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TUTGATHER PRACTICE PAPER

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2027

MATHEMATICS Extended Part Module M2
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: Applications of Differentiation

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. Find the equation of the tangent to the curve $y = x^3 - 2x + 1$ at the point where $x = 1$. **(3 marks)**

2. Find the coordinates of the stationary point of the curve $y = x^2 - 4x + 7$ and determine its nature. **(3 marks)**

3. The curve C has equation $y = x^3 - 3x^2 + 2$. Find the x-coordinates of the points where C crosses the x-axis, and sketch the curve indicating the y-intercept and the turning points. **(4 marks)**

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4. A rectangular box has a square base of side x cm and height h cm. Its volume is 64 cm^3 . (a) Express h in terms of x. (b) Show that the total surface area A of the box is given by $A = 2x^2 + \frac{256}{x}$. (c) Find the value of x that minimises A, and the corresponding minimum surface area. **(6 marks)**

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SECTION A(2) (24 marks)

5. The curve C has equation $y = \frac{x^2 + 1}{x - 1}$ for $x \neq 1$. (a) Find $\frac{dy}{dx}$. (b) Find the equations of the tangents to C that are parallel to the line $y = 3x + 2$. (c) Find the equation of the normal to C at the point where $x = 2$. **(7 marks)**

6. Let $f(x) = x^3 - 3x^2 + 4$. (a) Find $f'(x)$ and $f''(x)$. (b) Find the stationary points of $y = f(x)$ and determine their nature. (c) Find the points of inflexion of $y = f(x)$. (d) Hence sketch the graph of $y = f(x)$, indicating clearly the stationary points and the point of inflexion. **(8 marks)**

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7. The curve C has equation $y = \frac{x^2}{x-1}$ for $x \neq 1$. (a) Find the equations of the asymptotes of C. (b) Find the coordinates of the stationary points of C and determine their nature. (c) Find the x- and y-intercepts of C. (d) Hence sketch the graph of C, showing clearly the asymptotes and the stationary points. **(9 marks)**

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SECTION B (10 marks)

8. A right circular cone is inscribed in a sphere of radius R. The cone has base radius r and height h. (a) Show that $r^2 = h(2R - h)$. (b) Hence express the volume V of the cone in terms of h and R. (c) Find, in terms of R, the value of h that maximises V, and show that this gives a maximum. (d) Find the maximum volume of the cone in terms of R. **(10 marks)**

END OF PAPER

Answers written in the margins will not be marked.

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