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TUTGATHER PRACTICE PAPER

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2027

MATHEMATICS Compulsory Part
PAPER 1

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: More about Graphs of Functions

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. Consider the function $f(x) = x^2 - 4x + 3$. **(3 marks)**

   (a) Express $f(x)$ in the form $(x - h)^2 + k$.

   (b) Hence write down the coordinates of the vertex of the graph of $y = f(x)$ and state whether it is a maximum or a minimum point.

2. The graph of $y = g(x)$ passes through the point $(3, 5)$. Write down the coordinates of the image of this point under each of the following transformations. **(3 marks)**

   (a) The graph is translated 4 units to the left, giving $y = g(x + 4)$.

   (b) The graph is reflected in the x-axis, giving $y = -g(x)$.

   (c) The graph is translated 2 units downwards, giving $y = g(x) - 2$.

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3. The graph of $y = x^2$ is transformed into the graph of $y = 3(x + 1)^2 - 6$. **(4 marks)**

(a) Describe the sequence of transformations (dilation and translations) that maps the first graph onto the second.

(b) State the coordinates of the vertex of $y = 3(x + 1)^2 - 6$.

4. Let $f(x) = x^2 - 2x$ and $g(x) = -x^2 + 2x + 8$. **(6 marks)**

(a) Find the coordinates of the vertex of the graph of $y = f(x)$ and the coordinates of the vertex of the graph of $y = g(x)$.

(b) Describe how the graph of $y = g(x)$ can be obtained from the graph of $y = f(x)$ by a reflection and a translation.

(c) Hence, or otherwise, find the maximum value of $g(x)$ and the value of x at which it occurs.

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SECTION A(2) (24 marks)

5. Let $f(x) = x^2 - 6x + 5$. **(7 marks)**

(a) Find the x-intercepts and the y-intercept of the graph of $y = f(x)$.

(b) By completing the square, find the vertex of the graph of $y = f(x)$.

(c) Sketch the graph of $y = f(x)$ on a Cartesian plane, clearly marking the intercepts and the vertex.

(d) Using the graph (or otherwise), find the range of values of x for which $f(x) < 0$.

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6. The graph of $y = h(x)$ has vertex $P(2, 3)$ and passes through $Q(0, -1)$. It is known that $h(x) = a(x - 2)^2 + 3$ for some constant a. **(8 marks)**

(a) Find a.

(b) The graph of $y = h(x)$ is reflected in the x-axis to give $y = h_1(x)$, and then $y = h_1(x)$ is translated 5 units to the right to give $y = h_2(x)$. Find $h_2(x)$ in the form $a(x - p)^2 + q$.

(c) State the vertex of the graph of $y = h_2(x)$ and determine whether it is a maximum or a minimum point.

(d) Find the y-intercept of the graph of $y = h_2(x)$.

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7. Let $f(x) = x^2$ and $g(x) = 4x^2 - 16x + 13$. **(9 marks)**

(a) Show that $g(x) = 4(x - 2)^2 - 3$.

(b) Describe how the graph of $y = g(x)$ can be obtained from the graph of $y = f(x)$ by a dilation and translations. State the dilation factor and the direction of each translation.

(c) The graph of $y = g(x)$ is dilated vertically by a factor of $\frac{1}{2}$ to give $y = k(x)$. Find $k(x)$ and the minimum value of $k(x)$.

(d) A horizontal line $y = c$ cuts the graph of $y = g(x)$ at two distinct points. Find the range of possible values of c.

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SECTION B (10 marks)

8. Let $f(x) = x^2 - 4x + 7$ and $g(x) = -x^2 + 4x + 1$. **(10 marks)**

(a) Express $f(x)$ and $g(x)$ in the form $a(x - h)^2 + k$, and state the vertex and the extreme value of each graph.

(b) Show that $g(x) = 6 - f(x)$ for all x, and describe the transformation that maps the graph of $y = f(x)$ onto the graph of $y = g(x)$.

(c) Find the coordinates of the two points where the graphs of $y = f(x)$ and $y = g(x)$ intersect.

(d) A student claims: "For every real number x, $f(x) \geq g(x)$." Determine whether the claim is true, and if not, state the set of values of x for which $f(x) < g(x)$.

(e) The graph of $y = f(x)$ is translated t units to the right, where $t > 0$, to give $y = F(x)$. Find the value of t such that the minimum value of $F(x)$ equals the minimum value of $g(x)$.

END OF PAPER

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