdot 2^{-x} > 9$
- Solve logarithmic equation: $\log_x 10 + 2\log_{10x} 10 + 3\log_{100x} 10 = 0$
- Find the exact value of $\sin \theta$, $\tan \theta$ and $\cot \theta$ if $\cos \theta = -\frac{3}{4}$ and $\frac{\pi}{2} < \theta < \pi$.

6. Simplify: $\left(\frac{1}{b - \sqrt{a}} + \frac{1}{b + \sqrt{a}} \right) : \frac{a^{-2} \cdot b^{-1} \cdot \sqrt[3]{\frac{1}{9}}}{a^{-2} - a^{-1} \cdot b^{-2}}$.



7. Evaluate:

$$5 \tan 540^\circ + 2 \cos(-1170^\circ) - \sin(-900^\circ) - 3 \cos 810^\circ .$$

8. In the equation $x^2 - 2mx + 2 = 0$ determine the value of parameter m so that the roots of equation satisfy $(3x_1 - 1)(3x_2 - 1) = 10$.

- Which point on the x-axis is equidistant from points A(7, -4), B(1, -2).
- Solve the inequality: $2x^2 + x - 45 < 0$.
- Solve simultaneous equations:
$$\begin{cases} x + 5y + 2 = 0 \\ 5xy + 8 = 0 \end{cases}$$
- Find the inverse function of $f(x) = \log_2(x - 1) + 1$ and explain how to verify your answer.
- Suppose $f : x \mapsto x^2$ and $g : x \mapsto 2 - x$. Find the value(s) of x such that $(g \circ f)(x) = f(x)$

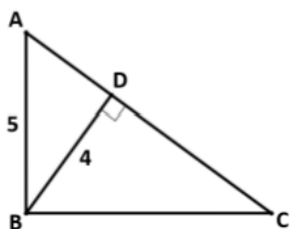
14. Calculate: $\left(\frac{1}{3}\right)^{\log_{\sqrt{3}}5 - \log_9 25}$.

15. Solve the inequality: $2^{\log_8(x-1)} > x-1$.

16. Find $P\left(\frac{1}{2}\right)$ if $P\left(\frac{x-2}{2}\right) = x^2 + 4x - 1$.

17. Find the value of the expression: $\frac{\sin(-328^\circ)\sin 958^\circ}{\cot 572^\circ} - \frac{\cos(-508^\circ)\cos(-1022^\circ)}{\tan(-212^\circ)}$.

18. Simplify the expression: $\frac{2a}{a^2 - 4x^2} + \frac{1}{2x^2 + 6x - ax - 3a} \cdot \left(x + \frac{3x-6}{x-2}\right)$.



19. Find the equation of quadratic function in the general form whose graph has x-intercept 4, the minimum value of -9 and the y-intercept -8 .

20. Find the area of triangle ABC:

Find the equation of the line that is perpendicular to the line with equation $4x + 5y - 3 = 0$ and passes through the point $(-8, 6)$. Express the equation in the form $y = mx + c$

HL ONLY questions

21. Simplify: $\left(\frac{a\sqrt{a} + b\sqrt{b}}{\sqrt{a} + \sqrt{b}} - \sqrt{ab}\right) \times \left(\frac{\sqrt{a} + \sqrt{b}}{a-b}\right)^2$, $a, b > 0$, $a \neq b$.

22. Evaluate: $\left(\frac{1+i}{\sqrt{2}}\right)^{300} + \left(\frac{1-i}{\sqrt{2}}\right)^{600}$.

23. Determine the values of parameter m for which the roots x_1 and x_2 of the equation

$$x^2 + (2m+2)x + m = 0 \text{ satisfy the condition } \frac{1}{x_1^2} + \frac{1}{x_2^2} > 8.$$

24. Solve the equation: $\sqrt{4x-3} = \sqrt{2x-1} + \sqrt{x-1}$

25. Solve the equation: $3 \cdot 4^x + \frac{1}{3} \cdot 9^{x+2} = 6 \cdot 4^{x+1} - \frac{1}{2} \cdot 9^{x+1}$.

26. Solve the inequality: $\log_3(1-x) < \log_{\frac{1}{3}}(x+2)$.

27. Sketch the graph of the function: $y = x^2 - 2|x| - 3$.

Entrance Exam to IB Diploma Program

Subject: Mathematics

Duration: 90 min

Date: 25th June, 2018

Name: _____

1. Find $P\left(\frac{1}{2}\right)$ if $P\left(\frac{x-2}{2}\right) = x^2 + 4x - 1$. [3]
2. Find the equation of the quadratic function whose graph has vertex $(-4,1)$ and passes through $(1,11)$. Hence, sketch the graph of the function by showing all important features (axes intercepts, turning point, axis of symmetry). Also, determine sign of the function and intervals of increase/decrease. [3]
3. Solve the inequality: $2^{x+3} - 5^x < 7 \cdot 2^{x-2} - 3 \cdot 5^{x-1}$. [4]
4. Solve the equation: $\log_4(x+12) \cdot \log_x 2 = 1$. [5]
5. Find the value of the expression: $\frac{\sin(-328^\circ)\sin 958^\circ}{\cot 572^\circ} - \frac{\cos(-508^\circ)\cos(-1022^\circ)}{\tan(-212^\circ)}$. [5]

Good luck!

