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TUTGATHER PRACTICE PAPER

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2027

MATHEMATICS Extended Part Module M1
PAPER

Question-Answer Book

Candidate Number

TUTGATHER
PRACTICE PAPER · NOT AN OFFICIAL HKEAA PAPER

1 hour 5 minutes

This paper must be answered in English

Topic practice: Second Derivative

INSTRUCTIONS

(1) This paper consists of THREE sections, A(1), A(2) and B.

(2) Attempt ALL questions in this paper. Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins.

(3) Unless otherwise specified, all working must be clearly shown.

(4) Unless otherwise specified, numerical answers should be either exact or correct to 3 significant figures.

(5) The diagrams in this paper are not necessarily drawn to scale.

(6) Calculators and mathematical drawing instruments may be used.

(7) The marks for each question are shown in brackets.

(8) No extra time will be given after the 'Time is up' announcement.

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SECTION A(1) (16 marks)

1. Let $y = 3x^4 - 5x^2 + 7x - 2$. Find $\frac{d^2y}{dx^2}$. **(3 marks)**

2. The curve C has equation $y = x^3 - 6x^2 + 9x + 1$. Find the x-coordinates of the points of inflection of C. **(3 marks)**

3. Let $y = x^2 e^{-x}$. Find $\frac{d^2y}{dx^2}$ and hence evaluate it at $x = 0$. **(4 marks)**

Answers written in the margins will not be marked.
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4. The curve C has equation $y = x^4 - 4x^3$. **(6 marks)**

(a) Find $\frac{d^2y}{dx^2}$ and determine the intervals on which C is concave upwards and concave downwards.

(b) Find the points of inflection of C.

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SECTION A(2) (24 marks)

5. Let $y = \frac{x^2}{x-1}$, where $x \neq 1$. **(7 marks)**

(a) Find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$.

(b) Using the second derivative test, determine the nature of the stationary point of the curve $y = \frac{x^2}{x-1}$.

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6. The curve C has equation $y = x^3 - 3x^2 + 4$. **(8 marks)**

(a) Find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$.

(b) Find the coordinates of the point of inflection of C.

(c) Find the equation of the tangent to C at its point of inflection.

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7. Let $f(x) = x^2 \ln x$ for $x > 0$. **(9 marks)**

(a) Find $f'(x)$ and $f''(x)$.

(b) Find the value of x at which $f''(x) = 0$, and show that this value gives a point of inflection of the curve $y = f(x)$.

(c) Determine whether f is concave upwards or concave downwards on the interval $0 < x < 1$.

Answers written in the margins will not be marked.

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SECTION B (10 marks)

8. Let $f(x) = \frac{x^2}{x^2 + 3}$ for all real x. **(10 marks)**

(a) Show that $f'(x) = \frac{6x}{(x^2 + 3)^2}$ and find $f''(x)$ in simplified form.

(b) Find the x-coordinates of the points of inflection of the curve $y = f(x)$, and determine the intervals on which the curve is concave upwards and concave downwards.

(c) Using the results of (a) and (b), describe the shape of the curve near $x = 0$ and state the nature of the stationary point at $x = 0$.

END OF PAPER

Answers written in the margins will not be marked.

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