

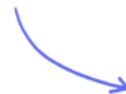
IB • DP • Maths

 47 mins  8 questions

2.8 Inequalities

2.8.1 Solving Inequalities Graphically / 2.8.2 Polynomial Inequalities

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Total Marks

/47

- 1 Consider the functions defined by $f(x) = x^2 - 6ax + b + 10$ and $g(x) = ax + 2b + 3$, where $a, b \in \mathbb{Z}^+$. Given that $f(x) \leq g(x)$ only for $2 \leq x \leq 5$, find the values of a and b .

(4 marks)

2 (a) The function defined by $f(x) = x^4 - 12x^3 + 46x^2 - 60x + 25$ can be factorised into the form $f(x) = (x - a)^2(x - b)^2$, where a and b are positive integers such that $a < b$.

(a) Find the values of a and b .

(3 marks)

(b) (b) Determine the set of values of that satisfy

(i) $f(x) \geq 0$,

(ii) $f(-x) \geq 0$,

(iii) $-f(x) < 0$.

(3 marks)

(c) (c) Determine the smallest positive value k such that the solution to the inequality $f(x) \leq k$ is a single interval.

(2 marks)

3 The function f is such that

$$f(x) \geq 0 \text{ for } x \leq 3 \text{ and for } 4 \leq x \leq 5,$$

$$f(x) \leq 0 \text{ for } 3 \leq x \leq 4 \text{ and for } x \geq 5.$$

Find a polynomial, of the lowest degree possible, that satisfies the condition $f(0) = 5$.

(5 marks)

4 (a) (a) Sketch the graph of $y = f(x)$ where

$$f(x) = \frac{(x+2)(x-4)(x-6)}{(x-1)(x-5)}$$

Label any intersections with the coordinate axes and state the equations of any vertical asymptotes.

(3 marks)

(b) (b) Find the values of x that satisfy

(i) $f(x) \geq 0$.

(ii) $f(|x|) \geq 0$.

(5 marks)

5 The region R is defined by the three straight lines given by the inequalities

$$y \geq 1,$$

$$y \leq 2x + 8,$$

$$x + y \leq 10.$$

The function f is defined by $f(x) = 2 + \frac{1}{x-1}$. Find the largest domain of f such that the graph of f lies within the region R . Give answers as exact values where appropriate.

(6 marks)

6 (a) (a) Consider the graphs with equations

$$y = \frac{(x+4)(x-1)}{x-1} \text{ and } y = 6 - x.$$

Explain why the two graphs do **not** intersect.

(1 mark)

(b) (b) Consider the graphs with equations

$$y = \frac{(x-6)(x-1)^2}{x-1} \text{ and } y = (8-x)(x-1).$$

(i) Find the coordinates of any points of intersections between the two graphs.

(ii) Hence, or otherwise, solve the inequality

$$\frac{(x-6)(x-1)^2}{x-1} \leq (8-x)(x-1).$$

(3 marks)

7 (a) Consider the functions defined by $f(x) = \sqrt{(9 - x^2)}$, $g(x) = 3 - \sqrt{(9 - x^2)}$ and $h(x) = \frac{x + 3}{2}$. All three functions have the domain $-3 \leq x \leq 3$.

(a) On the same diagram, sketch the graphs of f , g and h .

(3 marks)

(b) (b) Find the set of values of x which satisfy the inequality $f(x) > g(x) > h(x)$.

(3 marks)

8 Find the exact values for x such that

$$\frac{x}{(x+2)(x-3)} \geq x$$



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(6 marks)