IB Mathematics AA SL - Prediction Exams May 2025 - Paper 1

Paper 1 | 9 questions | 90 mins | 80 marks

Section A

Question 1

NO CALCULATOR | Easy

[Maximum mark: 4]

Consider the line L_1 which passes through the points $A(-4, -4)$ and $B(8, -1)$.

(a) Find the gradient of the line L_1. [1]

Line L_2 is perpendicular to L_1 and passes through the point $(-a, 2a)$ where $a \in \mathbb{R}$.

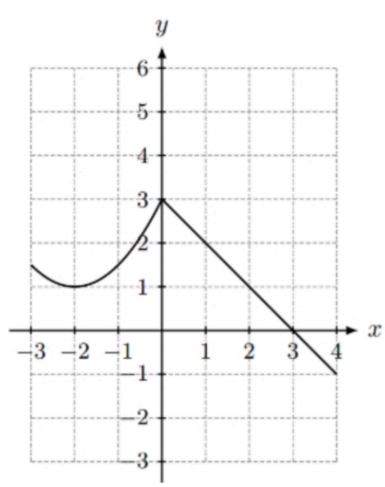
(b) Given that L_2 intersects the y-axis at $y = 2a - 3$, find the value of a. [3]

Question 2

NO CALCULATOR | Easy

[Maximum mark: 5]

The graph of $y = f(x)$ for $-3 \le x \le 4$ is shown in the following diagram.



(a) Write down the value of $f(2)$. [1]

Let $g(x) = 2f(x) - 1$ for $-3 \leq x \leq 4$.

(b) On the axes above, sketch the graph of g. [2]

(c) Hence determine the value of $(g \circ f)(2)$. [1]

(d) Hence solve the equation $(f \circ g)(x) = 0$ when $x > 0$. [1]

Question 3

NO CALCULATOR Medium

[Maximum mark: 5]

(a) Show that $12 \log_x 2 = \dfrac{12}{\log_2 x}$. [1]

(b) Hence solve the equation $\log_2 x = 8 - 12 \log_x 2$. [4]

Question 4

NO CALCULATOR Medium

[Maximum mark: 7]

(a) Show that $4 - 3\cos 2x = 6\sin^2 x + 1$. [1]

(b) Hence or otherwise solve $4 - 3\cos(4\theta + \frac{2\pi}{3}) - 9\sin(2\theta + \frac{\pi}{3}) = -2$ for $0 \leq \theta < \pi$. [6]

Question 5

NO CALCULATOR

Medium

[Maximum mark: 5]

Consider $f(x) = 2\cos\left(x - \frac{\pi}{2}\right) + 3$ and $g(x) = 4\cos\left(x + \frac{\pi}{2}\right) + 2$.

The function f is mapped onto g by three transformations.

(a) Fully describe each of the transformations and the order in which they must be applied. [3]

A new function is such that $h(x) = g(x) + k$ where $k \in \mathbb{R}$.

(b) Find the minimum value of k such that $h(x) \geq 0$ for all x. [2]

Question 6

NO CALCULATOR

Hard

[Maximum mark: 7]

(a) (i) Consider the following equation $2\binom{n}{r} = \binom{n}{r+1}$.

Show that it can be written as $3r + 2 = n$.

(ii) Now consider the following equation $7\binom{n}{r-1} = 2\binom{n}{r}$.

Show that it can be written as $9r - 2 = 2n$. [4]

Consider the expansion

$$(1+x)^n = 1 + a_1 x + \ldots + a_{k-1}x^{k-1} + a_k x^k + a_{k+1}x^{k+1} + \ldots + x^n$$

Where $a_i \in \mathbb{Q}$ and $k \in \mathbb{Z}$.

The coefficients of three consecutive terms of the expansion are such that

$$7 \times a_{k-1} = 2 \times a_k \quad \text{and} \quad 14 \times a_k = 7 \times a_{k+1}$$

(b) Find n. [3]

Section B

Question 7

NO CALCULATOR

Medium

[Maximum mark: 11]

Consider the function

$$f(x) = \frac{2}{3}\sqrt{x}(9x^2 - 8x + 3)$$

(a) Show that $f'(x) = \dfrac{1}{\sqrt{x}}(15x^2 - 8x + 1)$. [4]

(b) Hence find the $x-$coordinates of the two stationary points of $f(x)$. [3]

A particle, P, is moving along the $x-$axis. Its position s, in metres, relative to the origin after time t, measured in seconds, is given by

$$s(t) = \frac{2}{3}\sqrt{t}(9t^2 - 8t + 3)$$

Where $t \geq 0$.

The particle is moving to the left for $t = k$ seconds.

(c) Hence find k. [4]

Question 8

NO CALCULATOR

Hard ●●●●

[Maximum mark: 13]

Consider the function $f(x) = 4x - x^2 - 1$.

(a) Write $f(x)$ in the form $(x - h)^2 + k$. [2]

A line is drawn through the points $A(0, f(0))$ and $B(2, f(2))$.

(b) (i) Write down the coordinates of points A and B.

(ii) Find $g(x)$, the equation of the line passing through points A and B.

(iii) Hence, show that the area enclosed by $f(x)$ and $g(x)$ is $\frac{4}{3}$ units^2. [4]

A horizontal line is drawn through the points $C(1, f(1))$ and $D(3, f(3))$.

(c) Show that the area enclosed by $f(x)$ and line CD is $\frac{4}{3}$ units^2. [2]

Consider the two points $E(a, f(a))$ and $F(a + 2, f(a + 2))$.

(d) Show that the area enclosed by the function f and the line EF is $\frac{4}{3}$ units^2. [5]

Question 9

NO CALCULATOR Hard ●●●●

[Maximum mark: 23]

Consider the function $f(x) = \dfrac{\cos x}{2 + \sin x}$ for $-\pi \leq x \leq \pi$.

(a) Evaluate $f(0)$. [1]

(b) Find all possible values of a if $f(a) = 0$. [2]

(c) (i) Show that $f'(x) = -\dfrac{2\sin x + 1}{(2 + \sin x)^2}$.

(ii) Hence find the $x-$coordinates of any stationary points of f. [7]

(d) Given that $f''(x) = -\dfrac{2\cos x(1 - \sin x)}{(2 + \sin x)^3}$ find the nature of any stationary points of f. [5]

(e) Hence sketch the graph of f, clearly showing the values of the axes intercepts and the $x-$coordinates of any stationary points. [3]

The function f is positive and decreasing in the region $s < x < t$.

The area enclosed by f and the $x-$axis from $x = s$ to $x = t$ is $\ln c$ where $c \in \mathbb{Z}$.

(f) Find c. [5]