A Level Mathematics A

H240/01 Pure Mathematics

Question Set 3

1 **In this question you must show detailed reasoning.**

Solve the inequality $10x^2 + x - 2 > 0$. **[4]**

2 The point A is such that the magnitude of $\overrightarrow{OA}$ is 8 and the direction of $\overrightarrow{OA}$ is 240°.

(a) **(i)** Show the point A on a set of axes. **[1]**

(ii) Find the position vector of point A.
Give your answer in terms of **i** and **j**. **[3]**

The point B has position vector $6\mathbf{i}$.

(b) Find the exact area of triangle AOB. **[2]**

The point C is such that $OABC$ is a parallelogram.

(c) Find the position vector of C.
Give your answer in terms of **i** and **j**. **[2]**

3 A curve has equation $x^3 - 3x^2y + y^2 + 1 = 0$.

(a) Show that $\frac{dy}{dx} = \frac{6xy - 3x^2}{2y - 3x^2}$. **[4]**

(b) Find the equation of the normal to the curve at the point (1, 2). **[4]**

4 **In this question you must show detailed reasoning.**

A sequence $u_1, u_2, u_3 \ldots$ is defined by $u_n = 25 \times 0.6^n$.

Use an algebraic method to find the smallest value of N such that $\sum_{n=1}^{\infty} u_n - \sum_{n=1}^{N} u_n < 10^{-4}$. **[8]**

5 **(a)** Express $3\cos 3x + 7\sin 3x$ in the form $R\cos(3x - \alpha)$, where $R > 0$ and $0 < \alpha < \frac{1}{2}\pi$. **[3]**

(b) Give full details of a sequence of three transformations needed to transform the curve $y = \cos x$ to the curve $y = 3\cos 3x + 7\sin 3x$. **[4]**

(c) Determine the **greatest** value of $3\cos 3x + 7\sin 3x$ as x varies and give the smallest positive value of x for which it occurs. **[2]**

(d) Determine the **least** value of $3\cos 3x + 7\sin 3x$ as x varies and give the smallest positive value of x for which it occurs. **[2]**

6 A curve has equation $y = a^{3x^2}$, where a is a constant greater than 1.

(a) Show that $\frac{dy}{dx} = 6xa^{3x^2} \ln a$. **[3]**

(b) The tangent at the point $(1, a^3)$ passes through the point $(\frac{1}{2}, 0)$.

Find the value of a, giving your answer in an exact form. **[4]**

(c) By considering $\frac{d^2y}{dx^2}$ show that the curve is convex for all values of x. **[5]**

Total Marks for Question Set 3: 51 Marks

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