

Subject – Math AA(Higher Level)
Topic - Calculus
Year - May 2021 – Nov 2022
Paper -3
Questions

Question 1

[Maximum mark: 25]

This question asks you to investigate some properties of the sequence of functions of the form $f_n(x) = \cos(n \arccos x)$, $-1 \leq x \leq 1$ and $n \in \mathbb{Z}^+$.

Important: When sketching graphs in this question, you are not required to find the coordinates of any axes intercepts or the coordinates of any stationary points unless requested.

- (a) On the same set of axes, sketch the graphs of $y = f_1(x)$ and $y = f_3(x)$ for $-1 \leq x \leq 1$. [2]
- (b) For odd values of $n > 2$, use your graphic display calculator to systematically vary the value of n . Hence suggest an expression for odd values of n describing, in terms of n , the number of
- (i) local maximum points,
 - (ii) local minimum points. [4]
- (c) On a new set of axes, sketch the graphs of $y = f_2(x)$ and $y = f_4(x)$ for $-1 \leq x \leq 1$. [2]
- (d) For even values of $n > 2$, use your graphic display calculator to systematically vary the value of n . Hence suggest an expression for even values of n describing, in terms of n , the number of
- (i) local maximum points,
 - (ii) local minimum points. [4]
- (e) Solve the equation $f_n'(x) = 0$ and hence show that the stationary points on the graph of $y = f_n(x)$ occur at $x = \cos \frac{k\pi}{n}$ where $k \in \mathbb{Z}^+$ and $0 < k < n$. [4]

The sequence of functions, $f_n(x)$, defined above can be expressed as a sequence of polynomials of degree n .

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