Entrance Exam to IB Diploma Program

Subject: **Mathematics**

Duration: 90 min

Date: 15th June, 2020

Name: _____

1. Simplify the expression: $\frac{2a}{a^2 - 4x^2} + \frac{1}{2x^2 + 6x - ax - 3a} \cdot \left(x + \frac{3x - 6}{x - 2}\right)$. [5]
2. Find the equation of quadratic function in the general form whose graph has x-intercept 4, the minimum value of -9 and the y-intercept -8 . [5]
3. Solve the inequality: $2^{x+1} + 7 \cdot 2^{-x} > 9$. [5]
4. Find the value of the expression: $5 \tan 540^\circ + 2 \cos(-1170^\circ) - \sin(-900^\circ) - 3 \cos 810^\circ$. [5]

Good luck!

Entrance Exam to IB Diploma Program

Subject: **Mathematics**

Time allowed: 90 min

Maximum mark: 20

Date: 21th June, 2021

Name: _____

1. Graph of the function $y = (2a - 1)x - (-a - 2)$ has the x-intercept at 2. Find a and sketch its graph. /3 marks/
2. Factorize: $2x - 2y - x^2 + 2xy - y^2$ /3 marks/
3. Solve the inequality $-\frac{1}{2}x^2 \geq -2$. /4 marks/
4. Solve the equation $72 \cdot 7^{x-2} + 7^x = 11^x$ /5 marks/
5. Solve the inequality $\log_{\frac{1}{2}} \frac{x-2}{x+1} \leq 1$ /5 marks/

Good luck!

Entrance Exam to IB Diploma Program

Subject: **Mathematics**

Time allowed: 90 min

Maximum mark: 20

Date: 23th June, 2021

Name: _____

1. Simplify the expression $\left(\frac{x-y}{xy} \cdot \left(\frac{1}{x} + \frac{1}{y}\right)\right) \div \left(\frac{x^2+y^2}{xy} \cdot \left(\frac{1}{x} - \frac{1}{y}\right)\right)$ /3 marks/
2. Graph the function $y = |x+2| - |2x-4|$ /3 marks/
3. Solve the equation $\sqrt{2x-5} - \sqrt{x-2} = 2$ /4 marks/
4. Solve the equation $\log(5x+10) + \log\left(\frac{x-4}{8}\right) = 1$ /5 marks/
5. Solve the inequality $\log_{\frac{1}{2}} \frac{x-2}{x+1} \leq 1$ /5 marks/

Good luck!

Entrance Exam to IB Diploma Program

Subject: **Mathematics**

Duration: 90 min

Date: 22nd June, 2022

Name: _____

1. State domain and simplify the fraction: $\frac{(3a-b)^2+12ab}{9a^2-b^2}$. [5]
2. If $f(x) = \frac{2x+1}{x-2}$, find $(f \circ f)(x)$. [5]
3. Solve the inequality: $\left(\frac{1}{4}\right)^{x^2} < 16 \cdot 2^{5x-7}$. [5]
4. Determine parameters a and b so that function $y = ax + b$ passes through the points $M(3, 3)$ and $N(7,5)$. Hence, sketch the graph of a function by showing all important features. [5]

Good luck!

Entrance Exam to IB Diploma Program

Subject: Mathematics: Analysis and approaches HL

Duration: 90 min

Date: 23rd June, 2021

Name: _____

1. If $\sin \alpha + \cos \alpha = \frac{4}{3}$, find $\sin \alpha \cos \alpha$ [3]

2. If $2f(x) + f\left(\frac{1}{x}\right) = -\frac{3}{x}$ for any nonzero real number x , then find the value of $f(4)$. [5]

3. Find the remainder when polynomial $P(x) = 52x^{50} - 51x^{49} + 50x^{48} - \dots + 4x^2 - 3x + 2$ is divided by $Q(x) = x^2 - 1$. [5]

4. Solve the inequality: $\frac{x^2 + 3x}{\log_2(3-x)} \leq 0$. [7]

Good luck!

Entrance Exam to IB Diploma Program

Subject: **Mathematics: Analysis and approaches HL**

Duration: 90 min

Date: 22nd June, 2022

Name: _____

1. Determine lengths of legs of right-angled triangle if the length of its hypotenuse is $c = 2$ and $\tan A = 2\frac{1}{2}$. [5]
2. Find the equation of quadratic function, in general form, which has its maximum value 3 at $x = 4$, and if $f(0) = 11$. [5]
3. Determine real parameter $p \neq 0$ so that the equation $(2px+1)^2 = p(p+8x)-1$ has complex roots. [5]
4. Express $\log_{25} 27$ in terms of a if $\log_3 125 = a$ [5]

Good luck!

Entrance Exam to IB Diploma Program

Subject: **Mathematics: Analysis and approaches HL**

Duration: 90 min

Date: 27th June, 2023

Name and surname: _____

1. Number 3 is repeated root of a polynomial $f(x) = ax^2 + bx + c$. Determine this polynomial if $f(2) = -2$. [5]
2. Simplify the expression: $\frac{\sqrt{a}-\sqrt{b}+1}{a-\sqrt{ab}} + \frac{\sqrt{a}+\sqrt{b}}{2\sqrt{ab}} \left(\frac{\sqrt{a}}{b-\sqrt{ab}} + \frac{\sqrt{a}}{b+\sqrt{ab}} \right)$,
($a \geq 0, b \geq 0, a \neq b$) [5]
3. Determine real parameter $p \neq 0$ so that the equation $(2px + 1)^2 = p(p + 8x) - 1$ has no real roots. [5]
4. Six people are to sit at a circular table. Two of the people are not to sit immediately beside each other. Find the number of ways that the six people can be seated. [5]

Good luck!